FINAL

UNT 26051 TROUT RUN AND UNT 26053 PINE RUN WATERSHEDS TMDL
Clearfield County

For Acid Mine Drainage Affected Segments

<u>Prepared by:</u>

Pennsylvania Department of Environmental Protection

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UNT 26051 Trout Run and UNT 26053 Pine Run Watersheds
Clearfield County, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 08-C UNT Trout Run and UNT Pine Run								
Year	**Miles**	**Segment ID Assessment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996*	0.4	7167	26051	UNT Trout Run	HQ-CWF	RE	AMD	Metals
1998**	0.4	7167	26051	UNT Trout Run	HQ-CWF	305 (b) Report	AMD	Metals
2002		No new assessment		UNT Trout Run				
2004	0.6	7167	26051	UNT Trout Run	HQ-CWF	Aquatic Life	AMD	Metals
2004	0.5	20030707-0955-JLR	26053	UNT Pine Run	HQ-CWF	Aquatic Life	AMD	pH Metals

Cold Water Fishery= CWF
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD
See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists.*
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93
*Originally listed as Taylor Springs Run in 1996 and 1998
**1998 listing can be found in Part C, *Segments Identified on the 1996 303(D) List As Affected by AMD That Still Need To Be Placed On The GIS*

Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for one segment in the UNT 26051 Trout Run and one segment in the UNT 26053 Pine Run Watershed (Attachment A). It was done to address the impairments noted on the 1996 Pennsylvania 303(d) list (UNT 26051 Trout Run) and the 2004 Pennsylvania Integrated List (UNT 26053 Pine Run), required under the Clean Water Act, and covers one segment on this list (shown in Table 1). High levels of metals and in some areas depressed pH caused these impairments. Impairments resulted due to acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Directions to the UNT 26051 Trout Run and UNT 26053 Pine Run Watershed

The UNT 26051 Trout Run and UNT 26053 Pine Run Watershed are located in Central Pennsylvania, occupying a north central portion of Clearfield County within Goshen Township. The watersheds are found on the United States Geological Survey maps covering the Clearfield and Lecontes Mills 7.5-Minute Quadrangles.

[1] Pennsylvania's 1996, 1998, 2002 and 2004 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

The watershed can be easily reached by traveling East on State Route 879 from Clearfield to Shawville. Trout Run passes beneath State Route 879 in Shawville just before Trout Run flows into the West Branch of the Susquehanna River. UNT 26051 and UNT 26053 can be reached by traveling north on Goshen-Shawville Road or Trout Run Road.

Being small tributaries most of the watershed areas are comprised of forestlands with abandoned mine lands near the headwaters. UNT 26053 has several residences near the headwaters area. UNT 26051 has no residences within its watershed area.

Segments addressed in this TMDL

UNT 26051 Trout Run and UNT 26053 Pine Run are affected by pollution from AMD. This pollution has caused high levels of metals in the watershed as well as decreased pH. There are no active mining operations in the watershed. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Table 4 for TMDL calculations and see Attachment C for TMDL explanations.

Clean Water Act Requirements

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

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

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

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

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

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

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

Despite these requirements, states, territories, authorized tribes, and EPA 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, many lawsuits still are pending across the country.

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

These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

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

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

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

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to

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

be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

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

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

Watershed History

UNT 26051 Trout Run flows into Trout run near Trout Runs confluence with the West Branch of the Susquehanna River. UNT 26053 Pine Run flows into Pine Run about a mile before Pine Run flows into Trout Run. UNT 26051 Trout Run and UNT 26053 Pine Run watershed flow from the northwest to the southeast.

The UNT 26051 Trout Run and UNT 26053 Pine Run watershed lies within the Appalachian Plateaus Physiographic Province. The watershed areas are comprised of Pennsylvanian aged rocks, which are divided into the Pottsville and Allegheny Groups, and Mississippian aged rocks of the Pocono Formation.

