

FINAL

BIG RUN WATERSHED TMDL
Clearfield County

For Acid Mine Drainage Affected Segments



Prepared by:

Pennsylvania Department of Environmental Protection

September 9, 2004

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¹TMDL
Big Run Watershed
Clearfield County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 08-C Big Run								
Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	1	7162	25971	Big Run	CWF	305(b) Report	RE	pH
1998	1.09	7162	25971	Big Run	CWF	SWMP	AMD	pH
2002	1.1	7162	25971	Big Run	CWF	SWMP	AMD	pH

Cold Water Fishes=CWF

Surface Water Monitoring Program = SWMP

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.

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Big Run Watershed (**Attachment A**). These were done to address the impairments noted on the 1996 Pennsylvania 303(d) list of impaired waters, required under the Clean Water Act, and covers one segment on this list (shown in Table 1). Depressed pH is the cause of 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) and pH.

Directions to the Big Run Watershed

The Big Run Watershed is located in North Central Pennsylvania, occupying a northeastern portion of Clearfield County in Graham Township. The watershed area is found on United States Geological Survey maps covering Frenchville 7.5-Minute Quadrangle.

Traveling from Philipsburg north on State Route 53 five miles to the town of Morrisdale can access the watershed. From Morrisdale one can take Deer Creek Road (SR 1009) seven miles to the intersection with Big Run Road (TR737). TR737 then crosses over an unnamed tributary to Big Run less than a mile down the road and Big Run near the Big Run Park.

Land use within the watershed is dominated by forestlands with farmlands and housing located in the headwaters. Several abandoned mine lands are located on the hilltops at higher elevations. The watershed is sparsely populated. The village of Fairview is located near the headwaters of Big Run and the unnamed tributary to Big Run. The village consists of 10-15 permanent

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 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA*.

residences scattered within the village boundaries. There are also several hunting camps located within the watershed that are used seasonally.

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. 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 explanations.

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 U.S. 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 non-point 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 have 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, many 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 non-point source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1996 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 stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. 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 the performance of the segment using a series of biological metrics. 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.

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

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 to EPA.
7. EPA approval of the TMDL.

Watershed History

The area within the watershed consists of 3.10 square miles. There are two stream segments in the Big Run watershed: the main stem and an unnamed tributary. Big Run flows from an elevation of 1620 feet above sea level in its headwaters to an elevation of 930 feet above sea level at its confluence with the West Branch of the Susquehanna River. Big Run flows from the south to the north.

The Big Run watershed lies within the Appalachian Plateau Physiographic Province. The watershed area is comprised of Pennsylvanian and Mississippian aged rocks. Older Mississippian rocks of the Burgoon Sandstone are exposed in the valleys of the watershed and the younger Pennsylvanian aged rocks of the Pottsville and Allegheny Groups are on the hilltops and ridges surrounding the watershed. Strata in the watershed are oriented in a SW to NE trend and dip to the SW.

The earliest surface mining in or near the Big Run watershed area occurred in 1947. At least six different mining sites were mined within the watershed from this time up into the 1980's. During this time the Lower Kittanning and Clarion coal seams were mined. No extensive deep mining was done in the watershed. Several mines were "punched" into the Clarion coal, but were later removed during the surface mining. Companies that conducted mining within the watershed include the following: Lester G Smeal (1947), Thompson Brothers Coal (1960), Reed Jacox Coal Company (1960), Hartman and Stewart (1962), Earl M Brown (1970), Penn Coal Company (1975), T & T Clay Company (1977) and Richard Yingling (1984). Today there is no active mining within the watershed boundaries. There are currently no NPDES (National Pollutant Discharge Elimination System) permits in the Big Run watershed.

AMD Methodology

A two-step approach is used for the TMDL analysis of 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 @Risk³ 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:

$$PR = \text{maximum } \{0, (1 - C_c/C_d)\} \text{ where (1)}$$

PR = required percent reduction for the current iteration

C_c = criterion in mg/l

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

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

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

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

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:

$$\text{LTA} = \text{Mean} * (1 - \text{PR99}) \text{ where (2)}$$

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.

In Low 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) CaCO₃. 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 may not represent 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 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 all of the pollution sources in the watershed are nonpoint sources, 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	<i>Criterion Value (mg/l)</i>	<i>Total Recoverable/Dissolved</i>
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30-day average; Total Recoverable
Manganese (Mn)	1.00	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. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

TMDL Elements (WLA, LA, MOS)

$$\text{TMDL} = \text{WLA} + \text{LA} + \text{MOS}$$

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload 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. Table 3 contains the TMDL component summary for each point evaluated in the watershed. Refer to the maps in Attachment A.

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 also 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 margin of safety (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 and each TMDL includes upstream loads.

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 Big Run watershed and therefore all waste load allocations are equal to zero. The difference between the TMDL and the WLA 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 to the area upstream of the point 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 Big Run Watershed

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
BR09						
Aluminum (lbs/day)	0.14	0.06	0	0.1	0.08	57%
Iron (lbs/day)	0.45	0.11	0	0.1	0.34	76%
Manganese(lbs/day)	0.28	0.07	0	0.1	0.21	75%
Acidity (lbs/day)	8.39	1.76	0	1.8	6.63	79%
BR07						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	ND	ND	0	ND	NA	NA
Acidity (lbs/day)	8.48	4.75	0	4.8	0*	0%*
BR08						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA

Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	ND	ND	0	ND	NA	NA
Acidity (lbs/day)	52.37	13.62	0	13.6	38.75	74%
BR05						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	2.08	2.08	0	ND	NA	NA
Manganese(lbs/day)	0.98	0.98	0	ND	NA	NA
Acidity (lbs/day)	52.05	17.7	0	17.7	0*	0%*
BR06						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	0.34	0.15	0	0.2	0.19	56%
Acidity (lbs/day)	22.93	3.9	0	3.9	19.03	83%
BR04						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	ND	ND	0	ND	NA	NA
Acidity (lbs/day)	30.81	7.39	0	7.4	4.39	37%
BR03						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	0.97	0.97	0	ND	NA	NA
Acidity (lbs/day)	81.11	43.8	0	43.8	0*	0%*
BR02						
Aluminum (lbs/day)	0.021	0.016	0	0.02	0.05	24%
Iron (lbs/day)	1.63	0.05	0	0.05	1.58	97%
Manganese(lbs/day)	0.15	0.03	0	0.03	0.12	80%
Acidity (lbs/day)	2.78	2.37	0	2.4	0.41	15%
BR01						
Aluminum (lbs/day)	ND	ND	0	ND	NA	NA
Iron (lbs/day)	ND	ND	0	ND	NA	NA
Manganese(lbs/day)	7.29	3.21	0	3.2	3.96	55%
Acidity (lbs/day)	269.45	56.58	0	56.6	175.15	76%

