

BEAR CREEK WATERSHED TMDL IMPLEMENTATION PLAN



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Cover photos (clockwise from bottom left):

- Bear Creek downstream of Pottsville Street Bridge
 - Alkaline discharge entering Bear Creek
- Confluence of Bear Creek and Wiconisco Creek
- Bear Creek upstream of known AMD points

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List of Acronyms

US EPA	United States Environmental Protection Agency
OSM	United States, Department of the Interior, Office of Surface Mining
PA DEP	Pennsylvania Department of Environmental Protection
ACSI	Appalachian Clean Streams Initiative
PA DEP BAMR	Pennsylvania Department of Environmental Protection, Bureau of Abandoned Mine Reclamation
DCCD	Dauphin County Conservation District
TMDL	Total Maximum Daily Load
PGC	Pennsylvania Game Commission
NFWF	National Fish and Wildlife Foundation
AMD	Abandoned Mine Drainage
EPCAMR	Eastern Pennsylvania Coalition for Abandoned Mine Reclamation
WCRA	Wiconisco Creek Restoration Association

Section 1.0

Introduction

The Federal Clean Water Act of 1972 requires that all U.S. streams, rivers, and lakes meet certain water quality standards. States conduct monitoring activities to identify those water body segments that do not meet these standards. When streams or segments thereof fail to meet these standards, Section 303(d) of the Clean Water Act requires states to develop TMDL's for each pollutant. The TMDL, or Total Maximum Daily Load, sets a limit on the amount of pollution that a stream can tolerate and still maintain water quality standards. Once a TMDL is established and approved by the United States Environmental Protection Agency (EPA), a TMDL Implementation Plan is developed. The implementation plan outlines measures to reduce pollutants.

More than five miles of Bear Creek in Wiconisco Township, Dauphin County have been determined by the Pennsylvania Department of Environmental Protection (PA DEP) to be impaired by Abandoned Mine Drainage (AMD). The Dauphin County Conservation District, with cooperation from the Wiconisco Creek Restoration Association (WCRA) has developed the Bear Creek Watershed TMDL Implementation Plan to outline the strategy for reducing pollutants originating from AMD in Bear Creek in accordance with the Bear Creek Watershed TMDL established in 2001.

While pollution reduction is a major component of any TMDL Implementation Plan, the attainment of water quality goals is to be understood within the context of its relationship to the local community, particularly the social and economic benefits that may be derived from water quality improvement projects. Water quality improvement projects such as AMD remediation at Bear Creek can enhance the overall quality of life for residents and provide an aesthetically pleasing place for recreation. In addition to aesthetics, clean streams do have a positive effect on property values and can provide additional opportunities for water and wildlife-associated recreation.

Purpose of the Implementation Plan

The purpose of this TMDL Implementation Plan is to present the ways in which the waters covered in the Bear Creek Watershed Total Maximum Daily Load Study will achieve water quality standards over time. This Plan includes a description of remediation activities conducted to date and those planned for the future.

While Section 303(d) of the Clean Water Act and current EPA regulations do not require the development of implementation strategies, EPA has identified several elements that must be included in Watershed Implementation Plans in order for the plan to be approvable under current guidance. The following provides a summary of each of the required plan elements as provided by PA DEP:

- Identification of pollution sources
- Pollutant load reductions required to meet TMDLs
- Implementation actions/management measures required to achieve prescribed load reductions
- Technical and financial assistance needed to implement Best Management Practices: costs of design, installation and maintenance; evaluating funding sources and addressing shortfalls
- Public information and participation: will identify stakeholders and sources of information and influence in the watershed and outline a strategy for informing citizens about watershed issues
- Monitoring: a monitoring plan designed to determine the effectiveness of the implementation actions/best management practices. The monitoring plan will develop milestones leading to achievement of PA DEP standards for water quality and recommended use.
- Tracking Implementation: To achieve water quality goals, the plan will include milestones and a timeline for funding, construction and maintenance activities
- Remedial actions: will identify criteria for judging results of implementation and water quality monitoring against prescribed milestones. The remedial actions procedure will provide for the re-evaluation of milestones, efforts and/or the TMDL if milestones for attaining water quality are not met.

Bear Creek Watershed Setting

Bear Creek is a 4.7 square-mile watershed located within the Wiconisco Creek Watershed in northern Dauphin County, Pennsylvania and lies within the extreme southwestern portion of the anthracite coalfields of eastern Pennsylvania (Figure 1). The headwaters of Bear Creek begin between the Bear and Big Lick mountains in Bear Creek Swamp, and the creek flows in a westerly and southerly direction to its terminus at the Wiconisco Creek in the vicinity of the borough of Lykens. Bear Creek is one of the largest tributaries within the Wiconisco Creek Watershed and represents approximately 4% of the Wiconisco Creek drainage.

The land within the watershed was extensively underground and surface mined through the late 19th and early 20th centuries. While virtually nonexistent today, anthracite coal production in Dauphin County during the year 1930 was nearly one million tons. The underground mines which worked more than 20 anthracite beds, ranged in size from small punch mines along the coal outcrops to large operations such as the Williamstown mine in the Lykens Valley No. 4 and 5 veins, which extend as deep as 2,200 feet below sea level. The Bear Creek Watershed is underlain by the Williamstown Mine Pool which extends beyond the surface water drainage area of Bear Creek.

Above the known mine discharges, Bear Creek is acidic. This acidic nature is likely a combination of acid rain and a naturally acidic condition in Bear Swamp. Below the discharges, the creek bed is stained orange due to the iron or “yellowboy” precipitating out of the discharge water.

All mining in the watershed occurred well before modern reclamation practices and requirements. As a result, little to no reclamation or remediation activities were completed upon mine closures. The land use within the Bear Creek Watershed is mostly forest/conservation, with a small amount of residential and industrial land use in the lower watershed. Most of the watershed area is located on State Game Lands #264. Additional information about the Bear Creek Watershed setting may be found in the following documents: the Wiconisco Creek Watershed Assessment and Plan (Stoe 1998); Bear Creek Watershed TMDL (SRBC 2001); Wiconisco Creek Watershed Conservation Plan (DCCD 2004); and Effects of Historical Coal Mining and Drainage from Abandoned Mines on Streamflow and Water Quality in Bear Creek (Chaplin 2005).

Impairments

Due to discharges from these past mining activities, Bear Creek is severely impaired and the metal-loaded discharges have led to the complete absence of macroinvertebrates. Several abandoned mine discharge points are located within the watershed as well as many diffuse seeps (Figure 2). More than five miles of Bear Creek are listed by PA DEP as impaired (Table 1). The causes of these impairments are high levels of metals (primarily iron) and siltation due to Abandoned Mine Drainage (AMD) erroneously referred to as “Acid Mine Drainage”. For specific information on the pollution sources in the Bear Creek Watershed, see Section 2.0.