Older Mississippian aged rocks of the Pocono Formation are exposed in the valleys of the watershed and the younger Pennsylvanian aged rocks of the Pottsville and Allegheny Formations are on the hilltops surrounding the watersheds. Mineable coals within the watershed are confined to the Allegheny Group. Strata in the watershed are oriented in a SW to NE trend and dip to the SE towards the axis of the Clearfield Syncline, which lies to the southeast of the watershed areas.

Early mining in the watershed included small underground “punch” mines on the Lower and Middle Kittanning coal seams. Most of these underground workings were later daylighted and removed with the later strip-mining in the watershed. Past strip-mining operations on the Lower and Middle Kittanning coal seams were left abandoned and unreclaimed throughout the watersheds

Companies that have mined in the UNT 26051 to Trout Run watershed include: EM Brown (1950) and Roy Lutz (1955). Companies that have mined in the UNT 26053 watershed include: Lingle Coal Company (1950’s), EM Brown (1950), Shawville Coal Company (1957), Hoyt and

Thompson (1957), Bull Run Coal (1974) and Glen Irvan (1979). More recent mining includes the following:

The M. R. Hainsey Contracting Company Sawmill permit (SMP#17960102) was issued on October 3, 1996. The permitted area was 69.7 acres. The Upper Kittanning (4.8 acres), Middle Kittanning (38.9 acres) and Lower Kittanning (0.7 acres) were mined affecting 63.2 acres. The mining reclaimed 3.5 acres of previously affected area. Mining was completed and the site backfilled in December of 2004. The permit expired on October 3, 2006.

AMD Methodology

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

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

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

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

[3] @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.

In low pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and total acidity. Net alkalinity is alkalinity minus acidity, both in units of milligrams per liter (mg/l) $CaCO_3$. 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 may not represent a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

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

TMDL Endpoints

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

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

Table 2. Applicable Water Quality Criteria

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

For High Quality waters, applicable water-quality criteria are determined using the unimpaired segment of the TMDL water or the 95th percentile of a reference WQN stream. For UNT 26051 Trout Run, WQN 506 Little Wills Creek is used as the reference water. For UNT 26053 Pine Run, WQN 447 Spruce Run is used.

The following table shows the criteria used in the UNT 26051 Trout Run and UNT 26053 Pine Run TMDL development. Attachment D explains how to select a reference stream for HQ TMDL development.

Table 3. Reference Streams Little Wills Creek and Spruce Run

Little Wills Creek WQN 506 – UNT 26051 Trout Run

Parameter	*Criterion Value (mg/l)*
Aluminum (Al)	0.200
Iron (Fe)	0.139
Manganese (Mn)	0.010
Area	10 mi2
Alkalinity	22.0

Spruce Run WQN 447 – UNT 26053 Pine Run

Parameter	*Criterion Value (mg/l)*
Aluminum (Al)	0.200
Iron (Fe)	0.040
Manganese (Mn)	0.010
Area	2 mi2
Alkalinity	5.0

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

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 non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL. Table 4 contains the TMDL component summary for each point evaluated in the watershed. Refer to the maps in Attachment A.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 4 for each segment are based on the assumption that all upstream allocations are achieved and also take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit margin of safety (MOS) based on conservative assumptions in the analysis is included in the TMDL calculations.

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

There currently are no permitted discharges in the UNT 26051 Trout Run and UNT 26053 Pine Run Watershed. The difference between the TMDL and the WLA is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced to the area upstream of the point in order for water quality standards to be met at the point.