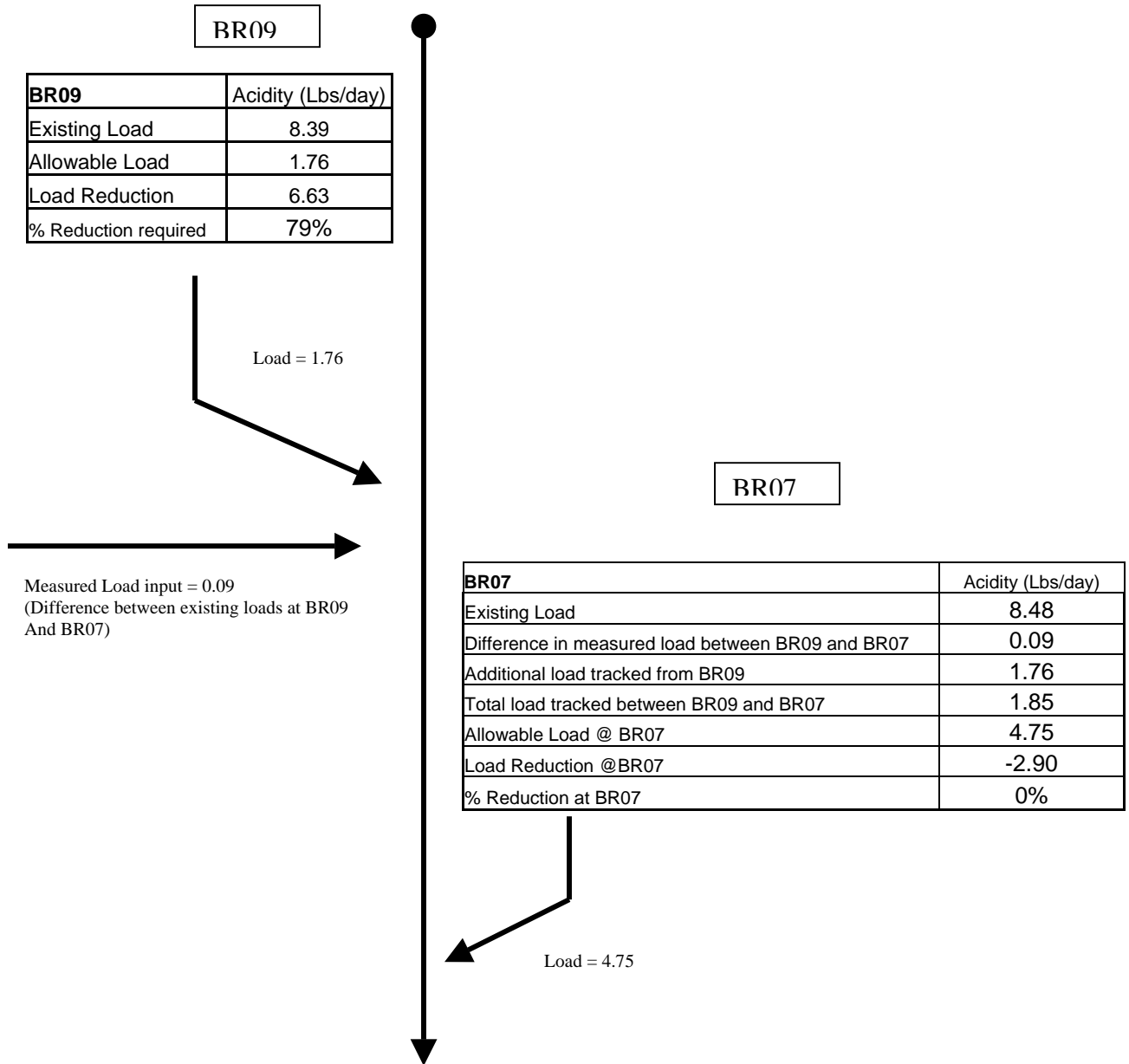
ND = non detection, data below the detection limits NA = not applicable

* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.

In the instance that the allowable load is equal to the measured load (e.g. iron and manganese BR05, Table 3), the simulation determined that water quality standards are being met instream and therefore 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, for a stream segment are calculated. For this example, acidity allocations for BR07 of Big 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. These analyses follow the example. Attachment A contains maps of the sampling point locations for reference.



The allowable load tracked from BR09 was 1.76 lbs/day. The existing load at BR09 was subtracted from the existing load at BR07 to show the actual measured increase of acidic load that has entered the stream between these two sample points. This value was then added to the allowable load at BR09 to calculate the total load that was tracked between BR09 and BR07 (allowable load @ BR09 + the difference in existing load between BR07 and BR09). The total load tracked was then subtracted from the calculated allowable load at BR07 to determine the amount of load to be reduced at BR07. Since this value was found to be 1.85 lbs/day, it was 2.90

lbs/day less than the BR07 allowable load of 4.75 lbs/day. Therefore, no reduction at BR07 is necessary. From this point, the allowable load at BR07 will be tracked to the next downstream point, BR05.

Recommendations

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 from 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; and 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 Reining 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 1960's, 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 reining 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.

The coal industry, through DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation identified in the above recommendations through the permitting, mining, and reclamation of abandoned and disturbed mine lands. Special consideration should be given to potential remining projects within these areas, as the environmental benefit versus cost ratio is generally very high.