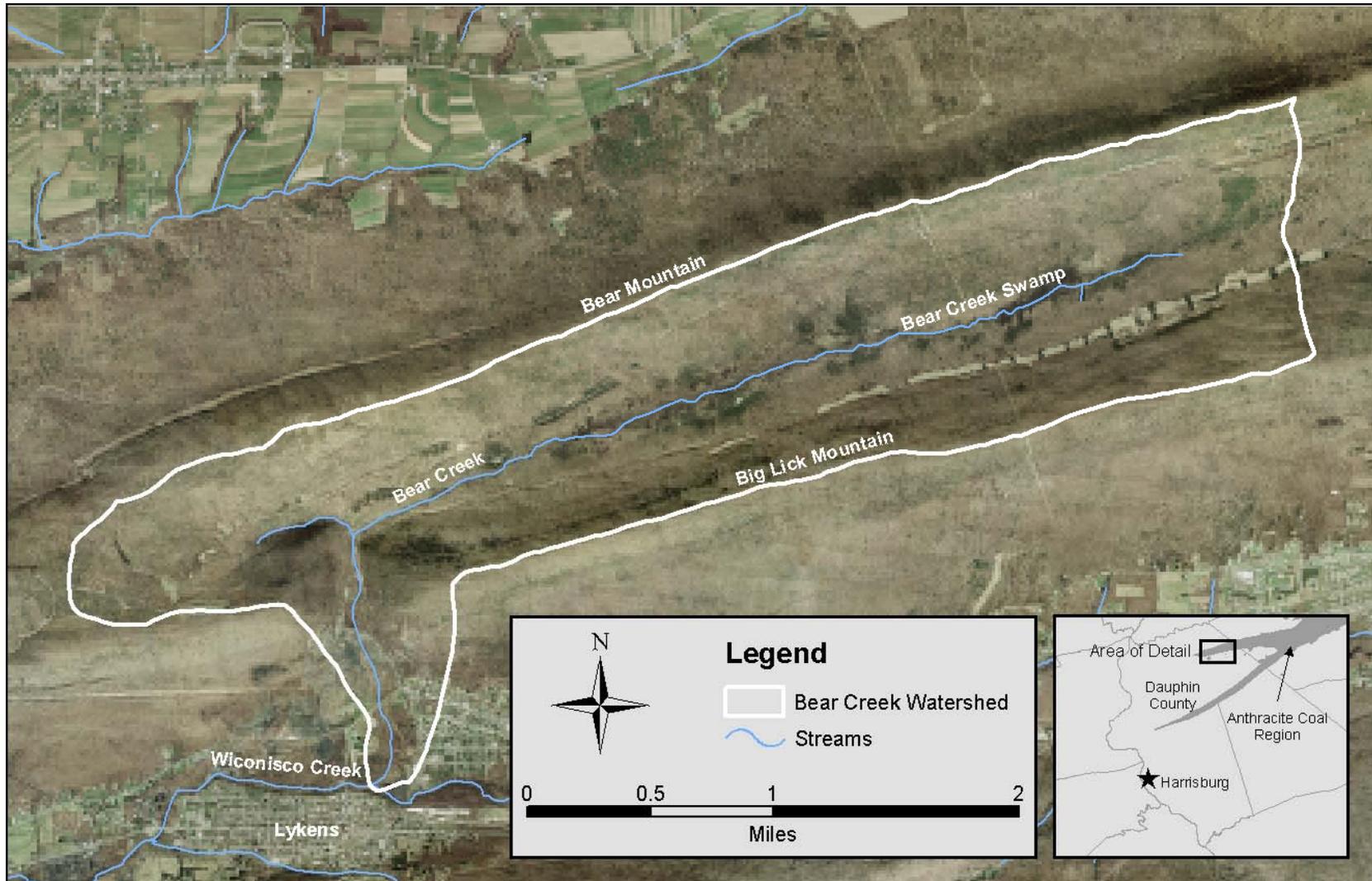


FIGURE 1. Bear Creek Watershed locator map.

Table 1. Impaired stream miles on Bear Creek.

Stream	Miles	Source of Impairment	Cause of Impairment	Priority
Bear Creek	5.27	Acid Mine Drainage	Metals, pH, Siltation	Medium

Water Quality Standards and Designated Uses

The state water quality designation for Bear Creek is Cold Water Fishery (CWF) and may be found in Pennsylvania Title 25, Chapter 93.9. Table 2 was extracted from the Bear Creek TMDL and lists Applicable Water Quality Criteria. The Chapter 93 Water Uses Protected in the Bear Creek and Wiconisco Creek Watersheds are given in Table 3.

Table 2. Applicable Water Quality Criteria

Parameter	Criterion Value (mg/l)	Duration	Total Recoverable/Dissolved
Iron (Fe)	1.50	1 day average Maximum	Total Recoverable Dissolved
	0.30		
Manganese (Mn)	1	Maximum	Total Recoverable
Aluminum (Al*)	0.1 of the 96-hour LC-50 0.75	Maximum One hour	Total Recoverable
pH **	6.0-9.0	At all times	N/A

(Taken from SRBC 2001)

Table 3. Protected Water Uses

Stream	Zone	Water Uses Protected
Bear Creek	Basin	CWF
Wiconisco Creek	Main Stem	WWF

Section 2.0

Review of the Bear Creek TMDL Development

The TMDL was prepared by the Susquehanna River Basin Commission (SRBC) in 2001 for segments in the Bear Creek Watershed to address the impairments noted in the 1996, 1998, and 2000 Pennsylvania 305(b) reports, required under the Clean Water Act, and covers three segments (Bear Creek upstream of B1, Bear Creek between points B1 and B2, and Bear Creek between B2 and B3). All of these TMDL segments encompass those impaired segments listed on the 2000 303(d) list (Table 4). Differences in miles listed is due to more accurate assessment techniques since the 1996 303(d) list.

Over the past 30 years, several studies have been conducted to gather data on the conditions of Bear Creek by examining the biological community and/or discharge water quality. The water quality data used by SRBC to calculate the TMDL for Bear Creek were found in the following reports, in addition to unpublished data from the Dauphin County Conservation District: Sanders and Thomas 1972; Gilligan 1985; Stoe 1998; Durlin and Schaffstall 2002.

Table 4. Bear Creek Segments Addressed

State Water Plan (SWP) Subbasin: 06C Wiconisco Creek								
<i>Year</i>	<i>Miles</i>	<i>Segment ID</i>	<i>DEP Stream Code</i>	<i>Stream Name</i>	<i>Designated Use</i>	<i>Data Source</i>	<i>EPA 305(b) Source Code</i>	<i>EPA 305(b) Cause Code</i>
1996	4.4	6570	17041	Bear Creek	CWF	305(b) Report	Resource Extraction	Metals
1998	4.33	6570	17041	Bear Creek	CWF	Surface Water Monitoring Program	Abandoned Mine Drainage	Metals
2000	4.81	970514-1151-JLR	17041	Bear Creek	CWF	Unassessed Project	Acid Mine Drainage	Metals Siltation
2000	0.46	970514-1151-JLR	17042	Bear Creek, Unt	CWF	Unassessed Project	Acid Mine Drainage	Metals Siltation

CWF = Cold Water Fishes

(Taken from: SRBC 2001)

Pollution Sources

Typically, TMDLs address point source (Waste Load Allocations) as well as non-point source pollution (Load Allocations). Because the pollution sources in the watershed are abandoned mines and have no responsible party, they are treated as non-point sources or Load Allocations.

Waste Load Allocations were not addressed in the Bear Creek TMDL. At the time of the TMDL development, the Wiconisco Township Wastewater Treatment Facility was not on-line and was not discharging into Bear Creek. However, this NPDES permitted discharge may have to be accounted for in a future revision of the TMDL, and its effluent limitations must be consistent with any future WLA for the discharge. Point source compliance with the TMDL is required by Pennsylvania's NPDES program and is not considered in this document.

The following list identifies and characterizes the non-point sources of the pollutants causing impairment in Bear Creek. Figure 2 locates these sources within the Bear Creek Watershed. For ease of identification and future treatment, the Adits (also known as Drift Entries) and the numerous seeps have been addressed together in the TMDL as the "Alkaline Discharges". This designation will also be applied here.