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

Table 4. UNT 26051 Trout Run and UNT 26053 Pine Run Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
PR01- **UNT 26053 to Pine Run**						
Aluminum (lbs/day)	0.41	.06	0	0.06	0.35	86%
Iron (lbs/day)	ND	NA	0	NA	NA	NA
Manganese(lbs/day)	2.57	0.01	0	0.01	2.56	99.6%
Acidity (lbs/day)	61.87	5.98	0	5.98	55.89	90%
TR01 - UNT 26051 to Trout Run						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	ND	NA	0	NA	NA	NA
Manganese(lbs/day)	0.72	0.01	0	0.01	0.71	99%
Acidity (lbs/day)	24.54	10.13	0	10.13	14.41	59%

*ND=non detection
NA = not applicable

In the instance where samples were measured at less than detection limits (e.g. aluminum at TR01, Table 4), no TMDL is necessary for the parameter at that point. No TMDL is necessary, this is denoted as "NA" in the above table. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. Attachment A contains maps of the sampling point locations for reference.

Recommendations

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

Additional opportunities for water quality improvement are both ongoing and anticipated. Historically, a great deal of research into mine drainage has been conducted by BAMR, 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 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 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.

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

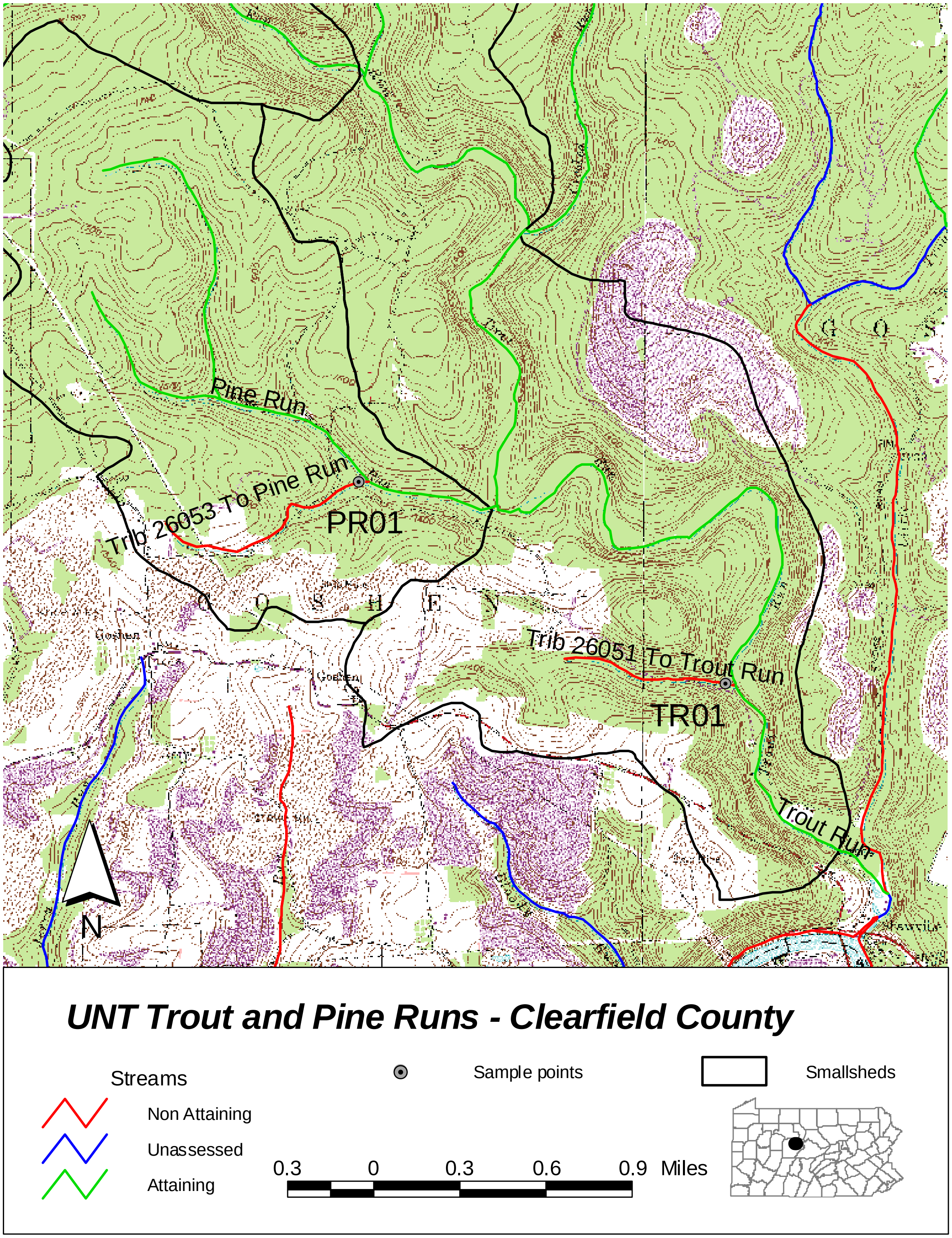
There is currently no watershed group in the UNT 26051 Trout Run and UNT 26053 Pine Run Watershed area. It is recommended that agencies work with local interests to form a watershed organization for the Trout Run Watershed. This watershed organization could then work to implement projects to achieve the reductions recommended in this TMDL document.

