FINAL

SANBOURN RUN WATERSHED TMDL

Clearfield County

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Sanbourn Run Watershed (Attachments 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) and one additional segment from a subsequent list. 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	3.3	7173	26184	Sanbourn Run	CWF	305(b) Report	RE	Metals & Other Inorganics
1998	3.36	7173	26184	Sanbourn Run	CWF	SWMP	AMD	Metals & Other Inorganics
2002	5.2	New assessment, new id. 990819-1055-LMS	26184	Sanbourn 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 Sanbourn Run Watershed

The Sanbourn Run Watershed is located in North Central Pennsylvania, occupying a southeastern portion of Clearfield County. The watershed area is found on United States Geological Survey maps covering portions of the Glen Richey and Wallaceton 7.5-Minute Quadrangles.

The headwaters of Sanbourn Run are located near the village of Sanbourn. Sanbourn can be reached easily by traveling five miles north on SR 153 from Houtzdale or traveling 10 miles south on SR 153 from Clearfield. Once in Sanbourn one can travel on Bucket Line Road to TR575, which crosses over Sanbourn Run near the headwaters and an unnamed tributary to Sanbourn Run near the headwaters.

Land use within the watershed is dominated by forestlands. Abandoned mine lands are found on the hilltops surrounding the watershed. The village of Sanbourn is located near the headwaters of Sanbourn Run. The village contains rural residential properties that are scattered throughout its boundaries. Seasonal camps are also located throughout the watershed.

Hydrology and Geology

The area within the watershed consists of 4.01 square miles. The area has been formed into broad, flat-topped and steep sloped ridges that have been deeply incised by the trellis drainage pattern of the stream valleys. The streams in the Sanbourn Run watershed drain the area from south to north. Sanbourn Run flows from an elevation of 1700 feet above sea level in its headwaters to an elevation of 1180 feet above sea level at its confluence with Clearfield Creek. Clearfield Creek is a tributary to the West Branch of the Susquehanna River.

The Sanbourn Run Watershed lies within the Appalachian Plateaus Physiographic Province. The watershed area is comprised of Pennsylvanian aged rocks, which are divided into the Pottsville, Allegheny, and Conemaugh Groups. The watershed is located regionally on the northwest limb of the Laurel Hill Anticline with the watershed headwaters near the axial plane of the anticline. The Clearfield Syncline is located approximately five miles northwest of the watershed.

Pennsylvanian rocks of the Pocono Formation are exposed in the valleys of the watershed and the younger rocks of the Conemaugh and Allegheny Groups are on the hilltops surrounding the watershed. Minable coals are confined to the Allegheny Group Strata in the watershed are oriented in a SW to NE trend and have a consistent northwesterly dip increasing in degree to the NW.

Segments addressed in this TMDL

There are no active mining operations in the watershed. All of the discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the PA 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 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;

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

5. Public review and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

The Lower Kittanning coal seam has been extensively stripped in the headwaters of the watershed. This strip mining is reported to have first started in the 1940's and subsequently reopened in the mid-sixties. Many mining companies operated in the watershed up into the early eighties. These companies focused on the Clarion and Mercer coals as well as the Mercer clays. These companies include Thompson and Phillips, Swistock Coal Company, Avery Coal Company, and Maple Hill Coal Company.

In December 1986, Al Hamilton Contracting Company acquired approximately 1,800 acres of land in Boggs Township, Clearfield County, for the purpose of surface mining the Lower Kittanning and Lower Kittanning rider coal seams. Analysis of the site's overburden revealed the presence of sandstone units in some areas that possess acidic tendencies as defined by DEP policy. These acidic lithologic units would require, in some instances, addition of off-site alkaline material as a neutralizing agent to minimize the potential for production of post mining acidic water. Since additional Department policy did not permit importing off-site alkaline material to neutralize acidic overburden strata at a site that has not been affected by past mining activities, the condition that existed at the Kauffman site, initial permit applications could not be approved. The decision was made to propose mining on the southern half of the original permit area as a demonstration project.

The project's main objective was to study the effect of mining in areas where existing sandstone strata contain coal streaks, both in naturally occurring alkaline environment and in a naturally occurring acidic environment where off-site alkaline material was employed as a neutralizing agent. Of particular interest was the post mining water quality that was the real indicator by which the long-term success of a mining site is measured.

The Kauffman permit (SMP#17890115) was issued to Al Hamilton Contracting Company on March 2, 1993, as a Demonstration Project. The total permit area was 639 acres with 538 total acres affected. The coal seams mined were the Lower Kittanning No. 2, Lower Kittanning No. 3 and the Lower Kittanning riders. There were 281 acres of coal removed. Mining is complete on the site and it has been backfilled and revegetated.

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 nonpoint 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 nonpoint 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:

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:

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

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.

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) a TMDL to address sulfates is not necessary. The nearest potable water withdrawal to Sanbourn Run occurs approximately 25 miles downstream of the mouth at the Shawville Power Plant (PWSID #6170333) located on the West Branch Susquehanna River. Sulfate data from WQN0422, located approximately 10 miles downstream of the mouth of Sanbourn Run on Clearfield Creek at the SR0153 Bridge in Boggs Township, has a nine-year average sulfate concentration of 192.78 mg/l. The data shows that Clearfield Creek provides the proper dilution for the sulfates in Sanbourn Run and water quality criterion of 250 mg/L will not be exceeded at the water supply intake on the West Branch Susquehanna River. A station map is located in Attachment A and sulfate data for the WQN station is located in Appendix E.

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 WLA is the portion of the load assigned to point sources. The LA is the portion of the load assigned to non-point sources. The MOS is applied to account for uncertainties in the computational process. The MOS 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 no permitted discharges in the watershed and therefore all waste load allocations are equal to zero. 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 Sanbourn 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 %
SBRN12	*Sanbourn Run, at bridge near Bucket Line Road*						
	Fe	19.0	2.9	0.0	2.9	16.1	85
	Mn	91.1	3.6	0.0	3.6	87.5	96
	Al	40.1	5.2	0.0	5.2	34.9	87
	Acidity	793.2	7.9	0.0	7.9	785.3	99

