FINAL

BRUBAKER RUN WATERSHED TMDL

Cambria County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

June 29, 2004

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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Brubaker Run Watershed (Attachment A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers one segment on this list (shown in Table 1). High levels of metals and sulfates, and in some areas depressed pH, caused these impairments. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum), sulfates, and pH.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 08-C Clearfield Creek								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	0.8 2	4026	26489	Brubaker Run	CWF	305(b) Report	RE	Other Inorganics & Metals
1998	2.9	4026	26489	Brubaker Run	CWF	SWMP	AMD	Other Inorganics & Metals
2002	New survey; new segment id (990819-0920-LMS)							
1996	Not on 303(d) list							
1998	Not on 303(d) list							
2002	7.23	990819-0920-LMS	26489	Brubaker Run	CWF	SWAP	AMD	Metals & pH

Resource Extraction=RE
Cold Water Fishes = CWF
Surface Water Monitoring Program = SWMP
Surface Water Assessment Program = SWAP
Abandoned Mine Drainage = AMD

See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists.*

The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

[1] Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Directions to the Brubaker Run Watershed

The Brubaker Run Watershed is located in West Central Pennsylvania, in the northeastern corner of Cambria County. The watershed is found on the United States Geological Survey map covering the Altoona 7.5-minute quadrangle. The area within the Brubaker Run watershed covers approximately 3.82 square miles. Most of the land within the watershed consists of forestland and previously mined land. The mainstem of Brubaker Run is approximately 3.16 miles from its source to its confluence with Clearfield Creek. Brubaker Run is designated as a cold-water fishery in PA Title 25 Chapter 93.

The mouth of Brubaker Run, at its confluence with Clearfield Creek, is located at the village of Dean on route 53 north. To arrive at Dean, take route 22 east from Altoona in Blair County, approximately 10 miles to the route 53 north exit. Take route 53 north approximately 13 miles to the village of Dean. Brubaker Run passes under route 53 at Dean.

Segments addressed in this TMDL

Currently, there are two active surface mining operations in the Brubaker Run watershed. Mining is complete on both permits; however, both operations are actively treating post-mining discharges. Since liability exists for these discharges, they are considered to be point-source discharges and will be assigned waste load allocations. All other discharges in the watershed are from abandoned mines and will be treated as non-point sources. The distinction between non-point and point sources in this case is determined on the basis of whether or not there is a responsible party for the discharge. Where there is no responsible party the discharge is considered to be a non-point source. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be “fishable” and “swimmable.”

Additionally, the federal Clean Water Act and the Environmental Protection Agency’s (EPA) implementing regulations (40 CFR Part 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);

- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;

- States to submit the list of waters to EPA every two years (April 1 of the even numbered years);

- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and nonpoint sources; and

- EPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and EPA had not developed many TMDLs. Beginning in 1986, organizations in many states filed lawsuits against the EPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While EPA has entered into consent agreements with the plaintiffs in several states, other lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require EPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

Prior to developing TMDLs for specific waterbodies, there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d) list. With guidance from the EPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting

[2] Section 305(b) of the Clean Water Act requires a biannual description of the water quality of the waters of the state.

process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the assessed stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates and habitat evaluations. Benthic macroinvertebrates are identified to the family level in the field.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on habitat scores and a series of narrative biological statements used to evaluate the benthic macroinvertebrate community. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

Although all watersheds must be handled on a case-by-case basis when developing TMDLs, there are basic processes or steps that apply to all cases. They include:

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculating TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

Multiple seams of coal, and in some cases the clay underlying the coal, have been extensively mined in the Brubaker Run watershed by numerous operators and clay refractories over many decades. Much of the affected area was left unreclaimed and several mine discharges resulted. Approximately 30-40% of the acreage in the Brubaker Run watershed has been previously affected by mining activities. Normally before surface mining activities commence, all saleable timber is removed from the site.

The last two active surface mine permits in the Brubaker Run watershed are associated with E.P. Bender Coal Company, Surface Mine Permit (SMP) 11793025 in Dean Township, Cambria County, and Cooney Brothers Coal Company, Mine Drainage Permit (MDP) 4270BSM1 also in Dean Township, Cambria County. There are two point source discharges for which E.P. Bender has incurred liability which are being treated together and discharged to the stream. There is one discharge on the Cooney Brothers site. These discharges have been identified as BEND and COON for the E.P. Bender and Cooney Brothers sites respectively and can be located on the map in Attachment A.

AMD Methodology

A two-step approach is used for the TMDL analysis of AMD impaired stream segments. The first step uses a statistical method for determining the allowable instream concentration at the point of interest necessary to meet water quality standards. This is done at each point of interest (sample point) in the watershed. The second step is a mass balance of the loads as they pass through the watershed. Loads at these points will be computed based on average annual flow.

The statistical analysis described below can be applied to situations where all of the pollutant loading is from non-point sources as well as those where there are both point and non-point sources. The following defines what are considered point sources and non-point sources for the purposes of our evaluation; point sources are defined as permitted discharges or a discharge that has a responsible party, non-point sources are then any pollution sources that are not point sources. For situations where all of the impact is due to non-point sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are point-source impacts alone, or in combination with non-point sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards*, will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

[3] @Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

PR = maximum {0, (1-Cc/Cd)} where (1)

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

Cd = randomly generated pollutant source concentration in mg/l based on the observed data

Cd = RiskLognorm(Mean, Standard Deviation) where (1a)

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

The overall percent reduction required is the 99th percentile value of the probability distribution generated by the 5,000 iterations, so that the allowable long-term average (LTA) concentration is:

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

Once the allowable concentration and load for each pollutant is determined, mass-balance accounting is performed starting at the top of the watershed and working down in sequence. This mass-balance or load tracking is explained below.

Load tracking through the watershed utilizes the change in measured loads from sample location to sample location, as well as the allowable load that was determined at each point using the @Risk program.

There are two basic rules that are applied in load tracking; rule one is that if the sum of the measured loads that directly affect the downstream sample point is less than the measured load at the downstream sample point it is indicative that there is an increase in load between the points being evaluated, and this amount (the difference between the sum of the upstream and downstream loads) shall be added to the allowable load(s) coming from the upstream points to give a total load that is coming into the downstream point from all sources. The second rule is that if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

Tracking loads through the watershed gives the best picture of how the pollutants are affecting the watershed based on the information that is available. The analysis is done to insure that water quality standards will be met at all points in the stream. The TMDL must be designed to meet standards at all points in the stream, and in completing the analysis, reductions that must be made to upstream points are considered to be accomplished when evaluating points that are lower in the watershed. Another key point is that the loads are being computed based on average annual flow and should not be taken out of the context for which they are intended, which is to depict how the pollutants affect the watershed and where the sources and sinks are located spatially in the watershed.

For pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both in units of milligrams per liter (mg/**l**) $CaCO_3$. Statistical procedures are applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for streams affected by low pH from AMD may not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

Information for the TMDL analysis performed using the methodology described above is contained in the "TMDLs by Segment" section of this report.

Method to Quantify Treatment Pond Pollutant Load

Surface coal mines remove soil and overburden materials to expose the underground coal seams for removal. After removal of the coal, the overburden is replaced as mine spoil and the soil is replaced for revegetation. In a typical surface mining operation the overburden materials is removed and placed in the previous cut where the coal has been removed. In this fashion, an active mining operation has a pit that progresses through the mining site during the life of the mine. The pit may have water reporting to it, as it is a low spot in the local area. Pit water can be the result of limited shallow groundwater seepage, direct precipitation into the pit, and surface runoff from partially regraded areas that have been backfilled but not yet revegetated. Pit water is pumped to nearby treatment ponds where it is treated to the required treatment pond effluent limits. The standard effluent limits are as follows, although stricter effluent limits may be applied to a mining permit's effluent limits to insure that the discharge of treated water does not cause instream limits to be exceeded.

