FINAL

Unt BUFFALO CREEK
Armstrong County, Pennsylvania

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Pennsylvania Department of Environmental Protection

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FINAL TMDL
Unt Buffalo Creek Watershed
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Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for a segment in the Unt (42685) to Buffalo Creek Watershed (Attachment A). It was done to address the impairments noted on the 1996 Pennsylvania 303(d) list, required under the Clean Water Act, and covers the one listed segment shown in Table 1. Metals in acidic discharge water from abandoned coalmines causes the impairment. The TMDL addresses the three primary metals associated with acid mine drainage iron, manganese, and aluminum.

Table 1. 303(d) Sub-List Allegheny River

State Water Plan (SWP) Subbasin: 18F

Year	SWP	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	18F	0.2	-	42685	Unt Buffalo Creek	TSF	303 (d) Report	Resource Extraction	Metals
1998	18F	0.2	-	42685	Unt Buffalo Creek	TSF	SWMP	AMD	Metals
2002	18F	0.2	-	42685	Unt Buffalo Creek	TSF	SWMP	AMD	Metals
2004	18F	3.1	20040930-0900-CLW	42685	Unt Buffalo Creek	TSF	SWMP	AMD	Metals

Trout Stocked Fishes = TSF
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD

Directions to the Unt (42685) Buffalo Creek Watershed

The Unnamed Tributary (42685) to Buffalo Creek Watershed is located in South Western Pennsylvania, occupying a west-central portion of Armstrong County and a small piece of Butler County. The watershed area is found on the Worthington 7.5-Minute Quadrangle United States Geological Survey map. The area within the watershed consists of 2.83 square miles. The headwaters of the watershed lie mostly around Route 422 at the Armstrong-Butler County line. The unnamed tributary to Bufflo Creek almost parallels Route 433 as it flows to the main Buffalo Creek stream. This Unnamed Tributary to Buffalo Creek can be accessed by taking route 66 north from Greensburg, PA to Route 422 west just south of Kittanning, PA. After traveling approximately 7.7 miles west on Route 422 the Unnamed Tributary to Buffalo Creek Passes under Route 422.

Segments addressed in this TMDL

The Unnamed Tributary to Buffalo Creek is affected by pollution from AMD. This pollution has caused high levels of manganese (at one sample point). The waterbody is net alkaline. The sources of the AMD are seeps and discharges from abandoned deep mines or refuse piles. Some of the discharges are considered to be nonpoint sources of pollution because they are from abandoned Pre-Act mining operations or from coal companies that have settled their bond forfeitures with the Pennsylvania Department of Environmental Protection (PADEP).

The designation for this stream segment can be found in PA Title 25 Chapter 93.

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 (USEPA) implementing regulations (40 CFR 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 USEPA every four 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

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

Despite these requirements, states, territories, authorized tribes, and USEPA have not developed many TMDLs since 1972. Beginning in 1986, organizations in many states filed lawsuits against the USEPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While USEPA 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 USEPA 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.).

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 USEPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (Pa. DEP) for evaluating waters changed between the publication of the 1996 and 1998 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 305(b) reporting process. Pa. DEP is now using the Unassessed Waters Protocol (UWP), a modification of the USEPA Rapid Bioassessment Protocol II (RPB-II), as the primary mechanism to assess Pennsylvania's waters. The UWP 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 303(d) list with the documented source and cause. A TMDL must be developed for the stream segment. A TMDL is for only one pollutant. If a stream segment is impaired by two pollutants, two TMDLs must be developed for that stream segment. 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. Calculate TMDL for the waterbody using USEPA approved methods and computer models;

3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;
5. Submit draft report for public review and comments; and
6. USEPA approval of the TMDL.

This document will present the information used to develop the Unnamed Tributary (42685) of Buffalo Creek Watershed TMDL.

Watershed History

The Unnamed Tributary (42685) of Buffalo Creek is part of the Allegheny River Basin in Armstrong County and drains to the main stem of Buffalo Creek, which then flows south to the Allegheny River near Freeport, PA. The watershed area is located in the Allegheny Plateau Physiographic Province. The plateau is characterized by gently rolling hills with a maximum elevation of 1357 feet and a minimum elevation of 980 feet where the unnamed tributary flows into the main stem of Buffalo Creek.

The watershed is located on the Kellersburg Anticline which bi-sects the tributary roughly in the middle as the anticline runs north to south and the tributary flows west to east. Rocks of the local structure generally slope to the south and east with a dip of 2.0 degrees SE. The axis of the Kellersburg Anticline forms a gentle arching of the strata in an east-west direction and plunges S 15 degrees 30 minutes W into the ground at 0 degrees 40 minutes from horizontal.

Land uses within the watershed include agriculture, forestland, abandoned mine lands, and rural residential properties with a few small communities stretched mostly along Route 422. Route 422 passes through the north two-thirds of the watershed area from west to east. The unnamed tributary then flows south through abandoned mine land areas before entering into the main stem of Buffalo Creek.

Several abandoned deep mines underlie the watershed on the following coal seams: Upper Kittanning, Lower Kittanning, Clarion #2, Brookville and Scrubgrass. West Freedom Mining Co, George Ambrosia, Bauldoff & Somerville did the deep coal mining. An abandoned underground noncoal deep mine into the Vanport Limestone lies in the northern watershed area mined by the Graff-Kittanning Clay Products Co., Inc. Surface mining occurred on the following coal seams: Upper and Lower Freeports, Upper, Middle and Lower Kittannings, Scrubgrass, clarion, and Brookville. Strip mining done in the 1950’s was by West Freedom Mining Co, John Heffelfinger, Ivywood Coal Co., Smith Contracting, North Star Coal, J. Russel Cravener, and Black Limestone Co. M & M Lime Co., Inc. surfaced mined coal in the early 1980’s and Allegheny Mineral Corp operated surface and auger mining in the watershed during the 1990’s. Deep mining on the Lower Freeport coal seam causes acid mine drainage in the watershed. Surface mining doesn’t cause discharge problems as long as the Vanport Limestone is encountered and left to neutralize the acid producing materials. There is one active mining permit in the watershed, Allegheny Minerals Graff mine Surface Permit No. 03840105, that is addressed in this TMDL.