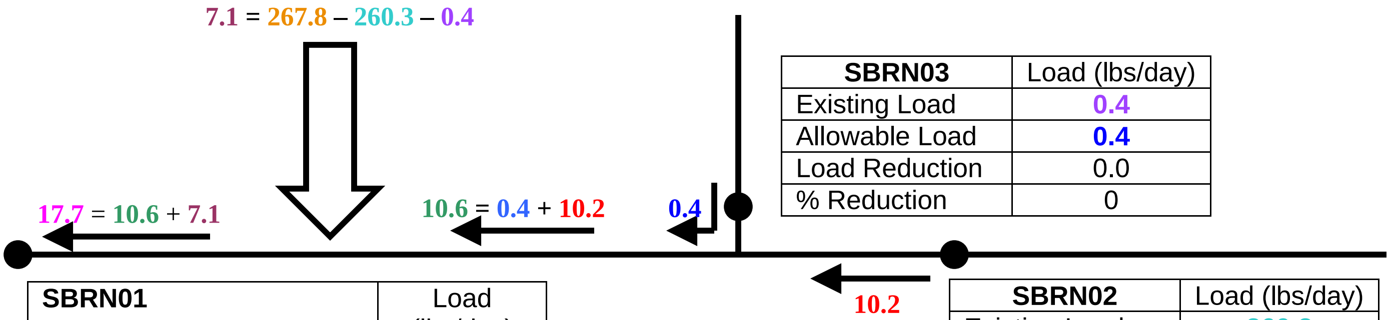
Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
SBRN11	*Sanbourn Run, upstream of Unidentified Tributary*						
	Fe	13.0	10.9	0.0	10.9	0.0	0
	Mn	185.6	5.6	0.0	5.6	92.6	94
	Al	96.7	6.8	0.0	6.8	55.0	89
	Acidity	1,564.1	15.6	0.0	15.6	763.2	98
SBRN10	*Mouth of Unidentified Tributary*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.8	0.3	0.0	0.3	0.5	58
	Al	0.7	0.2	0.0	0.2	0.4	64
	Acidity	10.4	2.0	0.0	2.0	8.5	81
SBRN07	*Sanbourn Run, upstream of Unnamed Tributary 26186*						
	Fe	15.1	15.1	NA	NA	0.0	0
	Mn	214.4	8.6	0.0	8.6	25.3	75
	Al	108.1	8.6	0.0	8.6	9.3	52
	Acidity	2,223.0	22.2	0.0	22.2	643.8	97
SBRN13	*Unnamed Tributary 26186, near bridge*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.4	0.4	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	26.2	5.5	0.0	5.5	20.7	79
SBRN08	*Mouth of Unnamed Tributary 26186*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	ND	NA	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	23.4	11.7	0.0	11.7	0.0	0
SBRN06	*Sanbourn Run, upstream of Unidentified Tributary near off trail road*						
	Fe	17.6	17.6	NA	NA	0.0	0
	Mn	226.4	9.1	0.0	9.1	11.5	56
	Al	116.8	9.3	0.0	9.3	8.0	46
	Acidity	2,665.8	26.7	0.0	26.7	419.8	94
SBRN05	*Mouth of Unidentified Tributary*						
	Fe	2.8	1.5	0.0	1.5	1.3	46
	Mn	24.4	0.7	0.0	0.7	23.7	97
	Al	9.0	0.7	0.0	0.7	8.3	92
	Acidity	223.2	0.0	0.0	0.0	223.2	100
SBRN04	*Sanbourn Run, downstream of Unidentified Tributary*						
	Fe	16.7	16.7	NA	NA	0.0	0
	Mn	250.0	10.0	0.0	10.0	0.0	0
	Al	123.7	9.9	0.0	9.9	0.0	0
	Acidity	2,899.9	29.0	0.0	29.0	8.6	23

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
SBRN02	*Sanbourn Run, upstream of Unnamed Tributary 26185*						
	Fe	16.5	16.5	NA	NA	0.0	0
	Mn	260.3	10.2	0.0	10.2	9.9	49
	Al	131.0	10.5	0.0	10.5	6.6	39
	Acidity	3,225.1	32.3	0.0	32.3	321.9	91
SBRN03	*Mouth of Unnamed Tributary 26185*						
	Fe	ND	NA	NA	NA	0.0	0
	Mn	0.4	0.4	NA	NA	0.0	0
	Al	ND	NA	NA	NA	0.0	0
	Acidity	25.0	5.5	0.0	5.5	19.5	78
SBRN01	*Mouth of Sanbourn Run*						
	Fe	16.4	16.4	NA	NA	0.0	0
	Mn	267.8	10.7	0.0	10.7	7.0	40
	Al	134.6	9.4	0.0	9.4	4.7	33
	Acidity	3,449.2	34.5	0.0	34.5	202.4	85

ND, not detected
NA, meets WQS. No TMDL necessary.

In the instance that the allowable load is equal to the existing load (e.g. iron point SBRN07, 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. In addition, when all measured values are below the method detection limit, denoted by ND (e.g. iron point SBRN10, Table 3), no TMDL is necessary. In this case the accounting for upstream loads is not carried through to the next downstream point. Rather, there is a disconnect noted and the allowable load is considered to start over because the water quality standard is satisfied.

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, manganese allocations for SBRN01 of Sanbourn Run 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. Attachment A contains a map of the sampling point locations for reference.



SBRN03	Load (lbs/day)
Existing Load	**0.4**
Allowable Load	**0.4**
Load Reduction	0.0
% Reduction	0

SBRN01	Load (lbs/day)
Existing Load	**267.8**
Difference in Existing Load	**7.1**
Upstream Load tracked	**10.6**
Total Load tracked	**17.7**
Allowable Load	10.7
Load Reduction	7.0
% Reduction	40

SBRN02	Load (lbs/day)
Existing Load	**260.3**
Allowable Load	**10.2**
Load Reduction	9.9
% Reduction	49

Recommendations

There is currently no watershed group focused on the Sanbourn Run Watershed. It is recommended that agencies work with local interests to form a watershed organization. This watershed organization could then work to implement projects to achieve the reductions recommended in this TMDL document.

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.

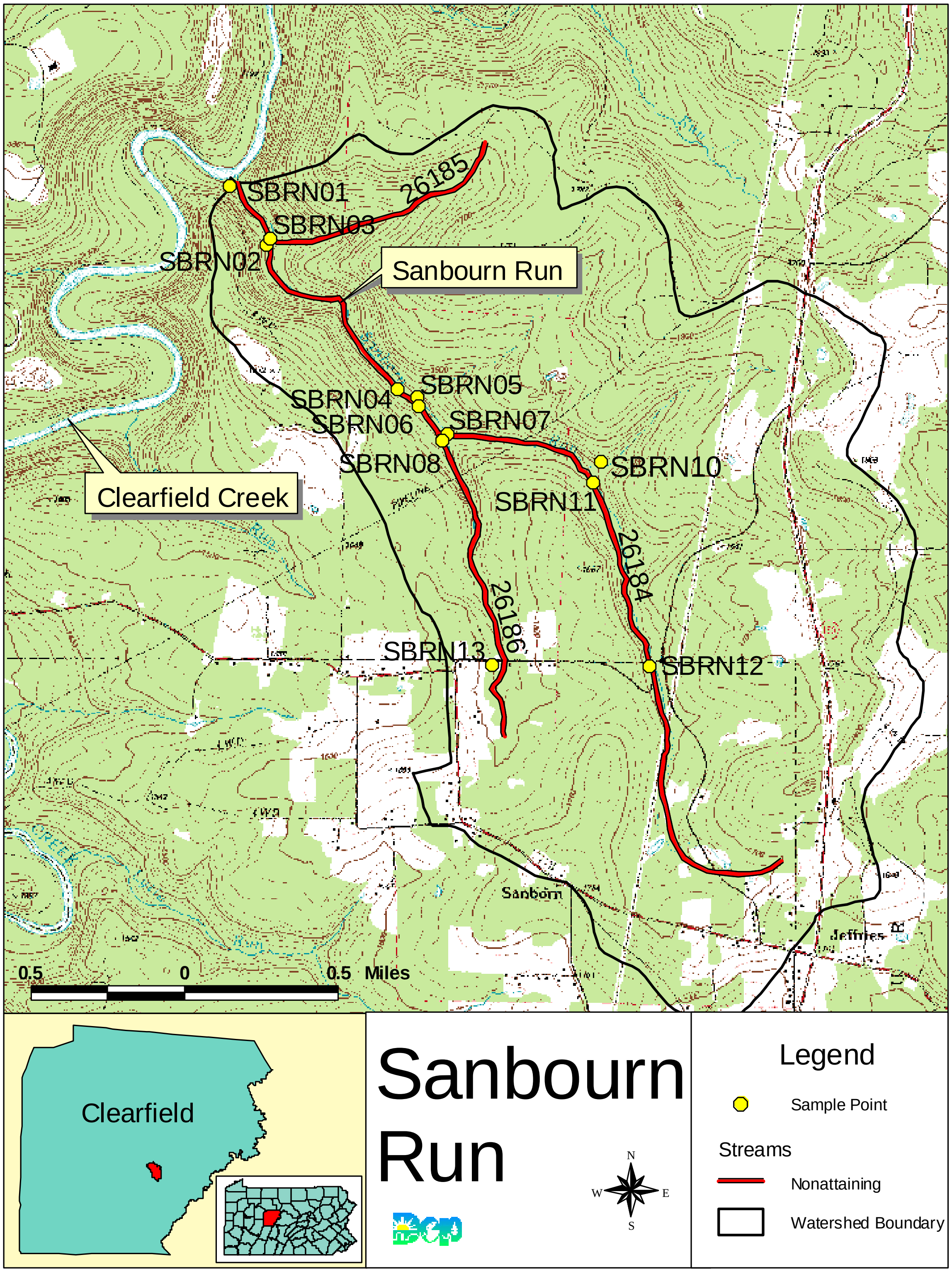
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of 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.