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and *The Progress,* to foster public comment on the allowable loads calculated. A public meeting was held on January 17, 2007 at the Moshannon District Mining Office, to discuss the proposed TMDL.

Attachment A

UNT 26051 Trout Run and UNT 26053 Pine Run Watershed Maps


Pine Run
Trib 26053 To Pine Run
PR01
Trib 26051 To Trout Run
TR01
Trout Run
N
UNT Trout and Pine Runs - Clearfield County
Streams
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Sample points
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0.3
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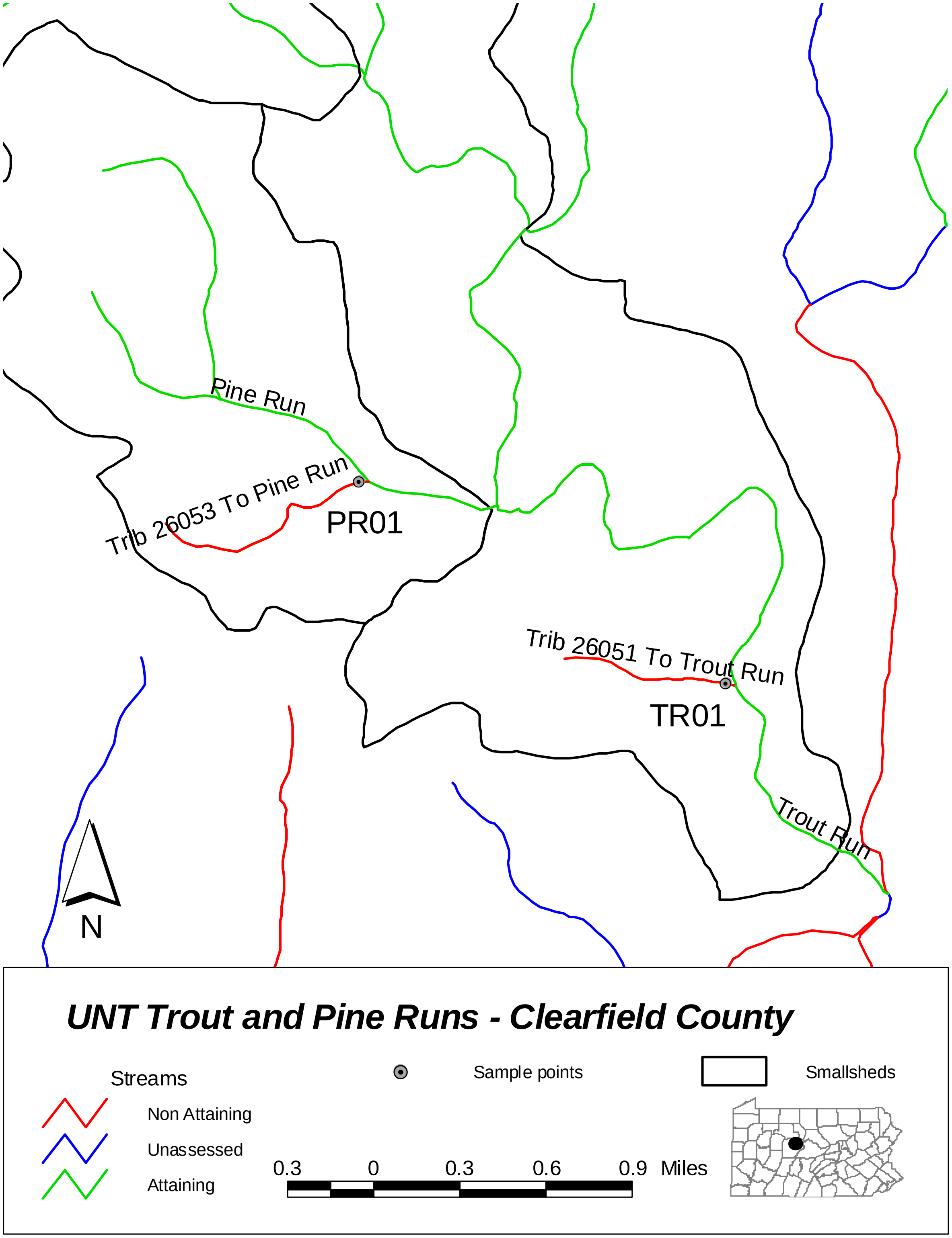