Standard Treatment Pond Effluent Limits:
Alkalinity > Acidity
6.0 <= pH <= 9.0
Fe <= 3.0 mg/l
Mn <= 2.0 mg/l
Al <= 2.0 mg/l

When a treatment plant has an NPDES permit a Waste Load Allocation (WLA) must be calculated. When there is flow data available this is used along with the permit Best Available

Technology (BAT) limits for one or more of the following: aluminum, iron, and manganese. The following formula is used:

Flow (mgd) X BAT limit (mg/l) X 8.34 = lbs/day

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for a comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

Because most of the pollution sources in the watershed are nonpoint sources, the larges part of the TMDL is expressed as Load Allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30 day average; Total Recoverable
Manganese (Mn)	1.00	Total Recoverable
Sulfates	250	Total Recoverable
pH *	6.0-9.0	N/A

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality.

Other Inorganics

The cause of inorganic impairment as listed on the 1996 and 1998 Section 303(d) lists is sulfates. Due to Title 25 Chapter 96.3(d), which requires that criterion not be exceeded at a point of potable water supply withdrawal, a TMDL to address sulfates is not necessary. The nearest potable water withdrawal to Brubaker Run occurs approximately 65 miles downstream of the mouth at the Shawville Power Plant (PWSID 6170333) located on West Branch Susquehanna River. Sulfate data from WQN0422, located approximately 15 miles upstream of the water supply intake and 50 miles downstream Brubaker Run, on Clearfield Creek at the SR 0153 Bridge in Boggs Township, has a ten-year average sulfate concentration of 192.78 mg/l. The data shows that Clearfield Creek provides the proper dilution for the sulfates in Brubaker Run and water quality criterion of 250 mg/L will not be exceeded at the water supply intake 15 miles further downstream on the West Branch Susquehanna River. Sulfate data for the WQN station is located in Appendix F.

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS). The waste load allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 3 for each segment are based on the assumption that all upstream allocations are achieved and take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit MOS based on conservative assumptions in the analysis is included in the TMDL calculations.

The allowable LTA concentration in each segment is calculated using Monte Carlo Simulation as described previously. The allowable load is then determined by multiplying the allowable concentration by the flow and a conversion factor at each sample point. The allowable load is the TMDL.

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. There are currently two permitted discharges in the watershed. The difference between the TMDL and the WLA at each point is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced within a segment in order for water quality standards to be met at the point.

In some instances, instream processes, such as settling, are taking place within a stream segment. These processes are evidenced by a decrease in measured loading between consecutive sample points. It is appropriate to account for these losses when tracking upstream loading through a segment. The calculated upstream load lost within a segment is proportional to the difference in the measured loading between the sampling points.

Table 3. TMDL Component Summary for the Brubaker Run Watershed

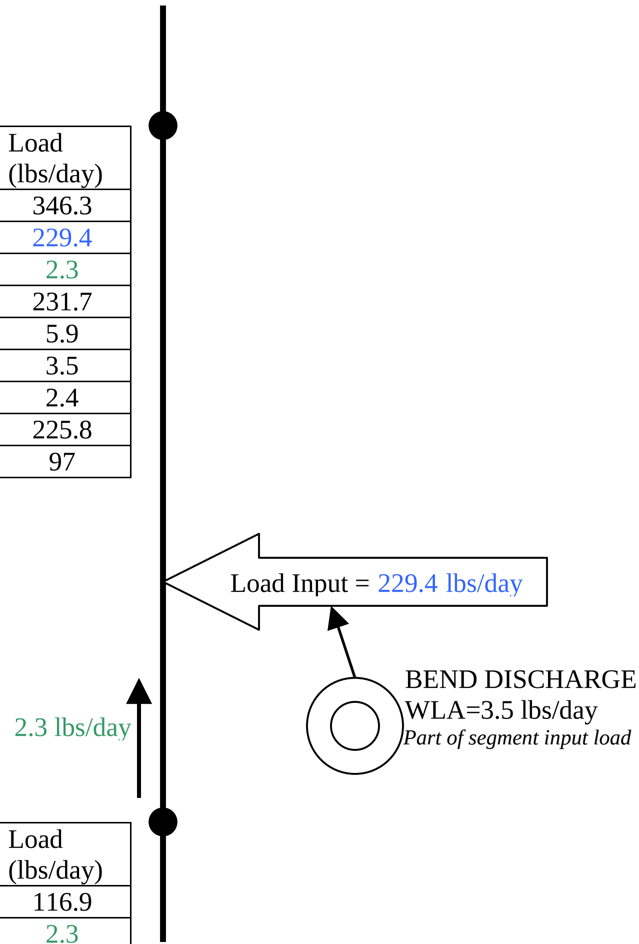
Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
BRBK06	*Brubaker Run, most upstream sample point*						
	Al	40.8	1.6	0.0	1.6	39.2	96
	Fe	3.3	3.3	NA	NA	0.0	0
	Mn	23.9	1.9	0.0	1.9	22.0	92
	Acidity	423.3	0.0	0.0	0.0	423.3	100
BRBK05	*Brubaker Run, upstream of E.P. Bender Coal Co. treatment discharge*						
	Al	116.9	2.3	0.0	2.3	78.8	97
	Fe	72.0	0.0	0.0	0.0	72.0	100
	Mn	100.1	1.0	0.0	1.0	77.2	99
	Acidity	1220.3	0.0	0.0	0.0	797.0	100
BRBK04	*Brubaker Run, upstream of Cooney Brothers Coal Co. treatment discharge & downstream of E.P. Bender Coal Co. treatment discharge*						
	Al	346.3	5.9	3.5	2.4	225.8	97
	Fe	670.9	5.2	5.2	0.0	593.6	99
	Mn	357.2	4.6	3.5	1.1	253.4	98
	Acidity	6407.9	0.0	0.0	0.0	5187.6	100
BRBK03	*Brubaker Run, downstream of Cooney Brothers Coal Co. treatment discharge*						
	Al	459.4	9.2	2.4	6.8	109.8	92
	Fe	891.4	8.9	3.6	5.3	216.8	96
	Mn	511.9	7.2	2.4	4.8	152.1	96
	Acidity	7619.9	0.0	0.0	0.0	1212.0	100
BRBK02	*Clay mine discharge*						
	Al	143.9	2.9	0.0	2.9	141.0	98
	Fe	1102.5	0.0	0.0	0.0	1102.5	100
	Mn	304.7	3.0	0.0	3.0	301.7	99
	Acidity	4101.8	0.0	0.0	0.0	4101.8	0
BRBK13	*Brubaker Run, downstream of clay mine discharge*						
	Al	577.8	12.1	0.0	12.1	0.0	0
	Fe	1799.4	16.2	0.0	16.2	0.0	0
	Mn	826.9	10.7	0.0	10.7	9.8	48
	Acidity	10526.2	0.0	0.0	0.0	0.0	0
BRBK01	*Brubaker Run, mouth*						
	Al	640.4	12.8	0.0	12.8	61.3	83
	Fe	1636.3	16.4	0.0	16.4	0.0	0
	Mn	909.7	13.6	0.0	13.6	80.0	85
	Acidity	12140.8	0.0	0.0	0.0	1614.6	100

NA, meets WQS. No TMDL necessary.

In the instance that the allowable load is equal to the existing load (e.g. iron point BRBK06, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point.

Following is an example of how the allocations, presented in Table 3 are calculated. For this example, aluminum allocations for points BRBK05 and BRBK04 are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains a map of the sampling point locations for reference.