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 describes 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, 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[1] 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)

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

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

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

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

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

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

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

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

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. 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 be a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

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

Method to Quantify Treatment Pond Pollutant Load

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

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

When a treatment plant has an NPDES permit a Waste Load Allocation (WLA) must be calculated. When there is flow data available this is used along with the permit Best Available Technology (BAT) limits for one or more of the following: aluminum, iron, and manganese. The following formula is used:

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

When site specific flow data is unavailable to determine a waste load allocation for an active mining operation, an average flow rate must be determined. This is done by investigating and quantifying the hydrology of a surface mine site. The following is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits when site specific flow data is unavailable.

The total water volume reporting to ponds for treatment can come from two primary sources: direct precipitation to the pit and runoff from the unregraded area following the pit's progression through the site. Groundwater seepage reporting to the pit is considered negligible compared to the flow rates resulting from precipitation.

In an active mining scenario, a mine operator pumps pit water to the ponds for chemical treatment. Pit water is often acidic with dissolved metals in nature. At the treatment ponds, alkaline chemicals are added to increase the pH and encourage dissolved metals to precipitate and settle. Pennsylvania averages 40 inches of precipitation per year. A maximum pit dimension without special permit approval is 1500 feet long by 300 feet wide. Assuming 100 percent runoff of the precipitation to be pumped to the treatment ponds results in the following equation and average flow rates for the pit area.

40 in. precip./yr x 1 ft/12/in. x 1500'x 300'/pit x 7.48 gal/ft3 x 1yr/365days x 1day/24hr. x 1hr/60mins. = 21.3

21.3 gal/min average discharge from direct precipitation into the open mining pit area.

Pit water can also result from runoff from the unregraded and revegetated area following the pit. DEP compliance efforts encourage that backfilling, topsoiling, and revegetation be as prompt and concurrent as mining conditions and weather conditions allow. Generally the revegatation follows about three pit widths behind the active mining area.

In the case of roughly backfilled land highly porous spoil; there is very little surface runoff. It is estimated that 80 percent of precipitation on the roughly regraded mine spoil infiltrates, 5 percent evaporates, and 15 percent may run off to the pit for pumping and potential treatment. The following equation represents the average flow reporting to the pit from the unregraded and unrevegatated spoil area.

40 in. precip./yr x 3 pit areas x 1 ft/12/in. x 1500'x 300'/pit x 7.48 gal/ft3 x 1yr/365days x 1day/24hr. x 1hr/60mins. x 15 in. runoff/100 in. precipitation =

= 9.6 gal/min average discharge from spoil runoff into the pit area.

The total average flow to the pit is represented by the sum of the direct pit precipitation and the water flowing to the pit from the spoil area as follows:

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

Total Average Flow = 21.3 gal./min. + 9.6 gal./min. = 30.9 gal./min.

The resulting average load from a permitted treatment pond area as follows.

Allowable Aluminum Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

Allowable Iron Waste Load Allocation:
30.9 gal./min. x 3 mg/l x 0.01202 = 1.1 lbs./day

Allowable Manganese Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

(Note: 0.01202 is a conversion factor to convert from a flow rate in gal./min. and a concentration in mg/l to a load in units of lbs./day.)

Field experience shows that the average flow rate of 30.9 gal./min. is excessively high. It is common for many mining sites to have very “dry” pits that rarely accumulate water that would require pumping and treatment. Also, it is the goal of DEP’s permit review process to not issue mining permits that would cause negative impacts to the enviroment. As a step to insure that a mine site does not produce acid drainage, it is common to require the addition of alkaline materials (limestone, alkaline shale or other rocks) may produce alkaline pit water with very low metals concentrations that does not require treatment. Also, while most mining operations are permitted to have a standard, 1500’ x 300’ pit, most are well below that size and have a corresponding decreased flow and load. Where pit dimensions are greater that the standard size is present, the calculations to define the potential pollution load are adjusted accordingly. Hence, the above calculated Waste Load Allocation is very generous and likely high compared to actual conditions that are generally encountered.

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 acceptable 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 of the nature of the pollution sources in the watershed, the TMDLs component makeup will be load allocations that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pennsylvania Title 25 Chapter 96.3(c) specifies that a minimum 99 percent level of protection is required. All metals criteria evaluated in this TMDL are specified as total recoverable. Pennsylvania does have dissolved criteria for iron; however, the data used for this analysis report iron as total recoverable. Table 2 shows the 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 0.3	Total Recoverable Dissolved
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)

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 nonpoint 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).

TMDL Allocations Summary

There was not enough paired data available to Analyze for critical flow conditions for pollutant sources.

Allocation Summary

This TMDL will focus remediation efforts on the identified numerical reduction targets for each watershed. The reductions 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 TMDL may be re-evaluated to reflect current conditions. Table 3 presents the estimated reductions identified for all points in the watershed. An implicit MOS based on conservative assumptions in the analysis is included in the TMDL calculations.