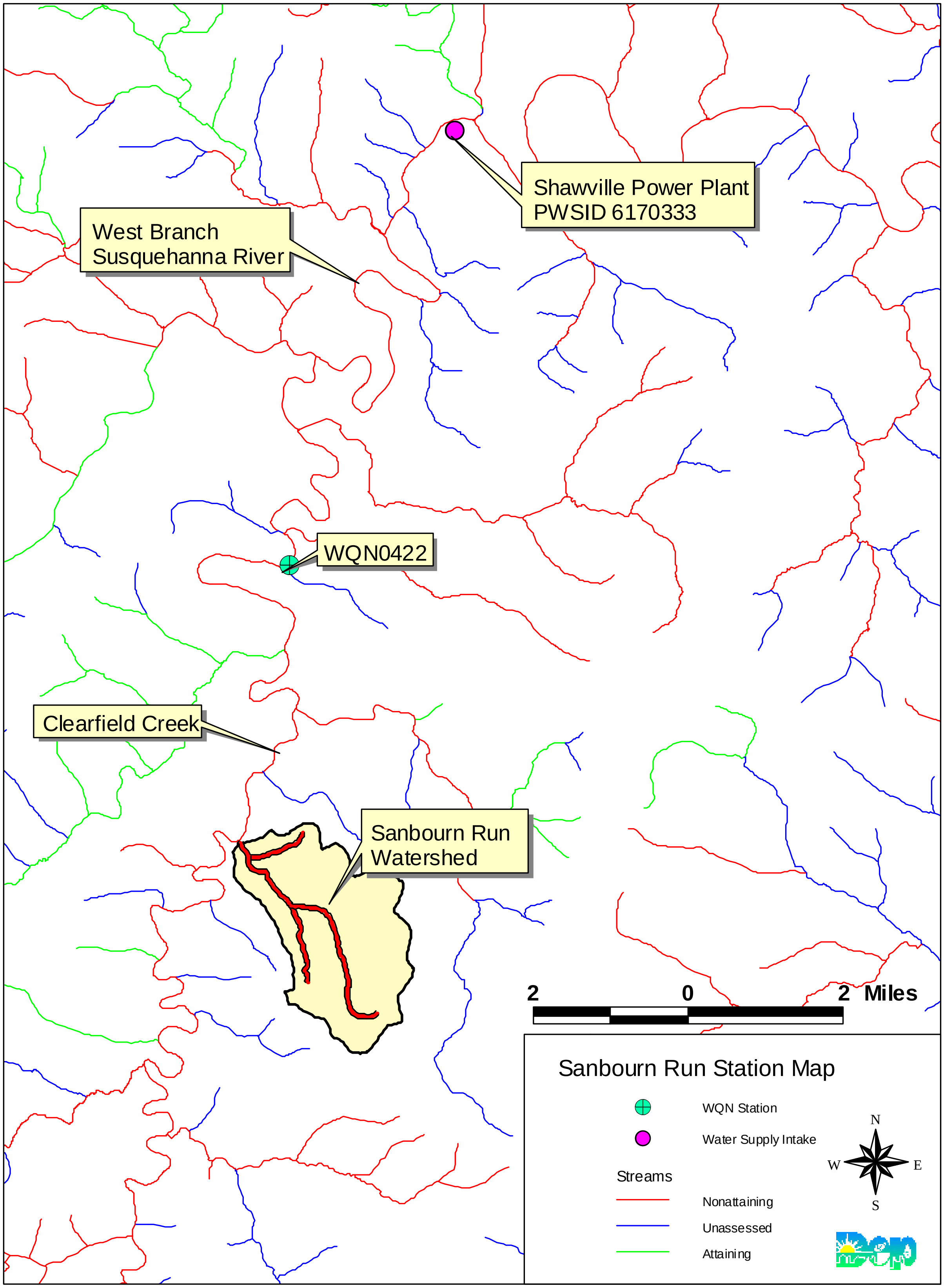
Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on August 14, 2004 and *The Progress* on August 16 and August 24, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from August 14, 2004 until October 13, 2004. A public meeting was held on September 1, 2004 at the Clearfield County Multiservice Center to discuss the proposed TMDL.