Pine Run
Trib 26053 To Pine Run
PR01
Trib 26051 To Trout Run
TR01
Trout Run
N
UNT Trout and Pine Runs - Clearfield County
Streams
Non Attaining
Unassessed
Attaining
Sample points
Smallsheds
0.3 0 0.3 0.6 0.9 Miles

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

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

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

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

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

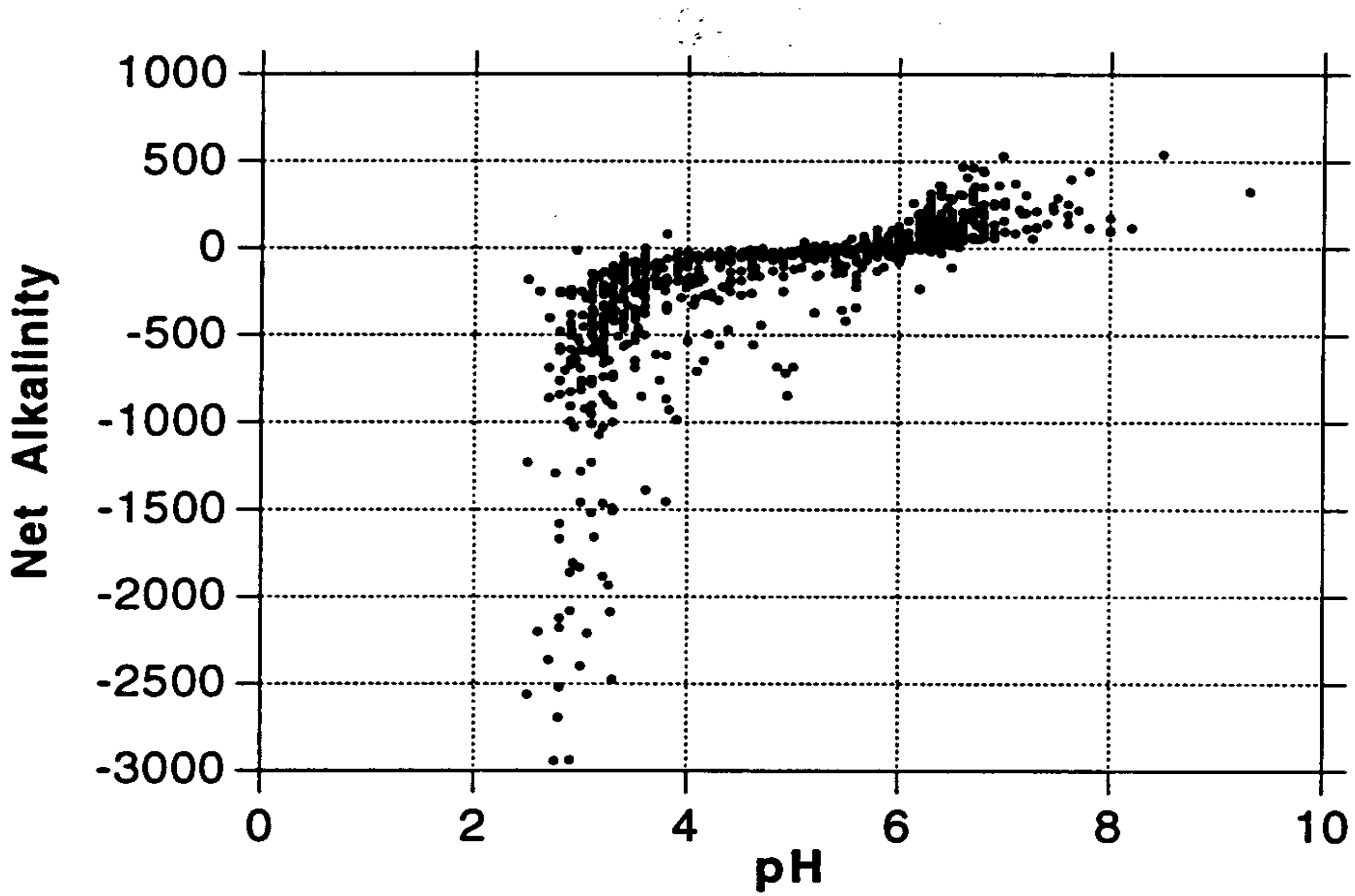


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
TMDLs By Segment

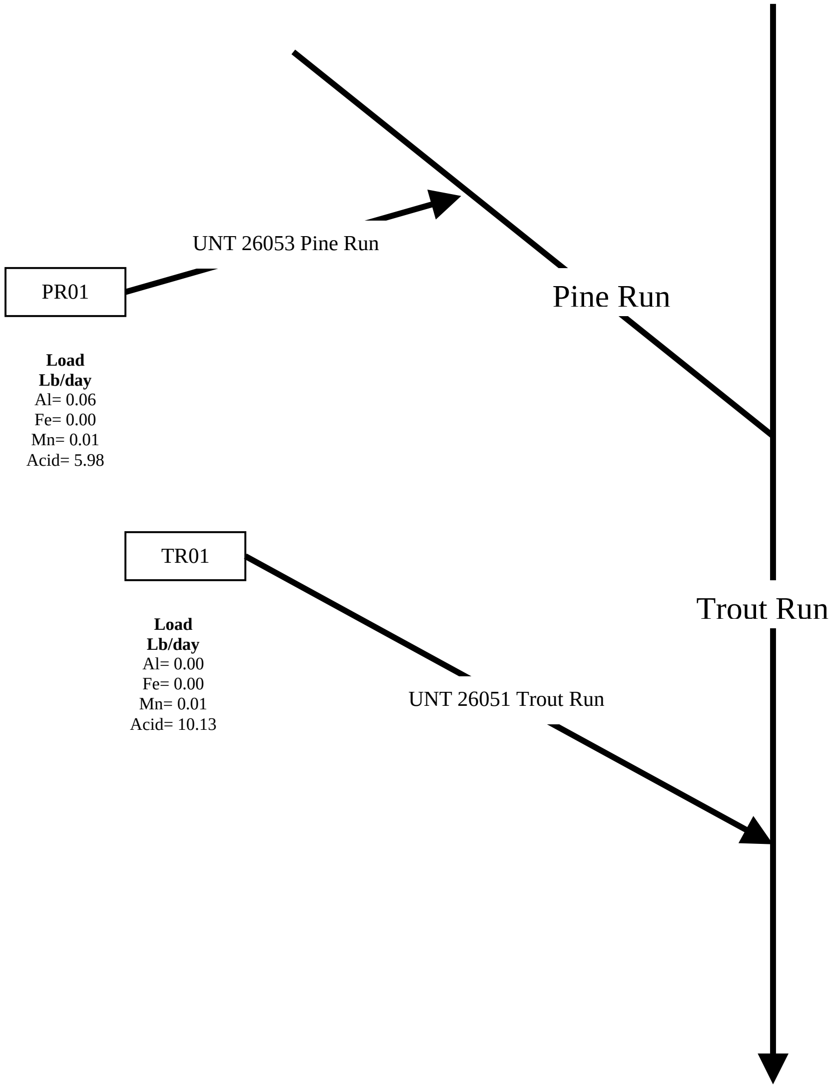
UNT 26051 Trout Run and UNT 26053 Pine Run

