FINAL

TEARING RUN WATERSHED TMDL

Indiana County

For Acid Mine Drainage Affected Segments

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Pennsylvania Department of Environmental Protection

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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Tearing Run Watershed (Attachments A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers one segment on this list. 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.

Table 1. 303(d) Sub-List
State Water Plan (SWP) Subbasin: 18-D Two Lick Creek

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	2.0	5067	44112	Tearing Run	CWF	305(b) Report	RE	Metals
1998	2.19	5067	44112	Tearing Run	CWF	SWMP	AMD	Metals
2002	2.2	5067	44112	Tearing Run	CWF	SWMP	AMD	Metals
2004	2.2	5067	44112	Tearing Run	CWF	**2004 Integrated List**	AMD	Metals

Resource Extraction=RE
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.

Directions to the Tearing Run Watershed

The Tearing Run Watershed is located in Western Pennsylvania, occupying a south central portion of Indiana County in Center Township. The watershed area is found on United States Geological Survey Brush Valley and Indiana 7.5-Minute Quadrangles. The area within the watershed consists of 4.5 square miles. Land uses within the watershed include abandoned mine lands, forestlands, and rural residential properties with small communities scattered throughout the area.

Tearing Run flows from the east into Two Lick Creek on the south side of the Borough of Homer City along U.S. Route 119. Homer City is located approximately 5 miles south of the Borough of Indiana and 27 miles north of the Borough of Greensburg, both of which are located on US Rt. 119. PA Rt. 56 is a northern boundary for the Tearing Run basin between Homer City and the village of Waterman. SR 2018, passing through the village of Luciusboro, defines the southern boundary of the drainage basin.

Hydrology and Geology

The streams in the watershed develop in higher elevations in the east and flow westerly to discharge into Two Lick Creek, which is a tributary of Blacklick Creek. The final stem of Tearing Run is oriented in an east to west direction (approximately ¾ mile) from the village of Tearing Run to its confluence with Two Lick Creek. At Tearing Run village, a fork in the stream occurs. The southern fork extends two miles almost due south to its headwaters. The northern fork continues 3000 feet to the east and splits again at the village of Coy. The southern split at Coy extends 8000 feet to its headwaters at the village of Luciusboro. The northern split at Coy flows from Waterman, approximately one mile away. The headwaters of all three branches flow from elevations between 1600 feet MSL and 1700 feet MSL to elevation 1000 MSL at the mouth.

The Tearing Run Watershed lies within the Appalachian Plateau Physiographic Province. The watershed area is comprised of Pennsylvanian aged rocks. The majority of the watershed is located regionally on the northwest limb of the Chestnut Ridge Anticline with the watershed headwaters lying across the axial plane of the anticline. The streamflow is westerly to the mouth of Tearing Run, which lies approximately ½ mile east of the axis of the Latrobe Syncline.

Pennsylvanian aged rocks of the Allegheny and Conemaugh Groups are exposed in the valleys of the watershed and on the hilltops. The members exposed are the Lower Kittanning through the Upper Freeport with the rocks of the Conemaugh Formation overlying the Upper Freeport outcrop area on the hilltops. The coals that are exposed are: the Lower Kittanning, Middle Kittanning, Upper Kittanning, Lower Freeport and Upper Freeport. Both Lower Kittanning and Upper Freeport seams dip to elevations below drainage level in westernmost areas of the drainage basin.

Segments addressed in this TMDL

There are five mining operations, four active and one proposed, in the Tearing Run Watershed. Mining is complete on the Keystone Coal Mining Corporation, Waterman No. 1 Mine, SMP 32813031 (NPDES PA0125547), but the site has two post-mining discharges requiring treatment. Britt Energies, Inc. has three recently activated mining operations in the watershed. These mines are the Flickinger Mine, SMP 32030103 (NPDES PA0249416), the Marbach Mine, SMP 32020106 (NPDES PA0249271), and the Kinkead Sandstone Quarry, Noncoal SMP 32030301 (NPDES PA0249408). Rosebud Mining Co. is awaiting approval for the Brush Valley Deep Mine, SMP 32041301. The permitted discharges from each of the operations are assigned waste load allocations. All of the remaining discharges in the watershed are from abandoned mines and will be treated as non-point sources. Each segment on the Section 303(d) list is addressed as a separate TMDL. These TMDLs are expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

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

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

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

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

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

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

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

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

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

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

Section 303(d) Listing Process

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

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[1] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

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

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

Basic Steps for Determining a TMDL

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

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculating the TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;

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

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

Watershed History

The date of the earliest mining in the area is not known, however, certainly it preceded the turn of the century: 1800's into the 1900's. Mining villages sprung up around the mining within the watershed. Early mining involved digging shafts into the coal and mining it. Deep mining later gave way to strip mining of the coal. The deep mining and strip mining of the past have left deep mine entries, refuse piles, subsidence and pooling areas, altered landscapes which were not reclaimed, and the exposure of acid bearing overburden to air and water. These sources have led to the pollution and degradation of the watershed.

All of the deep mining that has taken place in the basin is above drainage level. The mines enter the coal seams at lower elevations near drainage level and rise to the east, as do the streams. Most of the abandoned deep mines are either on the Lower Kittanning seam or the Upper Freeport seam, and most extensive deep mines have been developed by R & P Coal Company between 1900 and 1970. These have all been abandoned since 1970.

R & P Coal Company's Snyder No. 1 and Snyder No. 2 mines on the Lower Kittanning seam contribute major discharges of poor quality water in areas adjacent to the village of Coy, where the north fork of Tearing Run splits into a southern and northern split. The Snyder #3 deep mine by R & P Coal Company, discharges into the northern split of the north fork approximately midway between Coy and Waterman villages. At Waterman village, Lower Kittanning deep mines discharge poor quality as well.

Recent mining includes the following:

Active surface mining exists at Britt Energies Inc. SMP 32020106, Marbach Strip and Britt Energies Inc. SMP 32030103, Flickinger Strip. Both operations are on the Upper Freeport seam. Britt Energies Inc. recently received SMP 32030301, Large Industrial Mineral operation, which is a sandstone quarry, and SMP 32040102, Bracken Mine on the Upper Freeport coal seam. The Bracken Mine permit includes area in the Tearing Run Watershed but has no discharges in the watershed.

Rosebud Mining, Inc., has a pending application (SMP 32041301) for a deep mine on the Lower Kittanning seam. The mine plan is a slope to the north with workings outside the Tearing Run basin; however, the treated water will discharge to Tearing Run.

Kent Mining, now Keystone Coal Mining Corp., mined under SMP 32823004, Waterman Strip 2 on the Upper Freeport seam and SMP 32813031, Waterman No. 1 Mine on the Lower Kittanning seam. These operations are now complete; however, there are two post-mining discharges on the Waterman No. 1 Mine that require treatment.

Mining took place on the Upper Freeport seam by Marquise Mining, SMP 32950103, Luciusboro Mine and SMP 32813061, No 2 Strip. Amerikohl Mining, under SMP 32980105, Tearing Run Mine, mined Upper Freeport coal. M.B. Energy, Inc., mined the Lower Kittanning seam on SMP 32930106, Brush Valley 3 Mine. Mining and reclamation is now complete on all sites.

Older surface mining was by Hawk Contracting Co., under MDP #3971SM4. Mining at this site is complete and the permit is no longer active.

AMD Methodology

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

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

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[2] 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:

$$PR = \text{maximum } \{0, (1 - Cc/Cd)\} \text{ where} \qquad (1)$$

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

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

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

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

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

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

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

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

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

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

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

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

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

Method to Quantify Treatment Pond Pollutant Load

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.

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

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

Discharge from treatment ponds on a mine site is intermittent and often varies as a result of precipitation events. Measured flow rates are almost never available. If accurate flow data are available, it is used along with the Best Available Technology (BAT) limits to quantify the WLA for one or more of the following: aluminum, iron, and manganese. The following formula is used:

$$\text{Flow (MGD) X BAT limit (mg/l) X 8.34 = lbs/day}$$

The following is an approach that can be used to determine a waste load allocation for an active mining operation when treatment pond flow rates are not available. The methodology involves quantifying the hydrology of the portion of a surface mine site that contributes flow to the pit and then calculating waste load allocation using NPDES treatment pond effluent limits.

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 41.4 inches of precipitation per year (Mid-Atlantic River Forecast Center, National Weather Service, State College, PA, 1961-1990, http://www.dep.state.pa.us/dep/subject/hotopics/drought/PrecipNorm.htm). A maximum pit dimension without special permit approval is 1500 feet long by 300 feet wide. Assuming that 5 percent of the precipitation evaporates and the remaining 95 percent flows to the low spot in the active pit to be pumped to the treatment ponds, results in the following equation and average flow rates for the pit area.