Lykens Water Level Tunnel

The Lykens Water Level Tunnel is located to the west side of Bear Creek and approximately 1000 feet north of the Short Mountain Shaft. The collapsed portal (fig. 3), elevation 970.4 ft., is located on State Game Land No. 264. Discharge samples were taken monthly for a period of 12 months during 1970-71 for the Operation Scarlift report. Results at that time indicated a strongly acidic discharge with no alkalinity, an average total iron concentration of 15 mg/L, and an average pH of 3.4 su. Additional data from later years indicated that conditions may have been improving somewhat at this discharge. While previously net acidic, more recent data show a trend toward a more neutral or slightly alkaline state. However, much of the later data had been gathered during relatively dry years, and the droughty conditions that prevailed at the time, coupled with relatively few storm data sets may have skewed the results slightly in favor of a more alkaline condition. When all available data sets are considered however, the likely scenario is that this discharge has improved somewhat over the past 30 years and is now generally net neutral with occasional periods of slight net acidity. These periodic net acidic conditions must be accounted for in the passive treatment system design. Mean discharge water quality for the Lykens Water Level Tunnel is given in Table 5.

Table 5.
Summary of mean Lykens Water Level Tunnel discharge water quality.
Numbers of observations are indicated in parentheses.

	Sanders & Thomas, Inc. (1973)	Gilligan (1985)	Stoe (1998)	USGS (unpublished and Durlin & Schaffstall 2001, 2002)
Dates of Data Collection	12/70-11/71	9/83	11/98	4/97-9/01
Flow (gpm)	760 (12)	176 (1)	---	711 (27)
pH – field (s.u.)	3.4 (12)	5.3 (1)	4.6 (1)	5.9 (30)
Conductance (umhos/cm)	---	270 (1)	---	180 (51)
Alkalinity (mg/L CaCO ₃)	0 (12)	8.0 (1)	---	14.4 (47)
Alkalinity (lb/day)	0 (12)	17 (1)	---	141 (45)
Acidity (mg/L CaCO ₃)	47 (12)	124 (1)	---	10.3 (48)
Acidity (lb/day)	458 (12)	262 (1)	---	55 (46)
Iron (mg/L)	13.4 (12)	20.4 (1)	---	10.3 (48)
Iron (lb/day)	141 (12)	43 (1)	---	77 (49)
Aluminum (mg/L)	---	0.64 (1)	---	0.43 (42)
Aluminum (lb/day)	---	1.35 (1)	---	5.1 (41)

Unnamed seep near Lykens Water Level Tunnel

There is no documentation of this seep from the Operation Scarlift report. This seep is located approximately 150 feet south of the Lykens Water Level Tunnel. No data are available to characterize this seep with the exception of an estimated 2 Gallons Per Minute (GPM) given in Skelly and Loy, 2003. Given its proximity to the Lykens Water Level Tunnel, this seep is estimated to be marginally net acidic with similar metals concentrations and considering its low flow, is best treated by including it with the treatment system for Lykens Water Level Tunnel.

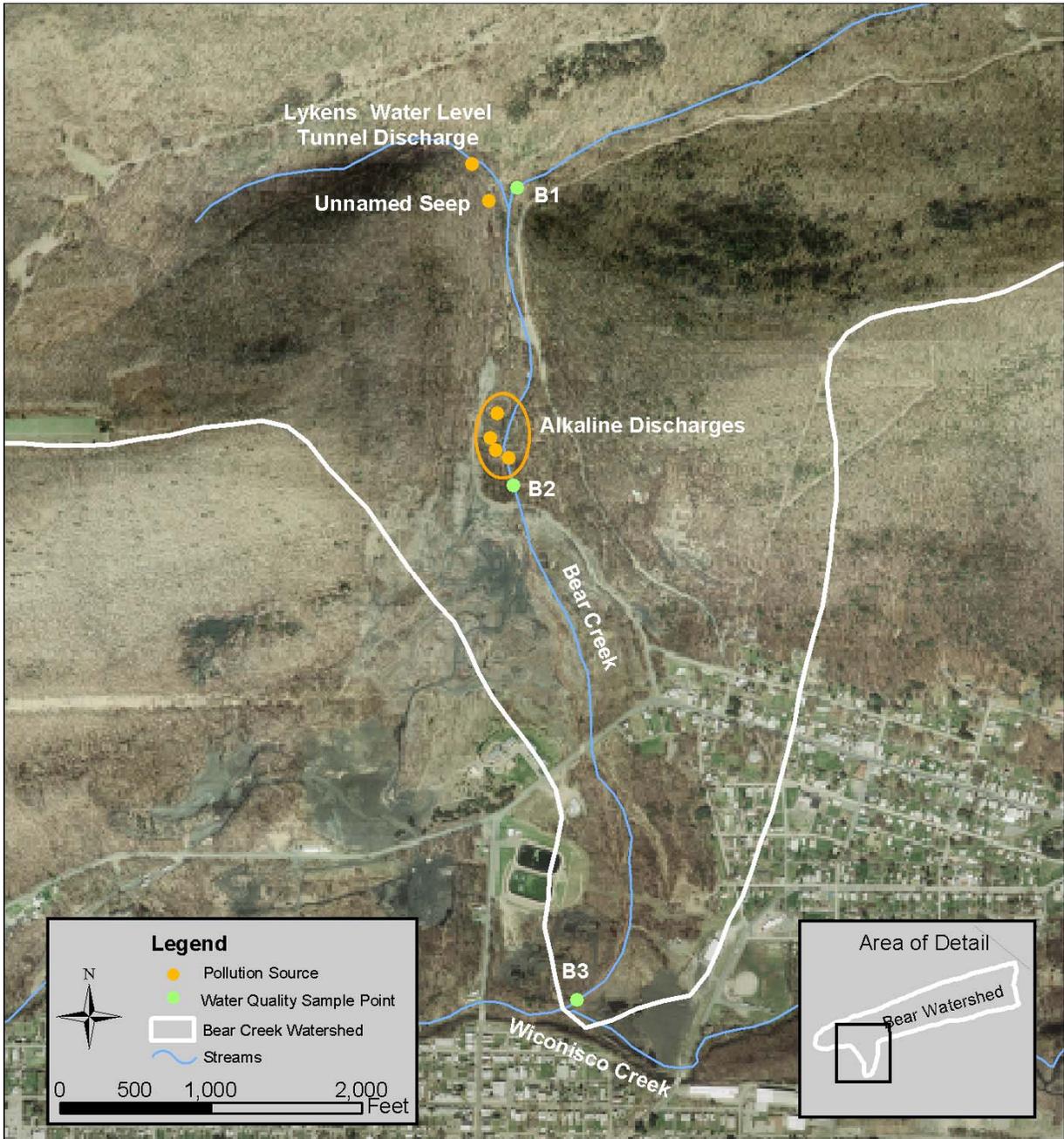


Figure 2 Location of pollution sources and in-stream monitoring points in the Bear Creek Watershed.



Figure 3. Photo of Lykens Water Level Tunnel Discharge

Alkaline Discharges (Adits and numerous diffuse seeps)

There are 4 interdependent sources that are included here: one intact drift entry tunnel, and several collapsed or filled-in drift entries (fig. 4). These sources, elevation of 850 ft., are located approximately 400 feet south of the Short Mountain Shaft on the east and west sides of Bear Creek. Since the discharges share similar water quality characteristics and are in proximity to each other, they have been considered as one source in the TMDL and are labeled as the “Alkaline Discharges”. Operation Scarlift treats most of these discharges in a similar fashion and labels them as “Source #2”. However, the seep on the east side of Bear Creek is characterized separately in the Operation Scarlift report as “Source #3”. Additionally, there are numerous diffuse seeps that may not have been accounted for in the Operation Scarlift report and it is uncertain as to whether these seeps were included in the TMDL. Studies conducted in recent years concur with Operation Scarlift and show that the water quality of these discharges hasn’t changed much since the 1970’s. All of these discharges can be characterized as net alkaline with low dissolved oxygen, total iron concentrations that are from 10-20mg/L, and little to no acidity. The diffuse seeps, while in the general vicinity of the larger adits, may be up to 75 yards away from the adits. The treatment system for the alkaline discharges should include as many of these seeps as is practical. Water quality data for the Alkaline Discharges is presented below in tables 6 and 7.