The allowable LTA concentrations 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 is one active mining permit in the watershed which requires a WLA, Allegheny Minerals Graff mine Surface Permit No. 03840105, that is addressed in this TMDL. This site has one treatment pond in operation. The difference between the TMDL and the WLA at each point is the load allocation 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. Summary Table–Unnamed (42685) Tributary to Buffalo Creek

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
BC6	Mouth of Unt (42687) Upstream of Confluence with Unt (42685) of Buffalo Creek						
	Al	0.3	0.2	0.0	0.2	0.1	51
	Fe	0.8	0.3	0.0	0.3	0.5	66
	Mn	0.1	0.1	0.0	0.1	0.0	0
	Acidity	0	0	0.0	0.0	0.0	0
BC5	Most Upstream Sample Point on Unt (42685) of Buffalo Creek						
	Al	0.4	0.4	0.0	0.4	0.0	0
	Fe	0.8	0.7	0.0	0.7	0.1	17
	Mn	5.7	0.6	0.0	0.6	5.1	90
	Acidity	0	0	0.0	0.0	0.0	0
BC4	Unt (42685) of Buffalo Creek Upstream of Confluence with Unt (42686) of Buffalo Creek						
	Al	9.3	0.7	0.103	0.597	8.5	93
	Fe	7.1	1.4	0.620	0.78	5.2	79
	Mn	8.2	1.8	0.207	1.593	1.3	42
	Acidity	0	0	0.0	0.0	0.0	0
BC3	Mouth of Unt (42686) of Buffalo Creek Upstream with Confluence with Unt (42685) of Buffalo Creek						
	Al	1.7	1.5	0.0	1.5	0.2	10
	Fe	2.1	2.1	0.0	2.1	0.0	0
	Mn	2.2	2.2	0.0	2.2	0.0	0
	Acidity	0	0	0.0	0.0	0.0	0
BC2	Mouth of Unt (42685) of Buffalo Creek Upstream of Confluence with Buffalo Creek						
	Al	5.7	1.5	0.0	1.5	0.0	0
	Fe	8.2	3.1	0.0	3.1	0.0	0
	Mn	12.4	2.6	0.0	2.6	3.0	54
	Acidity	0	0	0.0	0.0	15.8	0

All waste load allocations were calculated using the methodology explained previously in the Method to Quantify Treatment Pond Pollutant Load section of the report.

Wasteload allocations for the existing mining operations were incorporated into the calculations at CBR1. This is the first downstream monitoring point that receives all the potential flow of treated water from the treatment site. No required reductions of this permits is necessary at this time because there are upstream non-point sources that when reduced will met the TMDL or there is available assimilation capacity. All necessary reductions are assigned to non-point sources.

The Allegheny Mineral Corp., Graff Mine (SMP#03840105) has a non-standard pit size of 1000 feet in length and a width of 125 feet. In addition there are two pits of this size. This pit size was used in the Method to Quantify Treatment Pond Pollutant Load calculation example shown below:

40 in. precip./yr x 1 ft/12/in. x 1000’x 125’/pit x 7.48 gal/ft3 x 1yr/365days x 1day/24hr. x 1hr/60mins. = 5.93 gal/min average discharge from direct precipitation into the open mining pit area. There are two pits of this size so the total is 11.86 gal/min.

40 in. precip./yr x 3 pit areas x 1 ft/12/in. x 1000'x 125'/pit x 7.48 gal/ft3 x 1yr/365days x 1day/24hr. x 1hr/60mins. x 15 in. runoff/100 in. precipitation = 2.67 gal/min average discharge from spoil runoff into the pit area. There are two pits of this size so the total is 5.34 gal/min

The total average flow to the pit is represented by the sum of the direct pit precipitation and the water flowing to the pit from the spoil area as follows:

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

Total Average Flow = 11.86 gal./min. + 5.34 gal./min. = 17.19 gal./min.

The resulting average load from a permitted treatment pond area as follows.

Allowable Aluminum Waste Load Allocation:
17.19 gal./min. x 0.5 mg/l x 0.01202 = 0.103 lbs./day

Allowable Iron Waste Load Allocation:
17.19 gal./min. x 3 mg/l x 0.01202 = 0.620 lbs./day

Allowable Manganese Waste Load Allocation:
17.19 gal./min. x 1 mg/l x 0.01202 = 0.207 lbs./day

Table 5. Waste Load Allocation of Permitted Discharges

Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
Allegheny Mineral Corp., Graff Mine, SMP03840105			
T1			
Al	0.5	0.025	0.103
Fe	3	0.025	0.620
Mn	1	0.025	0.207

Recommendations

Two primary programs that provide reasonable assurance for maintenance and improvement of water quality in the watershed are in effect. The PADEP'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 PADEP'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 319 Grant program, and Pennsylvania's Growing Greener program have been used extensively to remedy mine drainage impacts. These many activities are expected to continue and result in water quality improvement.

The PA 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; and administers a loan program for bonding anthracite underground mines and for mine subsidence. 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 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

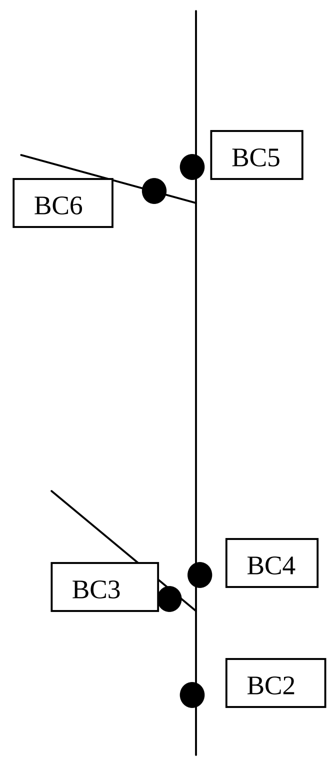
Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management 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 remining risks
- To maximize reclamation funding by expanding existing sources and exploring new sources.

Remining of the deep mines where possible with inclusion of the Vanport Limestone backfill would alleviate some acid mine drainage production. Also, partnering with existing watershed groups to explore treatment options of acid mine drainage problems would be a good avenue for watershed remediation.