The TMDL for UNT 26051 Trout Run and UNT 26053 Pine Run consists of load allocations to one sampling site on UNT 26051 Trout Run (TR01) and one sampling site on UNT 26053 Pine Run (PR01). Sample data sets were collected during 2004 and 2005. Both sample points are shown on the maps included in Attachment A as well as on the loading schematic presented on the following page.

UNT 26051 Trout Run is listed on the 1996 PA Section 303(d) list for metals from AMD as being the cause of the degradation to this stream. UNT 26053 Pine Run is listed on the 2004 PA Integrated List for pH and metals from AMD as being the cause of the degradation to this stream. For HQ-CWF streams, a WQN stream is used as a reference. The applicable water quality criteria shown in Table 3 for WQN 506 Little Wills Creek will be used as the target endpoint for UNT 26051 Trout Run and WQN 447 Spruce Run will be used for UNT 26053 Pine Run.

Although this TMDL will focus primarily on metals analysis to the UNT 26051 Trout Run and UNT 26053 Pine Run watershed, pH and reduced acid loading will be performed. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at each sample point for metals 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 log normally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards. Following is an explanation of the TMDL for each allocation point.



<u>TMDL calculations - PR01 - Unnamed Tributary 26053 to Pine Run</u>

The TMDL for sample point PR01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for UNT 26053 Pine Run was computed using water-quality sample data collected at point PR01. The average flow, measured at the sampling point PR01 (0.28 MGD), is used for these computations. This sample point is placed near the mouth of this tributary before it enters Pine Run. Loads from this tributary enter Pine Run, which is attaining its uses.

Sample data at point PR01 shows that UNT 26053 Pine Run has a pH ranging between 4.5 and 5.2. There currently is an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

The measured sample data for iron showed that all parameters were below detection limits. Because water quality standards are met, a TMDL for this parameter isn’t necessary and is not calculated. A TMDL has been calculated for aluminum, manganese and acidity. The existing and allowable loads for iron at PR01 in Table C1 will be denoted as “NA”. The concentrations will be denoted as “ND”.

Table C1 shows the measured and allowable concentrations and loads at PR01. Table C2 shows the reductions necessary to meet water quality standards.

Table C1		Measured		Allowable	
Flow (gpm)=	196.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.17	0.41	0.02	0.06
	Iron	ND	NA	ND	NA
ND = non detection	Manganese	1.09	2.57	0.003	0.01
NA = not applicable	Acidity	26.25	61.87	2.54	5.98
	Alkalinity	6.85	16.14		

Table C2. Allocations PR01			
PR01	Mn (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ PR01	0.41	2.57	61.87
Allowable Load @ PR01	0.06	0.01	5.98
Load Reduction @ PR01	0.35	2.56	55.89
% Reduction required @ PR01	86%	99.6%	90%

TMDL calculations - TR01 - Unnamed Tributary 26051 to Trout Run

The TMDL for sampling point TR01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point TR01. The average flow, measured at the sampling point TR01 (0.47 MGD), is used for these computations. . This sample point is placed near the mouth of this tributary before it enters Trout Run. Loads from this tributary enter Trout Run, which is attaining its uses.