41.4 in. precip./yr x 0.95 x 1 ft./12/in. x 1500'x300'/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. =

= 21.0 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. In the case of roughly backfilled and 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 (Jay Hawkins, Office of Surface Mining, Department of the Interior, Personal Communications 2003). Regrading and revegetation of the mine spoil is conducted as the mining progresses. DEP encourages concurrent backfilling and revegetation through its compliance efforts and it is in the interest of the mining operator to minimize the company's reclamation bond liability by keeping the site reclaimed and revegetated. Experience has shown that reclamation and revegetation is accomplished two to three pit widths behind the active mining pit area. DEP uses three pit widths as an area representing potential flow to the pit when reviewing the NPDES permit application and calculating effluent limits based on best available treatment technology and insuring that in-stream limits are met. The same approach is used in the following equation, which represents the average flow reporting to the pit from the unregraded and unrevegetated spoil area.

41.4 in. precip./yr x 3 pit areas x 1 ft./12/in. x 1500'x300'/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. x 15 in. runoff/100 in. precipitation =

= 9.9 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 = 21.0 gal./min + 9.9 gal./min. = 30.9 gal./min.

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

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

Allowable Aluminum 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.)

There is little or no documentation available to quantify the actual amount of water that is typically pumped from active pits to treatment ponds. Experience and observations suggest that the above approach is very conservative and overestimates the quantity of water, creating a large margin of safety in the methodology. County specific precipitation rates can be used in place of the long-term state average rate, although the margin of safety is greater than differences from individual counties. 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 environment. As a step to insure that a mine site does not produce acid mine drainage, it is common to require the addition of alkaline materials (waste lime, baghouse lime, limestone, etc.) to the backfill spoil materials to neutralize any acid-forming materials that may be present. This practice of 'alkaline addition' or the incorporation of naturally occurring alkaline spoil materials (limestone, alkaline shale or other rocks) may produce alkaline pit water with very low metals concentrations that does not require treatment. A comprehensive study in 1999 evaluated mining permits issued since 1987 and found that only 2.2 percent resulted in a post-mining pollution discharge (Evaluation of Mining Permits Resulting in Acid Mine Drainage 1987-1996: A Post Mortem Study, March 1999). As a result of efforts to insure that acid mine drainage is prevented, most mining operations have alkaline pit water that often meets effluent limits and requires little or no treatment.

While most mining operations are permitted and allowed 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 than the standard size or multiple pits are present, the calculations to define the potential pollution load can be adjusted accordingly. Hence, the above calculated Waste Load Allocation is very generous and likely high compared to actual conditions that are generally encountered. A large margin of safety is included in the WLA calculations.

This 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. This allows for including active mining activities and their associated Waste Load in the TMDL calculations to more accurately represent the watershed pollution sources and the reductions necessary to achieve in-stream limits. When a mining operation is concluded its WLA is available for a different operation. Where there are indications that future mining in a watershed are greater than the current level of mining activity, an additional WLA amount may be included to allow for future mining.

TMDL Endpoints

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

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

Table 2. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30 day average; Total Recoverable
Manganese (Mn)	1.00	Total Recoverable
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.

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

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

Allocation Summary

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

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

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

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

In the instance that the allowable load is equal to the existing load (e.g. iron point T-5, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. In addition, when all measured values are below the method detection limit, denoted by ND (e.g. iron point 702, Table 3), no

TMDL is necessary. In this case the accounting for upstream loads is not carried through to the next downstream point. Rather, there is a disconnect noted and the allowable load is considered to start over because the water quality standard is satisfied.

Table 3. TMDL Component Summary for the Tearing Run Watershed

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
22	*Mouth of Unnamed Tributary 44115*						
	Al	1.38	1.30	0.50	0.80	0.47	34
	Fe	1.18	1.05	0.80	0.25	0.71	60
	Mn	1.35	1.14	0.55	0.59	0.61	45
	Acidity	59.4	2.4	0.00	2.38	57.0	96
19	*Headwaters of Tearing Run*						
	A	0.7	0.7	0.2	0.5	0.0	0
	Fe	3.3	0.6	0.4	0.2	2.7	81
	Mn	0.7	0.4	0.2	0.2	0.3	46
	Acidity	0.0	0.0	0.0	0.0	0.0	0
21	*Tearing Run upstream of Unnamed Tributary 44115*						
	Al	1.6	0.9	0.0	0.9	0.6	41
	Fe	4.1	1.5	0.0	1.5	0.0	0
	Mn	3.0	0.6	0.0	0.6	2.1	78
	Acidity	90.1	6.3	0.0	6.3	83.8	93
T-5	*Tearing Run*						
	Al	2.8	2.4	0.0	2.4	0.0	0
	Fe	2.4	2.4	NA	NA	0.0	0
	Mn	2.0	1.8	0.0	1.8	0.0	0
	Acidity	96.5	10.6	0.0	10.6	0.0	0
4	*Tearing Run upstream of Unnamed Tributary 44114*						
	Al	159.02	0.8	0.3	0.5	157.4	99
	Fe	11.2	1.5	0.4	1.1	208.4	99
	Mn	10.5	1.7	0.3	1.4	7.6	82
	Acidity	1,225.2	0.0	0.0	0.0	1,134.3	100
702	*Headwaters of Unnamed Tributary 44114*						
	Al	1.2	1.2	NA	NA	0.0	0
	Fe	ND	NA	NA	NA	0.0	0
	Mn	2.3	1.2	0.0	1.2	1.1	49
	Acidity	5.6	2.5	0.0	2.5	3.1	55
56	*Unnamed Tributary 44114*						
	Al	8.6	1.6	0.0	1.6	7.0	81
	Fe	8.4	0.4	0.0	0.4	8.0	95
	Mn	0.8	0.5	0.0	0.5	0.0	0
	Acidity	25.4	4.1	0.0	4.1	18.2	82
3	*Mouth of Unnamed Tributary 44114*						
	Al	12.9	2.0	0.4	1.6	3.9	66
	Fe	23.0	3.2	0.7	2.5	11.8	79

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
	Mn	4.6	3.8	0.4	3.4	0.4	11
	Acidity	197.2	15.8	0.0	15.8	160.2	91
T-4	*Tearing Run upstream of Unnamed Tributary 44113*						
	Al	70.4	3.5	0.0	3.5	0.0	0
	Fe	26.1	7.8	0.0	7.8	0.0	0
	Mn	14.5	3.6	0.0	3.6	1.6	31
	Acidity	1,019.1	9.2	0.0	9.2	2.1	19
SW-43	*Headwaters of Unnamed Tributary 44113*						
	Al	4.0	0.3	0.0	0.3	3.7	92
	Fe	0.8	0.4	0.0	0.4	0.4	54
	Mn	2.7	0.3	0.0	0.3	2.4	88
	Acidity	49.4	0.0	0.0	0.0	49.4	100
T-3	*Mouth of Unnamed Tributary 44113*						
	Al	38.7	1.9	0.0	1.9	33.1	94
	Fe	7.2	3.2	0.0	3.2	3.6	53
	Mn	14.7	2.9	0.0	2.9	9.4	76
	Acidity	545.1	1.1	0.0	1.1	494.6	100
T-1	*Mouth of Tearing Run*						
	Al	174.3	12.2	0.0	12.2	56.1	82
	Fe	138.5	12.5	0.0	12.5	96.5	89
	Mn	46.3	19.4	0.0	19.4	4.3	18
	Acidity	2,110.0	63.3	0.0	63.3	492.7	89

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

Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. Attachment A contains a map of the sampling point locations for reference.

Waste load allocations are assigned to the permitted discharges for the following; Britt Energies Inc. Flickinger Mine SMP 32030103, Marbach Mine SMP 3202016, and Kinkead Quarry Noncoal SMP 32030301; Keystone Coal Mining Corporation Waterman No. 1 Mine SMP 32813031; and the Rosebud Mining Co. Brush Valley Deep Mine SMP 32041301.

For all three of the Britt Energy Inc. sites, the WLAs are calculated using the method as described in *The Method to Quantify Treatment Pond Pollutant Load* section of the report.

On the Flickinger Mine there are two permitted treatment pond discharges, TP1 and TP2. The permitted dimensions for the two Flickinger Mine pits are 120’ x 150’ and 120’ x 250’, for a total pit area of 48,000 square feet. Included in the permit are limits for iron and manganese. Although aluminum is not included in the permit, a waste load allocation is calculated to allow for the discharge of aluminum. The standard BAT limit of 2.0 mg/L is used for the calculations. The WLA for TP1 is being evaluated at sample point 4 and for TP2 at sample point 19.

The Marbach Mine permit contains four treatment discharges, three of which discharge to the Tearing Run Watershed, 010, 011 and 012. The permitted dimensions for the four pits are 85' x 300', 95' x 300', 300' x 95' and 200' x 90' for a total pit area of 100,500 square feet. Included in the permit are limits for iron, manganese and aluminum. The WLAs for 011 and 012 are being evaluated at sample point 22 and the WLA for 010 is evaluated at sample point 19.

The Kinkead Quarry permit contains two treatment discharges, 004 and 005. The permitted pit dimension is 500' x 100' for a pit area of 50,000 square feet. Included in the permit is an iron limit only. Although manganese and aluminum are not included in the permit, waste load allocations are calculated to allow for the discharge of manganese and aluminum. The standard BAT limit of 2.0 mg/L for each is used for the calculations. The WLAs for 004 and 005 are being evaluated at sample point 4.