BRBK04	Load (lbs/day)
Existing Load	346.3
Difference in Existing Load between BRBK05 & BRBK04	229.4
Load tracked from BRBK05	2.3
Total Load tracked between points BRBK05 & BRBK04	231.7
Allowable Load at BRBK04	5.9
WLA	3.5
LA	2.4
Load Reduction at BRBK04	225.8
% Reduction required at BRBK04	97



BRBK05	Load (lbs/day)
Existing Load	116.9
Allowable Load at BRBK05	2.3
Load Reduction at BRBK05	78.8
% Reduction required at BRBK05	97

Waste load allocations are assigned to the two permitted discharges in the Brubaker Run Watershed for iron and manganese. Waste load allocations are also being developed for aluminum to provide an allowance for the discharge of aluminum, which may occur, even though the parameter is not included in either permit. The waste load allocations are based on estimated flow and the permit limits, which are Best Available Technology (BAT) limits. Discharge BEND is from a mine drainage treatment facility for the E.P. Bender Coal Co. site (SMP 11793025). The average flow from the BEND discharge is estimated to be approximately 145 gpm. The WLA for this discharge is evaluated at BRBK04. Discharge COON is from a mine drainage treatment facility for the Cooney Brothers Coal Co. site (MDP 4270BSM1). The average flow from the COON discharge is estimated to be approximately 100 gpm. The WLA for this discharge is evaluated at BRBK03. No reductions of permit limits are required at this time. All necessary reductions are assigned to the non-point sources. Table 4 contains the waste load allocations for the two permitted discharges.

Table 4. Waste Load Allocations of Permitted Discharges

Parameter	Allowable Average Monthly Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Discharge BEND			
Al	2.0	0.209	3.5
Fe	3.0	0.209	5.2
Mn	2.0	0.209	3.5
Discharge COON			
Al	2.0	0.144	2.4
Fe	3.0	0.144	3.6
Mn	2.0	0.144	2.4

Recommendations

Currently, the Army Corps of Engineers has been engaged by a local watershed group to do a Section 206 Aquatic Ecosystem Restoration Project on the Brubaker Run clay mine discharge for which liability does not exist. This project is in the very early stages. First, the Corps must do a feasibility study that should take 12 to 24 months to complete. Upon completion of the feasibility study and design of a treatment system for the discharge is completed by the Corps, the watershed group must sign a construction agreement with the Corps and provide 35% match monies for the total project. Remediation/ treatment of this discharge is several years at the earliest.

E.P. Bender and Cooney Brothers operators are currently working with the Cambria District Mining Office to calculate trust fund agreements to insure adequate funding will be available to provide perpetual treatment for their respective discharges.

Two primary programs provide maintenance and improvement of water quality in the watershed. DEP's efforts to reclaim abandoned mine lands, coupled with its duties and responsibilities for issuing NPDES permits, will be the focal points in water quality improvement.

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by DEP's Bureau of Abandoned Mine Reclamation, which administers and oversees the Abandoned Mine Reclamation Program in Pennsylvania; the United States Office of Surface Mining; the National Mine Land Reclamation Center; the National Environmental Training Laboratory; and many other agencies and individuals. Funding from EPA's CWA Section 319(a) Grant program and Pennsylvania's Growing Greener program has been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

The DEP Bureau of Mining and Reclamation administers an environmental regulatory program for all mining activities, mine subsidence regulation, mine subsidence insurance, and coal refuse disposal; conducts a program to ensure safe underground bituminous mining and protect certain structures form subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; provides for training, examination, and certification of applicants for blaster's licenses; administers a loan program for bonding anthracite underground mines and for mine subsidence; and administers the EPA Watershed Assessment Grant Program, the Small Operator's Assistance Program (SOAP), and the Remining Operators Assistance Program (ROAP).

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960s, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management initiatives designed to enhance mine operator, volunteer land DEP reclamation efforts. Reclaim PA has the following four objectives.

- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources.

Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of streams polluted with mine drainage, over 7,000 orphaned and abandoned oil and gas wells, widespread subsidence problems, numerous hazardous mine openings, mine fires, abandoned structures and affected water supplies – representing as much as one third of the total problem nationally.

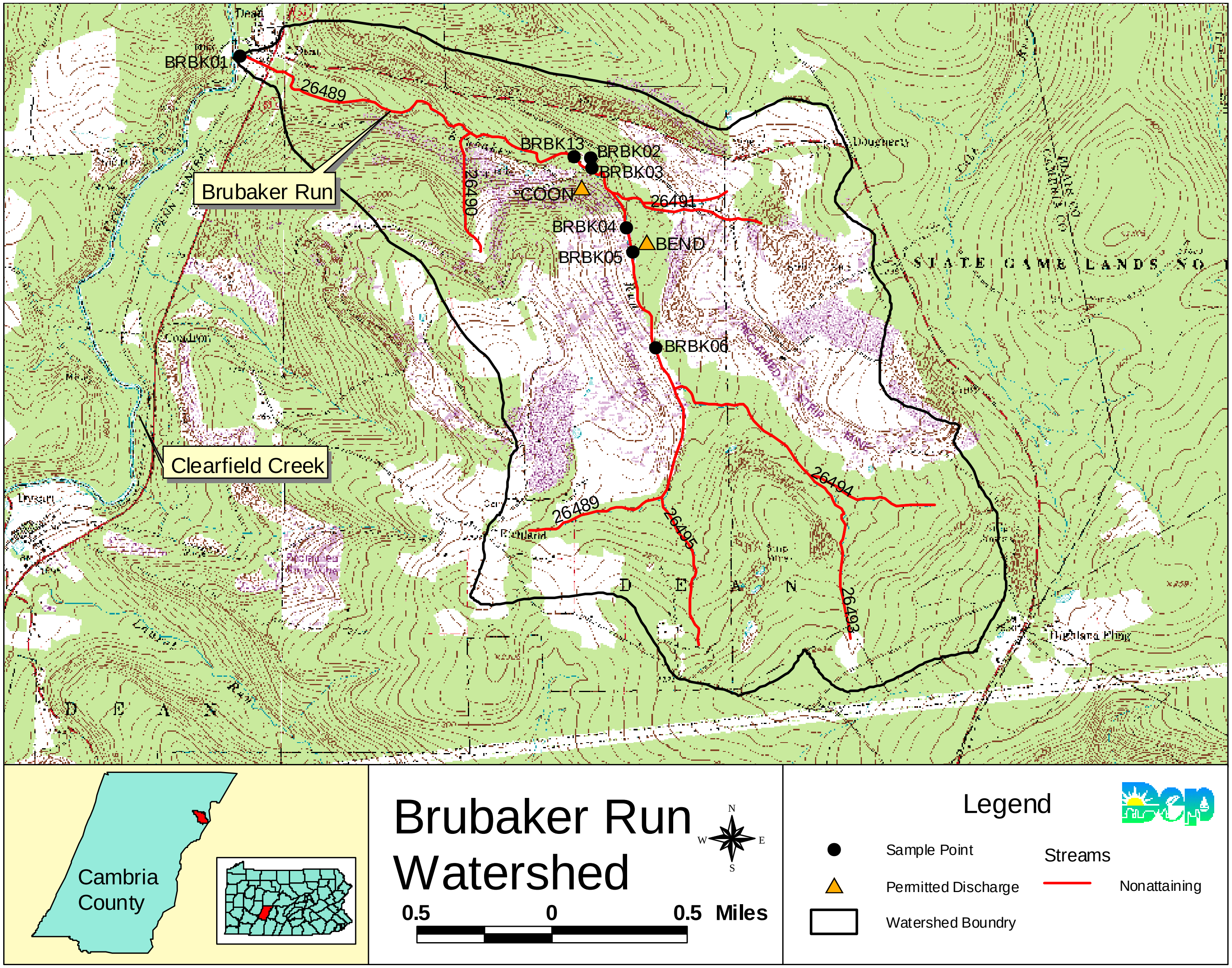
Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on January 31, 2004 and the *Altoona Mirror* on February 03, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from January 31, 2004 to

March 31, 2004. A public meeting was held on February 17, 2004 at the Saint Thomas Church in Ashville, to discuss the proposed TMDL.