Sample data at point TR01 shows pH ranging between 6.8 and 7.2; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

All measured sample data for aluminum and iron were below detection limits. Because water quality standards are met, a TMDL for these parameters isn’t necessary and is not calculated. The existing and allowable loads for aluminum and iron values at TR01 in Table C3 will be denoted as “NA”. The concentrations will be denoted as “ND”.

Table C3 shows the measured and allowable concentrations and loads at TR01. Table C4 shows the reductions required for manganese and acidity at TR01.

Table C3		Measured		Allowable	
Flow (gpm)=	327.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	ND	NA	ND	NA
	Manganese	0.18	0.72	0.002	0.01
	Acidity	6.25	24.54	2.58	10.13
	Alkalinity	21.00	82.47		

Table C4. Allocations TR01		
TR01	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ TR01	0.72	24.54
Allowable Load @ TR01	0.01	10.13
Load Reduction @ TR01	0.71	14.41
% Reduction required @TR01	99%	59%

Margin of Safety

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

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

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

Use of reference stream for High Quality waters

Streams placed on the 1996 303 (d) list with a designated use of High Quality (HQ) will be subject to Pennsylvania's anti degradation policy. Therefore, DEP must establish instream goals for TMDLs that restore the waterbody to existing (pre-mining) quality.

This is accomplished by sampling an unaffected stretch of stream to use as a reference. This stretch typically is the headwaters segment of the High Quality stream in question. If an unaffected stretch isn't available, a nearby-unimpaired stream will function as a surrogate reference.

The reference stream data will be selected from statewide ambient Water Quality Network (WQN) stations. To determine which WQN station represents existing water quality appropriate for use in developing TMDLs for HQ waters, alkalinity and drainage area are considered.

1. First step is to match alkalinities of TMDL stream and WQN reference stream. If alkalinities for candidate stream are not available, use pH as a surrogate. As a last resort, if neither pH nor alkalinity are available match geologies using current geological maps.
2. The second consideration is drainage area.
3. Finally, from the subset of stations with similar alkalinity and drainage area select the station nearest the TMDL stream.

Once a reference stream is selected, the 95th percentile confidence limit on the median for aluminum, iron and manganese is used as the applicable water quality criteria needed for the @Risk model.

Attachment E

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 lists. The 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

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

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

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

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

Attachment F
Water Quality Data Used In TMDL Calculations

PR01	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Flow**
Date	**Lab**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**gpm**
5/5/2004	4.9	6.6	38.80	<0.300	0.65	<0.500	158
7/6/2004	4.5	5.4	22.40	<0.300	1.80	0.69	28
10/5/2004	5.0	8.2	23.20	<0.300	1.42	<0.500	58
4/7/2005	5.2	7.2	20.60	<0.300	0.49	<0.500	541
AVERAGE		6.9	26.3	0.0	1.1	0.2	196.3
ST DEV		1.2	8.4	0.0	0.6	0.3	236.5
TR01	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Flow**
Date	**Lab**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**gpm**
5/5/2004	6.9	17.6	25.00	<0.300	0.13	<0.500	349
7/6/2004	6.8	18.8	0.00	<0.300	0.06	<0.500	129
10/5/2004	7.2	24.8	0.00	<0.300	0.40	<0.500	260
4/7/2005	6.8	22.8	0.00	<0.300	0.15	<0.500	570
AVERAGE		21.0	6.3	0.0	0.2	0.0	327.0
ST DEV		3.4	12.5	0.0	0.1	0.0	185.5

Zero has been substituted for the less than detection values in the TMDL calculations

Attachment G

Comment and Response

No official comments were received.