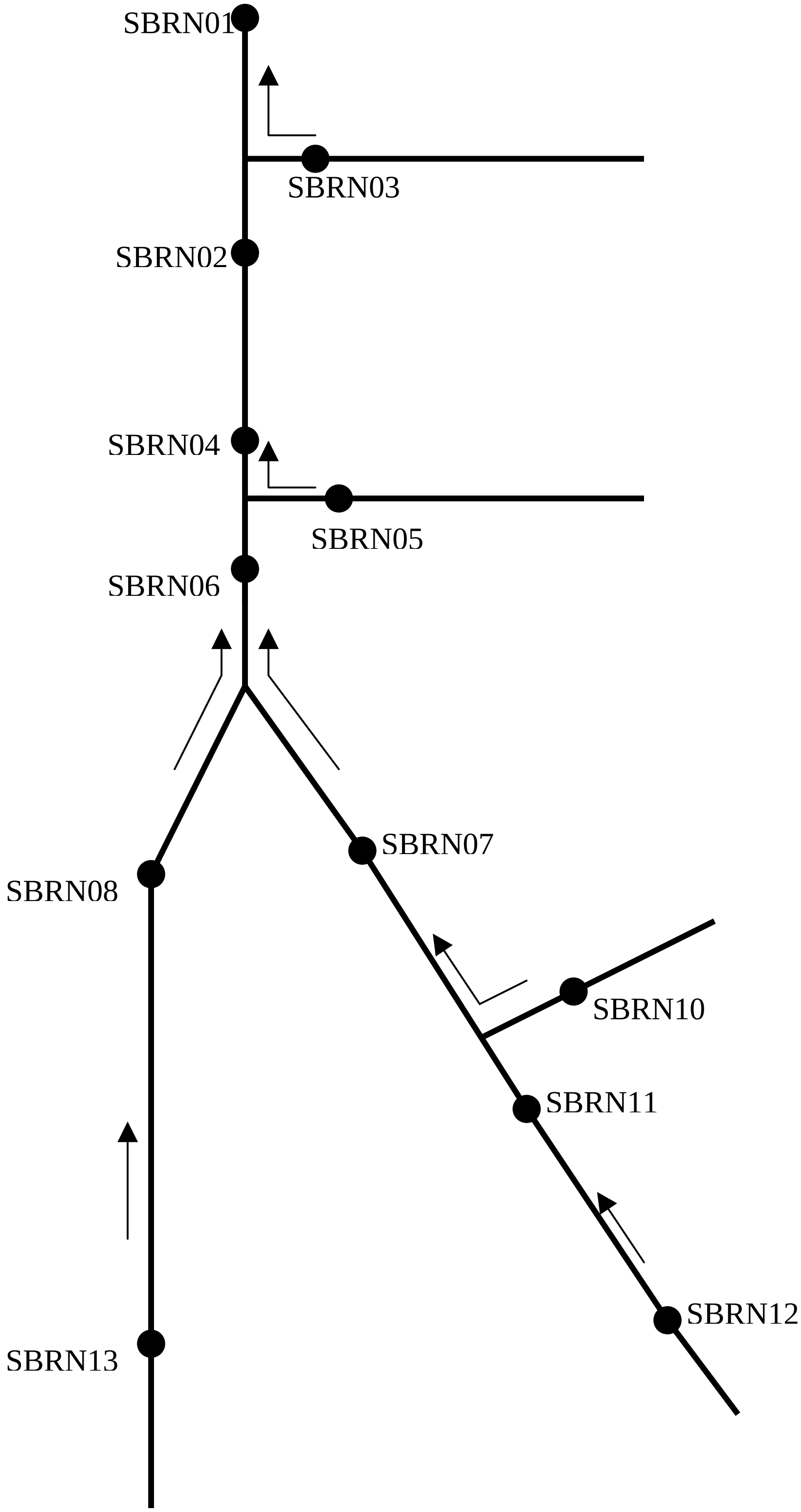
Attachment A

Sanbourn Run Watershed Maps


SBRN01
26185
SBRN03
SBRN02
Sanbourn Run
SBRN05
SBRN04
SBRN06
SBRN07
SBRN08
SBRN10
Clearfield Creek
SBRN11
26184
26186
SBRN13
SBRN12
Sanborn
Jeffries
0.5
0
0.5 Miles
Clearfield
Sanbourn Run
N
W
E
S
Legend
Sample Point
Streams
Nonattaining
Watershed Boundary


Shawville Power Plant
PWSID 6170333
West Branch
Susquehanna River
WQN0422
Clearfield Creek
Sanbourn Run
Watershed
2
0
2 Miles
Sanbourn Run Station Map
WQN Station
Water Supply Intake
Streams
Nonattaining
Unassessed
Attaining
N
W
E
S

Sanbourn Run Sampling Station Diagram
Arrows indicates direction of flow.
Diagram not to scale.



Attachment B

Method for Addressing Section 303(d) Listings for pH

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 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.*

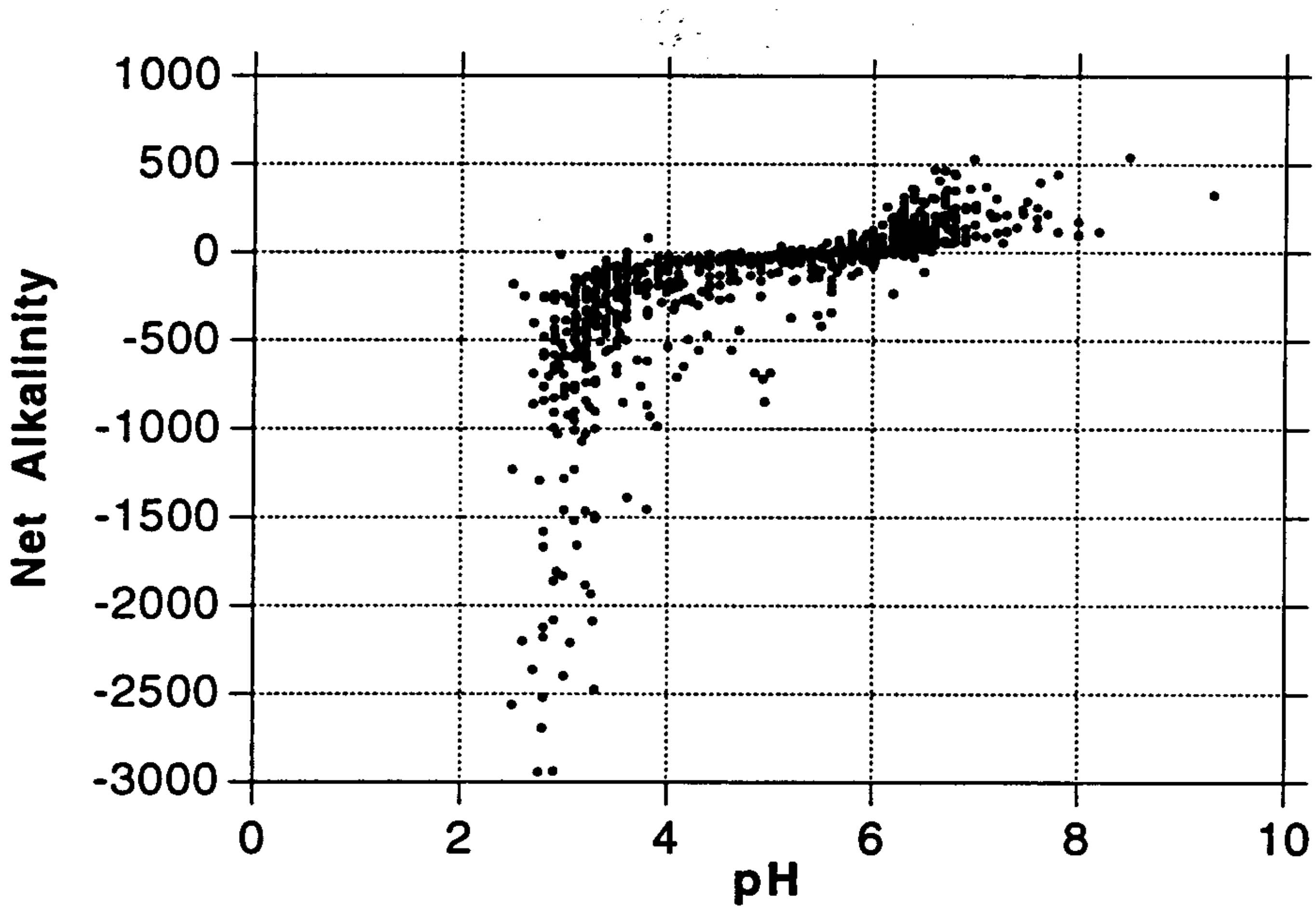


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
TMDLs By Segment

Sanbourn Run

The TMDL for the Sanbourn Run consists of load allocations of four tributaries and seven sampling sites along the stream.