Attachment A

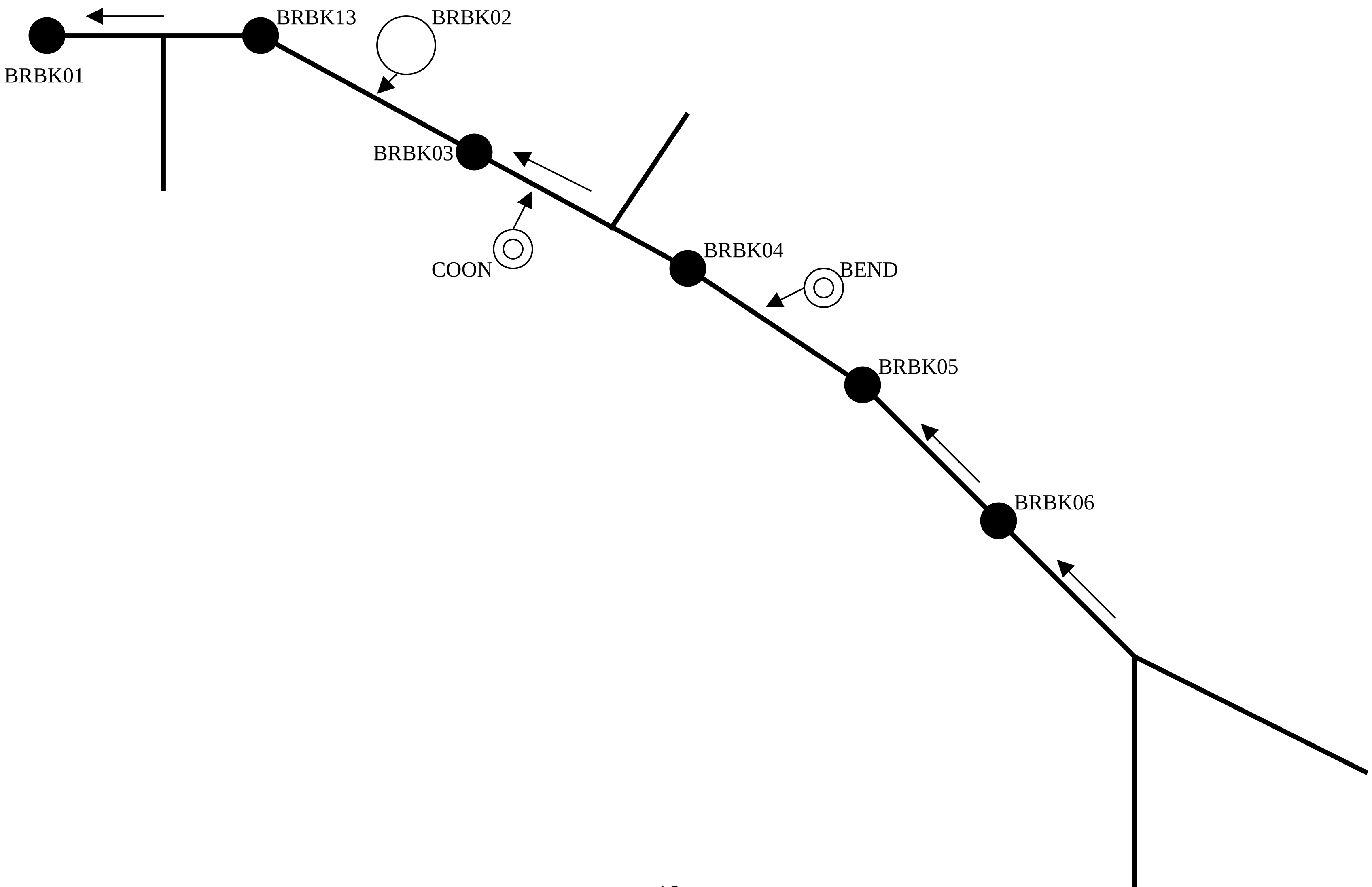
Brubaker Run Watershed Maps


BRBK01
26489
Brubaker Run
BRBK13
BRBK02
BRBK03
COON
26490
26491
BRBK04
BEND
BRBK05
BRBK06
Clearfield Creek
26494
26489
26495
26493
Cambria County
Brubaker Run Watershed
0.5 0 0.5 Miles
Legend
Sample Point
Permitted Discharge
Watershed Boundry
Streams
Nonattaining

Brubaker Run Sampling Station Diagram

Arrows indicate direction of flow.

(Diagram not to scale)



Attachment B

Method for Addressing Section 303(d) Listings for pH and Surface Mining Control and Reclamation Act

Method for Addressing Section 303(d) Listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published by the Pa. Department of Environmental Protection demonstrates that by plotting net alkalinity (alkalinity-acidity) vs. pH for 794 mine sample points, the resulting pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the EPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics. Additionally, pH does not measure latent acidity. For this reason, and based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the Section 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net alkalinity is a measure of the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable. Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria.

Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both being in units of milligrams per liter (mg/l) $CaCO_3$. The same statistical procedures that have been described for use in the evaluation of the metals is applied, using the average value for total alkalinity at that point as the target to specify a reduction in the acid concentration. By maintaining a net alkaline stream, the pH value will be in the range between six and eight. This method negates the need to specifically compute the pH value, which for mine waters is not a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

There are several documented cases of streams in Pennsylvania having a natural background pH below six. If the natural pH of a stream on the Section 303(d) list can be established from its upper unaffected regions, then the pH standard will be expanded to include this natural range. The acceptable net alkalinity of the stream after treatment/abatement in its polluted segment will be the average net alkalinity established from the stream's upper, pristine reaches added to the acidity of the polluted portion in question. Summarized, if the pH in an unaffected portion of a stream is found to be naturally occurring below six, then the average net alkalinity for that portion (added to the acidity of the polluted portion) of the stream will become the criterion for the polluted portion. This "natural net alkalinity level" will be the criterion to which a 99 percent confidence level will be applied. The pH range will be varied only for streams in which a natural unaffected net alkalinity level can be established. This can only be done for streams that have upper segments that are not impacted by mining activity. All other streams will be required to reduce the acid load so the net alkalinity is greater than zero 99% of time.

Reference: *Rose, Arthur W. and Charles A. Cravotta, III 1998. Geochemistry of Coal Mine Drainage. Chapter 1 in Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania. Pa. Dept. of Environmental Protection, Harrisburg, Pa.*

