Whites Run TMDL:
For Metals

Prepared by Pennsylvania Department of Environmental Protection

March 1, 2001

Copied from parks run:

Table of Contents

List of Tables

List of Attachments

Attachment	Description
A	Location and Watershed Map of Whites Run
B	Data Used to Calculate the TMDL
C	The pH Method
D	Example Calculation: Lorberry Creek
E	Comment\Response

Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for the Whites Run segment in the lower portion of the Mill Creek Watershed. It was done to address the impairments noted on the 1996 Pennsylvania 303(d) list, required under the Clean Water Act, and covers the one listed segment shown in Table 1. Metals in acidic discharge water from abandoned coalmines along with the natural condition of ground water associated with an absence or scarcity of alkaline producing material in the flow path of the water cause the impairment. The TMDL addresses pH and the three primary metals associated with acidic mine drainage (iron, manganese, aluminum).

Table 1. 303(d) Sub-List									
State Water Plan (SWP) Subbasin: 17B-Central Allegheny River									
Year	SWP	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	17-B	2		49707	Whites Run	CWF	305(b) Report	RE	Metals
1998	17-B	2.33	5386	49707	Whites Run	CWF	305(b) Report	AMD	Metals
2000	17-B	1.85	5386	49707	Whites Run	CWF	SWMR	AMD	Metals
2000	17-B	0.48	5386	49708	UNT to Whites Run	CWF	SWMR	AMD	Metals

AMD – Abandoned Mine Drainage
CWF – Cold Water Fishes
RE – Resource Extraction
SWMR – Surface Water Monitoring Report

Directions to the Whites Run Watershed

Whites Run in basin 17-B of the State Water Plan (attachment A) is located in east central Clarion County, Pennsylvania encompasses 2000 acres and flows through the north central area of the main bituminous coal region in northwestern Pennsylvania. Whites Run lies entirely within Clarion Township 3 miles east of the Borough of Clarion. The watershed flows to the north into Mill Creek upstream approximately 2000 feet from Mill Creek's confluence with the Clarion River. The Clarion River is a major tributary of the Allegheny River. Whites Run consists of one main branch and no major tributaries. Portions of State Game Lands No. 74 lie within the watershed.

Access to the mouth of Whites Run can be gained by taking Exit #11 (Strattanville) of Interstate 80. Take PA Rt. 322 West 5.0 miles into the Borough of Strattanville. Turn right (North) onto First Street, proceed 1500 feet through an S turn bearing to the north onto Millcreek Road which is tar and chip (First Street which is now SR 0000 turns to the northwest towards the village of Fisher). Proceed 3.0 miles to the Pennsylvania Fish and Boat Commission access at Mill Creek. Walk upstream 1500 feet on Mill Creek to the mouth of Whites Run.

Access to the headwaters can be gained by taking Exit #11 (Strattanville) of Interstate 80. Take PA Rt. 322 West 5.0 miles into the Borough of Strattanville. Turn right (North) onto First Street, proceed 1500 feet through S turn staying on SR 0000 (do not turn onto Millcreek Road). Travel another 4000 feet to a road culvert that is the headwaters of Whites Run.

Segments addressed in this TMDL

There are no active mining operations in the watershed. All of the discharges in the watershed are from abandoned mines and will be treated as non-point sources. The distinction between non-point and point sources in this case is determined on the basis of whether or not there is a responsible party for the discharge. Where there is no responsible party the discharge is considered to be a non-point source. Each segment on the 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.

For the Whites Run watershed, the focus of the TMDL is on several discharges from the Glacial Minerals Strattanville mine where treatment ceased when they went out of business. Four significant post-mining discharges contribute to the pollution loading of the stream. The four discharges flow to one discharge point located on property owned by the Pennsylvania Game Commission, and this discharge location is identified on the watershed reference map (Attachment A).

Watershed History

The Whites Run Watershed consists of 2.33 miles of stream and is classified as cold-water fishes (CWF), although the stream is devoid of fauna with the exception of acid tolerant taxa. The designation for this stream can be found in PA Title 25 Chapter 93.

Abandoned barren mine land, poorly vegetated highwalls and post mining discharges are present in the Whites Run watershed. There are no active mining operations in the watershed. The Upper and Lower Clarion coals have been mined in the watershed primarily by surface contour mining. Small drift mines on the Lower Clarion coal were developed which were later stripped out but not entirely daylighted. The Brookville Coal (Clarion No. 1) was surface mined to a lesser extent. Lower Kittanning coal was deep mined in the early 1900's by Grasso Coal Company, Thatcher Mine in the headwaters of the watershed near the Borough of Strattanville.