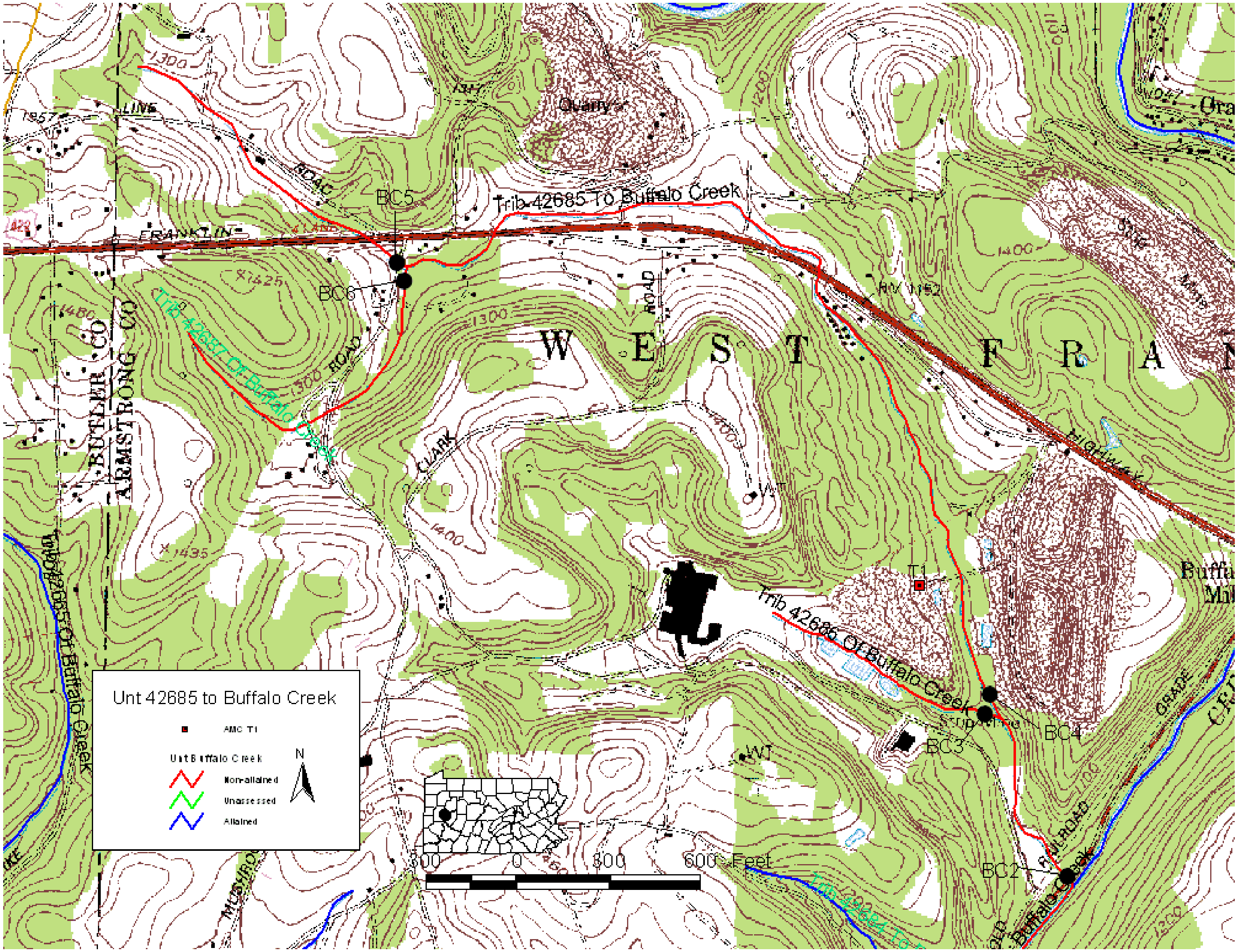
Public Participation

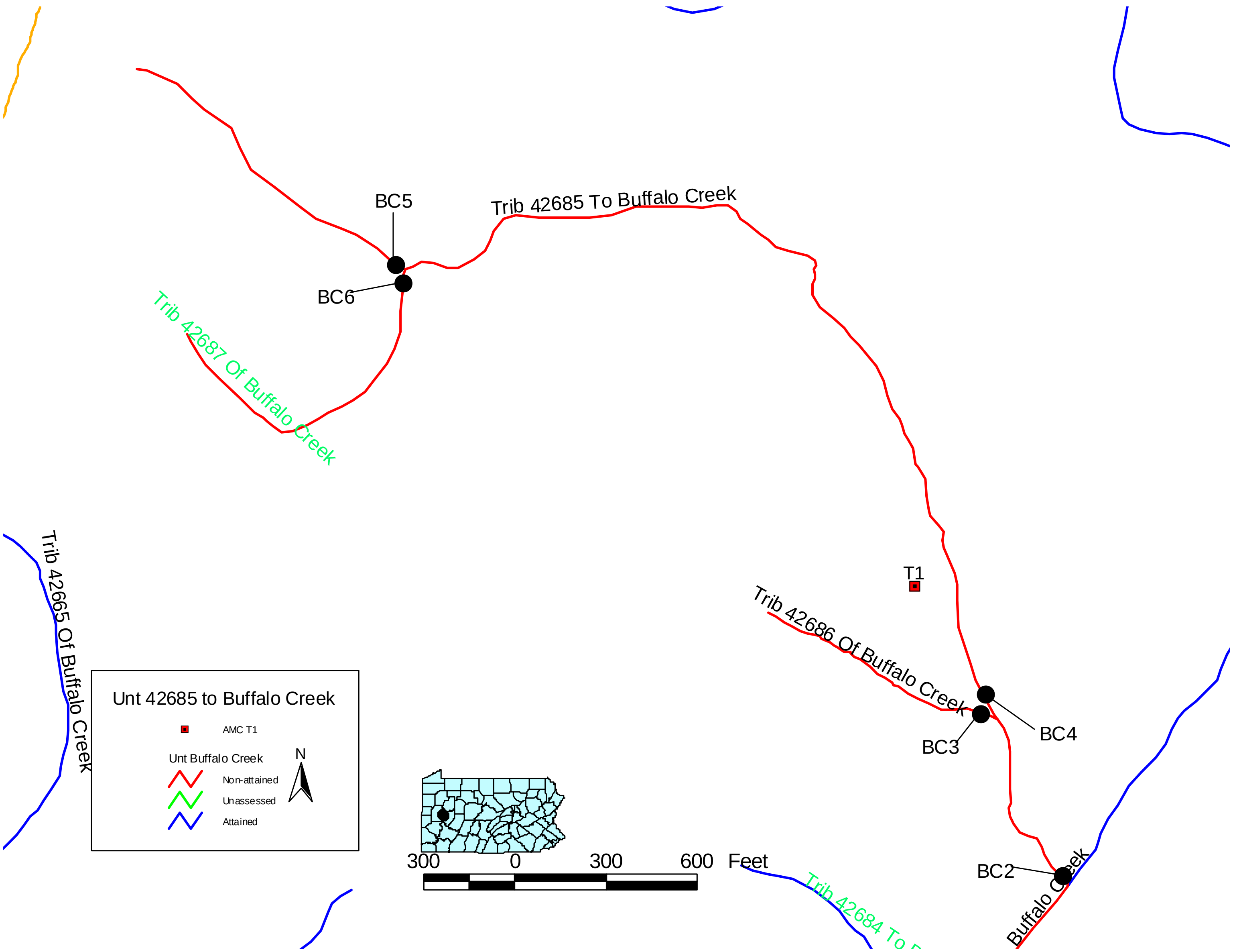
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on January 20, 2007 and the Leader Times, Kittanning, PA on January 17, 2007 to foster public comment on the allowable loads calculated. A public meeting was held on January 31, 2007 beginning at 1:00 p.m., at the Greensburg District Mining Office, Armbrust Building, 8205 Route 819, Greensburg, PA, to discuss the proposed TMDL.