Sanbourn Run is listed as impaired on the PA Section 303(d) list by both high metals and low pH from AMD as being the cause of the degradation to the stream. For pH, the objective is to reduce acid loading to the stream that 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). The method and rationale for addressing pH is contained in Attachment B.

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, 5000 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.

TMDL Calculations - Sample Point SBRN12 at bridge near Bucket Line Road

The TMDL for sample point SBRN12 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 SBRN12. The average flow of 1.11 MGD, measured at point SBRN12, is used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN12 shows pH ranging between 3.3 and 4.2; pH is addressed as part of this TMDL because of the mining impacts.

Table C1. TMDL Calculations at Point SBRN12

Flow = 1.11 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	2.05	19.0	0.31	2.9
Mn	9.82	91.1	0.39	3.6
Al	4.32	40.1	0.56	5.2
Acidity	85.50	793.2	0.86	7.9
Alkalinity	2.40	22.3		

Table C2. Calculation of Load Reduction Necessary at Point SBRN12				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	19.0	91.1	40.1	793.2
Allowable Load	2.9	3.6	5.2	7.9
Load Reduction	16.1	87.5	34.9	785.3
Total % Reduction	85	96	87	99

TMDL Calculations - Sampling Point SBRN11, upstream of Unidentified Tributary

The TMDL for sampling point SBRN11 consists of a load allocation of the area between sample points SBRN11 and SBRN12. The load allocation for this stream segment was computed using water-quality sample data collected at point SBRN11. The average flow of 1.96 MGD, measured at the point, was used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN11shows pH ranging between 3.4 and 4.1; pH is addressed as part of this TMDL because of the mining impacts.

Table C3. TMDL Calculations at Point SBRN11				
Flow = 1.96 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.80	13.0	0.67	10.9
Mn	11.34	185.6	0.34	5.6
Al	5.91	96.7	0.41	6.8
Acidity	95.50	1,564.1	0.96	15.6
Alkalinity	1.95	31.9		

The calculated load reductions for all the loads that enter point SBRN11 must be accounted for in the calculated reductions at sample point SBRN11 shown in Table C4. A comparison of measured loads between points SBRN12 and SBRN11 shows that there is additional loading entering the segment for all parameters except iron. This indicates that instream processes, such as settling, are taking place within the segment. To determine the total segment iron load, the percent decrease in existing loads between SBRN11 and SBRN12 is applied to the upstream loads entering the segment. For manganese, aluminum, and acidity, the total segment load is the sum of the upstream loads and the additional load entering within the segment.

Table C4. Calculation of Load Reduction Necessary at Point SBRN11				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	13.0	185.6	96.7	1,564.1
Difference in Existing Load between SBRN12 & SBRN11	-6.0	94.5	56.6	770.9
Load tracked from SBRN12	2.9	3.6	5.2	7.9
Percent loss due to instream process	31	-	-	-
Percent load tracked from SBRN12	69	-	-	-
Total Load tracked between points SBRN11 & SBRN12	2.0	98.2	61.8	778.8
Allowable Load at SBRN11	10.9	5.6	6.8	15.6
Load Reduction at SBRN11	0.0	92.6	55.0	763.2
% Reduction required at SBRN11	0	94	89	98

TMDL Calculations - Sample Point SBRN10, mouth of Unnamed Tributary (no stream code)

The TMDL for sample point SBRN10 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point SBRN10. The average flow of 0.049 MGD, measured at point SBRN10, is used for these computations.

This tributary is not included on the PA Section 303(d) list. Sample data at point SBRN10 shows pH ranging between 4.4 and 4.5; pH is addressed as part of this TMDL because of the mining impacts.

Iron values at SBRN10 are below the method detection limit, denoted by ND. No TMDL for iron is necessary because the WQS is met.

Table C5. TMDL Calculations at Point SBRN10				
Flow = 0.049 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	1.93	0.8	0.81	0.3
Al	1.63	0.7	0.59	0.2
Acidity	25.47	10.4	4.84	2.0
Alkalinity	5.67	2.3		

Table C6. Calculation of Load Reduction Necessary at Point SBRN10				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.8	0.67	10.4
Allowable Load	NA	0.3	0.24	2.0
Load Reduction	0.0	0.5	0.4	8.5
Total % Reduction	0	58	64	81

TMDL Calculations - Sampling Point SBRN07, Sanbourn Run upstream of Unnamed Tributary 26186

The TMDL for sampling point SBRN07 consists of a load allocation of the area between sample points SBRN07, SBRN11, and SBRN10. The load allocation for this stream segment was computed using water-quality sample data collected at point SBRN07. The average flow of 3.05 MGD, measured at the point, was used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN07 shows pH ranging between 3.7 and 4.3; pH is addressed as part of this TMDL because of the mining impacts.

The measured iron load is equal to the allowable load. Because the WQS is met, a TMDL for iron is not necessary. Although a TMDL is not necessary, the measured load is considered at the next downstream point, SBRN06.

Table C7. TMDL Calculations at Point SBRN07

Flow = 3.05 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.59	15.1	0.59	15.1
Mn	8.42	214.4	0.34	8.6
Al	4.24	108.1	0.34	8.6
Acidity	87.25	2,223.0	0.87	22.2
Alkalinity	1.95	49.7		

The calculated load reductions for all the loads that enter point SBRN07 must be accounted for in the calculated reductions. A comparison of measured loads between points SBRN11, SBRN10, and SBRN07 shows that there is additional loading entering the segment for all parameters. The total segment load is the sum of the upstream allocated loads plus the additional load entering within the segment.

Table C8. Calculation of Load Reduction Necessary at Point SBRN07

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	15.1	214.4	108.1	2,223.0
Difference in Existing Load between SBRN11, SBRN10 & SBRN07	2.0	28.0	10.7	648.4
Load tracked from SBRN10 & SBRN11	2.0	5.9	7.2	17.6
Total Load tracked between points SBRN11, SBRN10 & SBRN07	4.0	33.9	17.9	666.0
Allowable Load at SBRN07	15.1	8.6	8.6	22.2
Load Reduction at SBRN07	0.0	25.3	9.3	643.8
% Reduction required at SBRN07	0	75	52	97

TMDL Calculations - Sample Point SBRN13, Unnamed Tributary 26186 near bridge

The TMDL for sample point SBRN13 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point SBRN13. The average flow of 0.26 MGD, measured at point SBRN13, is used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN13 shows pH ranging between 6.3 and 6.5; pH is addressed as part of this TMDL because of the mining impacts.

Iron and aluminum values are below the method detection limits, denoted by ND. In addition, the allowable manganese load is equal to the measured load. TMDLs for iron, aluminum, and manganese at point SBRN13 are not necessary because WQS are met. The measured manganese load is considered at the next downstream point, SBRN08.