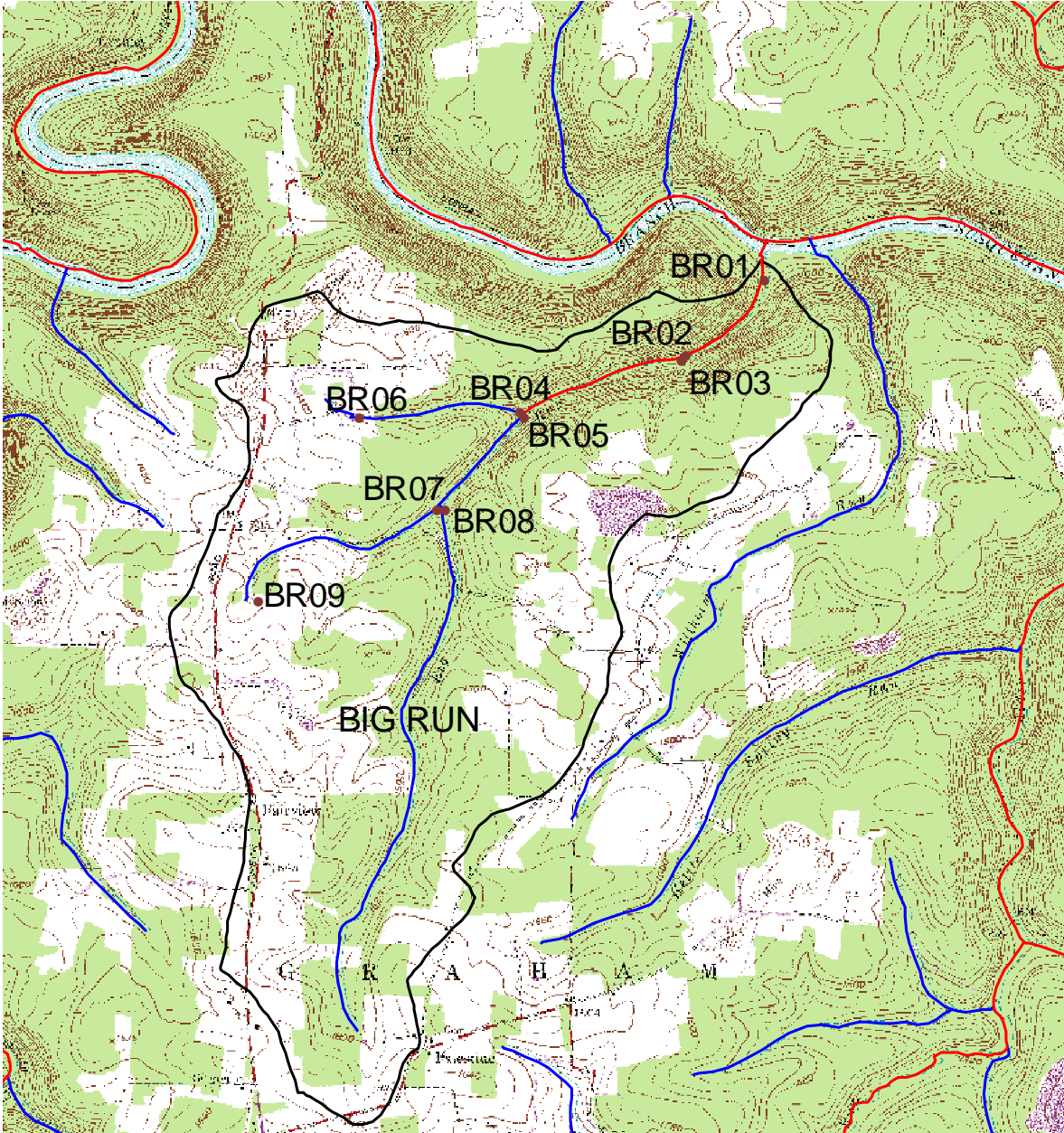
There is currently no watershed group focused on the Big Run Watershed area. It is recommended that agencies work with local interests to form a watershed organization. This watershed organization could then work to implement projects to achieve the reductions recommended in this TMDL document.

Public Participation

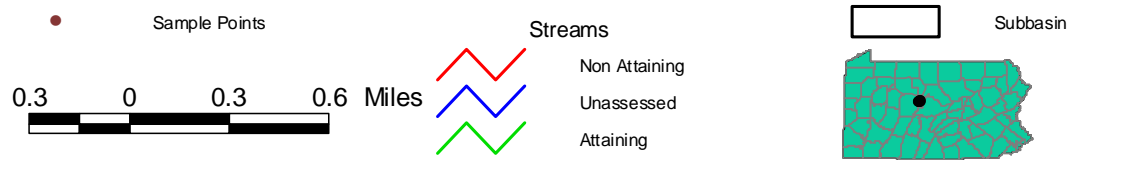
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and the Clearfield Progress to foster public comment on the allowable loads calculated. A public meeting was held on July 14, 2004, at the Multiservice Center in Clearfield, to discuss the proposed TMDL.

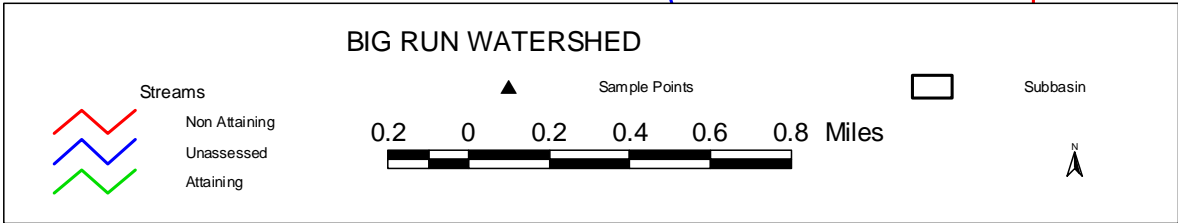
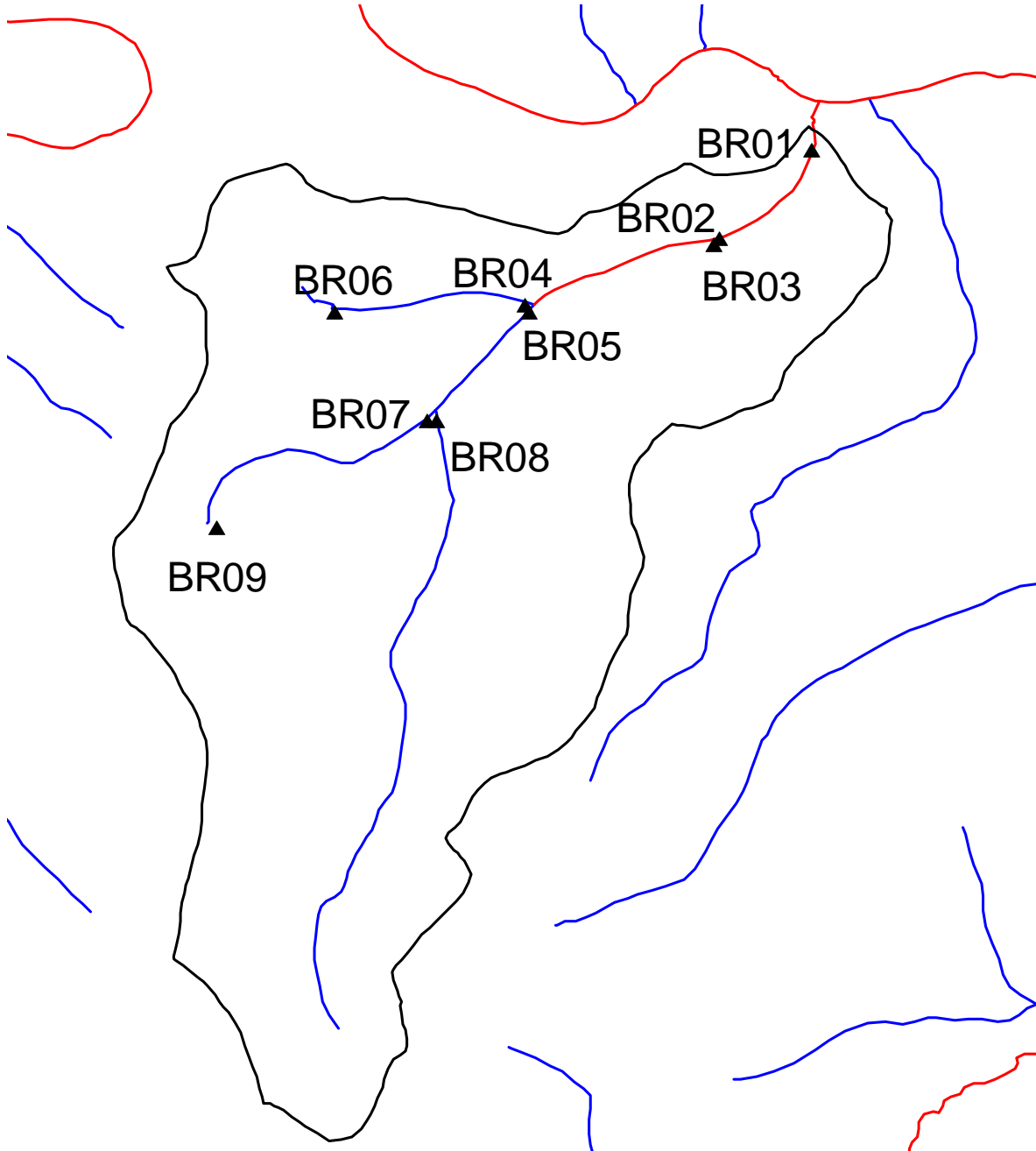
Attachment A