BC5
BC6
BC4
BC3
BC2

Attachment A

Unt (42685) of Buffalo Creek Watershed Maps


Unt 42685 to Buffalo Creek
AMC T1
Unt Buffalo Creek
Non-attained
Unassessed
Attained
N
300
0
300
600 Feet
Trib 42685 To Buffalo Creek
Trib 42687 Of Buffalo Creek
Trib 42686 Of Buffalo Creek
BC2
BC3
BC4
BC5
BC6
T1
Quarry
W E S T F R A N


Trib 42685 To Buffalo Creek
BC5
BC6
Trib 42687 Of Buffalo Creek
T1
Trib 42686 Of Buffalo Creek
BC4
BC3
BC2
Buffalo Creek
Trib 42665 Of Buffalo Creek
Trib 42684 To
Unt 42685 to Buffalo Creek
AMC T1
Unt Buffalo Creek
Non-attained
Unassessed
Attained
N
300
0
300
600
Feet

Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing 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 USEPA'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 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. 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.

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.*

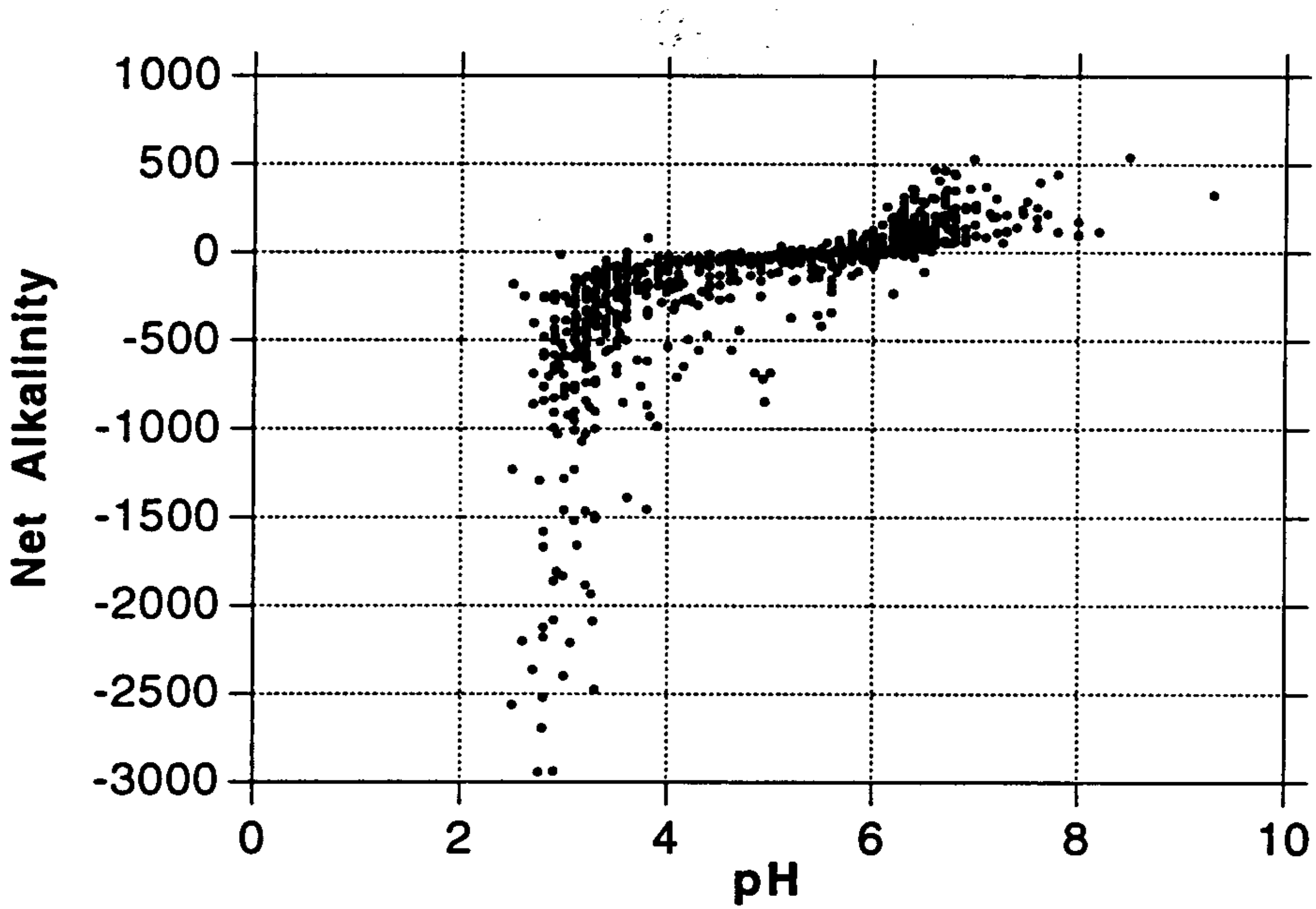


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

Unnamed (42685) Tributary to Buffalo Creek

The TMDL for Unt (42685) of Buffalo Creek consists of load allocations for five sampling sites along Unt (42685) of Buffalo Creek and two unnamed tributaries

Unt (42685) of Buffalo Creek is listed for metals from AMD as being the cause of the degradation to the stream. The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at the points below 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.