Glacial Minerals, Inc. mined the Clarion coals on two sites, MDP# 3676SM39 (Strattanville) and MDP# 1679125 (Reed) during the late 70's and early 80's. Both sites were reclaimed although there are numerous poorly vegetated areas and sludge drying ponds that need addressed. Glacial Minerals treated post-mining discharges on these sites with caustic soda until they went out of business in 1994. The discharge on the Reed site flows to an unnamed tributary of the Clarion River downstream of the outlet of Mill Creek.

The only permits issued in the watershed were Zacheral Coal Co. Inc. MDP 3675SM51 and the Glacial Minerals Permits identified above.

All of Whites Run is acidic with no capacity to assimilate acidic discharges and acidic precipitation.

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of acceptable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for 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 of the nature of the pollution sources in the watershed, most of the TMDLs' component makeup will be Load Allocations (LA) that are specified above a point in the stream segment. All allocations will be specified as long-term average concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time. PA Title 25 Chapter 93.5(b) specifies that a minimum 99% level of protection is required. All metals criteria evaluated in these TMDLs are specified as total recoverable. The data used for this analysis report iron as total recoverable. The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	Criterion value (mg/l)	Duration	Total Recoverable/ Dissolved
Aluminum*	0.1 of the 96 hour LC 50 0.75	Maximum one hour	Total recoverable
Iron	1.50 0.3	1 day average maximum	Total recoverable dissolved
Manganese	1.00	maximum	Total recoverable
PH**	6 - 9	At all times	NA

- *- This TMDL was developed using the value of 0.75 mg/l as the in-stream criterion for aluminum. This is the EPA national acute fish and aquatic life criterion for aluminum.

Pennsylvania's current aluminum criterion is 0.1 mg/l of the 96-hour LC-50 and is contained in PA Title 25 Chapter 93. The EPA national criterion was used because the Department has recommended adopting the EPA criterion and is awaiting final promulgation of it.

- ** - 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). This condition is met when the net alkalinity is maintained above zero.

Computational Methodology

A TMDL equation consists of a Wasteload Allocation (WLA), Load Allocation (LA) and a Margin of Safety (MOS). The WLA is the portion of the load assigned to Point Sources. The LA is the portion of the load assigned to Non-point Sources (NPS). The MOS is applied to account for uncertainties in the TMDL. The MOS may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load).

For purposes of this TMDL, point sources are identified as permitted discharge points and nonpoint sources are other discharges from abandoned mine lands which includes tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands are treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. As such, the discharges associated with these lands were assigned load allocations (as opposed to wasteload allocations).

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 (LA) made at that point will be for all of the watershed area that is above that point. For situations where there are only point-source impacts or a combination of point and non-point sources, the same type of evaluation is used. The point source is mass balanced with the receiving stream, and sources will be reduced as necessary to meet the water quality criteria below the discharge.

The load allocation for this stream segment was computed using water quality sample data collected at point MP-1. Instream flow measurements were not available for point MP-1. The flows for the watershed were determined by using estimated flows at monitoring point MP-1. Estimated flows were determined by evaluating the discharge from the Strattanville Mine Site which contributes approximately 80 % of the stream flow at MP-1. Monitoring point MP-1 can be located on Map 1.

Where a stream or stream segment is listed on the 303-d list for pH the evaluation is the same as that discussed above. The pH method is fully explained in Attachment C.

TMDLs and LAs for each parameter were determined using Monte Carlo simulation. For each source and pollutant, it was assumed that the observed data are log-normally distributed. The lognormal distribution has long been assumed when dealing with environmental data.

Each pollutant source was evaluated separately using @Risk[1]. Five thousand iterations were performed to determine the required percent reduction so that water-quality criteria will be met in-stream at least 99 percent of the time. For each iteration, the required percent reduction is:

PR = maximum{ 0, (1 – Cc/Cd) } where, (1)

PR = required percent reduction for the current iteration
Cc = criterion in mg/l
Cd = randomly generated pollutant source concentration in mg/l based on the observed data

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

Mean = average observed concentration
Standard Deviation = Standard deviation of observed data

The overall percent reduction required is the 99th percentile value of the probability distribution generated by the 5000 iterations, so that the allowable long-term average (LTA) concentration is:

LTA = Mean * $(1 – PR_{99})$ where (2)

LTA = allowable LTA source concentration in mg/l (the mean of five thousand iterations, from the statistics portion of the @Risk program.)