Big Run Watershed Map



Big Run - Clearfield County





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) CaCO₃. 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.*

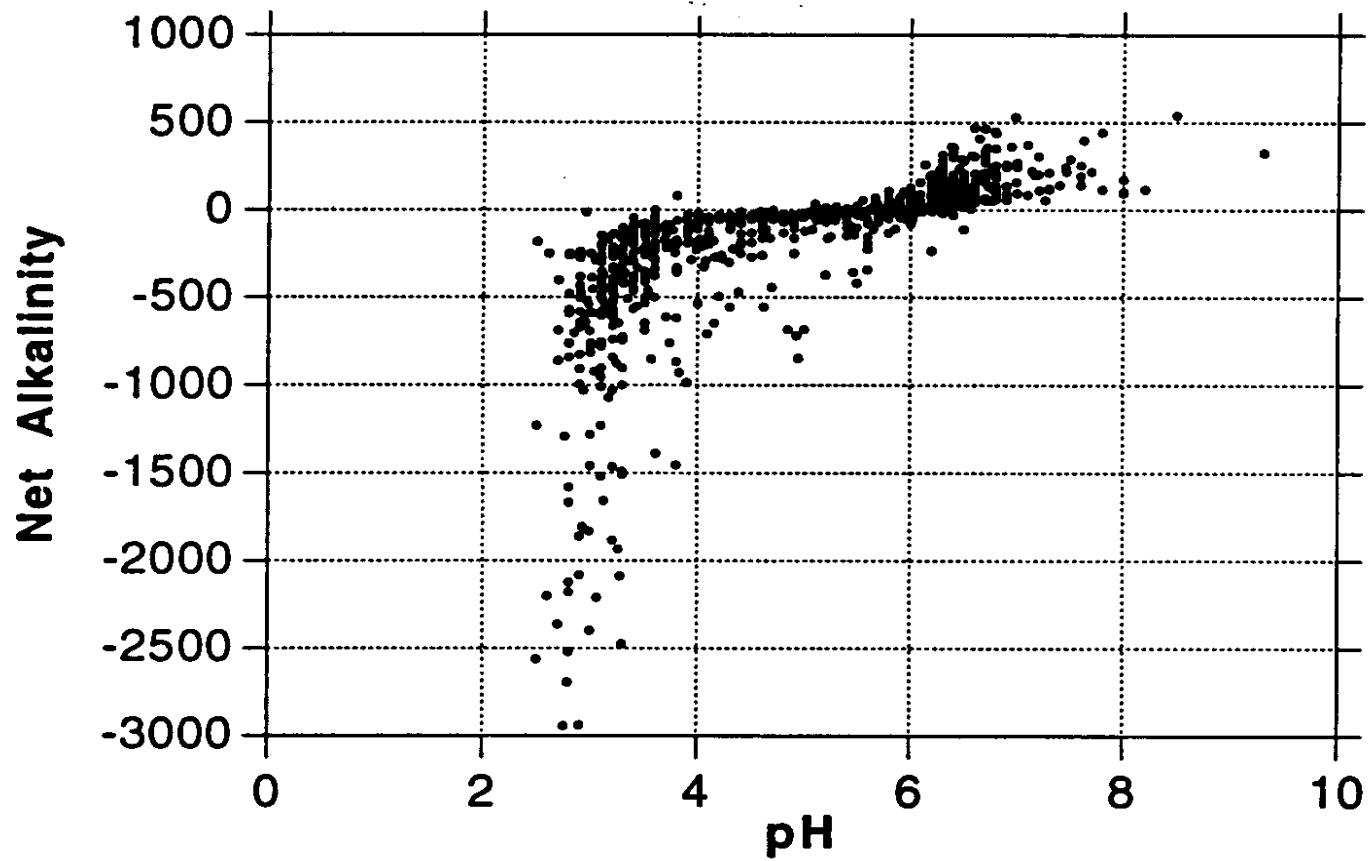


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

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 establish a nationwide program to, among other things, protect the beneficial uses of land or water resources, and public 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 non-point 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 non-point 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 – An 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