Table 6. Chemical summary of each of the Alkaline Discharges. Values are averages of 12 observations* reported in Sanders and Thomas, Inc. (1973).

	West Side – Upper	West Side – Upper Middle	West Side – Lower Middle	West Side – Lower	East Side
Discharge (cfs)	5.05	0.34	0.11	1.06	0.28
pH	6.3	6.4	6.4	6.4	6.7
Alkalinity (mg/L CaCO ₃)	117.6	114.5	119.1	120.0	122.0
Alkalinity (lb/day CaCO ₃)	3074	219	77	692	183
Acidity (mg/L CaCO ₃)	0	0	0	0	0
Acidity (lb/day CaCO ₃)	0	0	0	0	0
Iron (mg/L)	10.1	11.0	11.9	11.4*	11.3
Iron (lb/day)	288	19	7	66*	16

* one observation excluded due to an assumed erroneous iron concentration (12/17/70; 85 mg/L)

**Table 7. Selected summary water-quality data for the Alkaline Discharges.
Collected by USGS from March 1999 to December 2002.**

N, number of measurements; Max, maximum; Min, minimum; mg/L, milligrams per liter;
ANC, acid neutralizing capacity; ug/L, micrograms per liter

	Oxygen, dissolved (mg/L)	Field pH (standard units)	ANC, (mg/L as CaCO₃)	Acidity, heated, (mg/L as CaCO₃)	Iron, dissolved (ug/L)	Iron, total (ug/L)
N	42	44	38	38	42	42
Max	5.7	7.1	140	0.0	21,400	23,000
Min	0.2	6.1	106	0.0	15,600	15,800
Mean	0.8	6.5	123	0.0	18,600	19,000
Median	0.5	6.5	123	0.0	18,300	19,000

Taken from: Chaplin, J.J., 2005

Unknown Source of Acidity Upstream of Known Discharges

According to the Bear Creek TMDL, the water flowing in Bear Creek (fig. 5) upstream of the Lykens Water Level Tunnel (Bear Creek Above B1) and the Unnamed Tributary to Bear Creek both have a low pH and “higher concentrations of metals than would be expected in the absence of AMD”. The TMDL also explains that this acidity may be due to natural conditions or an unknown source of AMD. Similar to other creeks in the area, Bear Creek is poorly buffered upstream of the mine discharges. Because the buffering capacity is low, the pH is subject to change due to acid rain or runoff from unconsolidated coal spoil. A neighboring sub-watershed of the Wiconisco Creek, Rattling Creek, has long experienced low pH due to the naturally poor buffering capacity of the surrounding soils. Over time, it became apparent that the depressed pH in Rattling Creek was due to atmospheric deposition (acid rain) in the predominantly sandstone geology and not due to possible historical mining activity as once thought.

Since Bear Creek originates in Bear Swamp, increased acidity leading to low pH is likely in part, due to natural processes in the swamp and is exacerbated by acid rain. However, the TMDL calls for more detailed studies to help determine the source(s) of the acidity in the upstream portion of Bear Creek. The result of these studies will determine the extent of remediation efforts to achieve the load reductions for acidity called for in the Bear Creek TMDL for both Bear Creek upstream of the Lykens Water Level Tunnel Discharge and the Unnamed Tributary. Summary water quality data is presented below in Table 8.

**Table 8 Selected summary water-quality data for Bear Creek upstream of mining discharges.
Collected by USGS from March 1999 to December 2002.**

[N, number of measurements; Max, maximum; Min, minimum; mg/L, milligrams per liter;
ANC, acid neutralizing capacity; ug/L, micrograms per liter; --, not determined; <, less than; ≤, less than or equal to]

	Oxygen, dissolved (mg/L)	Field pH (standard units)	ANC, (mg/L as CaCO₃)	Acidity, heated, (mg/L as CaCO₃)	Iron, dissolved (ug/L)	Iron, total (ug/L)
N	41	43	37	38	42	42
Max	14.6	6.1	24	65.0	7,090	7,500
Min	0.9	4.3	3	1.4	<20	≤80
Mean	9.4	4.9	8.5	26.0	--	--
Median	10	4.6	7	24.0	410	550

Taken from: Chaplin, J.J., 2005



Figure 4. Photo of one of the Alkaline Discharges (Adits) entering Bear Creek.



Figure 5. Photo of Bear Creek upstream of known mine discharges

Pollutants of Concern

The load reductions specified in the Bear Creek Watershed TMDL (SRBC 2001) are concerned with the following pollutants originating from the abandoned mines:

Dissolved Iron (Fe)
Total Manganese (Mn)
Total Aluminum (Al)
Acidity*

* For the Lykens Water Level Tunnel discharge, Unnamed tributary, and Bear Creek upstream of Lykens Water Level Tunnel. There is no confirmation of acidity in the Unnamed tributary or Bear Creek upstream coming from abandoned mines.

Historical in-stream water quality and discharge water quality (flow, metals concentration, iron loadings, and other parameters) may be found in the following reports: Sanders and Thomas 1973; Growitz and others 1985; Wood 1996; Stoe 1998; Stoe 1999; SRBC 2001; Durlin and Schaffstall 2002; Chaplin 2005.

While some of these reports did not concentrate solely on Bear Creek Watershed, a great deal of information about Bear Creek may still be gleaned from them.

Water Quality Improvement Goals/Reductions

One of the components of a TMDL is the establishment of endpoints, which are used to evaluate the attainment of acceptable water quality. In-stream numeric endpoints are based on criteria available in water quality standards, and represent the water quality goals that are to be achieved by implementing the reductions specified in the Bear Creek TMDL.

TMDL's for each segment and/or discharge at Bear Creek are found in Table 9. All metals criteria evaluated in the TMDL are specified as total recoverable with the exception of iron, which is specified as dissolved. All load allocations in the TMDL are specified as long-term daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 % of the time (SRBC 2001). Specifics regarding the computational methodology used to develop the Bear Creek TMDL and the Margins of Safety can also be found within the TMDL report.

Reducing metals loading (specifically iron) will reduce AMD sedimentation in Bear Creek, as well as the portion of Wiconisco Creek that is immediately downstream of the confluence with Bear Creek, and will assist in re-colonization of the substrate by benthic macroinvertebrates.

Table 9. Summary Table of Measured and Allowable Loads – Bear Creek Watershed

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)	Percent
Instream monitoring point located at B1						
B1	Fe	0.67	6.5	0.02	0.2	97
	Mn	0.21	2.0	0.21	2.0	0
	Al	0.35	3.4	0.14	1.4	59
	Acidity	8.73	85.2	0.44	4.4	95.2
	Alkalinity	1.98	19.3			
Instream monitoring point located at the Lykens Discharge						
Lykens	Fe	4.31	42.4	0.18	1.8	99
	Mn	0.78	7.7	0.78	7.7	0
	Al	0.48	4.7	0.34	3.3	29
	Acidity	45.43	447.1	0.28	2.8	99.4
	Alkalinity	0.92	9.1			
Instream monitoring point located at the Alkaline Discharge						
Alkaline	Fe	18.43	430.4	0.04	0.9	99
	Mn	2.22	51.8	0.84	19.6	62
	Al	<0.20	<4.7	-	-	0
	Acidity	1.67	39.0	NA	NA	NA
	Alkalinity	117.11	2,734.8			
Instream monitoring point located at B2						
B2	Fe	9.99	505.7	0.10	5.1	83
	Mn	1.44	72.9	0.59	29.9	27
	Al	0.15	7.6	0.15	7.6	0
	Acidity	29.45	1,490.9	NA	NA	NA
	Alkalinity	66.67	3,375.1			
Instream monitoring point located at B3						
B3	Fe	2.60	144.8	0.10	5.6	0
	Mn	1.55	86.4	0.43	24.0	45
	Al	0.51	28.4	0.19	10.6	63
	Acidity	6.94	386.6	NA	NA	NA
	Alkalinity	70.17	3,909.3			

All allocations are load allocations to nonpoint sources. The margin of safety for all points is applied implicitly through the methods used in the computations.