Table C9. TMDL Calculations at Point SBRN13

Flow = 0.26 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.20	0.4	0.20	0.4
Al	ND	ND	NA	NA
Acidity	12.13	26.2	2.55	5.5
Alkalinity	12.33	26.7		

Table C10. Calculation of Load Reduction Necessary at Point SBRN13

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.4	ND	26.2
Allowable Load	NA	0.4	NA	5.5
Load Reduction	0.0	0.0	0.0	20.7
Total % Reduction	0	0	0	79

TMDL Calculations - Sampling Point SBRN08, Mouth of Unnamed Tributary 26186

The TMDL for sampling point SBRN08 consists of a load allocation of the area between sample points SBRN08 and SBRN13. The load allocation for this stream segment was computed using water-quality sample data collected at point SBRN08. The average flow of 0.71 MGD, measured at the point, was used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN08 shows pH ranging between 5.9 and 7.4; pH is addressed as part of this TMDL because of the mining impacts.

All concentrations for iron, manganese, and aluminum are below the method detection limits, denoted by ND. Because WQS are met, no TMDLs for iron, manganese, or aluminum are necessary.

Table C11. TMDL Calculations at Point SBRN08

Flow = 0.71 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	ND	ND	NA	NA
Al	ND	ND	NA	NA
Acidity	3.95	23.4	1.98	11.7
Alkalinity	11.65	69.0		

The calculated load reductions for all the loads that enter point SBRN08 must be accounted for in the calculated reductions. A comparison of measured loads between points SBRN13 and SBRN08 shows that there is no additional loading entering the segment for all parameters. Because existing manganese concentrations at SBRN08 are below the detection limit, it is not necessary to consider the upstream manganese load from SBRN13 entering the segment. For acidity the percent decrease in existing load is applied to the allowable upstream load entering the segment.

Table C12. Calculation of Load Reduction Necessary at Point SBRN08

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	ND	ND	23.4
Difference in Existing Load between SBRN13 & SBRN08	NA	NA	NA	-2.8
Load tracked from SBRN13	-	-	-	5.5
Percent loss due to instream process	-	-	-	11
Percent load tracked from SBRN13	-	-	-	89
Total Load tracked between points SBRN13 & SBRN08	-	-	-	4.9
Allowable Load at SBRN08	NA	NA	NA	11.7
Load Reduction at SBRN08	0.0	0.0	0.0	0.0
% Reduction required at SBRN08	0	0	0	0

TMDL Calculations - Sampling Point SBRN06, upstream of Unidentified Tributary (no stream code) near off road trail

The TMDL for sampling point SBRN06 consists of a load allocation of the area between sample points SBRN06, SBRN08, and SBRN07. The load allocation for this stream segment was computed using water-quality sample data collected at point SBRN06. The average flow of 3.60 MGD, measured at the point, was used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN06 shows pH ranging between 3.8 and 4.4; pH is addressed as part of this TMDL because of the mining impacts.

The measured iron load at SBRN06 is equal to the allowable load. A TMDL for iron is not necessary at SBRN06 because the WQS is met. Although a TMDL for iron is not necessary, the measured load is considered at the next downstream point, SBRN04.

Table C13. TMDL Calculations at Point SBRN06

Flow = 3.60 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.59	17.6	0.59	17.6
Mn	7.55	226.4	0.30	9.1
Al	3.89	116.8	0.31	9.3
Acidity	88.85	2,665.8	0.89	26.7
Alkalinity	3.15	94.5		

The calculated load reductions for all the loads that enter point SBRN06 must be accounted for in the calculated reductions. A comparison of existing loads between points SBRN06, SBRN07 and SBRN08 shows that there is additional loading entering the segment for all parameters. The total segment load is the sum of the upstream allocated loads and any additional loading within the segment.

Table C14. Calculation of Load Reduction Necessary at Point SBRN06

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	17.6	226.4	116.8	2,665.8
Difference in Existing Load between SBRN06, SBRN07 & SBRN08	2.5	12.0	8.7	419.4
Load tracked from SBRN07 & SBRN08	4.0	8.6	8.6	27.1
Total Load tracked between points SBRN06, SBRN07 & SBRN08	6.5	20.6	17.3	446.5
Allowable Load at SBRN06	17.6	9.1	9.3	26.7
Load Reduction at SBRN06	0.0	11.5	8.0	419.8
% Reduction required at SBRN06	0	56	46	94

TMDL Calculations - Sample Point SBRN05, mouth of Unidentified Tributary (no stream code)

The TMDL for sample point SBRN05 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point SBRN05. The average flow of 0.31 MGD, measured at point SBRN05, is used for these computations.

This segment is currently not included on the PA Section 303(d) list for impairments from AMD. Sample data at point SBRN05 shows pH ranging between 3.4 and 4.0; pH is addressed as part of this TMDL because of the mining impacts.

Table C15. TMDL Calculations at Point SBRN05				
Flow = 0.31 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.08	2.8	0.56	1.5
Mn	9.33	24.4	0.28	0.7
Al	3.43	9.0	0.27	0.7
Acidity	85.25	223.2	0.00	0.0
Alkalinity	0.25	0.7		

Table C16. Calculation of Load Reduction Necessary at Point SBRN05				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	2.8	24.4	9.0	223.2
Allowable Load	1.5	0.7	0.7	0.0
Load Reduction	1.3	23.7	8.3	223.2
Total % Reduction	46	97	92	100

TMDL Calculations - Sampling Point SBRN04, downstream of Unidentified Tributary (no stream code) near off-road trail

The TMDL for sampling point SBRN04 consists of a load allocation of the area between sample points SBRN04, SBRN05, and SBRN06. The load allocation for this stream segment was computed using water-quality sample data collected at point SBRN04. The average flow of 3.93 MGD, measured at the point, was used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN04 shows pH ranging between 3.7 and 4.3; pH is addressed as part of this TMDL because of the mining impacts.

The measured iron load at SBRN04 is equal to the allowable load. A TMDL for iron is not necessary because the WQS is met. Although a TMDL for iron is not necessary, the measured load is considered at the next downstream point, SBRN02.

Table C17. TMDL Calculations at Point SBRN04				
Flow = 3.93 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.51	16.7	0.51	16.7
Mn	7.63	250.0	0.31	10.0
Al	3.77	123.7	0.30	9.9
Acidity	88.45	2,899.9	0.88	29.0
Alkalinity	2.15	70.5		

The calculated load reductions for all the loads that enter point SBRN04 must be accounted for in the calculated reductions. A comparison of existing loads between points SBRN04, SBRN05 and SBRN06 shows that there is no additional loading entering the segment for iron, aluminum, or manganese. For metals the percent decrease in existing load is applied to the upstream load entering the segment. There is an increase in acidity loading within the segment. The total segment acidity load is the sum of the upstream loads and any additional loading within the segment.

Table C18. Calculation of Load Reduction Necessary at Point SBRN04				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	16.7	250.0	123.7	2,899.9
Difference in Existing Load between SBRN06, SBRN05 & SBRN04	-3.7	-0.8	-2.1	11.0
Load tracked from SBRN05 & SBRN06	8.0	9.8	10.0	26.7
Percent loss due to instream process	18	0	2	-
Percent load tracked from SBRN05 & SBRN06	82	100	98	-
Total Load tracked between points SBRN06, SBRN05 & SBRN04	6.5	9.8	9.8	37.6
Allowable Load at SBRN04	16.7	10.0	9.9	29.0
Load Reduction at SBRN04	0.0	0.0	0.0	8.6
% Reduction required at SBRN04	0	0	0	23

TMDL Calculations - Sampling Point SBRN02, Sanbourn Run upstream of Unnamed Tributary 26185

The TMDL for sampling point SBRN02 consists of a load allocation of the area between sample points SBRN04 and SBRN02. The load allocation for this stream segment was computed using water-quality sample data collected at point SBRN02. The average flow of 4.31 MGD, measured at the point, was used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN02 shows pH ranging between 3.8 and 4.4; pH is addressed as part of this TMDL because of the mining impacts.