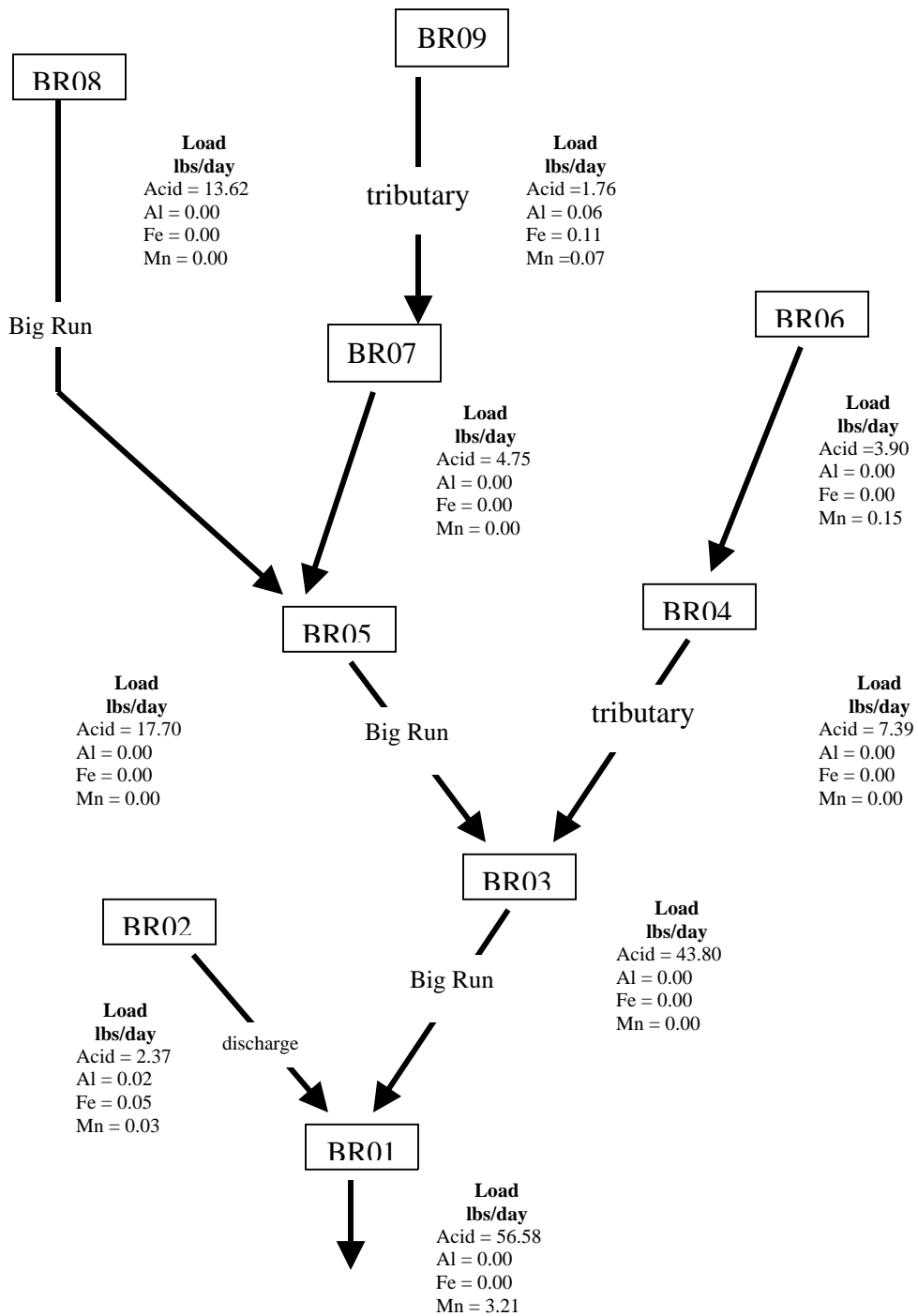
Big Run

The TMDL for Big Run consists of load allocations to four sampling sites along the stream (BR08, BR05, BR03 and BR01), four sampling sites along tributaries (BR09, BR07, BR06 and BR04) and 1 discharge (BR02). Data sets include four samples taken on the same four days for each sample point in the Big Run watershed. All sample points are shown on the maps included in Attachment A. Calculated allowable load values for each sample point are shown on the schematic on the next page.

Big Run is listed on the 1996 PA Section 303(d) list for pH from AMD as being the cause of the degradation to the stream. The objective of this TMDL is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. 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.

Although this TMDL will focus primarily on pH and reduced acid loading to the Big Run watershed, metals analysis will be performed as well where applicable. Although most of the sample data for metals in Big Run show that the metal concentrations are at or below detection limits, there were some instances where metal concentrations did exceed criteria and therefore reductions were necessary.

An allowable long-term average in-stream concentration was determined at each sample point for acidity, and for some metals when determined necessary. 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. Following is an explanation of the TMDL for each allocation point.



TMDL calculations- BR09-Headwaters of unnamed tributary near Deer Creek Road by farm fields

The TMDL for sample point BR09 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this headwaters segment was computed using water-quality sample data collected at point BR09. The average flow, measured at the sampling point BR09 (0.06 MGD), is used for these computations. Because this is the most upstream point of this segment, the allowable load allocations calculated at BR09 is equal to the actual load that will directly affect the downstream point BR07.

Sample data at point BR09 shows that the headwaters of Big Run have a pH ranging between 6.3 and 7.1. Because of the high pH values, there currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

Table C1 shows the measured and allowable concentrations and loads at BR09. Table C2 shows percent reductions for all parameters required at this point.

Table C1		Measured		Allowable	
Flow (gpm)=	38.81	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.31	0.1	0.14	0.1
	Iron	0.96	0.5	0.24	0.1
	Manganese	0.59	0.3	0.15	0.1
	Acidity	18.00	8.4	3.78	1.8
	Alkalinity	24.20	11.3		

Table C2. BR09				
BR09	Acidity (Lbs/day)	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)
Existing Load @ BR09	8.39	0.14	0.45	0.28
Allowable Load @ BR09	1.76	0.06	0.11	0.07
Load Reduction @ BR09	6.63	0.08	0.34	0.21
% Reduction required @ BR09	79%	57%	76%	75%

TMDL calculations- BR07 Unnamed tributary to Big Run below camp, along road to mouth of Big Run

The TMDL for sampling point BR07 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point BR07. The average flow, measured at the sampling point BR07 (0.27 MGD), is used for these computations. The calculated acidic load at BR07 will directly affect the downstream point BR05.

Sample data at point BR07 shows pH ranging between 6.4 and 6.9; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point BR07 for acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The additional load from point BR09 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between point BR09 and BR07 to determine a total load tracked for the segment of stream between BR09 and BR07. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at BR07.

A TMDL for acidity at BR07 has been calculated. All measured sample data for aluminum, iron and manganese fell below the detection limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. Their existing and allowable load values at BR07 in Table C3 will be denoted as "NA". In this case, the accounting for upstream loads (BR09) is not carried through to the next downstream point (BR07), for aluminum, iron and manganese.