The proposed Rosebud Mining Co. Brush Valley Deep Mine has two permitted surface runoff treatment ponds that will discharge to Tearing Run, 001 and 002. It is expected that the amount of runoff to be treated would be similar to that of an unregraded area of a typical surface mine. The flow for the Brush Valley discharges is determined using the unregraded portion of flow calculated with the method described previously using surface area drained. The surface area drained to 001 is 27.2 acres and to 002 is 25.0 acres. Permit limits have not yet been determined for the discharges; therefore, the WLAs are calculated using standard BAT limits for iron, manganese and aluminum. The WLAs for 001 and 002 are being evaluated at sample point 22.

Mining on the Keystone Coal Mining Corporation Waterman No. 1 Mine is complete; however, there are two post-mining discharges, G and 23 that require treatment. The WLAs are calculated using average measured flows and permit limits. Included in the permit are limits for iron and manganese. Although aluminum is not included in the permit, waste load allocations are calculated to allow for the discharge of aluminum. The standard BAT limit of 2.0 mg/L is used for the calculations. The WLAs for 23 and G are being evaluated at sample point 3.

No required reductions of permit limits are required at this time. All necessary reductions are assigned to non-point sources. Table 4 below contains the WLAs for the Tearing Run Watershed permitted discharges.

Table 4. Waste Load Allocations of Permitted Discharges

Mine	Station	Parameter	Allowable Average Monthly Conc. (mg/L)	Average Flow (MGD)	WLA (lbs/day)
Britt Energies Inc.	**TP1**	Al	2.0	0.0049	0.08
Flickinger Mine		Fe	3.0	0.0049	0.12
SMP 32030103		Mn	2.0	0.0049	0.08
NPDES PA0249416					
	TP2	Al	2.0	0.0049	0.08
		Fe	3.0	0.0049	0.12
		Mn	2.0	0.0049	0.08
Britt Energies Inc.	**010**	Al	0.6	0.0102	0.05
Marbach Mine		Fe	3.0	0.0102	0.26
SMP 3202016		Mn	1.1	0.0102	0.09
NPDES PA0249271					
	011	Al	0.4	0.0102	0.03
		Fe	1.3	0.0102	0.11
		Mn	0.9	0.0102	0.08
	012	Al	0.4	0.0102	0.03
		Fe	1.3	0.0102	0.11
		Mn	0.9	0.0102	0.08
Britt Energies Inc.	**004**	Al	2.0	0.0051	0.08
Kinkead Quarry		Fe	3.0	0.0051	0.13
SMP 32030301		Mn	2.0	0.0051	0.08
NPDES PA0249408					
	005	Al	2.0	0.0051	0.08
		Fe	3.0	0.0051	0.13
		Mn	2.0	0.0051	0.08
Keystone Mining Corp.	**23**	Al	2.0	0.024	0.4
Waterman No. 1 Mine		Fe	3.0	0.024	0.6
SMP 32813031		Mn	2.0	0.024	0.4
NPDES PA0125547					
	G	Al	2.0	0.0018	0.030
		Fe	3.0	0.0018	0.045
		Mn	2.0	0.0018	0.030
Rosebud Mining Co.	**001**	Al	2.0	0.012	0.20
Brush Valley Mine		Fe	3.0	0.012	0.30

Mine	Station	Parameter	Allowable Average Monthly Conc. (mg/L)	Average Flow (MGD)	WLA (lbs/day)
SMP 32041301 No NPDES		Mn	2.0	0.012	0.20
	002	Al	2.0	0.011	0.19
		Fe	3.0	0.011	0.28
		Mn	2.0	0.011	0.19

Recommendations

Currently there is a watershed assessment underway for the Kiski-Conemaugh drainage basin, which includes Blacklick Creek and its tributaries Two Lick Creek and Tearing Run. All of the tributaries and sources of acid mine drainage will be evaluated and prioritized based on their severity and flow. The Kiski-Conemaugh Stream Team is an active watershed group and its efforts involve the Blacklick Creek Watershed Association. The group will use the watershed assessment to focus its attention on the top priorities for the watershed. Once the problem areas have been prioritized the group can then apply for funding to begin the process of cleaning up the watershed.

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

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

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

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 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.

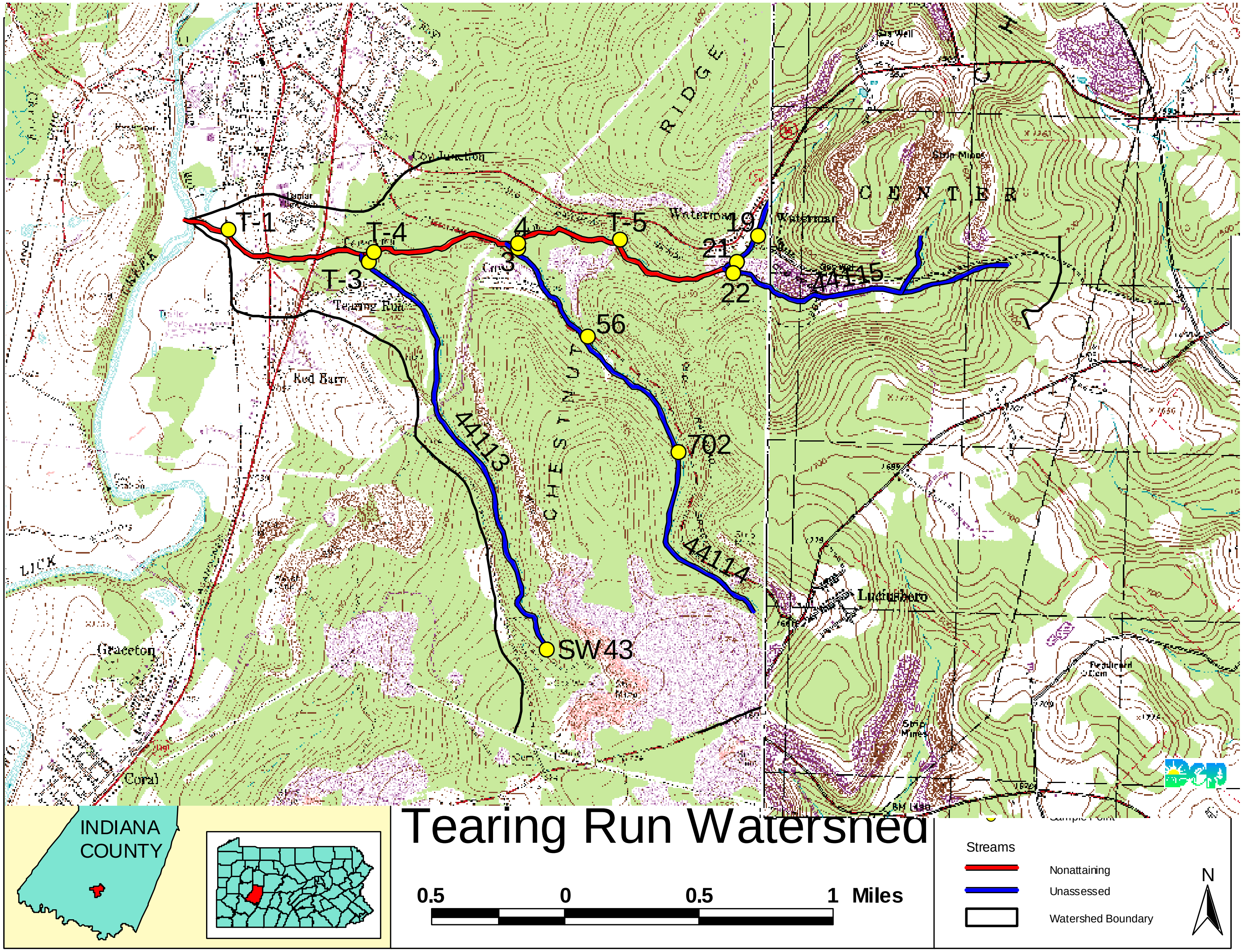
- To encourage private and public participation in abandoned mine reclamation efforts
- To improve reclamation efficiency through better communication between reclamation partners
- To increase reclamation by reducing remining risks
- To maximize reclamation funding by expanding existing sources and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