The measured iron load at SBRN02 is equal to the allowable load. A TMDL for iron is not necessary because the WQS is met. Although a TMDL for iron is not necessary, the loading at SBRN02 is considered at the next downstream point, SBRN01.

Table C19. TMDL Calculations at Point SBRN02				
Flow = 4.31 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.46	16.5	0.46	16.5
Mn	7.24	260.3	0.28	10.2
Al	3.64	131.0	0.29	10.5
Acidity	89.70	3,225.1	0.90	32.3
Alkalinity	2.95	106.1		

The calculated load reductions for all the loads that enter point SBRN02 must be accounted for in the calculated reductions. A comparison of existing loads between points SBRN02 and SBRN04 shows that there is no additional iron loading entering the segment. For iron the percent decrease in existing load is applied to the upstream load entering the segment. There is an increase in manganese, aluminum, and acidity loading within the segment. The total segment manganese, aluminum, and acidity load is the sum of the upstream loads and any additional loading within the segment.

Table C20. Calculation of Load Reduction Necessary at Point SBRN02				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	16.5	260.3	131.0	3,225.1
Difference in Existing Load between SBRN02 & SBRN04	-0.1	10.3	7.3	325.1
Load tracked from SBRN04	6.5	9.8	9.8	29.0
Percent loss due to instream process	1	-	-	-
Percent load tracked from SBRN04	99	-	-	-
Total Load tracked between points SBRN04 & SBRN02	6.5	20.1	17.1	354.1
Allowable Load at SBRN02	16.5	10.2	10.5	32.3
Load Reduction at SBRN02	0.0	9.9	6.6	321.9
% Reduction required at SBRN02	0	49	39	91

TMDL Calculations - Sample Point SBRN03, Mouth of Unnamed Tributary 26185

The TMDL for sample point SBRN03 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point SBRN03. The average flow of 0.25 MGD, measured at point SBRN03, is used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN03 shows pH ranging between 4.8 and 5.2; pH is addressed as part of this TMDL because of the mining impacts.

Iron and aluminum concentrations are below the method detection limits, denoted by ND. The measured manganese load is equal to the allowable load. TMDLs for iron, manganese, and aluminum are not necessary because WQS are met. Although a TMDL is not necessary for manganese, the measured load is considered at the next downstream point, SBRN01.

Table C21. TMDL Calculations at Point SBRN03				
Flow = 0.25 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	ND	ND	NA	NA
Mn	0.20	0.4	0.20	0.4
Al	ND	ND	NA	NA
Acidity	12.07	25.0	2.65	5.5
Alkalinity	6.80	14.1		

Table C22. Calculation of Load Reduction Necessary at Point SBRN03				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	ND	0.4	ND	25.0
Allowable Load	NA	0.4	NA	5.5
Load Reduction	0.0	0.0	0.0	19.5
Total % Reduction	0	0	0	78

TMDL Calculations-Sampling Point SBRN01, Mouth of Sanbourn Run

The TMDL for sampling point SBRN01 consists of a load allocation of the area between sample points SBRN01, SBRN03, and SBRN02. The load allocation for this stream segment was computed using water-quality sample data collected at point SBRN01. The average flow of 4.67 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 and 1998 PA Section 303(d) lists for metals impairments from AMD. In 1999 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point SBRN01 shows pH ranging between 3.8 and 4.4; pH is addressed as part of this TMDL because of the mining impacts.

The measured iron load at SBRN01 is equal to the allowable load. No TMDL for iron is necessary at SBRN01 because the WQS is met.

Table C23. TMDL Calculations at Point SBRN01				
Flow = 4.67 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.42	16.4	0.42	16.4
Mn	6.87	267.8	0.27	10.7
Al	3.45	134.6	0.24	9.4
Acidity	88.50	3,449.2	0.89	34.5
Alkalinity	2.95	115.0		

The calculated load reductions for all the loads that enter point SBRN01 must be accounted for in the calculated reductions. A comparison of existing loads between points SBRN01, SBRN02 and SBRN03 shows that there is no additional iron loading entering the segment. For iron the percent decrease in existing load is applied to the upstream load entering the segment. There is an increase in manganese, aluminum, and acidity loading within the segment. The total segment manganese, aluminum, and acidity load is the sum of the upstream loads and any additional loading within the segment.

Table C24. Calculation of Load Reduction Necessary at Point SBRN01				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	16.4	267.8	134.6	3,449.2
Difference in Existing Load between SBRN01, SBRN02 & SBRN03	-0.1	7.1	3.6	199.1
Load tracked from SBRN02 & SBRN03	6.5	10.6	10.5	37.8
Percent loss due to instream process	1	-	-	-
Percent load tracked from SBRN02 & SBRN03	99	-	-	-
Total Load tracked between points SBRN01, SBRN02 & SBRN03	6.4	17.7	14.1	236.9
Allowable Load at SBRN01	16.4	10.7	9.4	34.5
Load Reduction at SBRN01	0.0	7.0	4.7	202.4
% Reduction required at SBRN01	0	40	33	85

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 lists. 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