Table C3 shows the measured and allowable concentrations and loads at BR07. Table C4 shows the percent reduction required for acidity at this point was equal to zero. Because the total acidic load tracked to this point was less than the allowable load calculated at BR07, there is no percent reduction needed.

Table C3		Measured		Allowable	
Flow (gpm)=	185.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	ND	NA		
	Manganese	ND	NA		
ND = non detection	Acidity	3.80	8.5	2.13	4.8
NA = not applicable	Alkalinity	18.10	40.4		

Table C4. BR07	
BR07	Acidity (Lbs/day)
Existing Load @ BR07	8.48
Difference in measured load between BR09 and BR07	0.09
Additional load tracked from BR09	1.76
Total load tracked between BR09 and BR07	1.85
Allowable Load @ BR07	4.75
Load Reduction @BR07	-2.90
% Reduction at BR07	0%

The difference in measured loads between BR09 and BR07 was 0.09 lbs/day. This was added to the allowable load from BR09 (1.76 lbs/day) to give a total load that has been tracked at BR07. This total load was then compared to the allowable load at BR07. This value of 1.85 lbs/day was found to be less than the calculated allowable load, therefore there is no reduction necessary at this sample point.

TMDL calculations- BR08-Big Run below Big Run Park near camp Hemlock Hollow before confluence with unnamed tributary

The TMDL for sample point BR08 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point BR08. The average flow, measured at the sampling point BR08 (1.1 MGD), is used for these computations. The allowable load allocations calculated at BR08 will directly affect the downstream point BR05.

Sample data at point BR08 shows pH ranging between 6.1 and 6.9; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

A TMDL for acidity at BR08 has been calculated. All measured sample data for aluminum, iron and manganese fell below the detection limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. Their existing and allowable load values at BR08 in Table C5 will be denoted as "NA".

Table C5 shows the measured and allowable concentrations and loads at BR08. Table C6 shows the percent reduction for acidity required at this point.

Table C5		Measured		Allowable	
Flow (gpm)=	765.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	ND	NA		
	Manganese	ND	NA		
ND = non detection	Acidity	5.70	52.4	1.48	13.6
NA = not applicable	Alkalinity	12.50	114.8		

Table C6. BR08	
BR08	Acidity (Lbs/day)
Existing Load @ BR08	52.37
Allowable Load @ BR08	13.62
Load Reduction @ BR08	38.75
% Reduction required @ BR08	74%

TMDL Calculation –BR05- Big Run above unnamed tributary from farm

The TMDL for sampling point BR05 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point BR05. The average flow, measured at the sampling point BR05 (1.44 MGD), is used for these computations. The allowable load calculated at BR05 will directly affect the downstream point BR03.

Sample data at point BR05 shows pH ranging between 6.0 and 6.8; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point BR05 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The allowable load from points BR07 and BR08 show the total load that was permitted from upstream sources. This value, for each parameter, was subtracted from the existing load at point BR05 to determine a remaining load for the segment of stream between BR08 – BR07 and BR05. This remaining allowable load will be compared to the calculated allowable load to determine if further reductions are needed to meet the calculated TMDL at BR05.

A TMDL for acidity at BR05 has been calculated. All measured sample data for aluminum, iron and manganese fell below applicable water quality criteria limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. Their existing and allowable load values at BR05 in Table C7 will be denoted as "NA". In this case, the accounting for upstream loads (BR08 and BR07) is not carried through to the next downstream point (BR05), for aluminum, iron and manganese.

Table C7 shows the measured and allowable concentrations and loads at BR05. Table C8 shows the percent reduction for acidity required at BR05.

Table C7		Measured		Allowable	
Flow (gpm)=	996.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	ND	NA		
	Manganese	ND	NA		
ND = non detection	Acidity	4.35	52.1	1.48	17.7
NA = not applicable	Alkalinity	12.80	153.2		

Table C8 BR05	
BR05	Acidity (Lbs/day)
Existing Load @ BR05	52.05

Difference in measured Loads between upstream loads and existing BR05	-8.80
Percent loss due calculated at BR05	14%
Additional load tracked from above samples	18.37
Percentage of upstream loads that reach the BR05	86%
Total load tracked between BR07/BR08 and BR05	15.71
Allowable Load @ BR05	17.70
Load Reduction @ BR05	-1.99
% Reduction required at BR05	0%

The upstream existing loads from BR07 and BR08 were summed and found to be greater than the existing load at sample point BR05. The percent of upstream loads that actually reach sample point BR05 was calculated resulting in a value for percent loss of upstream loads that occurs before the loads reach this sample point. Therefore this loss is considered in the reductions at BR05. A loss of 8.8 lbs between upstream points and BR05 results in a 14% loss in this segment of stream. Because the total load tracked at BR05 is less than the calculated allowable load, there is no percent reduction needed.

TMDL calculations- BR06 Headwaters of unnamed tributary below farm

The TMDL for sample point BR06 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point BR06. The average flow, measured at the sampling point BR06 (0.08 MGD), is used for these computations. The allowable load calculated at BR06 will directly affect the downstream point BR04.

Sample data at point BR06 shows pH ranging between 5.6 and 6.2; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

A TMDL for acidity and manganese at BR06 has been calculated. All measured sample data for aluminum and iron fell below detection limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. Their existing and allowable load values at BR06 in Table C9 will be denoted as "NA".

Table C9 shows the measured and allowable concentrations and loads at BR06. Table C10 shows the percent reductions for acidity and manganese that are required at BR06.

Table C9		Measured		Allowable	
		Concentration	Load	Concentration	Load
Flow (gpm)=	53.33	mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	ND	NA		
	Manganese	0.53	0.3	0.23	0.2
ND = non detection	Acidity	35.80	22.9	6.09	3.9

NA = not applicable	Alkalinity	9.40	6.0		
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Table C10 BR06		
BR06	Acidity (Lbs/day)	Mn (Lbs/day)
Existing Load @ BR06	22.93	0.34
Allowable Load @ BR06	3.90	0.15
Load Reduction @ BR06	19.03	0.19
% Reduction required @ BR06	83%	56%

TMDL calculations- BR04- Unnamed tributary from farm before confluence with Big Run

The TMDL for sampling point BR04 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point BR04. The average flow, measured at the sampling point BR04 (0.29 MGD), is used for these computations. The allowable load calculated at BR04 will directly affect the downstream point BR03.

Sample data at point BR04 shows pH ranging between 5.6 and 5.8; pH will be addressed as part of this TMDL. There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point BR04 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The load from point BR06 shows the total load that was permitted from upstream sources. This value, for acidity, was subtracted from the TMDL at point BR04 to determine a remaining load for the segment of stream between BR06 and BR04. This remaining load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at BR04.