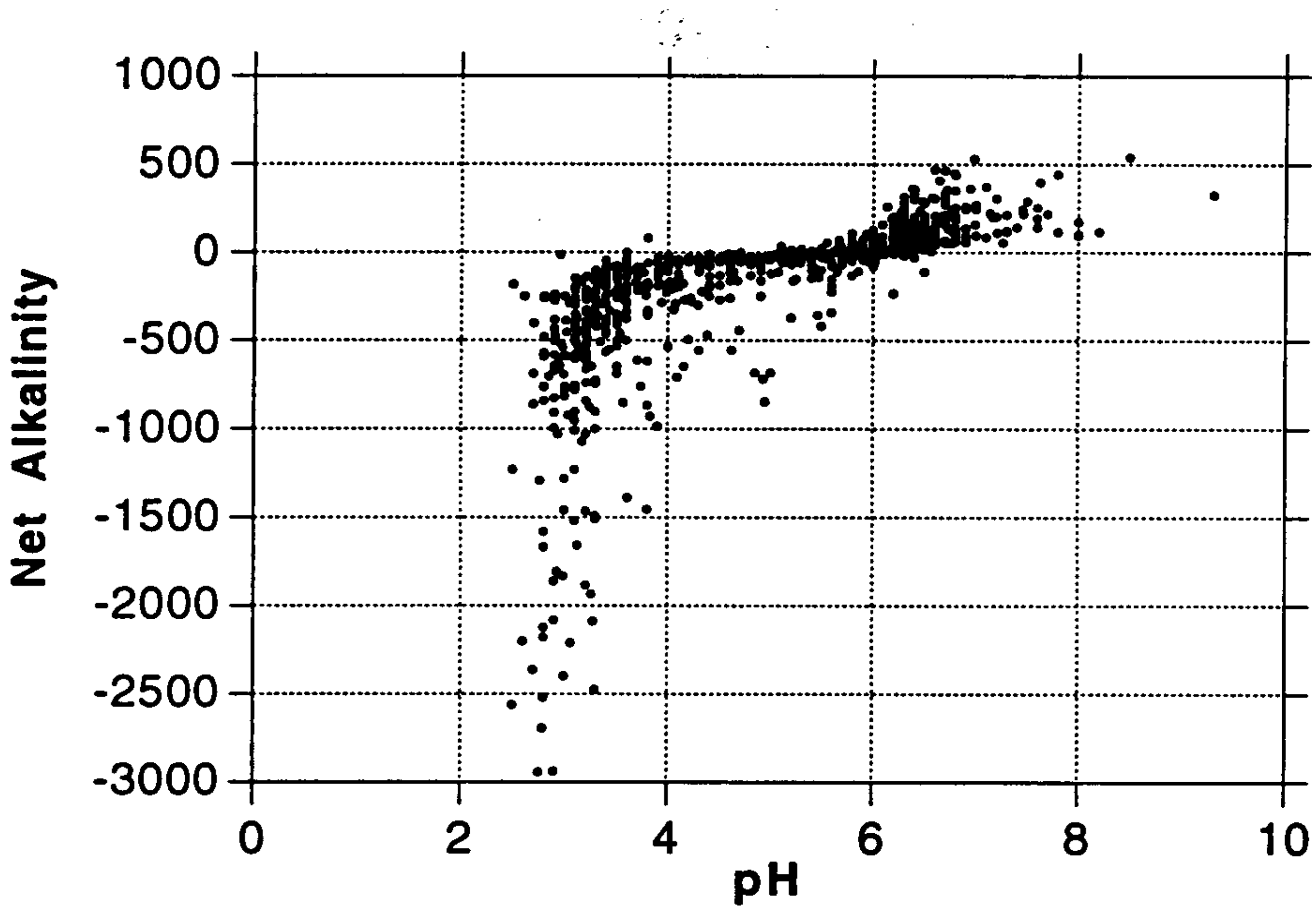


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Surface Mining Control and Reclamation Act

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to established a nationwide program to, among other things, protect the beneficial uses of land or water resources, and pubic health and safety from the adverse effects of current surface coal mining operations, as well as promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by the regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA, (often called "pre-law" mines) are not subject to the requirements of SMCRA.

Title IV of the Act is designed to provide assistance for reclamation and restoration of abandoned mines, while Title V states that any surface coal mining operations shall be required to meet all applicable performance standards. Some general performance standards include:

- Restoring the affected land to a condition capable of supporting the uses which it was capable of supporting prior to any mining,

- Backfilling and compacting (to insure stability or to prevent leaching of toxic materials) in order to restore the approximate original contour of the land with all highwalls being eliminated, and topsoil replaced to allow revegetation, and

- Minimizing the disturbances to the hydrologic balance and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by avoiding acid or other toxic mine drainage.

For purposes of these TMDLs, point sources are identified as NPDES-permitted discharge points, and nonpoint sources include discharges from abandoned mine lands, including but not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. In the absence of an NPDES permit, the discharges associated with these land uses were assigned load allocations.

The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

Related Definitions

Pre-Act (Pre-Law) - Mines that ceased operating by the effective date of SMCRA and are not subject to the requirements of SMCRA.

Bond – A instrument by which a permittee assures faithful performance of the requirements of the acts, this chapter, Chapters 87-90 and the requirements of the permit and reclamation plan.

Postmining pollution discharge – A discharge of mine drainage emanating from or hydrologically connected to the permit area, which may remain after coal mining activities have been completed, and which does not comply with the applicable effluent requirements described in Chapters 87.102, 88.92, 88.187, 88.292, 89.52 or 90.102. The term includes minimal-impact postmining discharges, as defined in Section of the Surface Mining Conservation and Reclamation Act.

Forfeited Bond – Bond money collected by the regulatory authority to complete the reclamation of a mine site when a permittee defaults on his reclamation requirements.

Attachment C
TMDLs By Segment

Brubaker Run

The TMDL for Brubaker Run consists of load allocations of an abandoned clay mine discharge and six sampling sites along the stream. Waste load allocations are assigned to discharges from the E.P. Bender and Cooney Brothers sites.

Brubaker Run is listed as impaired on the CWA 303(d) list by both high metals and low pH from AMD. The method and rationale for addressing pH is contained in Attachment B. The objective is to reduce acid loading to the stream which will in turn raise the pH to the acceptable range. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 2).

An allowable long-term average in-stream concentration was determined at each sample point for aluminum, iron, manganese, and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, five thousand iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards.

For the analysis, aluminum data from the April 12, 2002 sampling event was not included because concentration results for that day were 3 to 5 times greater than the rest of the sampling events. Aluminum data for this day was considered to be an outlier and not representative of normal conditions. Inclusion of the data in the analysis would result in extremely high standard deviations, which would then result in extremely low long-term averages.

TMDL Calculations - Sample Point BRBK06, Brubaker Run most upstream sample point

The TMDL for sample point BRBK06 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point BRBK06. The average flow of 1.36 MGD, measured at the point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals and other inorganics impairments. A reassessment of the segment in 1999 removed other inorganics and added pH as a cause of impairment to the PA 2002 Section 303(d) list. Sample data at point BRBK06 shows pH ranging between 3.88 and 4.25; pH will be addressed as part of this TMDL because of the mining impacts.

Water quality analysis determined that the existing and allowable iron loads are equal. Because WQS are met, a TMDL for iron is not necessary at BRBK06.

Table C1. TMDL Calculations at Point BRBK06				
Flow = 1.36 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	3.59	40.8	0.14	1.6
Fe	0.29	3.3	0.29	3.3
Mn	2.10	23.9	0.17	1.9
Acidity	37.25	423.3	0.00	0.0
Alkalinity	0.00	0.0		

Table C2. Calculation of Load Reduction Necessary at Point BRBK06				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	40.8	3.3	23.9	423.3
Allowable Load = TMDL	1.6	3.3	1.9	0.0
Load Reduction	39.2	0.0	22.0	423.3
Total % Reduction	96	0	92	100

TMDL Calculations - Sampling Point BRBK05, Brubaker Run upstream of E.P. Bender Coal Co. discharge

The TMDL for sampling point BRBK05 consists of a load allocation to the area between points BRBK06 and BRBK05. The TMDL for this stream segment was computed using water-quality sample data collected at point BRBK05. The average flow of 1.61 MGD, measured at the sampling point, is used for these computations

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals and other inorganics impairments. A reassessment of the segment in 1999 removed other inorganics and added pH as a cause of impairment to the PA 2002 Section 303(d) list. Sample data at point BRBK05 shows pH ranging between 3.47 and 4.07; pH will be addressed as part of this TMDL because of the mining impacts.

Table C3. TMDL Calculations at Point BRBK05				
Flow = 1.61 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	8.69	116.9	0.17	2.3
Fe	5.36	72.0	0.00	0.0
Mn	7.44	100.1	0.07	1.0
Acidity	90.73	1220.3	0.00	0.0
Alkalinity	0.00	0.0		

The calculated load reductions for all the loads that enter point BRBK05 must be accounted for in the calculated reductions at the sample point shown is Table C4. A comparison of measured loads between points BRBK05 and BRBK06 shows that there is additional loading entering the segment for all parameters.