(Taken from SRBC 2001)

Section 3.0

Implementation Plan Development

Public Participation

One initial public meeting was held as part of this Implementation Plan process on March 22, 2005. Representatives from local government, watershed associations and the general public were invited to come together at the Northern Dauphin County Library in Lykens, PA in order to review the Implementation Plan purpose and the activities that are scheduled to take place within the watershed. Also, the public has been able to stay informed of this planning process as well as current remediation activities through information routinely posted on the Dauphin County Conservation District's website (www.dauphincd.org).

The Dauphin County Conservation District's website, developed and maintained by DCCD, allows for public access to local activities related to the Bear Creek Watershed, and will include the final draft of the Bear Creek TMDL Implementation Plan. By providing this service, interested citizens may keep abreast of the remediation activities without having to schedule time to attend meetings.

Watershed Planning Integration

The Implementation of the TMDL for Bear Creek is consistent with the environmental goals of Dauphin County and the Commonwealth of Pennsylvania and ties in with existing watershed plans such as the Wiconisco Creek Watershed Conservation Plan (Dauphin County Conservation District 2004) and the Wiconisco Creek Watershed Assessment and Plan (Stoe 1998). Successfully implementing the remediation measures outlined in this plan should help Dauphin County government reach their overall natural resource and water quality improvement goals listed in the Dauphin County Draft Comprehensive Plan (Dauphin County Planning Commission 2005), specifically through the following objectives:

NR-1.2 of the 2005 Draft County Comprehensive Plan *"Promote the protection of the quality and quantity of water supplies"*

NR-1.6 of the 2005 Draft County Comprehensive Plan *"Involving the public"*

Also, implementation of this plan will help Dauphin County achieve the goals for reducing sedimentation caused by AMD listed in the Dauphin County Chesapeake Bay Tributary Strategy (Dauphin County Conservation District 2005).

Section 4.0

Implementation Actions

Management Measures/Reduction Strategy

Several attempts have been made over the years to collect data and recommend treatment options for the Bear Creek Watershed. The earliest of these studies is known as the Operation Scarlift Report. The Operation Scarlift Report (Sanders and Thomas 1973) recommended treating mine drainage in the Bear Creek Watershed by passive treatment. Additionally, backfilling of the cropfalls was listed as a possible alternative to reduce the amount of inflow to the underlying mine pool. Since then, it has been shown that backfilling of cropfalls would have a small reduction in inflow for a large amount of expenditure (Skelly and Loy 2003). All studies concur that passive treatment is the most effective way to treat the discharges.

While progress on implementation of remediation activities in the past had been sluggish due to land acquisition and other technical challenges, significant progress has been made recently toward the successful implementation of Best Management Practices (BMPs) through negotiations with the current landowner and the Pennsylvania Game Commission (PGC) as the potential future landowner. When considering passive treatment, locating suitable land on which to construct the system is the main concern. Before the BMPs listed herein can be implemented, suitable land must be acquired and the landowner willing to accept such treatment systems. Local government, landowners, businesses and residents have been supportive of the efforts by the project partners aimed at restoring Bear Creek.

The strategy for reducing AMD pollution from known discharges, is an iterative approach that takes advantage of current passive treatment technology. This phased approach will spread out the total construction costs over time and allow for more systematic remediation. The strategy for a succeeding phase is an innovative approach to remove relict iron deposits that have accumulated over the course of more than 100 years by removing iron deposits from the streambed. Removal of the relict iron deposits will prevent them from getting re-dissolved in the naturally acidic conditions of Bear Creek. The re-dissolution could keep dissolved iron levels elevated for several years and prevent the reductions from being met at in-stream sites BC-2 and BC-3 described in the TMDL. Also, removal of relict iron deposits may allow the streambed to be re-colonized by benthic macroinvertebrates, which can result in a more timely removal of Bear Creek from the Commonwealth's 303(d) list. Without the removal of iron deposits within the streambed, it is likely that Bear Creek's 303(d) listed segments will remain unable to sustain an appropriate macroinvertebrate community for many years.

There are no verified AMD discharges upstream of the Lykens Water Level Tunnel and acidity upstream is likely due to naturally acidic conditions at the headwaters in Bear Swamp and possibly aggravated by atmospheric deposition. However, more investigations need to be conducted to verify the cause of the acidic conditions. If atmospheric deposition is exacerbating a naturally acidic condition, then remediation measures similar to existing atmospheric deposition mitigation projects may be established in the final phase of remediation.

Best Management Practices Existing and Planned

At the time of this plan, there are no existing BMPs in place to remediate AMD in Bear Creek. However, treatment systems are planned in a phased implementation approach and construction of Phase I is likely to begin by 2006 and be completed during that same year. It should be noted that as of January 2005, the all of the land area intended for Phases I and II of remediation as shown in Figure 6 is under contract to be sold with the intent to deed the land to the Pennsylvania Game Commission. The following lists the types of BMPs planned for each phase of remediation in the watershed.

Phase I: Lykens Water Level Tunnel

Status: Currently funded

Phase I consists of an aerobic sedimentation pond (Pond A) (fig. 6) in proximity to the discharge origination point that will perform preliminary settling of iron. After treatment in Pond A, the discharge will be conveyed to a second pond (Pond B), which will consist of a sedimentation forebay with underflow baffles and a Vertical Flow Pond (VFP). The discharge water will enter the forebay where additional iron will settle out and then be directed to the VFP portion of Pond B to generate alkalinity. The discharge water will exit Pond B and be conveyed to Pond C, the final aerobic sedimentation pond where final iron settling will occur before the treated discharge is then re-directed back to Bear Creek.

Expected results: After passive treatment within the VFP and sedimentation ponds, all applicable TMDL load reductions for metals and acidity for the Lykens Water Level Tunnel discharge are expected to be achieved.

Phase II: Alkaline Discharges

Status: Future Project

Construction of at least one, large aerobic sedimentation pond and associated conveyances on land currently owned by Medco Development Corp. (fig. 6), to passively treat the Alkaline Discharges (drift entries and multiple seeps). Alkaline Discharges will be collected as anoxic as possible at their source and directed (piped) to the system located on suitable land several hundred feet to the south. The discharge water will enter at least one aerobic sedimentation pond and will encounter underflow baffles, which will slow the flow and allow for more even settling of sludge. After treatment, the discharge water can be directed to one or a series of vegetated wetlands, which will act as a final “polishing” agent to remove what little metals remain in the discharge after sedimentation. The treated discharge will then be directed back to Bear Creek.

Expected results: After passive treatment within the aerobic sedimentation pond(s), it is anticipated that the prescribed iron and manganese load reductions will be achieved. Additional final treatment (polishing) to remove more metals can be supplied by vegetated wetlands.