BC6 Mouth of Unt (42687) Upstream of Confluence with Unt (42685) of Buffalo Creek

The TMDL for this sample point on the Unt (42685) of Buffalo Creek consists of a load allocation to the segment upstream. The load allocation for this segment was computed using water-quality sample data collected at point BC6. The average flow, measured at the sampling point BC6 (0.15 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point LUB05 shows pH ranging between 6.7 and 7.6, pH will not be addressed in this TMDL because this segment is net alkaline.

Table C1. Load Allocations for Point BC6

	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. mg/l	Load Lbs/day
Aluminum	0.21	0.3	0.11	0.1
Iron	0.52	0.7	0.20	0.3
Manganese	0.07	0.1	0.07	0.1
Acid	0.00	0.0	0.00	0.0
Alkalinity	33.75	42.9		

Table C2. Calculation of Load Reduction Necessary at Point BC6				
	Al	Fe	Mn	Acidity
	(lbs/day)	(lbs/day)	(lbs/day)	(lbs/day)
Existing Load	0.3	0.7	0.1	0.0
Allowable Load=TMDL	0.1	0.3	0.1	0.0
Load Reduction	0.2	0.5	0.0	0.0
Total % Reduction	46	62	0	0

BC5 Most Upstream Sample Point on Unt (42685) of Buffalo Creek

The TMDL for this segment of Unt (42685) of Buffalo Creek consists of a load allocation to all of the watershed area upstream of sample point BC5. The load allocation for this segment was computed using water-quality sample data collected at point BC5. The average flow, measured at the sampling point BC5 (0.28 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point BC5 shows pH ranging between 7.2 and 8.0, pH will not be addressed in this TMDL because the segment is net alkaline.

Table C3. Load Allocations at Point BC5				
	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.16	0.4	0.16	0.4
Iron	0.29	0.7	0.25	0.6
Manganese	2.44	5.7	0.24	0.6
Acid	0.00	0.0	0.00	0.0
Alkalinity	97.35	225.9		

Table C4. Calculation of Load Reduction Necessary at Point BC5				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	0.4	0.7	5.7	0.0
Allowable Load=TMDL	0.4	0.6	0.6	0.0
Load Reduction	0.0	0.1	5.1	0.0
Total % Reduction	0	12	90	0

Waste Load Allocations– Permitted Discharges

The Allegheny Mineral Corporation SMP 03840105, Graff Mine has one permitted treatment pond, T1, that discharges to Unt 42685 to Buffalo Creek. The waste load allocation for the discharge is calculated with average monthly permit limits and average flow, which is estimated with permitted pit areas and average rainfall. There is one permitted pits in the permit with a total combined pit area of 250,000 square feet. Included in the permit are limits for aluminum, iron and manganese. The WLA for T1 is evaluated at point CBR1.

Table C5. Waste Load Allocations for Permitted Discharges

Parameter	Allowable Average Monthly Conc. (mg/l)	Calculated Average Flow (MGD)	WLA (lbs/day)
Allegheny Mineral Corp., Graff Mine, SMP03840105			
T1			
Al	0.5	0.025	0.103
Fe	3	0.025	0.620
Mn	1	0.025	0.207

BC4 Unt (42685) of Buffalo Creek Upstream of Confluence with Unt (42686) of Buffalo Creek

The TMDL for sampling point BC4 consists of a load allocation to the area between sample points BC06, BC05 and BC04. The load allocation for this tributary was computed using water-quality sample data collected at point BC4. The average flow, measured at the sampling point BC4 (0.91 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point BC4 shows pH ranging between 7.4 and 7.8, pH will not be addressed in this TMDL because this segment is net alkaline.

Table C6. Load Allocations at Point BC4

	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	1.22	9.3	0.09	0.7
Iron	0.93	7.1	0.19	1.4
Manganese	1.08	8.2	0.24	1.8
Acid	0.00	0.0	0.00	0.0
Alkalinity	95.83	728.1		

The calculated load reductions for all the loads that enter point BC4 must be accounted for in the calculated reductions at sample point BC4 shown in Table C6. A comparison of measured loads between points BC6, BC5, and BC4 shows that there is an increase in aluminum, iron and manganese loading within the segment. The total segment load for aluminum, iron and manganese is the sum on the upstream allocated loads and any additional loading within the segment.

Table C7. Calculation of Load Reduction at Point BC4				
	Al	Fe	Mn	Acidity
Existing Load	9.3	7.1	8.2	0.0
Difference in Existing Load between BC6, BC5 & BC4	8.7	5.8	2.5	0.0
Load tracked from BC6 & BC5	0.5	0.8	0.7	0.0
Percent loss due to instream process	-	-	-	-
Percent load tracked from BC6 & BC5	-	-	-	-
Total Load tracked from BC6 & BC5	9.2	6.6	3.1	0.0
Allowable Load at BC4	0.7	1.4	1.8	0.0
Load Reduction at BC4	8.5	5.2	1.3	0.0
% Reduction required at BC4	93	79	42	0

BC3 Mouth of Unt (42686) of Buffalo Creek Upstream with Confluence with Unt (42685) of Buffalo Creek

The TMDL for this segment of Unt (42685) of Buffalo Creek consists of a load allocation to all of the watershed area upstream of sample point BC3. The load allocation for this segment was computed using water-quality sample data collected at point BC3. The average flow, measured at the sampling point BC3 (0.53 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point BC3 shows pH ranging between 7.7 and 8.3, pH will not be addressed in this TMDL because this segment is net alkaline.