Where a stream or stream segment is listed on the 303(d) list for pH, the same type of evaluation is used. This analysis cannot be performed for pH and therefore utilizes data for acidity and alkalinity. The result is a reduction in acid loading for the stream. The pH method is fully explained in Attachment C.

An example calculation, including detailed tabular summaries of the Monte Carlo results is presented for the Lorberry Creek TMDL in Attachment D.

Hydrology

Flows for the Whites Run TMDL were estimates not measured flows. These estimates were determined by knowing the flow of a surface mine discharge measured by a weir that contributes significant flow to Whites Run. At the point where the discharge confluences with Whites Run the stream flow is estimated by comparing that flow with the discharge flow. The TMDL point is approximately 500 feet downstream of where the discharge enters Whites Run. There are no

---

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

other contributing surface flows between the TMDL point and where the discharge confluences with Whites Run.

In order to justify the location of Whites Run downstream sampling point MP-1 several flows and stream samples were obtained from Whites Run at various locations on February 7, 2001. A Baski portable weir was used to measure flows at the sample locations. The upstream sample location above the influences of mining was flowing at 18 gpm. This water exhibits a pH of 6.7, 26 mg/l alkalinity, 0 acidity, 33 sulfates with metals below detectable limits.

Downstream monitoring point MP-1 located below the impacts of the Strattanville-Reed discharge can be characterized as acid mine drainage with a pH 0f 3.4, 157mg/l net acidity, 317 mg/l iron, 18.9 mg/l manganese, 6.9 mg/l aluminum and 340 sulfates. The stream flow was measured at 155 gpm.

The final sampling point on Whites Run is situated below the influence of an abandoned surface mine discharge entering the stream from the east. A flow of 163 gpm was determined with the Baski portable weir. The water quality at this location is very similar to MP-1 as would be expected. The pH was reported at 3.5, 112 mg/l net acidity, 213 mg/l iron, 14.1 mg/l manganese, 5.2 mg/l aluminum and 310 mg/l sulfates. The

The stream flows and water quality data supports the continued evaluation of Whites Run at MP-1. When the water quality standard is met at MP-1 this standard will obviously be met downstream.

Whites Run MP-1

There are four major contributors to the impairments of Whites Run. The major contributor is the abandoned Glacial Minerals site discussed above. Three other surface mine discharges are located east of Whites Run. Since BAMR will be addressing the Glacial discharge there are only the three discharges east of Whites Run to consider. Two of the three discharges are captured by sample site MP-1 and the third discharge has been determined to be an insignificant contributor to the impairment of Whites Run. The following sections describe the TMDL in detail.

Whites Run is not listed on the Pa 303(d) list for impairment due to pH. Since sample data at point MP-1 shows pH ranging between 2.7 and 3.8, pH will be addressed as part of this TMDL because the data at MP1 shows that Whites Run is also impaired due to low pH. There are no upstream samples. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range. The alkalinity at sampling point MP-1 will be used in the evaluation. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see Table 2). The method and rationale for addressing pH is contained in Attachment C.

Table 3 presents the estimated reductions needed to meet water quality standards at all points in Whites Run.

Table 3. Whites Run MP-1

POINT	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc (mg/l)	Load (lbs/day)	Conc (mg/l)	load (lbs/day)	%
Aluminum	9.65	23.2	0.34	0.8	96%
Iron	68.85	165.2	0.40	1.0	99%
Manganese	40.05	96.1	0.30	0.7	99%
Acidity	397.23	953.4	0.00	0.0	100%
Alkalinity	0.00	0.0			

All values shown in this table are Long-Term Average Values
Whites Run is listed on the 303(d) list as impaired due to metals.

The TDML for Whites Run is a load allocation for all three metals and acidity at point MP1.

Margin of Safety

For this study the margin of safety is applied implicitly. A MOS is built in because the allowable concentrations and loadings were simulated using Monte Carlo techniques and employing the @Risk software. 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 represent all seasons.

Critical Conditions

The reductions specified in this TMDL apply at all flow conditions. A critical flow condition could not be identified from the data used for this analysis. An estimated flow was used at this point to derive loading values for the TMDL.