A TMDL for acidity at BR04 has been calculated. All measured sample data for aluminum, iron and manganese fell below the detection limits. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. Their existing and allowable load values at BR04 in Table C11 will be denoted as "NA".

Table C11 shows the measured and allowable concentrations and loads at BR04. Table C12 shows the percent reduction for acidity required at BR04.

Table C11		Measured		Allowable	
Flow (gpm)=	198.33	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	ND	NA		
	Manganese	ND	NA		

ND = non detection	Acidity	12.93	30.8	3.10	7.4
NA = not applicable	Alkalinity	7.70	18.3		

Table C12 BR04	
BR04	Acidity (Lbs/day)
Existing Load @ BR04	30.81
Difference in measured load between BR06 and BR04	7.88
Additional load tracked from BR06	3.90
Total load tracked between BR06 and BR04	11.78
Allowable Load @ BR04	7.39
Load Reduction @BR04	4.39
% Reduction at BR04	37%

The difference in measured loads between BR06 and BR04 was added to the allowable load tracked from BR06 to calculate the total load that has been tracked between these two points on this segment of the stream. The total load was then subtracted from the allowable load at BR04 to determine the amount of reduction necessary at this sample point. It has been determined that a 37% reduction will be needed at BR04.

TMDL calculations- BR03 Big Run before discharge enters

The TMDL for sampling point BR03 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point BR03. The average flow, measured at the sampling point BR03 (2.90 MGD), is used for these computations. The allowable load calculated at BR03 will directly affect the downstream point BR01.

There currently is an entry for this segment on the Section Pa 303(d) list for impairment due to pH. Sample data at point BR03 shows pH ranging between 6.2 and 6.7; pH will be addressed as part of this TMDL.

The measured and allowable loading for point BR03 for acidity was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The load from points BR04 and BR05 show the total acidic load that was permitted from upstream sources. This value, was subtracted from the TMDL at point BR03 to determine a remaining load for the segment of stream between BR04 – BR05 and BR03. This remaining load will determine if further reductions are needed to meet the calculated TMDL at BR03.

A TMDL for acidity at BR03 has been calculated. All measured sample data for aluminum and iron fell below detection limits. The measured sample data at manganese was above detection limits but fell below applicable water quality criteria limits. Because water quality standards are met in both instances, a TMDL for these parameters isn't necessary and is not calculated. Their existing and allowable load values at BR03 in Table C13 will be denoted as "NA".

Table C13 shows the measured and allowable concentrations and loads at BR03. Table C14 shows the percent reduction for acidity required at BR03.

Table C13		Measured		Allowable	
		Concentration	Load	Concentration	Load
Flow (gpm)=	2016.00	mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	ND	NA		
	Manganese	ND	NA		
ND = non detection	Acidity	3.35	81.1	1.81	43.8
NA = not applicable	Alkalinity	11.40	276.0		

Table C14 BR03	
BR03	Acidity (Lbs/day)
Existing Load @ BR03	81.11
Difference in measured Loads between the upstream loads and existing BR03	-1.75
Percent loss due calculated at BR03	2%
Additional load tracked from above samples	25.09
Percentage of upstream loads that reach the BR03	98%
Total load tracked between BR05/BR04 and BR03	24.56
Allowable Load @ BR03	43.80
Load Reduction @ BR03	-19.24
% Reduction required at BR03	0%

The upstream existing loads from BR04 and BR05 were summed and found to be greater than the existing load at sample point BR03. The percent of upstream loads that actually reach sample point BR03 was calculated resulting in a value for percent loss of upstream loads that occurs before the loads reach this sample point. Therefore this loss is considered in the reductions at BR03. A loss of 1.75 lbs/day between upstream points and BR03 results in a 2% loss of acidic load in this segment of stream. Because the total load tracked at BR03 was less than the calculated allowable load, the percent reduction for acidity is shown to be zero.

TMDL calculations- BR02- Discharge in Big Run near big rock along camp road

The TMDL for sample point BR02 consists of a load allocation to the discharge shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point BR02. The average flow, measured at the sampling point BR02 (0.01 MGD), is used for these computations. The allowable load calculated at BR02 will directly affect the downstream point BR01.

There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point BR02 shows pH ranging between 6.3 and 6.4, pH will be addressed in this TMDL.

Table C15 shows the measured and allowable concentrations and loads at BR02. Table C16 shows the percent reductions for aluminum, iron, manganese and acidity required at BR02.

Table C15	Flow (gpm)=	Measured		Allowable	
		Concentration	Load	Concentration	Load
	8.75	mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.20	0.02	0.15	0.02
	Iron	15.48	1.6	0.46	0.1
	Manganese	1.41	0.2	0.30	0.03
	Acidity	26.50	2.8	22.53	2.4
	Alkalinity	53.40	5.6		

Table C16 BR02				
BR02	Acidity (Lbs/day)	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)
Existing Load @ BR02	2.78	0.02	1.63	0.15
Allowable Load @ BR02	2.37	0.02	0.05	0.03
Load Reduction @ BR02	0.41	0.01	1.58	0.12
% Reduction required @ BR02	15%	24%	97%	80%

TMDL Calculation – BR01- Big Run before confluence with West Branch Susquehanna River at camp Rat Race bridge

The TMDL for sampling point BR01 on Big Run consists of a load allocation of the area above point BR01 as shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point BR01. The average flow, measured at the sampling point BR01 (3.12 MGD), is used for these computations.

There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point BR01 shows pH ranging between 6.3 and 7.0; pH will be addressed as part of this TMDL.

The existing and allowable loading for point BR01 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any loads already specified from upstream sources. The existing load from points BR02 and BR03 show the total load that was permitted from upstream sources. This value, for acidity, was subtracted from the existing load at point BR01 to determine a remaining load for the segment of stream between BR02 – BR03 and BR01. This remaining load will determine if further reductions are needed to meet the calculated TMDL at BR01.

A TMDL for manganese and acidity at BR01 has been calculated. All measured sample data for aluminum and iron fell below detection limits. Because water quality standards are met, a TMDL for these parameters aren't necessary and are not calculated. Their existing and allowable load values for aluminum at BR01 in Table C17 will be denoted as "NA".

The data set for the iron parameter at BR01 contained one sample for iron that was considerably higher than the other samples, which resulted in an elevated standard deviation (greater variation in the data). This sample value was tested and deemed an outlier and was removed from the data set. Without this extremely high sample, the remaining iron data fell well below detection limits.