Table C8. Load Allocations for Point BC3				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.38	1.7	0.34	1.5
Iron	0.48	2.1	0.48	2.1
Manganese	0.40	1.8	0.34	1.5
Acid	0.00	0.0	0.00	0.0
Alkalinity	59.78	263.0		

Table C9. Calculation of Load Reduction Necessary at Point BC3				
	Al	Fe	Mn	Acidity
	(#/day)	(#/day)	(#/day)	(#/day)
Existing Load	1.7	2.1	1.8	0.0
Allowable Load=TMDL	1.5	2.1	1.5	0.0
Load Reduction	0.2	0.0	0.3	0.0
Total % Reduction	10	0	17	0

BC2 Mouth of Unt (42685) of Buffalo Creek Upstream of Confluence with Buffalo Creek

The TMDL for this Unt (42685) of Buffalo Creek consists of a load allocation to all of the watershed area between sample points BC4, BC3 and BC2. The load allocation for this segment was computed using water-quality sample data collected at point BC2. The average flow, measured at the sampling point BC2 (1.61 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point BC2 shows pH ranging between 6.9 and 7.9, pH will not be addressed in this TMDL because this segment is net alkaline.

Table C10. Load Allocations at Point BC2				
	Measured Sample Data		**Allowable**	
Parameter	Conc. (mg/l)	Load (lbs/day)	Conc. (mg/l)	Load (lbs/day)
Aluminum	0.42	5.7	0.11	1.5
Iron	0.61	8.2	0.23	3.1
Manganese	0.92	12.4	0.19	2.6
Acid	0.00	0.0	0.00	0.0
Alkalinity	82.96	1116.5		

The calculated load reductions for all the loads that enter point BC2 must be accounted for in the calculated reductions at sample point BC2 shown in Table C10. A comparison of measured loads between points BC4, BC3, and BC2 shows that there is an increase in aluminum, iron and manganese loading within the segment. The total segment load for aluminum, iron and manganese is the sum on the upstream allocated loads and any additional loading within the segment.

Table C11. Calculation of Load Reduction at Point BC2				
	Al	Fe	Mn	Acidity
Existing Load	5.7	8.2	12.4	0.0
Difference in Existing Load between BC4, BC3 & BC2	-5.3	-1.0	2.3	0.0
Load tracked from BC4 & BC3	2.2	3.5	3.3	0.0
Percent loss due to instream process	48	10	-	-
Percent load tracked from BC4 & BC3	52	90	-	-
Total Load tracked from BC4 & BC3	1.1	3.15	5.6	0.0
Allowable Load at BC3	1.5	3.13	2.6	0.0
Load Reduction at BC2	0.0	0.02	3.0	0.0
% Reduction required at BC2	0	1	54	0

Margin of Safety (MOS)

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 added when 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 represent 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, 2002, and 2004 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP 303(d) narratives that justify changes in listings between the 1996, 1998, 2002, and 2004 list. 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).

The most notable difference between the 1998 and Draft 2000 303(d) lists are the listing of unnamed tributaries in 2000. In 1998, the GIS stream layer was coded to the named stream level so there was no way to identify the unnamed tributary records. As a result, the unnamed tributaries were listed as part of the first downstream named stream. The GIS stream coverage used to generate the 2000 list had the unnamed tributaries coded with the DEP’s five-digit stream code. As a result, the unnamed tributary records are now split out as separate records on the 2000 303(d) list. This is the reason for the change in the appearance of the list and the noticeable increase in the number of pages. After due consideration of comments from EPA and PADEP on the Draft 2000 Section 303(d) list, the Draft 2002 Pa Section 303(d) list was written in a manner similar to the 1998 Section 303(d) list.

Attachment E

Water Quality Data Used In TMDL Calculations

Site	Site Name	Bottle ID	Date-time	Flow (gpm)	pH	Acidity (mg/L)	Alkalinity (mg/L)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)
6	Buffalo Creek	44A	12/13/2005	-	6.87	-9.01	33.74	0.02	0.0	0
6	Buffalo Creek	8B	2/24/2006	73.3	6.77	-18.74	19.49	0.24	0.11	0.0
6	Buffalo Creek	-	4/7/2006	139						
6	Buffalo Creek	25D	6/2/2006	183	6.79	-33.59	38.93	0.72	2.1	0.25
6	Buffalo Creek	24E	8/1/2006	95	7.57	-36.64	43.51	0.0	0.24	0.04
6	Buffalo Creek	7F	9/22/2006	39	7.46	-29.23	33.08	0.06	0.14	0.04
BC6			avg=	105.86	7.09	-25.44	33.75	0.26	0.65	0.08
			stdev=			11.41		0.32	0.97	0.11

Site	Site Name	Bottle ID	Date-time	Flow (gpm)	pH	Acidity (mg/L)	Alkalinity (mg/L)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)
5	Buffalo Creek	27A	12/13/2005	-	7.77	-110.61	125.38	0.20	0.0	5.4
5	Buffalo Creek	17B	2/24/2006	-	7.5	-85.82	88.91	0.23	0	3.7
5	Buffalo Creek	20C	4/7/2006	243	7.77	-75.00	78.79	0.13	0.39	1.8
5	Buffalo Creek	4D	6/2/2006	354	7.20	-86.36	90.91	0.33	0.97	2.70
5	Buffalo Creek	18E	8/1/2006	97	7.77	-87.35	91.67	0.0	0.15	0.87
5	Buffalo Creek	38F	9/22/2006	79	7.98	-102.31	108.46	0.06	0.16	0.17
BC5			avg=	193.25	7.67	-91.24	97.35	0.19	0.34	2.44
			stdev=			12.88		0.10	0.37	1.92