Summary of Allocations

There have been no projects to date in the Whites Run Watershed. The PA Bureau of Abandoned mine reclamation is currently developing a plan to remediate the largest single source of degradation to Whites Run. This TMDL will focus remediation efforts on the identified numerical reduction targets for each watershed. As changes occur in the watershed, the TMDL may be re-evaluated to reflect current conditions.

Recommendations

The Bureau of Abandoned Mine Reclamation is designing a remediation project for the most significant discharge commonly referred to as the "Strattanville Discharge." This water enters Whites Run from the west approximately 1 mile from the mouth. It is expected that the final effluent will be net alkaline with less than 10 mg/l iron and somewhat higher concentrations of manganese and aluminum.

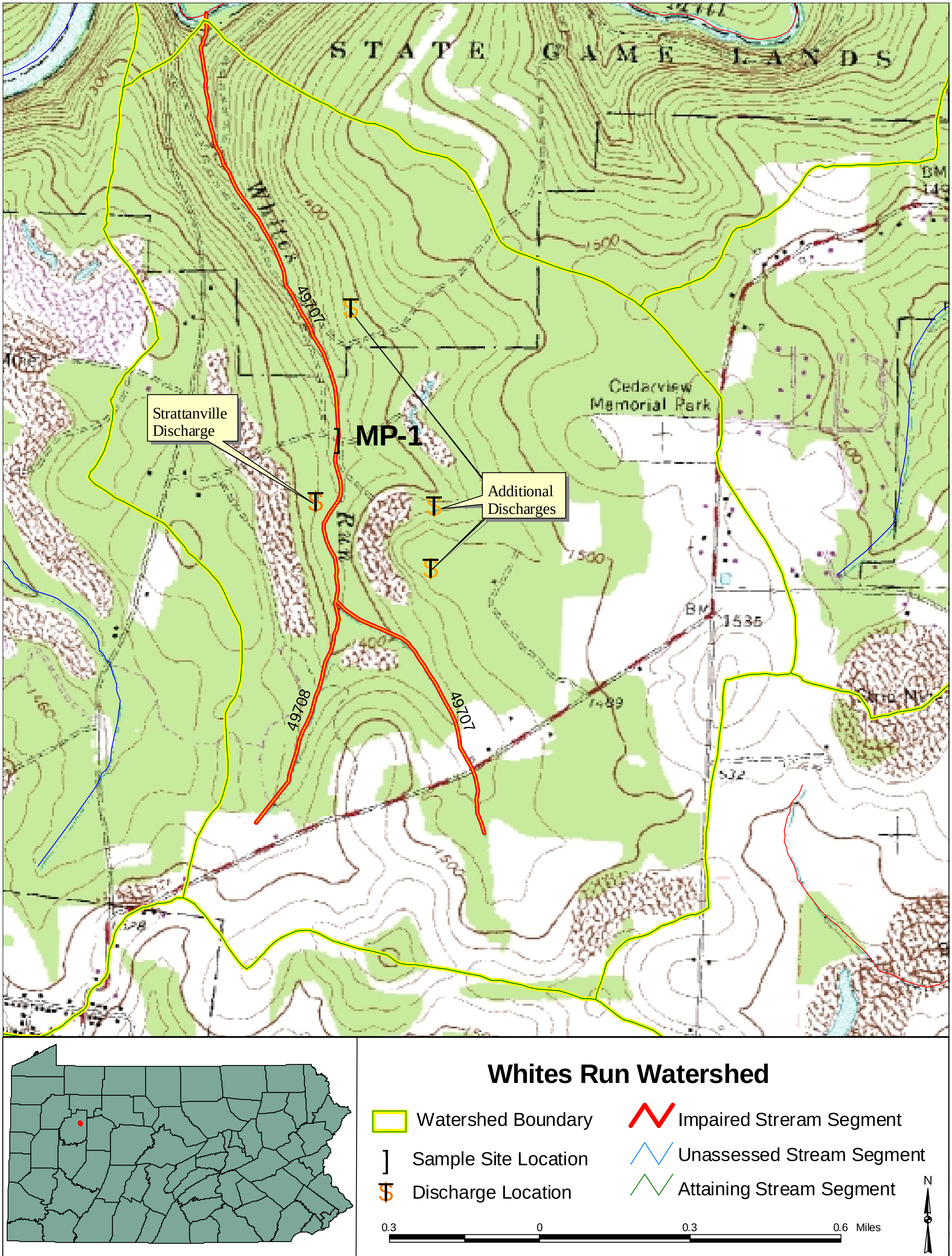
Should funding be available an alkalinity generating system e.g. ALD or vertical flow (SAP) treatment system constructed downslope of each of the surface mine discharges. Each project will have before and after monitoring done to determine the remediation technique efficiency.