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

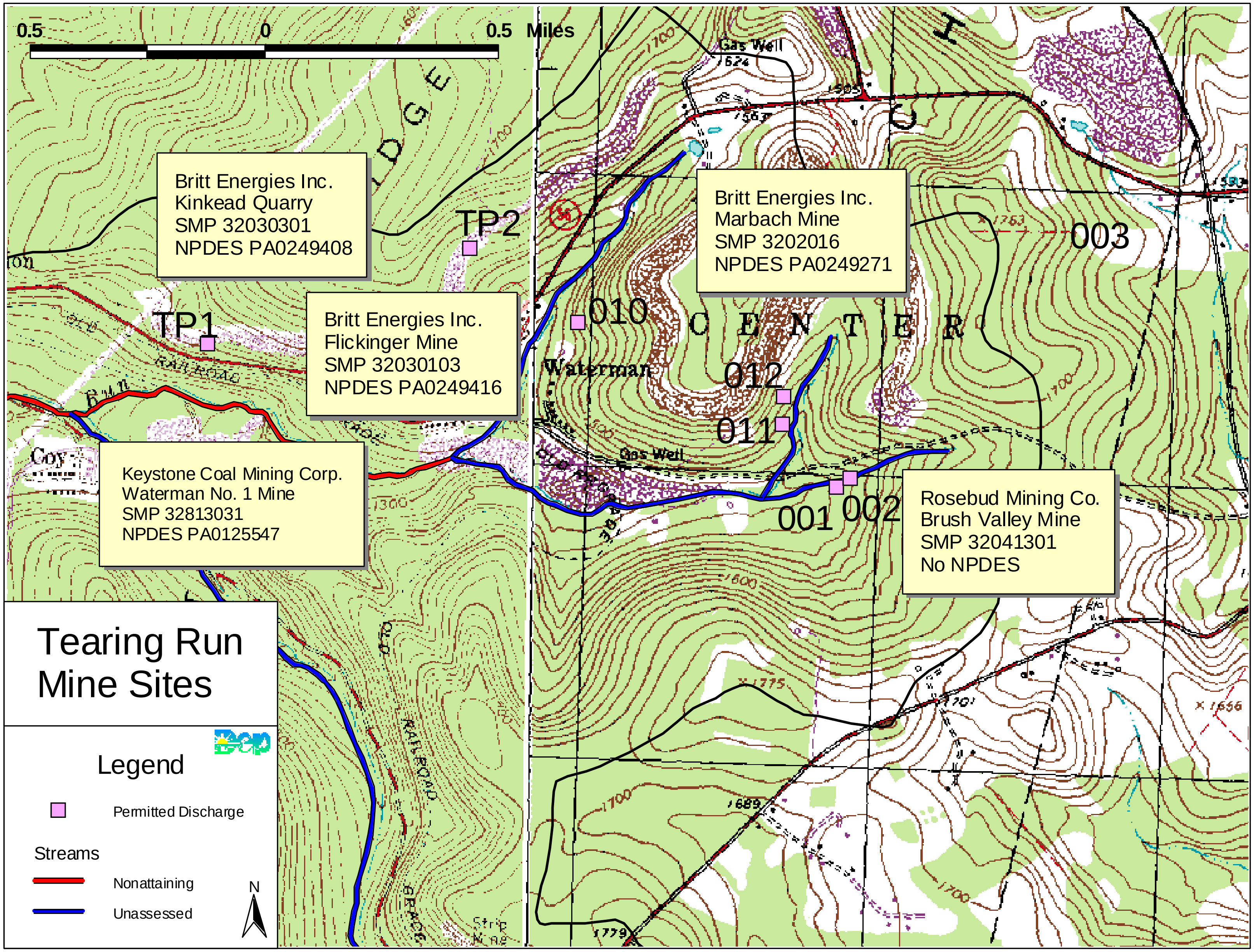
Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on March 25, 2006 and the Indiana Gazette, Indiana PA to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from March 16, 2006 to May 15, 2006. A public meeting was held on March 16, 2006 at the Robert Shaw building Conference Room, Indiana University, Indiana Pennsylvania, to discuss the proposed TMDL.

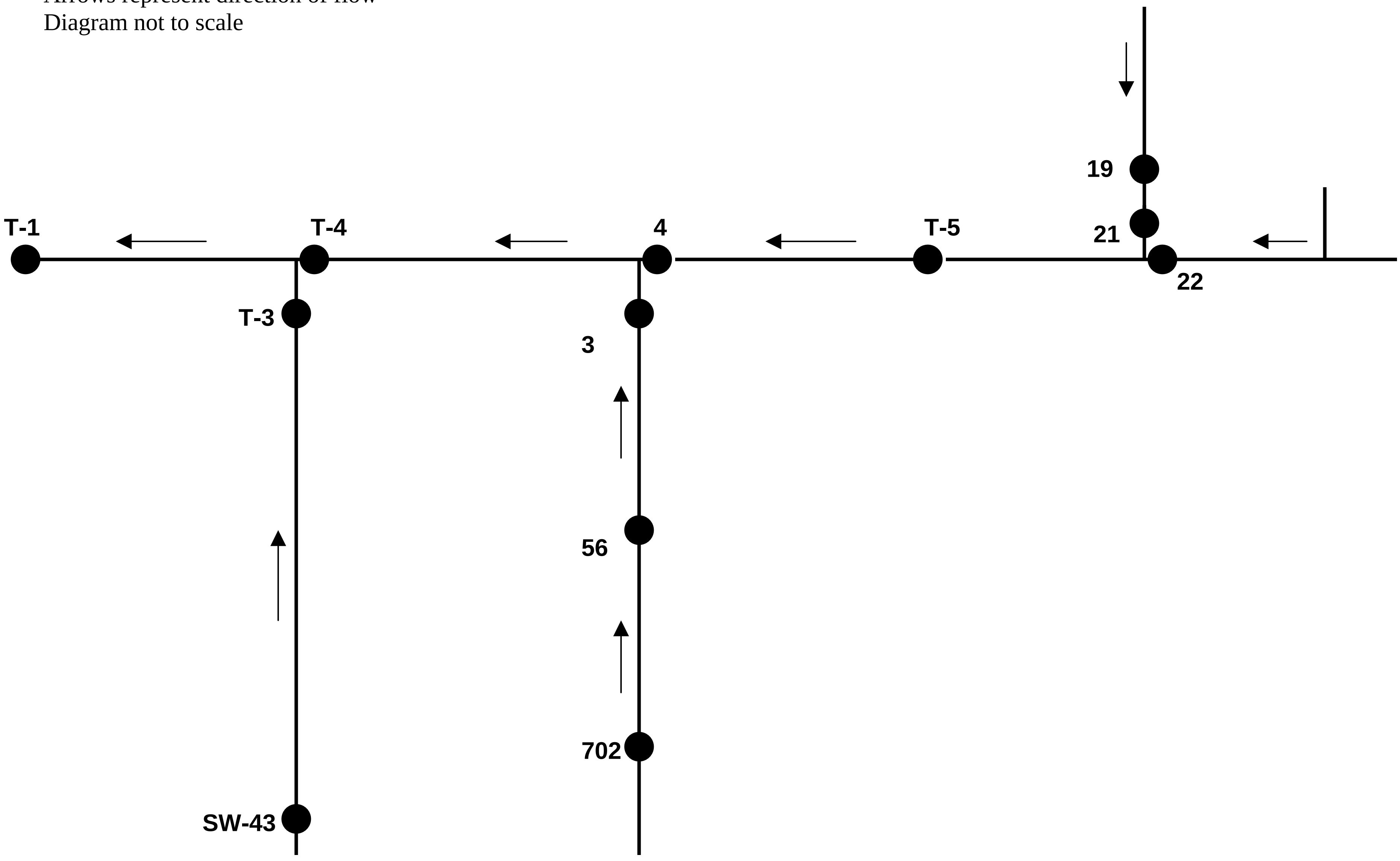
Attachment A
Tearing Run Watershed Maps


T-1
T-4
T-3
4
3
T-5
19
21
22
44115
56
702
44113
44114
SW43
RIDGE
CHESTNUT
CENTER
Tearing Run
Red Barn
Graceton
Coral
Lucernemines
LICK
INDIANA COUNTY
Tearing Run Watershed
0.5
0
0.5
1 Miles
Streams
Nonattaining
Unassessed
Watershed Boundary
N


Tearing Run
Station Map
Legend
Permitted Discharge
Sample Point
Streams
Nonattaining
Unassessed
Watershed Boundary
N
0.5
0
0.5 Miles
T-1
T-3
T-4
3
4
T-5
56
702
SW43
19
21
22
23
TP1
TP2
004
005
010
011
012
001
002
Coy Junction
Tearing Run
Red Barn
Waterman
Lucinsboro
Gas Well


0.5 0 0.5 Miles
Britt Energies Inc.
Kinkead Quarry
SMP 32030301
NPDES PA0249408
TP2
TP1
Britt Energies Inc.
Flickinger Mine
SMP 32030103
NPDES PA0249416
Britt Energies Inc.
Marbach Mine
SMP 3202016
NPDES PA0249271
003
010
012
011
001
002
Keystone Coal Mining Corp.
Waterman No. 1 Mine
SMP 32813031
NPDES PA0125547
Rosebud Mining Co.
Brush Valley Mine
SMP 32041301
No NPDES
Tearing Run
Mine Sites
Legend
Permitted Discharge
Streams
Nonattaining
Unassessed
N

Tearing Run Sampling Station Diagram
Arrows represent direction of flow
Diagram not to scale



Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing Section 303(d) Listings for pH