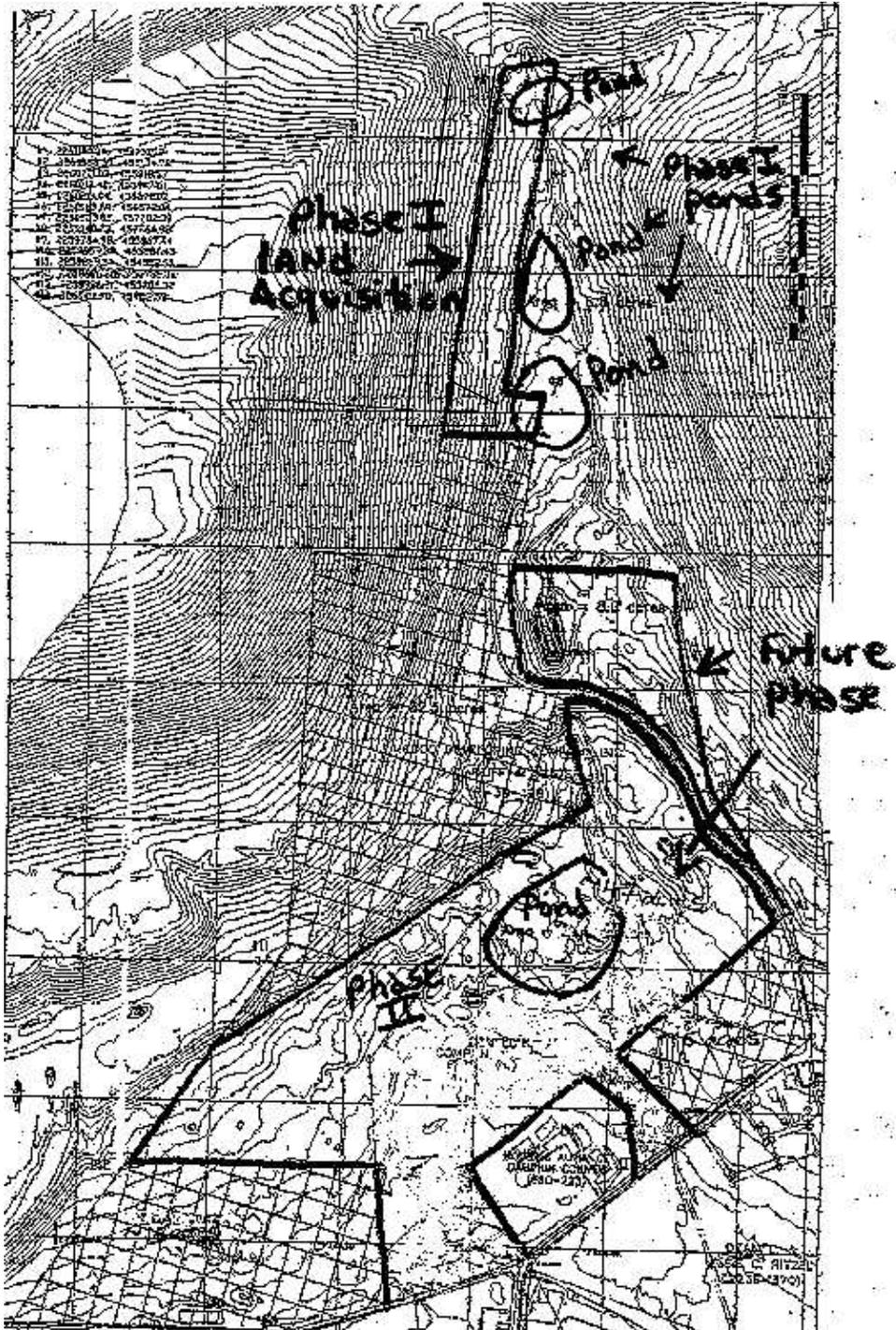


Figure 6. Land acquisition areas and general locations of Phase I and II treatment systems.

Phase III: Removal of Relict Iron Deposits from the Affected Portions of Bear Creek Streambed.

Status: Future Project

Utilizing a vacuum truck or similar pumping device to remove historical iron deposits from Bear Creek streambed. Dredge material may be pumped to “Geo Tubes” for de-watering and air drying or directly to Phase II sedimentation pond(s) for settling.

Expected results: By preventing re-dissolution of historical iron deposits in the streambed, the TMDL endpoints will be achieved at in-stream points BC-2 and BC-3. After iron removal is completed, Bear Creek substrate should be able to harbor benthic macroinvertebrates almost immediately. It is anticipated that within a year after Phase III is completed, benthic organisms will begin to recolonize the substrate. Once an appropriate macroinvertebrate community is established, Bear Creek can be removed from the PA 303(d) list.

Phase IV: Addition of limestone to Bear Creek and Unnamed Tributary.

Status: Potential Future Project if found to be necessary

Depending on the results of investigations as to the source(s) of acidity in Bear Creek upstream of Lykens Water Level Tunnel and the Unnamed Tributary, the addition of limestone to the stream channel(s) may prove useful at these sites as a way to treat the diffuse source of acidity due to atmospheric deposition. The size of the limestone placed in the channel may be similar to sand at first but may transition to larger sizes that last much longer in the stream (ie. Cobble or boulders) once the initial desired effect is achieved. Periodic replenishing of limestone may be necessary.

Expected results: If atmospheric deposition or small acidic discharges are found to be the source of increased acidity/ depressed pH, the addition of the limestone (sand, cobble, or boulders) may increase the buffering capacity of the affected areas. It is anticipated that if Phase IV is required and then completed, pH levels in these affected areas would rise to acceptable levels.

Section 5

Technical and Financial Assistance Needed

As with any AMD remediation project, long term monitoring (both pre and post-construction) provides data that can be used to assist engineering subcontractors in the initial design process and to determine system effectiveness after construction. Additionally, accurate post-construction monitoring can help to determine the frequency of maintenance activities such as sludge removal. Adequate funding for implementation activities including monitoring is vital to the continuation of remediation within the Bear Creek Watershed.

Technical and engineering assistance needed for remediation of the discharges within the Bear Creek Watershed:

- Engineering assistance for conceptual and final designs for BMPs
- Engineering assistance with bid package for construction and construction oversight
- Technical assistance with development of operation and maintenance plans
- Technical assistance with monitoring and sample analyses
- Technical assistance with investigating sources of acidity in the upper watershed
- Technical assistance for resource recovery efforts to utilize iron sludge

Estimated financial assistance, in 2005 dollars, needed for remediation of the discharges within the Bear Creek Watershed and associated monitoring, is broken down into the appropriate phase. Cost estimates for Phases I and II construction and maintenance were calculated by using the AMDTreat computer program. AMDTreat was developed cooperatively by the following agencies: the Pennsylvania Department of Environmental Protection, the West Virginia Department of Environmental Protection and the U.S. Office of Surface Mining Reclamation and Enforcement (OSM). Phase II vegetated wetlands cost estimate is presented as a unit cost per acre to construct based on personal communication with local consultants. The exact acreage of vegetated wetlands that can be placed at the Phase II site is not known at this time, so the only cost estimate presented is the unit cost per acre. Phase III cost estimate was based on personal communication with the private sector. Phase IV cost estimate was based on previous experience mitigating atmospheric deposition in Dauphin County.

PROJECT COST ESTIMATES

Phase I: Lykens Water Level Tunnel

Status: Currently funded project

Current Funding and In-Kind Sources: Section 319, OSM ACSI, PA DEP BAMR, DCCD, WCRA and other project partners.

Total funding requirements for Phase I: \$290,000

Phase II: Alkaline Discharges

Status: Future Project

Potential Project Funding Sources: Growing Greener, Section 319, OSM ACSI, PA DEP BAMR, Five Star Restoration Grant,

Estimated funding requirements for Phase II (not including vegetated wetlands for polishing): \$524,000

Estimated unit cost per acre funding requirements for Phase II vegetated wetlands: \$40,000/acre

Phase III: Removal of Relict Iron Deposits

Status: Future Project

Potential Project Funding Sources: Section 319, OSM ACSI, PADEP BAMR, USEPA Targeted Watershed Grant, PA Energy Harvest Grant

Estimated funding requirements: \$150,000

Phase IV: In-stream Limestone (If required)

Status: Potential Future Project

Potential Project Funding Source: Section 319

Estimated funding requirements: up to \$5,000/ year

MAINTENANCE COST ESTIMATES

Phases I and II System Maintenance

Status: Future maintenance project

Potential Project Funding Sources: Section 319, OSM ACSI, PADEP BAMR, USEPA Targeted Watershed Grant, PA Energy Harvest Grant

Estimated funding requirements: \$25,000 every 5 years

POST PROJECT MONITORING COST ESTIMATES

Phase I (Lykens Water Level Tunnel) Post construction monitoring

Status: Funded partially by OSM ACSI. Remaining through potential contributions by PADEP BAMR and in-kind contributions by project partners.