Public Participation

Public notice of the draft TMDL was published in the *Press Herald* on January 14, 1999 and January 21, 1999 and in the *Pennsylvania Bulletin* on January 23, 1999 to foster public comment on the allowable loads calculated. A public meeting was held on January 27, 1999 at the Tremont Sportsmans Club in Tremont, PA to discuss the proposed TMDL. Notice of final plan approval will be published in the *PA Bulletin*.

Attachment A

Location and Watershed Map of Whites Run


STATE GAME LANDS
Whites Run
49707
49708
MP-1
Strattanville Discharge
Additional Discharges
Cedarview Memorial Park
Whites Run Watershed
Watershed Boundary
Sample Site Location
Discharge Location
Impaired Strream Segment
Unassessed Stream Segment
Attaining Stream Segment
0.3
0
0.3
0.6 Miles
N

Attachment B

Data Used To Calculate the TMDL

Whites Run MP1						
DATE	**PH**	**ALK**	**HOT A**	**FE**	**MN**	**AL**
9/17/1997	2.8	0	758			
6/11/1998	3.1	0	594	170	64.3	13.5
8/27/1998	2.7	0	558	98	64.1	10.5
9/23/1998	2.7	0	738	110	82.3	13.9
10/26/1998	2.8	0	466	70.1	53.4	11.9
11/23/1998	3	0	382	67.1	50.2	12.5
1/28/1999	3.8	0	54	5.89	6.39	4.32
2/26/1999	3.4	0	196	57.7	29.1	9.27
3/24/1999	3.5	0	152	30	16.3	6.39
4/13/1999	3.8	0	90	11.5	7.19	5.83
5/25/1999	3.5	0	116	23.1	14.3	5.15
6/7/1999	3	0	442	114	53	12.9
7/8/1999	2.7	0	618			

Attachment C

The pH Method

Method for Addressing 303(d) listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published[2] by the PA Department of Environmental Protection demonstrates, that by plotting net alkalinity vs. pH for 794 mine sample points, where net alkalinity is positive (greater or equal to zero), the pH range is most commonly 6 to 8, which is within the EPA's acceptable range of 6 to 9, and meets Pennsylvania water quality criteria in Chapter 93. The included graph (page 3) presents the nonlinear relationship between net alkalinity and pH. The nonlinear positive relation between net alkalinity and pH indicates that pH generally will decline as net alkalinity declines and vice versa; however, the extent of pH change will vary depending on the buffering capacity of solution. Solutions having near-neutral pH ($6 < pH < 8$) or acidic pH ($2 < pH < 4$) tend to be buffered to remain in their respective pH ranges.[3] Relatively large additions of acid or base will be required to change their pH compared to poorly buffered solutions characterized by intermediate pH ($4 < pH < 6$) where the correlation between net alkalinity and pH is practically zero.

The parameter of pH, a measurement of hydrogen ion acidity presented as a negative logarithm of effective hydrogen ion concentration, is not conducive to standard statistics. Additionally pH does not measure latent acidity that can be produced from hydrolysis of metals. For these reasons PA is using the following approach to address the stream impairments noted on the 303(d) list due to pH. The concentration of acidity in a stream is partially dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values which would result from treatment of acid 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 able to measure the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable (>6.0). 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 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 PA'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 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. In other words, if the pH in an unaffected portion of a stream is found to be naturally occurring below 6, then the average net alkalinity for that portion of the stream

---

[2] 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.

[3] Stumm, Werner, and Morgan, J.J., 1996, Aquatic Chemistry--Chemical Equilbria and Rates in Natural Waters (3rd ed.), New York, Wiley-Interscience, 1022p.

will become the criterion for the polluted portion. This “natural net alkalinity level” will be the criterion to which a 99% 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 meet a minimum net alkalinity of zero.