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

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

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

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.*

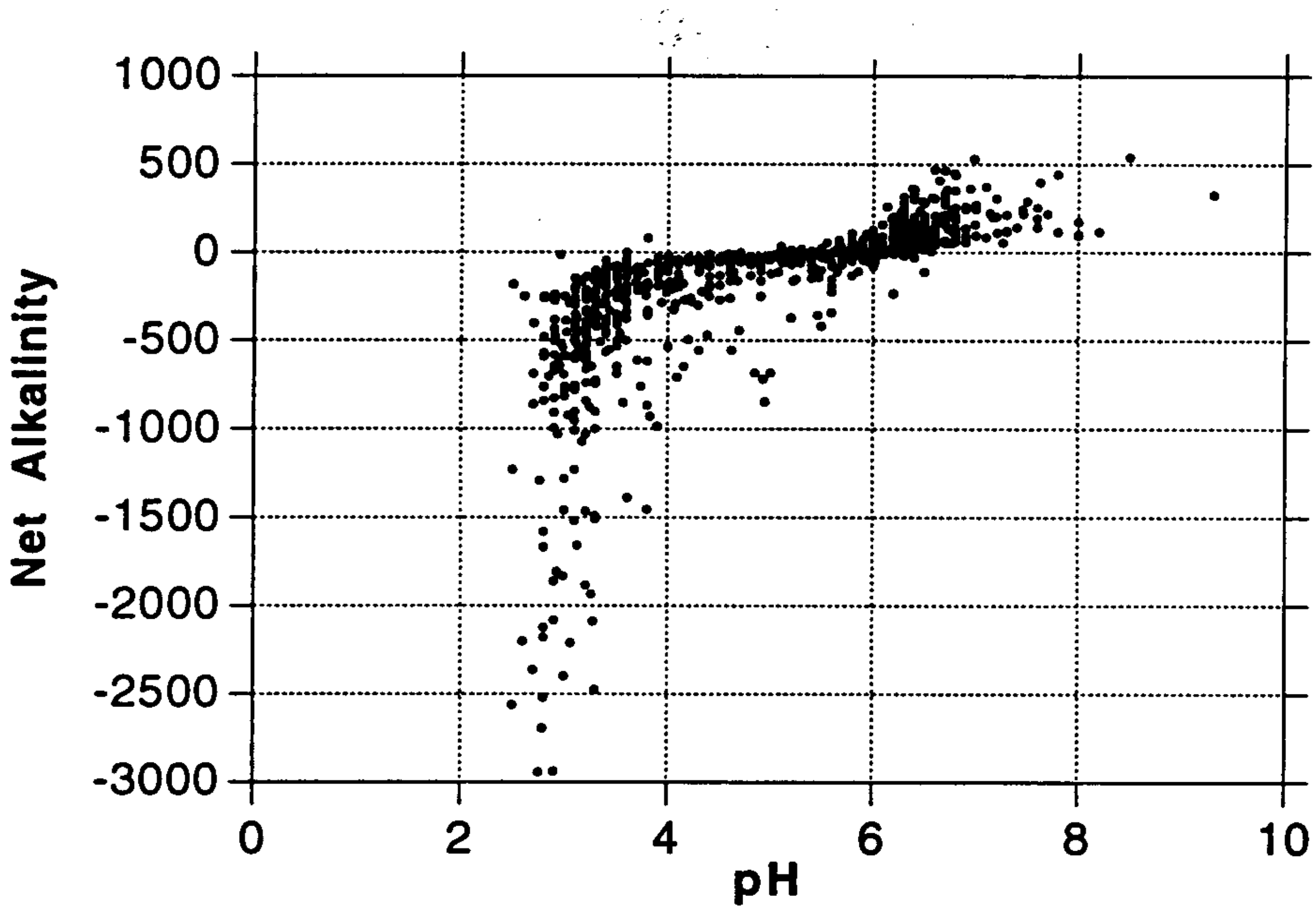


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

Tearing Run

The TMDL for the Tearing Run Watershed consists of waste load allocations of eleven permitted discharges and load allocations to three tributaries and five sampling sites along the stream.

Tearing Run is listed as impaired on the PA Section 303(d) list by high metals from AMD as being the cause of the degradation to the stream. The stream is not listed for pH impairments; however, data shows that the water quality standard is not met at all points; therefore, pH is addressed as part of the TMDL for Tearing Run. The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at each point for iron, manganese, aluminum, 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.

Waste Load Allocations– Permitted Discharges

The Britt Energies Inc. SMP 3202016, Marbach Mine has four permitted treatment ponds; of these, three discharge to Tearing Run, 010, 011 and 012. The waste load allocations for the discharges are calculated with average monthly permit limits and average flow, which is estimated with permitted pit areas and average rainfall. There are four permitted pits in the permit with a total combined pit area of 100,500 square feet. Included in the permit are limits for iron, manganese and aluminum. The WLAs for 011 and 012 are evaluated at point 22 and 010 at point 19.

The Britt Energies Inc. SMP 32030103, Flickinger Mine has two permitted treatment ponds, TP1 and TP2. The waste load allocations for the discharges are calculated with average monthly permit limits and average flow, which is estimated with permitted pit areas and average rainfall. There are two permitted pits in the permit with a total combined pit area of 48,000 square feet. Included in the permit are limits for iron and manganese. Although aluminum is not included in the permit, waste load allocations are calculated to allow for the discharge of aluminum. The standard BAT limit of 2.0 mg/L is used for the calculations. The WLA for TP1 is evaluated at point 4 and TP2 at point 19.

The Britt Energies Inc. Noncoal SMP 32030301, Kinkead Sandstone Quarry has two permitted treatment ponds, 004 and 005. The waste load allocations for the discharges are calculated with average monthly permit limits and average flow, which is estimated with the permitted pit area and average rainfall. There is one permitted pit in the permit with an area of 50,000 square feet. Included in the permit is a limit for iron. Although manganese and aluminum are not included in the permit, waste load allocations are calculated to allow for the discharge of manganese and aluminum. The standard BAT limit of 2.0 mg/L for both is used for the calculations. The WLAs for both 004 and 005 are evaluated at point 4.

The proposed Rosebud Mining Co. SMP 32041301 Brush Valley Deep Mine has three permitted treatment ponds; of these, two will discharge to Tearing Run, 001 and 002. The ponds that will discharge to Tearing Run are for collecting surface runoff from disturbed areas. The waste load allocations for these discharges are calculated with standard BAT average monthly permit limits and average flow, estimated with surface runoff drainage areas. The permitted surface runoff area to the 001 and 002 discharges is 27.2 and 25.0 acres respectively. The WLAs for both 001 and 002 are evaluated at point 22.

The Keystone Coal Mining Corporation SMP 32813031, Waterman No.1 Mine has two post-mining treatment discharges, 23 and G. The waste load allocations for the discharges are calculated with average monthly permit limits and average measured flows. Included in the permit are limits for iron and manganese. Although aluminum is not included in the permit, waste load allocations are calculated to allow for the discharge of aluminum. The standard BAT limit of 2.0 mg/L is used for the calculations. The WLAs for both 23 and G are evaluated at point 3.

The following table contains the waste load allocations for each discharge.

Table C1. Waste Load Allocations for Permitted Discharges

Mine	Station	Parameter	Allowable Average Monthly Conc. (mg/L)	Average Flow (MGD)	WLA (lbs/day)
Britt Energies Inc.	**TP1**	Al	2.0	0.0049	0.08
Flickinger Mine		Fe	3.0	0.0049	0.12
SMP 32030103		Mn	2.0	0.0049	0.08
NPDES PA0249416					
	TP2	Al	2.0	0.0049	0.08
		Fe	3.0	0.0049	0.12
		Mn	2.0	0.0049	0.08
Britt Energies Inc.	**010**	Al	0.6	0.0102	0.05
Marbach Mine		Fe	3.0	0.0102	0.26
SMP 3202016		Mn	1.1	0.0102	0.09
NPDES PA0249271					
	011	Al	0.4	0.0102	0.03
		Fe	1.3	0.0102	0.11

Mine	Station	Parameter	Allowable Average Monthly Conc. (mg/L)	Average Flow (MGD)	WLA (lbs/day)
		Mn	0.9	0.0102	0.08
	012	Al	0.4	0.0102	0.03
		Fe	1.3	0.0102	0.11
		Mn	0.9	0.0102	0.08
Britt Energies Inc.	**004**	Al	2.0	0.0051	0.08
Kinkead Quarry		Fe	3.0	0.0051	0.13
SMP 32030301		Mn	2.0	0.0051	0.08
NPDES PA0249408					
	005	Al	2.0	0.0051	0.08
		Fe	3.0	0.0051	0.13
		Mn	2.0	0.0051	0.08
Keystone Mining Corp.	**23**	Al	2.0	0.024	0.4
Waterman No. 1 Mine		Fe	3.0	0.024	0.6
SMP 32813031		Mn	2.0	0.024	0.4
NPDES PA0125547					
	G	Al	2.0	0.0018	0.030
		Fe	3.0	0.0018	0.045
		Mn	2.0	0.0018	0.030
Rosebud Mining Co.	**001**	Al	2.0	0.012	0.20
Brush Valley Mine		Fe	3.0	0.012	0.30
SMP 32041301		Mn	2.0	0.012	0.20
No NPDES					
	002	Al	2.0	0.011	0.19
		Fe	3.0	0.011	0.28
		Mn	2.0	0.011	0.19

TMDL Calculations - Sample Point 22, Mouth of Unnamed Tributary 44115

The TMDL for sample point 22 consists of a waste load allocation to the Rosebud Mining Co. 001 and 002 and the Marbach Mine 011 and 012 discharges and a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point 22. The average flow of 0.23 MGD, measured at the point, is used for these computations.