Table C4. Calculation of Load Reduction Necessary at Point BRBK05				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	116.9	72.0	100.1	1220.3
Difference in Existing Load between BRBK05 & BRBK06	76.1	68.7	76.3	797.0
Load tracked from BRBK06	1.6	3.3	1.9	0.0
Total Load tracked between points BRBK05 & BRBK06	77.7	72.0	78.2	797.0
Allowable Load at BRBK05	2.3	0.0	1.0	0.0
Load Reduction at BRBK05	75.4	72.0	77.2	797.0
% Reduction required at BRBK05	97	100	99	100

Waste Load Allocation – Discharge BEND

The waste load allocation for discharge BEND, located on E.P. Bender Coal Co. site (SMP 11793025), is determined from estimated flow and the monthly average permit limits for iron and manganese. Although aluminum is not included in the permit, a waste load allocation is being calculated using the standard BAT limit for aluminum and the estimated flow. The following table shows the waste load allocations for the discharge.

Table C5. Waste Load Allocations at Discharge BEND			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
Discharge BEND			
Al	2.0	0.209	3.5
Fe	3.0	0.209	5.2
Mn	2.0	0.209	3.5

TMDL Calculations - Sample Point BRBK04, Brubaker Run upstream of Cooney Brothers Coal Co. discharge and downstream of E.P. Bender Coal Co. discharge

The TMDL for sample point BRBK04 consists of a waste load allocation to the E.P. Bender discharge and a load allocation to all of the area between sample point BRBK04 and sample point BRBK05 shown in Attachment A. The TMDL for this stream segment was computed using water-quality sample data collected at point BRBK04. The average flow of 1.98 MGD, measured at the sampling point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals and other inorganics impairments. A reassessment of the segment in 1999 removed other inorganics and added pH as a cause of impairment to the PA 2002 Section 303(d) list. Sample data at point BRBK04 shows pH ranging between 3.19 and 4.20; pH will be addressed as part of this TMDL because of the mining impacts.

Table C6. TMDL Calculations at Point BRBK04				
Flow = 1.98 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	20.94	346.3	0.36	5.9
Fe	40.57	670.9	0.32	5.2
Mn	21.60	357.2	0.28	4.6
Acidity	387.53	6407.9	0.00	0.0
Alkalinity	0.00	0.0		

The calculated load reductions for all the loads that enter point BRBK04 must be accounted for in the calculated reductions at the sample point shown is Table C7. A comparison of measured loads between points BRBK04 and BRBK05 shows that there is additional loading entering the segment for all parameters.

Table C7. Calculation of Load Reduction Necessary at Point BRBK04				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	346.3	670.9	357.2	6407.9
Difference in Existing Load between BRBK05 & BRBK04	229.4	598.9	257.1	5187.6
Load tracked from BRBK05	2.3	0.0	1.0	0.0
Total Load tracked between points BRBK04 & BRBK05	231.7	598.9	258.1	5187.6
Allowable Load at BRBK04	5.9	5.2	4.6	0.0
WLA (BEND)	3.5	5.2	3.5	0.0
LA (Allowable – WLA)	2.4	0.0	1.1	0.0
Load Reduction at BRBK04	225.8	593.6	253.4	5187.6
% Reduction required at BRBK04	97	99	98	100

Waste Load Allocation – Discharge COON

The waste load allocation for discharge COON, located on Cooney Brothers Coal Co. site (MDP 270BSM1), is determined from estimated flow and the monthly average permit limits for iron and manganese. Although aluminum is not included in the permit, a waste load allocation is being calculated using the standard BAT limit for aluminum and the estimated flow. The following table shows the waste load allocations for the discharge.

Table C8. Waste Load Allocations at Discharge COON			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
Discharge COON			
Al	2.0	0.144	2.4
Fe	3.0	0.144	3.6
Mn	2.0	0.144	2.4

TMDL Calculation - Sample Point BRBK03, Brubaker Run downstream of Cooney Brothers Coal Co. discharge

The TMDL for sample point BRBK03 consists of a waste load allocation to the Cooney Brothers discharge and a load allocation to all of the area between sample point BRBK03 and sample point BRBK04 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point BRBK03. The average flow of 2.36 MGD, measured at sample point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals and other inorganics impairments. A reassessment of the segment in 1999 removed other inorganics and added pH as a cause of impairment to the PA 2002 Section 303(d) list. Sample data at point BRBK03 shows pH ranging between 3.22 and 4.39; pH will be addressed as part of this TMDL because of the mining impacts.

Table C9. TMDL Calculations at Point BRBK03				
Flow = 2.36 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	23.38	459.4	0.47	9.2
Fe	45.37	891.4	0.45	8.9
Mn	26.05	511.9	0.36	7.2
Acidity	387.79	7619.9	0.00	0.0
Alkalinity	0.00	0.0		

The calculated load reductions for all the loads that enter point BRBK03 must be accounted for in the calculated reductions at the sample point shown is Table C10. A comparison of measured loads between points BRBK03 and BRBK04 shows that there is additional loading entering the segment for all parameters.

Table C10. Calculation of Load Reduction Necessary at Point BRBK03				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	459.4	891.4	511.9	7619.9
Difference in Existing Load between BRBK04 & BRBK03	113.1	220.5	154.7	1212.0
Load tracked from BRBK03	5.9	5.2	4.6	0.0
Total Load tracked between points BRBK04 & BRBK03	119.0	225.8	159.3	1212.0
Allowable Load at BRBK03	9.2	8.9	7.2	0.0
WLA (COON)	2.4	3.6	2.4	0.0
LA (Allowable – WLA)	6.8	5.3	4.8	0.0
Load Reduction at BRBK03	109.8	216.8	152.1	1212.0
% Reduction required at BRBk03	92	96	96	100

TMDL Calculations - Sample Point BRBK02, abandoned clay mine discharge

The TMDL for BRBK02 consists of a load allocation to an abandoned clay mine discharge. The TMDL was computed using water-quality sample data collected at point BRBK02. The average flow of 0.59 MGD, measured at the sampling point, is used for these computations.

This discharge does not appear on the PA Section 303(d) list because it is not a stream, however the segment to which it discharges appeared on the 1996 and 1998 PA Section 303(d) lists for metals and other inorganics impairments. A reassessment of the segment in 1999 removed other inorganics and added pH as a cause of impairment to the PA 2002 Section 303(d) list. Sample data at point BRBK02 shows pH ranging between 2.90 and 3.16; pH will be addressed as part of this TMDL because of the mining impacts.

Table C11. TMDL Calculations at Point BRBK02

Flow = 0.59 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	29.36	143.9	0.59	2.9
Fe	225.01	1102.5	0.00	0.0
Mn	62.19	304.7	0.62	3.0
Acidity	837.12	4101.8	0.00	0.0
Alkalinity	0.00	0.0		

Table C12. Calculation of Load Reduction Necessary at Point BRBK02

	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	143.9	1102.5	304.7	4101.8
Allowable Load = TMDL	2.9	0.0	3.0	0.0
Load Reduction	141.0	1102.5	301.7	4101.8
Total % Reduction	98	100	99	0

TMDL Calculation - Sample Point BRBK13, Brubaker Run downstream of clay mine discharge

The TMDL for sample point BRBK13 consists of a load allocation to all of the area between sample points BRBK13 and sample points BRBK03 and BRBK02 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point BRBK13. The average flow of 2.91 MGD, measured at sample point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals and other inorganics impairments. A reassessment of the segment in 1999 removed other inorganics and added pH as a cause of impairment to the PA 2002 Section 303(d) list. Sample data at point BRBK13 shows pH ranging between 3.00 and 3.35; pH will be addressed as part of this TMDL because of the mining impacts.