		pH	Alkalinity	Acidity	Iron	Manganese	Aluminum	Flow	Sulfates
Site	**Date**	**Lab**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**gpm**	**mg/l**
SBRN01	*Mouth of Sanbourn Run*								
Latitude:	9/3/2002	3.8	0.0	128.20	0.37	12.70	5.76	56	288.5
40 56' 02"	11/5/2002	4.0	2.2	105.00	0.47	8.86	4.08	615	238.4
Longitude:	3/24/2003	4.4	5.4	65.00	<0.3	2.81	1.96	7500	110.0
78 25' 05"	4/14/2003	4.2	4.2	55.80	<0.3	3.11	2.01	4810	129.5
	Avg	4.10000	2.95000	88.50000	0.42050	6.87000	3.45250	3245.25000	191.60000
	St Dev	0.25820	2.36854	34.00921	0.06718	4.78087	1.82818	3542.16839	85.81923
SBRN02	*Sanbourn Run, upstream of Unnamed Tributary 26185*								
Latitude:	9/3/2002	3.8	0.0	130.20	0.41	13.00	5.83	60	344.8
40 55' 52"	11/5/2002	4.0	2.4	102.00	0.51	9.29	4.23	415	244.3
Longitude:	3/24/2003	4.4	5.2	68.80	<0.3	3.16	2.23	7000	123.6
78 24' 57"	4/14/2003	4.2	4.2	57.80	<0.3	3.51	2.28	4500	135.9
	Avg	4.10000	2.95000	89.70000	0.46000	7.24000	3.64250	2993.75000	212.15000
	St Dev	0.25820	2.28254	32.89357	0.06930	4.75883	1.73031	3345.42816	103.7381
SBRN03	*Mouth of Unnamed Tributary 26185*								
Latitude:	9/3/2002	no flow						0	
40 55' 53"	11/5/2002	4.9	8.0	18.40	<0.3	0.37	<0.5	0.5	114.6
Longitude:	3/24/2003	5.2	6.6	10.40	<0.3	0.10	<0.5	330	33.7
78 24' 56"	4/14/2003	4.8	5.8	7.40	<0.3	0.12	<0.5	359	41.2
	Avg	4.96667	6.80000	12.06667	ND	0.19633	ND	172.37500	63.16667
	St Dev	0.20817	1.11355	5.68624	NA	0.15143	NA	199.10524	44.70015
SBRN04	*Sanbourn Run, downstream of Unnamed Tributary near off road trail*								
Latitude:	9/3/2002	3.7	0.0	122.40	0.75	13.30	5.75	47	360.4
40 55' 25"	11/5/2002	3.9	0.0	98.80	0.66	9.81	4.40	553	244.5
Longitude:	3/24/2003	4.3	4.8	72.40	0.32	3.44	2.42	5900	132.5
78 24' 26"	4/14/2003	4.2	3.8	60.20	0.31	3.95	2.52	4420	164.6
	Avg	4.02500	2.15000	88.45000	0.50875	7.62500	3.77250	2730.00000	225.50000
	St Dev	0.27538	2.51595	27.78123	0.22768	4.76094	1.60232	2877.66213	101.5165
SBRN05	*Mouth of Unnamed Tributary*								
Latitude:	9/3/2002	3.4	0.0	115.20	1.34	13.50	4.51	10	546.0
40 55' 26"	11/5/2002	3.6	0.0	107.40	1.72	13.80	5.20	62	597.9
Longitude:	3/24/2003	4.0	1.0	68.80	0.60	4.34	1.80	445	198.5
78 24' 24"	4/14/2003	3.9	0.0	49.60	0.67	5.69	2.20	355	273.4
	Avg	3.72500	0.25000	85.25000	1.08200	9.33250	3.42750	218.00000	403.95000
	St Dev	0.27538	0.50000	31.24713	0.54082	5.01729	1.68019	214.39683	197.5245
SBRN06	*Sanbourn Run, upstream of Unnamed Tributary near off road trail*								
Latitude:	9/3/2002	3.8	0.0	122.00	0.63	13.60	6.04	37	293.4
40 55' 25"	11/5/2002	4.0	2.8	99.40	0.55	9.33	4.32	456	247.4
Longitude:	3/24/2003	4.4	5.4	72.00	<0.3	3.44	2.56	5500	134.6
78 24' 24"	4/14/2003	4.2	4.4	62.00	<0.3	3.81	2.65	4000	148.4
	Avg	4.10000	3.15000	88.85000	0.58600	7.54500	3.89250	2498.25000	205.95000
	St Dev	0.25820	2.35726	27.17272	0.05657	4.85285	1.64457	2676.70773	76.95979

		pH	Alkalinity	Acidity	Iron	Manganese	Aluminum	Flow	Sulfates
Site	**Date**	**Lab**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**gpm**	**mg/l**
SBRN07	*Sanbourn Run, upstream of Unnamed Tributary 26186*								
Latitude:	9/3/2002	3.7	0.0	117.80	0.77	14.60	6.40	30	373.8
40 55' 20"	11/6/2002	3.9	0.0	91.60	0.85	9.66	3.91	914	275.4
Longitude:	3/24/2003	4.3	4.4	73.00	0.39	4.54	3.35	4335	166.6
78 24' 17	4/14/2003	4.2	3.4	66.60	0.36	4.86	3.31	3207	176.9
	Avg	4.02500	1.95000	87.25000	0.59100	8.41500	4.24250	2121.50000	248.17500
	St Dev	0.27538	2.28838	22.96163	0.25020	4.74194	1.46418	1992.51274	97.0523
SBRN08	*Sanbourn Run, mouth of Unnamed Tributary 26186*								
Latitude:	9/3/2002	6.6	14.0	0.00	<0.3	<0.05	<0.5	5	23.6
40 55' 19"	11/6/2002	7.4	16.2	0.00	<0.3	<0.05	<0.5	218	42.6
Longitude:	3/24/2003	6.2	8.6	9.80	<0.3	<0.05	<0.5	1009	27.2
78 24' 18"	4/14/2003	5.9	7.8	6.00	<0.3	<0.05	<0.5	740	35.3
	Avg	6.52500	11.65000	3.95000	ND	ND	ND	493.00000	32.17500
	St Dev	0.65000	4.09675	4.81768	NA	NA	NA	462.25318	8.499559
SBRN10	*Mouth of Unnamed Tributary*								
Latitude:	9/4/2002	no flow						0	
40 55' 16"	10/30/2002	4.4	4.8	24.40	<0.3	1.76	1.85	0.5	115.0
Longitude:	3/25/2003	4.5	5.2	24.20	<0.3	1.94	1.49	50	112.4
78 23' 42"	4/15/2003	4.5	7.0	27.80	<0.3	2.10	1.54	86	113.1
	Avg	4.46667	5.66667	25.46667	ND	1.93333	1.62667	34.12500	113.50000
	St Dev	0.05774	1.17189	2.02320	NA	0.17010	0.19502	41.78591	1.345362
SBRN11	*Sanbourn Run, upstream of Unnamed Tributary*								
Latitude:	9/4/2002	3.6	0.0	139.60	1.06	19.80	8.10	25	544.5
40 55' 12"	10/30/2002	3.8	0.0	82.00	1.07	12.10	5.91	415	239.3
Longitude:	3/25/2003	3.4	3.4	76.80	0.54	6.60	5.05	2735	200.8
78 23' 46"	4/15/2003	4.1	4.4	83.60	0.51	6.84	4.56	2280	211.1
	Avg	3.72500	1.95000	95.50000	0.79550	11.33500	5.90500	1363.75000	298.92500
	St Dev	0.29861	2.28838	29.54296	0.31143	6.18780	1.56611	1343.15782	164.5235
SBRN12	*Sanbourn Run, at bridge near Bucket Line Road*								
Latitude:	9/4/2002	3.30	0.00	120.00	4.90	16.70	4.03	11.00	446.40
40 54' 41"	11/6/2002	3.80	0.0	73.20	1.86	8.97	3.83	638	239.5
Longitude:	3/25/2003	4.2	4.0	73.40	0.63	6.80	4.90	1518	209.1
78 23' 31"	4/15/2003	4.2	5.6	75.40	0.81	6.81	4.53	923	190.3
	Avg	3.87500	2.40000	85.50000	2.04825	9.82000	4.32250	772.50000	271.32500
	St Dev	0.42720	2.84722	23.02144	1.97743	4.69884	0.48466	626.20364	118.4639
SBRN13	*Unnamed Tributary 26186, near bridge*								
Latitude:	9/4/2002	no flow						0	
40 54' 41"	11/6/2002	6.3	14.4	24.20	<0.3	0.29	<0.5	72	27.7
Longitude:	3/25/2003	6.4	10.2	12.20	<0.3	0.16	<0.5	400	34.7
78 24' 06"	4/15/2003	6.5	12.4	0.00	<0.3	0.16	<0.5	248	29.2
	Avg	6.40000	12.33333	12.13333	ND	0.20167	ND	180.00000	30.53333
	St Dev	0.10000	2.10079	12.10014	NA	0.07564	NA	179.89627	3.685557

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

No comments were received on the Sanbourn Run Watershed Draft TMDL.