There is currently no entry for this segment on the PA Section 303(d) list for impairments from AMD. Sample data at point 22 shows pH ranging between 4.9 and 6.6; pH is addressed as part of this TMDL.

The Rosebud Mining Co. discharges did not exist at the time of sampling and are therefore not included in the existing load. The load reduction calculations are based on the allowable load minus the WLA assigned to the Rosebud discharges, 001 and 002.

Table C2. TMDL Calculations at Point 22

	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.73	1.38	0.68	1.30
Fe	0.62	1.18	0.55	1.05
Mn	0.71	1.35	0.60	1.14
Acidity	31.30	59.42	1.25	2.38
Alkalinity	8.67	16.5		

Table C3. Calculation of Load Reduction Necessary at Point 22

	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	1.38	1.18	1.35	59.4
Allowable Load	1.30	1.05	1.14	2.4
Load Reduction	0.47	0.71	0.61	57.0
% Reduction required	34	60	45	96

TMDL Calculations - Sample Point 19, Headwaters of Tearing Run

The TMDL for sample point 19 consists of a waste load allocation to the Marbach Mine 010 and the Flickinger Mine TP2 discharges and a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point 19. The average flow of 0.14 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) list for impairments from AMD. Sample data at point 19 shows pH ranging between 6.6 and 7.2; pH is not addressed as part of this TMDL. Water quality analysis determined that allowable aluminum load is equal to the existing aluminum load. Because the WQS is met, a TMDL for aluminum is not necessary. Although a TMDL is not necessary, the measured load is considered at the next downstream point, 21. In addition a WLA for aluminum is assigned to the permitted discharge on the segment.

Table C4. TMDL Calculations at Point 19

	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.55	0.7	0.55	0.7
Fe	2.73	3.3	0.52	0.6
Mn	0.55	0.7	0.30	0.4
Acidity	0.00	0.0	0.00	0.0
Alkalinity	36.77	44.2		

Table C5. Calculation of Load Reduction Necessary at Point 19

	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	0.7	3.3	0.7	0.0
Allowable Load	0.7	0.6	0.4	0.0
Load Reduction	0.0	2.7	0.3	0.0
% Reduction Required	0	81	46	0

TMDL Calculations - Sample Point 21, Tearing Run upstream of Unnamed Tributary 44115

The TMDL for sample point 21 consists of a load allocation to all of the area between points 19 and 21 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point 21. The average flow of 0.29 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) list for impairments from AMD. Sample data at point 21 shows pH ranging between 4.2 and 7.2; pH is addressed as part of this TMDL.

Table C6. TMDL Calculations at Point 21

	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.67	1.6	0.38	0.9
Fe	1.67	4.1	0.64	1.5
Mn	1.22	3.0	0.24	0.6
Acidity	37.00	90.1	2.59	6.3
Alkalinity	15.45	37.6		

The calculated upstream load reductions for all the loads that enter point 21 must be accounted for in the calculated reductions at the sample point shown in Table C7. A comparison of measured loads between points 19 and 21 shows that there is an increase in loading for all parameters. The total segment load is the sum of the upstream loads and the additional load entering the segment.

Table C7. Calculation of Load Reduction Necessary at Point 21				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	1.6	4.1	3.0	90.1
Difference in Existing Load between 19 & 21	0.9	0.8	2.3	90.1
Load tracked from 19	0.7	0.6	0.4	0.0
Total Load tracked between points 19 & 21	1.6	1.4	2.7	90.1
Allowable Load	0.9	1.5	0.6	6.3
Load Reduction	0.6	0.0	2.1	83.8
% Reduction Required	41	0	78	93

TMDL Calculations - Sample Point T-5, Tearing Run

The TMDL for sample point T-5 consists of a load allocation to all of the area between points 22, 21 and T-5 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point T-5. The average flow of 0.47 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. Sample data at point T-5 shows pH ranging between 4.7 and 6.7; pH is addressed as part of this TMDL. Water quality analysis determined that allowable iron load is equal to the existing iron load. Because the WQS is met, a TMDL for iron is not necessary. Although a TMDL for iron is not necessary, the measured load is considered at the next downstream point, 4.

Table C8. TMDL Calculations at Point T-5				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.71	2.8	0.61	2.4
Fe	0.62	2.4	0.62	2.4
Mn	0.51	2.0	0.45	1.8
Acidity	24.43	96.5	2.69	10.6
Alkalinity	9.69	38.3		

The calculated upstream load reductions for all the loads that enter point T-5 must be accounted for in the calculated reductions at the sample point shown in Table C9. A comparison of measured loads between points 21, 22 and T-5 shows that there is a decrease in all loadings. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C9. Calculation of Load Reduction Necessary at Point T-5				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	2.8	2.4	2.0	96.5
Difference in Existing Load between T-5, 21 & 22	-0.2	-2.8	-2.3	-53.0
Load tracked from 21 & 22	2.2	2.5	1.7	8.7
Percent Load lost	8	54	53	35
Percent Load tracked	92	46	47	65
Total Load tracked between points T-5, 21 & 22	2.0	1.1	0.8	5.6
Allowable Load	2.4	2.4	1.8	10.6
Load Reduction	0.0	0.0	0.0	0.0
% Reduction Required	0	0	0	0

TMDL Calculation - Sampling Point 4, Tearing Run upstream of Unnamed Tributary 44114

The TMDL for sample point 4 consists of waste load allocations to the Kinkead Quarry 004 and 005 and the Flickinger Mine TP1 discharges and a load allocation to all of the area between points T-5 and 4 (Attachment A). The load allocation for segment was computed using water-quality sample data collected at point 4. The average flow of 0.83 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. Sample data at point 4 shows pH ranging between 2.9 and 4.0; pH is addressed as part of this TMDL.

Table C10. TMDL Calculations at Point 4				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	22.92	159.0	0.11	0.8
Fe	30.45	211.2	0.21	1.5
Mn	1.51	10.5	0.24	1.7
Acidity	176.69	1,225.2	0.00	0.0
Alkalinity	0.20	1.4		

The calculated upstream load reductions for all the loads that enter point 4 must be accounted for in the calculated reductions at the sample point shown in Table C11. A comparison of measured loads between points T-5 and 4 shows that there is an increase in loading for all parameters. The total segment load is the sum of the upstream loads and the additional loading entering the segment.

Table C11. Calculation of Load Reduction Necessary at Point 4				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	159.0	211.2	10.5	1,225.2
Difference in Existing Load between 4 & T-5	156.2	208.7	8.5	1,128.7
Load tracked from T-5	2.0	1.1	0.8	5.6
Total Load tracked between points 4 & T-5	158.2	209.9	9.3	1,134.3
Allowable Load	0.8	1.5	1.7	0.0
Load Reduction	157.4	208.4	7.6	1,134.3
% Reduction Required	99	99	82	100

TMDL Calculations - Sample Point 702, Headwaters of Unnamed Tributary 44114

The TMDL for sample point 702 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point 702. The average flow of 0.22 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) list for impairments from AMD. Sample data at point 702 shows pH ranging between 6.3 and 6.7. Although the criterion is met, water quality analysis determined that it is not met 99 percent of the time; pH is addressed as part of this TMDL.

All values for iron are below the method detection limit (<0.3 mg/L), denoted by ND. Water quality analysis determined that the allowable aluminum load is equal to the existing aluminum load. Because WQS are met, TMDLs for iron and aluminum are not necessary. Although a TMDL for aluminum is not necessary, the measured load is considered at the next downstream point, 56.

Table C12. TMDL Calculations at Point 702				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.64	1.2	0.64	1.2
Fe	ND	ND	NA	NA
Mn	1.23	2.3	0.63	1.2
Acidity	3.00	5.6	1.35	2.5
Alkalinity	13.02	24.3		

Table C13. Calculation of Load Reduction Necessary at Point 702				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	1.2	ND	2.3	5.6
Allowable Load	1.2	NA	1.2	2.5
Load Reduction	0.0	0.0	1.1	3.1
% Reduction Required	0	0	49	55

TMDL Calculation - Sampling Point 56, Unnamed Tributary 44114 upstream of Keystone Mine

The TMDL for sample point 56 a load allocation to all of the area between points 56 and 702 (Attachment A). The load allocation for segment was computed using water-quality sample data collected at point 56. The average flow of 0.26 MGD, measured at the point, is used for these computations.

This segment was not included on the PA Section 303(d) list for impairments from AMD. Sample data at point 56 shows pH ranging between 5.0 and 7.0; pH is addressed as part of this TMDL.