Estimated funding requirements: \$6,000 for one year post-construction quarterly monitoring

Phase II (Alkaline Discharges) Post construction monitoring

Status: Future monitoring project

Potential project funding sources: Section 319, OSM ACSI, PADEP BAMR, Growing Greener

Estimated funding requirements: \$8,000 for one year of quarterly monitoring

Phase III (Relict iron removal) Post project monitoring

Status: Future monitoring project

Potential project funding sources: Section 319, OSM ACSI, PADEP BAMR, Growing Greener

Estimated funding requirements: \$5,000 for one year of quarterly monitoring

Phase IV (Limestone) Post project monitoring

Status: Potential future monitoring project

Estimated funding requirements: Estimates not possible at this time. More information will be required before accurate cost estimate is possible.

Evaluation of Funding Sources

The following is a list of potential funding sources that could be used for implementation activities in the Bear Creek Watershed. Each of the sources has specific requirements and benefits that will vary in applicability. While at the current time, most of these programs are viable avenues for funding, potential future budget cuts from federal and state levels may preclude the use of some or all of these programs. All remediation efforts described in this document will depend entirely upon availability of adequate funding and available staff within the partnering agencies/entities.

Growing Greener Program

Grant funds for engineering, construction, and monitoring of projects. Eligible recipients include: conservation districts, watershed associations, non-profits, local governments.

Administering Agency: PA DEP, Growing Greener Grants Center. Telephone: 717.705.5400

US EPA Non-point source grants, Administered by PA DEP (Section 319 of the Clean Water Act)

Grant funds for engineering, construction, and limited monitoring of project. Eligible recipients include: conservation districts, watershed associations, local governments, non-profits.

Administering Agency: PA DEP Non-point source management section.

PA DEP, Bureau of Abandoned Mine Reclamation

Funding and/or technical assistance for engineering, construction, and monitoring of projects. Eligible recipients include: conservation districts, watershed associations, local governments, non-profits.

Administering Agency: PA DEP, Bureau of Abandoned Mine Reclamation. Wilkes-Barre, PA.

United States Dept. of Interior, Office of Surface Mining (OSM) Appalachian Clean Streams Initiative (ACSI)

Funding and technical assistance for land acquisition, engineering, construction, and limited monitoring of projects. Eligible recipients: Non-profits with 501(C)(3) status only.

Administering Agency: Office of Surface Mining. Harrisburg Field Office. Telephone: 782.2285 ext 15

Five-Star Restoration Matching Grants Program

Funding for restoration including training, education, outreach and monitoring.

Administering Agency: Multiple partnership including: National Fish and Wildlife Foundation, USEPA, National Association of Counties, etc.
Contact: www.nfwf.org or www.epa.gov

National Fish and Wildlife Foundation Grant

Potential funding for land acquisition.

Administering Agency: NFWF
Contact: www.nfwf.org

Chesapeake Bay Small Watersheds Grant Program

Funding for education and limited funds for construction.

Administering Agency: Pennsylvania Association of Conservation Districts

Contact: PACD at 717-238-7223 or e-mail Yvonne Harhigh (yvonne-harhigh@pacd.org), PACD Education Specialist, or Kathleen Banski (Kathleen-banski@pacd.org), PACD Director of Administration/Education.

PA League of Women Voters Watershed Resource and Education Network (WREN) Grants

Funding for primarily non-point source educational projects.

Administering Agency: PA League of Women Voters

Contact: WREN Resource Center, League of Women Voters of Pennsylvania, 226 Forster Street, Harrisburg, PA 17102. 1-800-692-7281

Section 6 Measurable Goals

Implementation Goals and Milestones

The goal of this implementation plan is to bring Bear Creek into compliance with water quality standards (meeting TMDL requirements), which eventually may allow macroinvertebrates to re-colonize the creek bed. Once an appropriate benthic fauna is re-established, Bear Creek could then be removed from the 303(d) list. This goal will be measured or evaluated by the concentration of iron in samples, but milestones for objectives along the way will include timing for the implementation of BMPs and results from water quality and discharge measurements.

A phased BMP implementation approach is recommended for the Bear Creek discharges, which will allow for a systematic improvement in water quality from upstream to downstream. Ultimately, the one factor that will determine whether or not the implementation goals and milestones will be met, regardless of funding availability for construction, is the accessibility and acquisition of suitable land for placement of the treatment systems for Phases I and II.

Implementation activities are scheduled to begin with land acquisition procedures during summer/fall 2005 after which several milestones are to be met within the next 6 years. A timeline of implementation milestones is given in Table 10.

Assessment of progress toward implementation goals will be performed by DCCD through tracking of BMPs installed by the project partners and continued water quality monitoring by DCCD, WCRA or other entities.

Table 10. Timeline of Implementation Milestones for Bear Creek Watershed.

	May, 2005	October, 2005	June, 2006	August, 2006	November, 2006	August, 2007
Phase I: Lykens Water Level Tunnel	Phase I final engineering begins	Phase I land acquired and deeded to PGC	Phase I construction begins	Phase I construction complete Phase I post-construction monitoring begins	Phase I operation and Maintenance Plan complete	Phase I post-construction monitoring complete
Phase II Alkaline Discharges	December, 2007 Phase II land acquired and deeded to PGC Phase II final engineering begins	May, 2008 Phase II construction begins	September, 2008 Phase II construction complete Phase II post-construction monitoring begins	August, 2009 Phase II Operation and Maintenance Plan complete	September, 2009 Phase II post-construction monitoring complete	
Phase III: Removal of Relict Iron Deposits	June, 2010 Mobilize equipment and begin suction dredging	August, 2010 Suction dredging complete	September, 2010 Begin post-dredging macroinvertebrate and water chemistry monitoring	September, 2011 Post-dredging quarterly water chemistry monitoring complete		
	June, 2010					
Phase IV: Placement of Limestone (if needed).	Begin placement of limestone in upper Bear Creek					

Monitoring Plan

Historical pre-construction monitoring has occurred at 6 sampling sites throughout Bear Creek. Some of these sites are identical to the sites listed in the TMDL. Discharge specific monitoring will occur after the Phase I construction phase is completed to document reductions in the final treated discharge and to determine the rate of sludge accumulation in each treatment cell. Phase II post-construction monitoring will not only document pollutant reductions in the treated discharge as it goes through the treatment system, but will also document in-stream reductions at points within Bear Creek identified in the TMDL. Water quality monitoring and flow measurements after Phase III will occur after the relict iron has been removed and will consist of only three in-stream sites quarterly for a period of one year.

Depending upon funding availability, DCCD personnel will conduct post-project quarterly monitoring for a period of one year. Parameters will include the specific pollutants listed in the TMDL as long as funding or in-kind sample analysis by PA DEP is available for appropriate laboratory analysis.

Water Quality Monitoring Goals and Milestones

Progress toward the milestones for water quality monitoring will be assessed through monitoring results and communicated to project partners. Proposed monitoring sites are presented in Figure 2. A list of current project partners is given in Appendix A. Milestones for water quality are given in Table 11.

Table 11. Water Quality milestones for Bear Creek AMD Remediation.