Table C17 shows the measured and allowable concentrations and loads at BR01. Table C18 shows the percent reductions required for acidity and manganese at sample point BR01.

Table C17		Measured		Allowable	
		Concentration	Load	Concentration	Load
Flow (gpm)=	2167.75	mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA		
	Iron	ND	NA		
	Manganese	0.28	7.3	0.12	3.2
ND = non detection	Acidity	10.35	269.5	2.17	56.6
NA = not applicable	Alkalinity	12.10	315.0		

Table C18 BR01		
BR01	Acidity (Lbs/day)	Mn (Lbs/day)
Existing Load @ BR01	269.45	7.29
Difference in measured load between BR03/BR02 and BR01	185.56	7.14
Additional load tracked from BR03/BR02	46.17	0.03
Total load tracked between BR03/BR02 and BR01	231.73	7.17
Allowable Load @ BR01	56.58	3.21
Load Reduction @BR01	175.15	3.96
% Reduction at BR01	76%	55%

The measured acidic and manganese loads from BR03 and BR02 were subtracted from the measured loads at BR01. These values were then added to the allowable loads tracked from these upstream points to calculate a total load that has been tracked from upstream sources. This total value was then subtracted from the calculated allowable load at BR01. The load reduction needed was 175.15 lbs/day for acidity and 3.96 lbs/day for manganese, resulting in a 76% and a 55% reduction respectively for these two parameters at BR01.

Margin of Safety

PADEP used an implicit MOS in these TMDLs derived from the Monte Carlo statistical analysis. The Water Quality standard states that water quality criteria must be met at least 99% of the time. All of the @Risk analyses results surpass the minimum 99% level of protection. Another margin of safety used for this TMDL analysis results from:

- 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.
- A MOS is also the fact that the calculations were performed with a daily Iron 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 303(d) narratives that justify changes in listings between the 1996, 1998, and 2002 lists. The 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 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 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 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

BR09 ND = nondetect Calculated as Zero in the Data set.							
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	7.1	52.0	0.00	0.25	2.71	1.81	0.6
10/28/2002	6.4	14.0	52.00	25	1.12	0.41	0.633
3/27/2003	6.3	15.0	20.00	100	ND	0.06	ND
4/22/2003	6.6	15.8	0.00	30	ND	0.098	ND
average	6.6	24.2	18.0	38.8	1.9	0.6	0.6
st dev	0.4	18.5	24.5	42.8	1.1	0.8	0.02

BR07 ND = nondetect Calculated as Zero in the Data set.							
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	6.9	24.0	0.00	2	ND	ND	ND
10/28/2002	6.8	19.6	0.00	216	ND	ND	ND
3/27/2003	6.4	14.0	15.20	367	ND	ND	ND
4/22/2003	6.7	14.6	0.00	158	ND	ND	ND
average	6.7	18.1	3.8	185.8	NA	NA	NA
st dev	0.2	4.7	7.6	150.9	NA	NA	NA

BR08 ND = nondetect Calculated as Zero in the Data set.							
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	6.9	20.0	0.00	3	ND	ND	ND
10/28/2002	6.6	11.8	0.00	300	ND	ND	ND
3/27/2003	6.1	9.2	22.80	1996	ND	ND	ND
4/22/2003	6.5	9.0	0.00	761	ND	ND	ND
average	6.5	12.5	5.7	765.0	NA	NA	NA
st dev	0.3	5.2	11.4	877.9	NA	NA	NA

BR05 ND = nondetect Calculated as Zero in the Data set.							
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	6.8	17.8	0.00	5	0.322	0.061	ND
10/28/2002	6.7	13.4	0.00	727	0.374	0.267	ND
3/27/2003	6.0	10.0	17.40	2448	ND	ND	ND
4/22/2003	6.6	10.0	0.00	805	ND	ND	ND
average	6.5	12.8	4.4	996.3	0.35	0.16	NA
st dev	0.4	3.7	8.7	1032.7	0.04	0.15	NA

BR06 ND = nondetect Calculated as Zero in the Data set.							
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	no flow			0			
10/28/2002	6.2	11.4	39.00	10	ND	ND	ND

3/27/2003	5.6	8.8	40.20	100	ND	0.812	ND
4/22/2003	5.7	8.0	28.20	50	ND	0.781	ND
average	5.8	9.4	35.8	53.3	NA	0.80	NA
stdev	0.3	1.8	6.6	45.1	NA	0.02	NA
BR04	ND = nondetect Calculated as Zero in the Data set.						
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	no flow			0.00			
10/28/2002	5.8	8.0	10.80	63	ND	ND	ND
3/27/2003	5.6	7.8	19.60	356	ND	ND	ND
4/22/2003	5.8	7.2	8.40	176	ND	ND	ND
average	5.7	7.7	12.9	198.3	NA	NA	NA
stdev	0.1	0.4	5.9	147.8	NA	NA	NA
BR03	ND = nondetect Calculated as Zero in the Data set.						
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	6.6	14.0	0.00	19	ND	0.11	ND
10/28/2002	6.7	13.2	0.00	845	ND	ND	ND
3/26/2003	6.2	8.4	9.40	4800	ND	ND	ND
4/22/2003	6.3	10.0	4.00	2400	ND	0.05	ND
average	6.5	11.4	3.4	2016.0	NA	0.08	NA
stdev	0.2	2.6	4.5	2102.2	NA	0.04	NA
BR02	ND = nondetect Calculated as Zero in the Data set.						
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	6.4	64.0	35.00	5	18.3	1.83	ND
10/28/2002	6.3	32.0	36.00	20	ND	ND	ND
3/26/2003	6.3	56.2	22.60	5	23.4	1.94	0.792
4/22/2003	6.4	61.2	12.40	5	20.2	1.86	ND
average	6.4	53.4	26.5	8.8	15.6	1.9	NA
stdev	0.1	14.6	11.2	7.5	10.4	0.1	NA
BR01	ND = nondetect Calculated as Zero in the Data set.						
	pH*	Alkalinity^	Acidity	Flow	Iron	Manganese	Aluminum
Date	Lab	mg/l	mg/l	gpm	mg/l	mg/l	mg/l
9/11/2002	6.6	14.8	0.00	52	ND	ND	ND
10/28/2002	7.0	14.6	0.00	1026	14.3	1.06	ND
3/26/2003	6.3	8.6	23.80	4966	ND	0.06	ND
4/22/2003	6.3	10.2	17.60	2627	ND	ND	ND
average	6.6	12.1	10.4	2167.8	NA	0.6	NA
stdev	0.3	3.1	12.2	2146.4	NA	0.7	NA

Attachment F

Comment and Response

No official comments were received during the final comment period.