Table C14. TMDL Calculations at Point 56				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	3.98	8.6	0.72	1.6
Fe	3.90	8.4	0.19	0.4
Mn	0.35	0.8	0.22	0.5
Acidity	11.71	25.4	1.87	4.1
Alkalinity	16.91	36.6		

The calculated upstream load reductions for all the loads that enter point 56 must be accounted for in the calculated reductions at the sample point shown in Table C15. A comparison of measured loads between points 56 and 702 shows that there is an increase in iron, aluminum and acidity loading and a decrease in manganese. For increase in load, the total segment load is the sum of the upstream loads and the additional loading entering the segment. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C15. Calculation of Load Reduction Necessary at Point 56				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	8.6	8.4	0.8	25.4
Difference in Existing Load between 702 & 56	7.4	8.4	-1.5	19.8
Load tracked from 702	1.2	NA	1.2	2.5
Percent load lost	-	-	67	-
Percent load tracked	-	-	33	-
Total Load tracked between points 702 & 56	8.6	8.4	0.4	22.3
Allowable Load	1.6	0.4	0.5	4.1
Load Reduction	7.0	8.0	0.0	18.2
% Reduction Required	81	95	0	82

TMDL Calculation - Sampling Point 3, Mouth of Unnamed Tributary 44114

The TMDL for sample point 3 consists of waste load allocations to the Waterman No.1 G and 23 discharges and a load allocation to all of the area between points 56 and 3 (Attachment A). The load allocation for segment was computed using water-quality sample data collected at point 3. The average flow of 0.66 MGD, measured at the point, is used for these computations.

This segment was not included on the PA Section 303(d) list for impairments from AMD. Sample data at point 3 shows pH ranging between 4.6 and 6.7; pH is addressed as part of this TMDL.

Table C16. TMDL Calculations at Point 3				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	2.35	12.9	0.36	2.0
Fe	4.20	23.0	0.59	3.2
Mn	0.84	4.6	0.69	3.8
Acidity	35.97	197.2	2.88	15.8
Alkalinity	11.94	65.5		

The calculated upstream load reductions for all the loads that enter point 3 must be accounted for in the calculated reductions at the sample point shown in Table C17. A comparison of measured loads between points 3 and 56 shows that there is an increase in loading for all parameters. The total segment load is the sum of the upstream loads and the additional loading entering the segment.

Table C17. Calculation of Load Reduction Necessary at Point 3				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	12.9	23.0	4.6	197.2
Difference in Existing Load between 3 & 56	4.3	14.6	3.8	171.9
Load tracked from 56	1.6	0.4	0.4	4.1
Total Load tracked between points 3 & 56	5.9	15.0	4.2	176.0
Allowable Load	2.0	3.2	3.8	15.8
Load Reduction	3.9	11.8	0.4	160.2
% Reduction Required	66	79	11	91

TMDL Calculations - Sample Point T-4, Tearing Run upstream of Unnamed Tributary 44113

The TMDL for sample point T-4 consists of a load allocation to all of the area between points T-4, 3 and 4 (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point T-4. The average flow of 1.40 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. Sample data at point T-4 shows pH ranging between 3.4 and 4.6; pH is addressed as part of this TMDL.

Table C18. TMDL Calculations at Point T-4				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	6.03	70.4	0.30	3.5
Fe	2.23	26.1	0.67	7.8
Mn	1.24	14.5	0.31	3.6
Acidity	87.25	1,019.1	0.79	9.2
Alkalinity	1.68	19.6		

The calculated upstream load reductions for all the loads that enter point T-4 must be accounted for in the calculated reductions at the sample point shown in Table C19. A comparison of measured loads between points T-4, 3 and 4 shows that there is a decrease in all loadings. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C19. Calculation of Load Reduction Necessary at Point T-4				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	70.4	26.1	14.5	1,019.1
Difference in Existing Load between 3, 4 & T-4	-101.4	-208.1	-0.6	-403.3
Load tracked from 3 & 4	2.8	4.7	5.4	15.8
Percent load lost	59	89	4	28
Percent load tracked	41	11	96	72
Total Load tracked between points 3, 4 & T-4	1.1	0.5	5.2	11.3
Allowable Load at T-4	3.5	7.8	3.6	9.2
Load Reduction at T-4	0.0	0.0	1.6	2.1
% Reduction required at T-4	0	0	31	19

Upstream manganese and acidity loads are greater than the allowable loads at point T-4. This is due to data variability and it is expected that with upstream reductions the allowable loads at T-4 will be met.

TMDL Calculations - Sample Point SW-43, Headwaters of Unnamed Tributary 44113

The TMDL for sample point SW-43 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point SW-43. The average flow of 0.07 MGD, measured at the point, is used for these computations.

This segment is not included on the PA Section 303(d) list for impairments from AMD. Sample data at point SW-43 shows pH ranging between 3.4 and 3.5; pH is addressed as part of this TMDL.

Table C20. TMDL Calculations at Point SW-43				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	7.30	4.0	0.58	0.3
Fe	1.43	0.8	0.66	0.4
Mn	4.90	2.7	0.59	0.3
Acidity	89.70	49.4	0.00	0.0
Alkalinity	0.00	0.0		

Table C21. Calculation of Load Reduction Necessary at Point SW-43				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	4.0	0.8	2.7	49.4
Allowable Load	0.3	0.4	0.3	0.0
Load Reduction	3.7	0.4	2.4	49.4
% Reduction Required	92	54	88	100

TMDL Calculation - Sampling Point T-3, Mouth of Unnamed Tributary 44113

The TMDL for sample point T-3 consists of a load allocation to all of the area between points SW-43 and T-3 (Attachment A). The load allocation for segment was computed using water-quality sample data collected at point T-3. The average flow of 0.80 MGD, measured at the point, is used for these computations.

This segment was not included on the PA Section 303(d) list for impairments from AMD. Sample data at point T-3 shows pH ranging between 3.5 and 4.0; pH is addressed as part of this TMDL.

Table C22. TMDL Calculations at Point T-3

	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	5.81	38.7	0.29	1.9
Fe	1.08	7.2	0.48	3.2
Mn	2.21	14.7	0.44	2.9
Acidity	81.83	545.1	0.16	1.1
Alkalinity	0.29	1.9		

The calculated upstream load reductions for all the loads that enter point T-3 must be accounted for in the calculated reductions at the sample point shown in Table C23. A comparison of measured loads between points T-3 and SW-43 shows that there is an increase in loading for all parameters. The total segment load is the sum of the upstream loads and the additional loading entering the segment.

Table C23. Calculation of Load Reduction Necessary at Point T-3

	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	38.7	7.2	14.7	545.1
Difference in Existing Load between SW-43 & T-3	34.7	6.4	12.0	495.7
Load tracked from SW-43	0.3	0.4	0.3	0.0
Total Load tracked between points SW-43 & T-3	35.0	6.8	12.3	495.7
Allowable Load	1.9	3.2	2.9	1.1
Load Reduction	33.1	3.6	9.4	494.6
% Reduction Required	94	53	76	100

TMDL Calculation - Sampling Point T-1, Mouth of Tearing Run

The TMDL for sample point T-1 consists of a load allocation to all of the area between points T-1, T-4 and T-3 (Attachment A). The load allocation for segment was computed using water-quality sample data collected at point T-1. The average flow of 3.27 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. Sample data at point T-1 shows pH ranging between 3.6 and 4.6; pH is addressed as part of this TMDL.

Table C24. TMDL Calculations at Point T-1				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	6.39	174.3	0.45	12.2
Fe	5.08	138.5	0.46	12.5
Mn	1.70	46.3	0.71	19.4
Acidity	77.34	2,110.0	2.32	63.3
Alkalinity	4.26	116.1		

The calculated upstream load reductions for all the loads that enter point T-1 must be accounted for in the calculated reductions at the sample point shown in Table C25. A comparison of measured loads between points T-1, T-4 and T-3 shows that there is an increase in loading for all parameters. The total segment load is the sum of the upstream loads and the additional loading entering the segment.

Table C25. Calculation of Load Reduction Necessary at Point T-1				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	174.3	138.5	46.3	2,110.0
Difference in Existing Load between T-1, T-3 & T-4	65.2	105.3	17.1	545.8
Load tracked from T-3 & T-4	3.1	3.7	6.6	10.3
Total Load tracked between points T-1, T-3 & T-4	68.3	109.0	23.7	556.0
Allowable Load	12.2	12.5	19.4	63.3
Load Reduction	56.1	96.5	4.3	492.7
% Reduction Required	82	89	18	89

Margin of Safety

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

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

- An additional MOS is provided because that the calculations were done with a daily Fe average instead of the 30-day average

Seasonal Variation

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

Critical Conditions

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

Attachment D

Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists

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

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

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

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

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

Attachment E

Water Quality Data Used In TMDL Calculations

Station	Date	Flow	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
T-1	06/11/01		4.0	3.4	65.8	3.97	1.80	6.38
	7/17/2001	503.9	3.6	0	96.2	<0.3	1.58	6.86
Latitude:	6/18/2002	4708		9.2	70.8	9.63	1.86	6.61
40.53139	7/10/2002	1467	3.8	0	72	4.51	2.02	7.45
Longitude:	8/7/2002	285	3.6	0	107.6	0.644	1.81	8.04
-79.16361	6/9/2003		4.6	7.8	59.8	4.61	1.24	4.05
Mouth of Tearing Run	8/6/2003	4394	4.6	9.4	69.2	7.1	1.57	5.33
	AVG	2271.58	4.03	4.26	77.34	5.08	1.70	6.39
	ST DEV	2130.69	0.46	4.44	17.56	3.04	0.26	1.34
T-3	6/11/2001		4	2	70.8	<0.3	3.12	7.89
	7/17/2001	165.3	3.5	0	79	1.66	0.954	7.38
Latitude:	6/18/2002	490	3.9	0	92.2	1.19	2.69	7
40.52972	7/10/2002	569	3.6	0	73.6	1.94	1.06	0.644
Longitude:	8/7/2002	81	3.9	0	89.8	0.379	3.04	5.1
-79.15361	6/9/2003		3.8	0	88	0.455	2.25	6.19
Mouth of Unnamed Tributary 44113	8/6/2003	1468	3.7	0	79.4	0.826	2.37	6.45
	AVG	554.66	3.77	0.29	81.83	1.08	2.21	5.81
	ST DEV	551.03	0.18	0.76	8.29	0.64	0.88	2.45