	7/1/2005	12/31/2006	12/31/2009	9/30/2011	9/30/2011
Implementation Begins	Prescribed reductions met for Lykens Water Level Tunnel.	Prescribed reductions met for Alkaline Discharges	Prescribed reductions met for Bear Creek at mouth (BC-3) and Bear Creek downstream of alkaline discharges	Prescribed increase in pH for upper Bear Creek and the unnamed tributary	All water quality goals met.
	PHASE I Completed: Lykens Water Level Tunnel	Phase II Completed: Alkaline Discharges	Phase III Completed: Removal of Relict Iron Deposits	Phase IV Completed: Addition of Limestone to Creek	

Section 7

Stakeholders' Roles and Responsibilities

AMD, by its definition, has no responsible party who holds the burden of remediation. Continued stakeholder/partner participation is the key to improving water quality and removing Bear Creek from the impaired waters list. Appendix A contains a list of current project partners and duties for Phase I remediation activities.

Since one of the goals of the project is to acquire and transfer to the commonwealth, the land needed for passive treatment, the responsibility lies upon all of the those involved, as concerned agencies and citizens of the Commonwealth, to be active in remediation efforts. The Commonwealth must also ensure the continued funding, not only for construction activities, but also for periodic future maintenance and assistance for post-project monitoring.

Responsibility lies not only with the entities involved with implementation activities, but also with the stakeholders charged with overseeing the nation's environmental health. In order to achieve a lasting, positive change on the environment of Bear Creek and many other AMD impacted watersheds, federal and state governments must be willing and able to make positive changes in programs, funding and/or legislation to address the widespread impacts of AMD.

The Pennsylvania Game Commission (PGC) has agreed to own the land with the treatment systems and, as such, will ultimately be the party responsible for system maintenance. Project partners, led by DCCD and WCRA will review milestones and expected results periodically to determine the efficiency of the BMPs and the need for any revisions to the Implementation Plan.

Quarterly post-construction water quality monitoring for one year after each phase is completed will likely be accomplished by DCCD with assistance from WCRA and is largely dependent upon laboratory analysis assistance provided by PADEP and funding from grant sources. Periodic long-term post-project sampling for limited parameters will be accomplished by DCCD as part of its Countywide Monitoring Program subject to availability of adequate resources.

The roles and responsibilities of some of the major stakeholders are described below.

Federal Government

U.S. Environmental Protection Agency (EPA): Responsibility of overseeing programs related to the Clean Water Act and is also responsible for providing funding and technical assistance through Section 319 of the Clean Water Act.

U.S. Office of Surface Mining (OSM): Federal agency working closely with state agencies and local non-profits for the reclamation of abandoned mine sites. Conservation Districts and non-profits rely on the expertise of OSM staff and vital funding from programs such as the Appalachian Clean Streams Initiative (ACSI) to assist with design, construction, and land acquisition costs.

State Government

P.A. Department of Environmental Protection (PADEP): While PADEP is not the only state agency involved with activities that impact water quality in Pennsylvania, it is the agency responsible for planning the reduction of pollutants that impact the State's waters. PADEP has the lead role in

developing or arranging for the development of suitable implementation plans and provides available funding and technical support to implement non-point source BMPS.

P.A. Game Commission (PGC): The PGC, as the future owner of the land with the treatment systems, has a vested interest in clean water to provide habitat for wildlife.

Local Government

Dauphin County Conservation District (DCCD): The DCCD's role is one of project organization and acts to secure funding to implement BMPS to reduce non-point source pollution in Dauphin County watersheds. Post-construction monitoring will be performed by DCCD with assistance from project partners and is ultimately contingent upon available funding and other assistance.

Wiconisco Township: Local government officials work closely with DCCD staff and may help to promote education and outreach to citizens to stress the importance of non-point source pollution reduction in their municipality.

Citizen Groups, Citizens, and Businesses

The main role of citizens and local businesses is to be informed and involved with the remediation process by providing local feedback.

The Wiconisco Creek Restoration Association (WCRA) provides additional project financial support, project guidance, and assistance in the dissemination of information to the general public. Their volunteer restoration efforts serve to showcase citizen action.

Section 8 Education/Outreach

While the activities listed in this document are largely construction projects, the opportunity exists to educate a broad audience on present and future water quality conditions of Bear Creek and the significant AMD non-point source pollution problem that exists in the Commonwealth. The opportunity exists for informative kiosks to be placed throughout the site to accommodate self-guided tours of the treatment systems.

Successes and challenges with regard to AMD remediation will continue to be communicated to the scientific community, government agencies, and the general public through presentations and press releases. The Bear Creek remediation project is especially relevant and valuable as an education tool given its proximity to the State Capitol and the large population centers of Central Pennsylvania.

The strategy for informing and involving the public revolves around using existing media outlets for dissemination of information and to continue to garner public support. The WCRA and the DCCD will continue to communicate with local newspapers, radio, and television and will encourage public participation through membership in and events sponsored by the WCRA.

Section 9

Evaluation of Progress/ Remedial Actions

It is necessary to evaluate the progress of the Implementation Plan regularly in order to assess the effectiveness or unsuitability of the Plan and milestones and to make adjustments as needed.

If the monitoring process reveals that implementation milestones and water quality milestones are being met on schedule, then implementation and monitoring should continue as planned. If the monitoring process indicates that water quality standards are met, the next step is to inform PADEP. PADEP will determine if the appropriate stream segments may be de-listed based on established guidance requirements.

If implementation milestones are being met and yet water quality is not showing the corresponding expected improvements, then one of the following may be true:

- The TMDL or Implementation Plan may need to be revised
- Greater time period may be required between implementation of BMPs and their effectiveness
- TMDL is not attainable even with BMP implementation
- Installed BMPs may need to be modified
- Additional BMPs may be required

If the established water quality milestones are far from being met, the Plan or TMDL itself may need revision. If deterrents to progress are part of the Plan (e.g., inappropriate BMPS), then the Plan must be refined. If the Plan is not at fault, then a revision of the TMDL and the endpoints may be indicated.

If neither the Plan nor the water quality milestones are being met, then a determination must be made as to why. If outside influences (funding availability, land ownership, etc.) are responsible, then it may be appropriate to revise the Plan's schedule and establish new milestones and goals.

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Appendix A

Bear Creek Project Partners

**Bear Creek Remediation
Current Listing of Project Partners and duties for
Phase I (Lykens Water Level Tunnel)**

Dauphin County Conservation District (DCCD): Coordination of remediation activities and land acquisition procedures, assisting with locating funding sources for construction and maintenance, grant holder for 319 grants and grant administration

PA Game Commission (PGC): Final owner of the land with treatment system, technical assistance, maintenance of treatment system

Eastern PA Coalition for Abandoned Mine Reclamation (EPCAMR): Grant holder and administration for OSM ACSI funding for land acquisition and additional construction, interim landowner, additional technical assistance

Wiconisco Creek Restoration Association (WCRA): Public relations, land acquisition funding assistance, public education, general project support and guidance

PA Department of Environmental Protection Non-Point Source: Funding and technical support

PA Dept. of Environmental Protection, BAMR: In-kind support for analysis of post-construction water samples.

Wiconisco Township: General project support and public education, zoning, etc.

Skelly and Loy, Inc.: Phase I project engineer and oversight, bid document preparation, operation and maintenance plan preparation

Medco, Inc.: Current landowner at locations of Phases I and II

Kerwin and Kerwin, Inc.: Legal assistance with land transfer

Burch Associates: Subdivision, survey

US Geological Survey (USGS): Additional general technical assistance, TAG grant to assist with weir construction for discharge measurements.

US Environmental Protection Agency (EPA): Funding support through 319

Dauphin County Commissioners: General project support, funding, public relations

PHASE II POTENTIAL PARTNERS (IN ADDITION TO ABOVE)

PA Dept of Transportation (PennDOT): Source of funding for RTE 322 by-pass mitigation wetlands to be placed at bear creek for habitat enhancement and additional treatment polishing. Potential to provide funding to monitor wetlands over several years.

Army Corps of Engineers (ACOE): Final approval for any 404 permitting procedures and approval for PennDOT involvement.

Federal Highways Administration (FHWA): Approval for PennDOT involvement.