Site	Site Name	Bottle ID	Date-time	Flow (gpm)	pH	Acidity (mg/L)	Alkalinity (mg/L)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)
			9/14/1995		7.1	0	64	0.55	1.02	0.864
			11/15/1995							
			2/7/1996		6.8	0	56	1.35	0	1.57
			4/3/1996		7.4	0	88	0	0	0.572
			10/15/1996		7.8	0	286	0	0	0.993
			1/6/1997		6.8	0	54	0.975	0.752	1.06
			4/3/1997		7	0	70	1.53	1.6	1.18
			5/15/1997		7.2	0	90	0	0.549	0.6
			7/2/1997		7.6	0	176	1.14	1.51	0.166
			6/25/1998		7.1	0	64	0.719	0	0.632
			4/7/1999		7	0	80	10.5	7.23	4.19
			11/30/1999		7.3	0	71.8	0.813	0	0.686
			5/21/2003							
4	Buffalo Creek	41B	2/25/2006	443	7.68	-64.18	69.40	0.62	0.38	0.71
4	Buffalo Creek	14C	4/7/2006	1082	7.78	-69.23	73.85	0.59	0.77	0.40
4	Buffalo Creek	49D	6/6/2003	840	7.41	-70.92	78.31	0.53	0.54	0.90
4	Buffalo Creek	36E	8/1/2006	360	7.81	-77.85	83.08	0.2	0.44	1.0
4	Buffalo Creek	16F	9/22/2006	438	7.77	-122.19	128.91	0.07	0.16	1.8
BC4			avg=	632.60	7.35	-25.27	95.83	1.22	0.93	1.08
			stdev=			40.59		2.52	1.76	0.92

Site	Site Name	Bottle ID	Date-time	Flow (gpm)	pH	Acidity (mg/L)	Alkalinity (mg/L)	Al	Fe	Mn
3	Buffalo Creek	19B	2/25/2006	583	8.26	-44.01	50.08	0.60	0.39	0.51
3	Buffalo Creek	31C	4/7/2006	362	8.07	-55.64	54.14	0.45	0.61	0.0
3	Buffalo Creek	5D	6/6/2006	242	7.70	-64.09	71.21	0.3	0.31	0.53
3	Buffalo Creek	29E	8/1/2006	168	7.80	-61.71	66.20	0.23	0.56	0.42
3	Buffalo Creek	27F	9/22/2006	477	7.91	-53.79	57.27	0.32	0.51	0.56
BC3			avg=	366.40	7.95	-55.85	59.78	0.38	0.48	0.51
			stdev=			7.85		0.15	0.12	0.06

Site	Site Name	Bottle ID	Date-time	Flow (gpm)	pH	Acidity (mg/L)	Alkalinity (mg/L)	Al	Fe	Mn
			9/14/1995		7.1	0	64	0.551	1.04	0.874
			2/7/1996		7.7	0	86	0	<.3	0.583
			10/15/1996		6.4	0	88	0	2.72	1.33
			1/6/1997		6.9	0	54	0.995	0.523	1.08
			4/3/1997		6.9	0	70	0.629	0.436	0.881
			5/15/1997		7.1	0	90	0.603	0.934	0.644
			7/2/1997		6.9	0	60	0	0	0.577
			11/24/1997		6.8	0	54	0.601	0.4	0.714
			2/25/1998		6.9	0	84	0	0	0.398
			12/22/1998		7.1	0	48	1.14	0.64	0.727
			1/27/1999		7.3	0	118	0	0	0.09
			9/23/1999		7	0	60	1.77	2.66	0.647
			2/23/2000		7.6	0	122	0	0	0.674
			9/13/2000		7.3	0	88	0	0	0.35
			12/8/2000		7.4	0	58	0.508	0.385	0.592
			2/21/2001		7.6	0	96	0	0	0.395
			5/24/2001		7.2	0	84	0	0	0.265
			12/10/2001		7	0	56	0	0.39	0.474
			3/21/2002		6.8	0	72	1.94	2.2	0.597
			5/28/2002		7.9	0	118	0	0	0.081
			7/25/2002		7.6	0	80	0	0	0.298
			12/12/2002		7.7	0	124.4	0	0.381	4.27
			1/30/2003		7.6	0	74.4	2.31	3.41	0.76
			11/19/2003		7.4	13.4	40.4	0.944	1.11	0.721
			4/14/2004		7.9	-110	152.6	0	0	4.87
			8/17/2004		7.8	-46.4	81	0.923	0.902	1.85
			12/15/2004		7.6	-36.4	69.8	0.938	0.569	1.45
			1/25/2005		8	-51	86.8	0	0	0.264
			5/26/2005		7.7	-70.6	93.6	0.699	0.899	0.319
			8/31/2005		7.8	-45.6	89	0	0	0.306
			11/21/2005		7.8	-38.2	69.2	0	0	0.647
			1/17/2006		7.5	-69.4	83.2	0	0.391	0.446
			5/16/2006		7.9	-102	122.6	0	0	1.615
			8/9/2006		7.9	-68.4	83.6	0	0.63	1.07
2	Buffalo Creek	43A	12/13/2005	716	6.90	-70.55	94.57	0.37	0.20	0.6
2	Buffalo Creek	18B	2/24/2006	725	7.58	-54.92	63.08	0.22	0.14	0.12
2	Buffalo Creek	15C	4/7/2006	1896	7.81	-69.39	73.94	0.79	1.1	0.39
2	Buffalo Creek	47D	6/2/2006	1222	7.48	-74.77	76.92	0.55	0.99	0.66
2	Buffalo Creek	1E	8/1/2006	1384	7.60	-85.93	94.81	0.28	0.55	2.9
2	Buffalo Creek	45F	9/22/2006	778	7.88	-90.08	94.66	0.14	0.26	1.2
BC2			avg=	1120.17	7.41	-26.76	82.96	0.42	0.61	0.92
			stdev=			36.53		0.59	0.83	1.00

Attachment F
Comment and Response

Comment: Darrel Lewis, of C.H. Snyder Associates (State Industries, Allegheny Minerals) submitted additional sampling data he requested to be added to the tmdl report.

Response: The submitted data was included at sample points BC4 BC2 and appear in the report.