Station	Date	Flow	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
T-4	6/11/2001		3.8	0	61.8	2.71	0.831	5.64
	7/17/2001	405.6	3.6	0	75.2	2.59	1.74	7.27
Latitude:	6/18/2002	2082	4.1	3.8	69.2	2.94	0.798	4
40.53028	6/21/2002	705	3.2	0	143.6	1.41	0.803	9.76
Longitude:	7/10/2002	150	3.8	0	94	0.44	2.91	5.66
-79.15333	8/7/2002	209	3.4	0	105.6	2.12	1.43	9.88
Tearing Run upstream of Unnamed Trib 44113	6/9/2003		4.6	5.6	51.6	2.68	0.641	2.55
	8/6/2003	2284	4	4	97	2.98	0.756	3.47
	AVG	972.60	3.81	1.68	87.25	2.23	1.24	6.03
	ST DEV	959.52	0.44	2.37	29.38	0.89	0.78	2.76
T-5	6/11/2001	374	5	7.8	30	1.01	0.492	0.719
	7/17/2001	120.6	4.8	10.4	38	<0.3	0.503	0.637
Latitude:	6/21/2002	360	5.8	10	28	0.386	0.311	<0.5
40.53111	7/10/2002	162	5	7.6	31.2	<0.3	0.46	<0.5
Longitude:	8/10/2002	73	4.7	6	43.8	0.371	0.93	0.761
-79.13583	6/9/2003		6.7	12.2	0	0.62	0.428	<0.5
Tearing Run	8/6/2003	884	6.7	13.8	0	0.695	0.444	<0.5
	AVG	328.93	5.53	9.69	24.43	0.62	0.51	0.71
	ST DEV	299.29	0.88	2.75	17.52	0.26	0.20	0.06
SW-43	6/11/2001	35	3.5	0	79.8	1.15	5.16	7.87
	7/23/2001	30	3.5	0	83.6	1.48	5.13	7.27
Latitude:	6/18/2002	8	3.5	0	85.8	1.16	4.7	8.15
40.50944	7/10/2002	13.3	3.5	0	83	2.01	5.07	6.78
Longitude:	8/8/2002	12	3.4	0	113.2	2.15	6.32	7.79
-79.13694	6/18/2003	177	3.5	0	92.8	0.621	3.03	5.94
Headwaters of Unnamed Trib 44113	**AVG**	45.88	3.48	0.00	89.70	1.43	4.90	7.30
	ST DEV	65.13	0.04	0.00	12.31	0.58	1.07	0.83

Station	Date	Flow	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
3	6/11/2001		6.1	13.8	40	4.88	0.679	2.22
	7/17/2001	217.7	5.5	8.4	49	5.55	0.744	2.38
Latitude:	6/21/2002	689	5.8	13.2	42.2	6.03	0.946	2.65
40.53056	7/11/2002	324	6	10.4	52.4	6.23	0.967	3
Longitude:	8/7/2002	130	4.6	6.8	68.2	1.72	1.04	3.59
-79.14306	6/9/2003		6.6	14.2	0	2.38	0.708	1.25
Mouth of Unnamed Tributary 44114	8/6/2003	922	6.7	16.8	0	2.63	0.767	1.37
	AVG	456.54	5.90	11.94	35.97	4.20	0.84	2.35
	ST DEV	336.13	0.71	3.54	26.21	1.90	0.14	0.84
4	6/11/2001		3.2	0	177.6	110	4.04	84
	6/21/2002	705	3.2	0	143.6	14.1	0.803	9.76
Latitude:	7/17/2001		3.3	0	220.2	25.4	1.32	18.5
40.53083	7/10/2002	287	3.1	0	220.6	22.1	1.28	16.8
Longitude:	8/7/2002	145	2.9	0	314	28.7	1.95	24.4
-79.14306	6/9/2003	753	4	1.4	63.6	6.09	0.543	2.66
Tearing Run upstream of Unt 44114	8/6/2003	997	3.5	0	97.2	6.79	0.649	4.35
	AVG	577.40	3.31	0.20	176.69	30.45	1.51	22.92
	ST DEV	351.60	0.35	0.53	84.54	36.16	1.22	28.04
19	6/18/2001	94	6.6	38	0	2.76	0.537	<0.5
	7/17/2001	45.8	6.6	38	0	2.84	0.583	<0.5
Latitude:	6/25/2002	186	7.2	36	0	1.21	0.216	<0.5
40.53139	7/11/2002	28	6.8	36	0	3.7	0.594	0.55
Longitude:	8/8/2002	17	6.7	40	0	4.94	1.19	<0.5
-79.12583	6/18/2003	230	7	32.6	0	0.933	0.194	<0.5
Headwaters of Tearing Run	**AVG**	100.13	6.82	36.77	0.00	2.73	0.55	0.55
	ST DEV	88.70	0.24	2.53	0.00	1.51	0.36	NA

Station	Date	Flow	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
21	6/25/2002	264	7.2	24	0	1.11	0.488	<0.5
	7/11/2002	73	5.9	8.6	79.6	2.62	1.22	0.517
Latitude:	8/8/2002	76	4.2	4.4	68.4	1.79	2.61	0.829
40.53000	6/18/2003	398	7	24.8	0	1.17	0.552	<0.5
Longitude:								
-79.1275	**AVG**	202.75	6.08	15.45	37.00	1.67	1.22	0.67
Tearing Run upstream of Unt 44115	**ST DEV**	157.88	1.37	10.48	42.97	0.70	0.99	0.22
22	6/18/2001	30	5.1	9	1	0.456	0.776	<0.5
	7/17/2001	56.7	5.1	6.2	38.6	0.3	0.677	<0.5
Latitude:	6/25/2002	365.8	6.6	11.4	0	1.2	0.557	0.708
40.52972	7/10/2002	89	5	7	100.8	0.488	0.63	<0.5
Longitude:	8/8/2002	37	4.9	6.8	47.4	0.558	1.02	0.748
-79.1275	6/18/2003	370	6.5	11.6	0	0.72	0.619	<0.5
Mouth of Unnamed Tributary 44115								
	AVG	158.08	5.53	8.67	31.30	0.62	0.71	0.73
	ST DEV	163.81	0.79	2.39	40.05	0.32	0.17	0.03
56	6/20/2001		6.6	16.4	0	<0.3	0.137	<0.5
	7/17/2001	173	5	14.2	66.4	10.9	1.02	3.98
Latitude:	6/21/2002	208	6.1	16.4	15.6	<0.3	0.185	<0.5
40.52583	7/11/2002	89	6.5	19.6	0	0.404	0.121	<0.5
Longitude:	8/7/2002	74	6.8	13	0	<0.3	0.119	<0.5
-79.13806	6/9/2003		6.9	16.4	0	0.389	0.495	<0.5
Unnamed Tributary 44113	8/6/2003	357	7	22.4	0	<0.3	0.4	<0.5
	AVG	180.20	6.41	16.91	11.71	3.90	0.35	3.98
	ST DEV	113.66	0.69	3.18	24.81	6.06	0.33	NA

Station	Date	Flow	pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/L	mg/L	mg/L	mg/L
702	8/21/2001		6.5	12.3	0	<0.3	0.782	<0.5
	6/25/2002	33.7	6.7	13.8	0	<0.3	1.59	0.642
Latitude:	7/11/2002	25	6.3	12	18	<0.3	1.29	<0.5
40.51972	8/7/2002	45	6.6	11.8	0	<0.3	1.21	<0.5
Longitude:	6/18/2003	349	6.6	13	0	<0.3	1.3	<0.5
-79.13111	8/6/2003	323	6.5	15.2	0	<0.3	1.19	<0.5
Headwaters of Unnamed Tributary 44114	**AVG**	155.14	6.53	13.02	3.00	ND	1.23	0.64
	ST DEV	165.51	0.14	1.30	7.35	NA	0.26	NA

Permitted Discharge Flow Data		
Date	Flow (gpm)	
	23	**G**
2/8/2002		1
6/21/2002		1.5
8/27/2002		0.25
12/19/2002		2
2/21/2003		1
4/2/2003		1
6/27/2003		0.75
7/12/2003		1
10/21/2003		1
2/20/2004	17	
3/26/2004	10	1.5
4/16/2004	12	
5/17/2004	10	
6/16/2004	25	
6/21/2004		2
6/25/2004	25	
7/7/2004	20	
7/22/2004		1.5
9/15/2004	25	2
10/20/2004	5	1
Avg (gpm)	16.56	1.25
Avg (MGD)	0.024	0.0018

Attachment F
Comment and Response

No Comments Received.