Table C13. TMDL Calculations at Point BRBK13				
Flow = 2.91 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	23.79	577.8	0.50	12.1
Fe	74.07	1799.4	0.67	16.2
Mn	34.04	826.9	0.44	10.7
Acidity	433.33	10526.2	0.00	0.0
Alkalinity	0.00	0.0		

The calculated load reductions for all the loads that enter point BRBK13 must be accounted for in the calculated reductions at the sample point shown is Table C14. A comparison of existing loads between points BRBK13, BRBK02, and BRBK03 shows that there is additional manganese loading and a loss of iron, aluminum, and acidity loading within the segment. The loss of loading indicates that instream processes, such as settling, are taking place within the segment. It also indicates that no additional loading is directly entering the segment. To determine the total segment load, the percent decrease in existing loads between BRBK03, BRBK02, and BRBK13 is applied to the upstream loads entering the segment.

Table C14. Calculation of Load Reduction Necessary at Point BRBK13				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	577.8	1799.4	826.9	10526.2
Difference in Existing Load between BRBK03, BRBK02 & BRBK13	-25.5	-194.6	10.3	-1195.6
Load tracked from BRBK02 & BRBK03	12.1	8.9	10.2	0.0
Percent loss due to instream process	4	10	-	10
Percent load tracked from BRBK02 & BRBK03	96	90	-	90
Total Load tracked between points BRBK02, BRBK13 & BRBK03	11.6	8.0	20.5	0.0
Allowable Load at BRBK13	12.1	16.2	10.7	0.0
Load Reduction at BRBK13	0.0	0.0	9.8	0.0
% Reduction required at BRBK13	0	0	48	0

TMDL Calculation - Sample Point BRBK01, Mouth of Brubaker Run

The TMDL for sample point BRBK01 consists of a load allocation to all of the area between sample point BRBK01 and sample point BRBK13 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point BRBK01. The average flow of 3.66 MGD, measured at sample point, is used for these computations.

This segment appeared on the 1996 and 1998 PA Section 303(d) lists for metals and other inorganics impairments. A reassessment of the segment in 1999 removed other inorganics and added pH as a cause of impairment to the PA 2002 Section 303(d) list. Sample data at point BRBK01 shows pH ranging between 3.06 and 3.41; pH will be addressed as part of this TMDL because of the mining impacts.

Table C15. TMDL Calculations at Point BRBK01				
Flow = 3.66 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	21.00	640.4	0.42	12.8
Fe	53.66	1636.3	0.54	16.4
Mn	29.83	909.7	0.45	13.6
Acidity	398.13	12140.8	0.00	0.0
Alkalinity	0.00	0.0		

The calculated load reductions for all the loads that enter point BRBK01 must be accounted for in the calculated reductions at the sample point shown is Table C16. A comparison of existing loads between points BRBK01 and BRBK13 shows that there is additional aluminum, manganese, and acidity loading and a loss of iron loading within the segment. The loss of loading indicates that instream processes, such as settling, are taking place within the segment. It also indicates that no additional loading is directly entering the segment. To determine the total segment load, the percent decrease in existing loads between BRBK13 and BRBK01 is applied to the upstream loads entering the segment.

Table C16. Calculation of Load Reduction Necessary at Point BRBK01				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	640.4	1636.3	909.7	12140.8
Difference in Existing Load between BRBK13 & BRBK01	62.5	-163.1	82.9	1614.6
Load tracked from BRBK 13	11.6	8.0	10.7	0.0
Percent loss due to instream process	-	9	-	-
Percent load tracked from BRBK02 & BRBK03	-	91	-	-
Total Load tracked between points BRBK13 & BRBK01	74.1	7.3	93.6	1614.6
Allowable Load at BRBK01	12.8	16.4	13.6	0.0
Load Reduction at BRBK01	61.3	0.0	80.0	1614.6
% Reduction required at BRBK01	83	0	85	100

Margin of Safety

For this study the margin of safety is applied implicitly. A MOS is implicit because the allowable concentrations and loadings were simulated using Monte Carlo techniques and employing the @Risk software. Other margins of safety used for this TMDL analysis include the following:

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.
- An additional MOS is provided because the calculations were done with a daily Fe average instead of the 30-day average

Seasonal Variation

Seasonal variation is implicitly accounted for in these TMDLs because the data used represents all seasons.

Critical Conditions

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis.

Attachment D

Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP Section 303(d) narratives that justify changes in listings between the 1996, 1998, and 2002 list. The Section 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 Section 303(d) narrative, strategies were outlined for changes to the listing process. Suggestions included, but were not limited to, a migration to a Global Information System (GIS), improved monitoring and assessment, and greater public input.

The migration to a GIS was implemented prior to the development of the 1998 Section 303(d) list. As a result of additional sampling and the migration to the GIS some of the information appearing on the 1996 list differed from the 1998 list. Most common changes included:

1. mileage differences due to recalculation of segment length by the GIS;
2. slight changes in source(s)/cause(s) due to new EPA codes;
3. changes to source(s)/cause(s), and/or miles due to revised assessments;
4. corrections of misnamed streams or streams placed in inappropriate SWP subbasins; and
5. unnamed tributaries no longer identified as such and placed under the named watershed listing.

Prior to 1998, segment lengths were computed using a map wheel and calculator. The segment lengths listed on the 1998 Section 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

Attachment E

Water Quality Data Used In TMDL Calculations

Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)	SO4 (mg/L)
BRBK01	020315-0930-xbp	1284	3.17	276	0	17	52	27	859
Latitude:	020412-1010-xbp	1842	3.09	612	0		67	35	1241
N40°62.195'	020510-1155-xbp	4356	3.27	236	0	18	33	19	604
Longitude:	020617-1145-xbp	5534	3.41	320	0	22	45	24	842
W78°50.281'	020725-1000-xbp	998	3.06	658	0	29	88	50	1834
Mouth of Brubaker Run	021101-1155-xbp	1221	3.27	288	0	19	37	24	1143
	Avg.	2539	3.21	398	0	21.00	53.66	29.83	1087
	St Dev.	1921	0.13	186	0	4.85	20.69	11.20	431

Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)	SO4 (mg/L)
BRBK13	020315-1215-xbp	840	3.20	151	0	19	70	30	920
Latitude:	020412-1140-xbp	1778	3.00	734	0		92	41	1436
N40°61.670'	020510-1140-xbp	3511	3.32	286	0	21	45	23	699
Longitude:	020617-1130-xbp	4432	3.35	404	0	25	56	27	920
W78°47.937'	020725-1125-xbp	719	3.14	708	0	31	115	57	1962
Downstream of clay mine discharge	021101-1135-xbp	856	3.24	316	0	23	66	26	1282
	Avg.	2023	3.21	433	0	23.79	74.07	34.04	1203
	St Dev.	1584	0.13	238	0	4.62	25.48	12.85	458

Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)	SO4 (mg/L)
BRBK02	020315-1150-xbp	233	2.90	975	0	34	247	72	1123
Latitude:	020412-1130-xbp	528	3.06	606	0		172	55	1545
N40°61.663'	020510-1130-xbp	446	3.16	733	0	28	204	60	1772
Longitude:	020617-1055-xbp	742	3.12	884	0	27	202	56	1958
W78°47.818'	020725-1115-xbp	313	3.12	958	0	28	253	64	2163
Clay mine discharge	021101-1130-xbp	186	3.14	867	0	30	272	66	2669
	Avg.	408	3.08	837	0	29.36	225.01	62.19	1872
	St Dev.	208	0.10	142	0	2.71	38.10	6.50	530

Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)	SO4 (mg/L)
BRBK03	020315-1100-xbp	837	4.39	152	0	24	48	17	486
Latitude:	020412-1115-xbp	1047	3.22	871	0		68	35	1460
N40°61.610'	020510-1115-xbp	3237	3.37	221	0	21	26	18	583
Longitude:	020617-1050-xbp	3702	3.70	308	0	24	36	21	682
W78°47.817'	020725-1050-xbp	361	3.36	612	0	30	89	51	1880
Downstream of Cooney	021101-1115-xbp	633	3.69	162	0	18	5.4	14	823
Brothers treatment discharge	Avg.	1636	3.62	388	0	23.38	45.37	26.05	986
	St Dev.	1446	0.42	292	0	4.45	29.94	14.25	558

Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)	SO4 (mg/L)
BRBK04	020315-1115-xbp	682	4.20	95	0	12	16	10	311
Latitude:	020412-1100-xbp	790	3.19	990	0		88	27	1382
N40°61.291'	020510-1100-xbp	2717	3.42	213	0	20	30	14	478
Longitude:	020617-1040-xbp	3150	3.71	284	0	22	40	18	674
W78°47.567'	020725-1105-xbp	361	3.43	596	0	33	64	50	1846
Upstream of Cooney Brothers &	021101-1105-xbp	561	3.74	147	0	18	5.6	11	788
Downstream of E.P. Bender Coal Co.	Avg.	1377	3.62	388	0	20.94	40.57	21.60	913
	St Dev.	1222	0.35	344	0	7.77	30.81	15.25	586

Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)	SO4 (mg/L)
BRBK05	020315-1130-xbp	569	3.77	80	0	6.6	5.4	5.6	170
Latitude:	020412-1045-xbp	631	3.86	54	0		4.5	4.8	129
N40°61.164'	020510-1045-xbp	2338	4.07	37	0	3.0	1.2	2.2	69
Longitude:	020617-1020-xbp	2700	3.99	41	0	2.8	1.3	2.0	74
W78°47.526'	020725-1040-xbp	71	3.47	232	0	20	16	21	686
Upstream of E.P. Bender Coal Co.	021101-1050-xbp	411	3.74	100	0	11	3.8	9.1	293
	Avg.	1120	3.82	91	0	8.69	5.36	7.44	237
	St Dev.	1107	0.21	73	0	7.15	5.48	7.13	235

Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	Al (mg/L)	Fe (mg/L)	Mn (mg/L)	SO4 (mg/L)
BRBK06	020315-1020-xbp	236	4.18	28	0	2.1	0.20	0.99	32
Latitude:	020412-1020-xbp	231	4.16	28	0		0.04	1.20	38
N40°60.649'	020510-1020-xbp	1911	4.25	30	0	1.9	0.24	1.00	36
Longitude:	020617-1000-xbp	2200	4.14	32	0	1.6	0.41	0.91	39
W78°47.358'	020725-1030-xbp	0	NA	NA	0	NA	NA	NA	NA
Brubaker Run	021101-1130-xbp	153	3.88	69	0	8.8	0.56	6.4	187
	Avg.	789	4.12	37	0	3.59	0.29	2.10	66
	St Dev.	989	0.14	18	0	3.48	0.20	2.41	68

Aluminum Data for 04/12/02 - not used in analysis

Bottle ID	Site	date-time-samplerID	Al (mg/L)
91J	BRBK01	020412-1010-xbp	71
90J	BRBK13	020412-1140-xbp	97
85J	BRBK02	020412-1130-xbp	25
88J	BRBK03	020412-1115-xbp	129
89J	BRBK04	020412-1100-xbp	151
87J	BRBK05	020412-1045-xbp	5.5
86J	BRBK06	020412-1020-xbp	2.1

WQN422 Clearfield Creek SR 0153 Bridge Boggs Twp	
Date	**Sulfates**
	mg/L
1/11/1990	113
2/8/1990	113
3/7/1990	219
4/16/1990	113
5/22/1990	101
6/11/1990	92
7/17/1990	96
8/8/1990	197
9/19/1990	142
10/19/1990	108
11/6/1990	210
12/4/1990	107
1/7/1991	145
2/5/1991	158
3/5/1991	69
4/1/1991	137
5/7/1991	127
6/4/1991	310
7/2/1991	410
8/6/1991	438
9/3/1991	464
10/1/1991	372
11/5/1991	428
12/2/1991	236
1/7/1992	143
2/4/1992	152
3/4/1992	98
4/6/1992	128
5/5/1992	189
6/4/1992	236
7/8/1992	343
8/5/1992	176
9/10/1992	208
10/15/1992	105
11/17/1992	141
12/9/1992	200
1/5/1993	118
2/4/1993	206
3/2/1993	258
4/6/1993	161
5/4/1993	204
6/1/1993	309
7/14/1993	374
8/11/1993	345
9/7/1993	259
10/5/1993	206
11/4/1993	177
12/14/1993	117
1/11/1994	222
2/22/1994	51
3/23/1994	64
4/21/1994	180
5/17/1994	153
6/14/1994	178
7/20/1994	516
8/11/1994	90
9/1/1994	172
10/20/1994	296
11/16/1994	199
12/13/1994	84
1/12/1995	177
2/2/1995	162
3/8/1995	94
4/11/1995	119
5/10/1995	184
6/1/1995	138
7/19/1995	157
8/9/1995	253
9/13/1995	364
10/18/1995	257
11/7/1995	208
12/22/1995	152
1/10/1996	197
2/20/1996	186
3/19/1996	124
4/10/1996	191
5/16/1996	107
6/5/1996	203
7/10/1996	288
8/7/1996	209
9/10/1996	102
10/2/1996	138
11/5/1996	187
12/17/1996	97
1/9/1997	143
2/13/1997	131
3/11/1997	75
4/1/1997	105
5/1/1997	161
6/18/1997	152
7/10/1997	869
8/19/1997	208
9/9/1997	203
10/8/1997	187
11/6/1997	108
12/2/1997	99
1/13/1998	113
2/3/1998	122
3/4/1998	96
4/7/1998	162
5/4/1998	118
6/2/1998	273
7/7/1998	250
8/5/1998	90
10/14/1998	192
12/9/1998	321
Average	192.78
St Dev	114.09

Attachment F
Comment and Response

Comments/Responses on Brubaker Run Watershed TMDL

EPA Region III Comments

Comment:
The amended draft TMDL Report does not calculate a TMDL for sampling point BRBK06 and removed the monitoring data from Attachment E. It is strongly suggested that the monitoring data be included and a statement why TMDLs were not developed at BRBK06.

Response:
A TMDL has been calculated for BRBK06 and the monitoring data is included in Attachment E.

Comment:
The aluminum data collected April 12, 2002, was not used in the calculations because it appeared to be an outlier. An outlier should not be removed from the data set unless there is a physical reason to do so, a measurement or recording error.[4] Future TMDLs should include statistical outliers unless there is a reason to remove them.

Response:
It is believed, but not confirmed, that the Bender treatment facility may have experienced difficulties that resulted in excess aluminum concentrations in the stream. This is believed because the concentration spike occurred downstream of the BEND discharge. Because the discharge is regulated by an NPDES permit, the high loading on April 12, 2002 is not representative of the normal conditions of a treated discharge and therefore the data was not used in the TMDL calculation. Proper considerations are made before removing any statistical outliers from future TMDLs.

Arthur W. Rose, Clearfield Creek Watershed Association (CCWA)

The CCWA collected water quality data as a part of a feasibility investigation in conjunction with the Corps of Engineers. This data was submitted to the Department by the CCWA during the comment period. Although the data was not used in TMDL development, the data will be included in the TMDL file for use in any future implementation plans that occur in the watershed.

[4] Helsel, D.R. and R.M. Hirsch, *Studies in Environmental Science 49: Statistical Methods in Water Resources*, 1993.