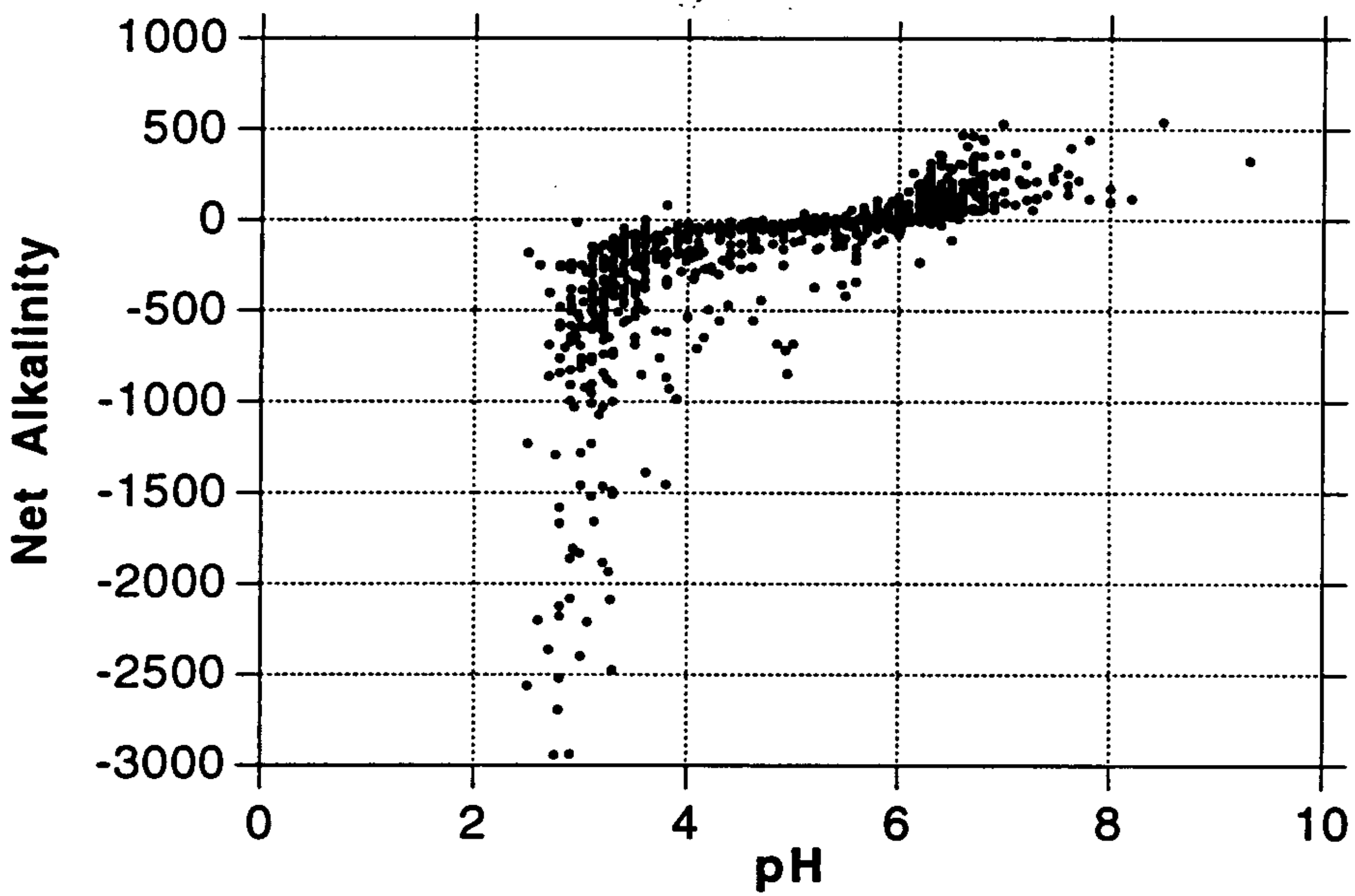


Figure 1.2, Graph C, net alkalinity vs. pH, page 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in PA

Attachment D

Example Calculation: Lorberry Creek

Lorberry creek was evaluated for impairment due to high metals contents in the following manner. The analysis was completed in a stepwise manner starting at the headwaters of the stream and moving to the mouth. The Rowe Tunnel (Swat-04) was treated as the headwaters of Lorberry Creek for the purpose of this analysis.

1. A simulation of the concentration data at point Swat-04 was completed. This estimated the necessary reduction needed for each metal to meet water quality criteria 99% of the time as a long-term average daily concentration. Appropriate concentration reductions were made for each metal.

2. A simulation of the concentration data at point Swat-11 was completed. It was determined that no reductions in metals concentrations are needed for Stumps Run at this time, and therefore no TMDL for metals in Stumps Run is required at this time.

3. A mass balance of loading from Swat-04 and Swat-11 was completed to determine if there was any need for additional reductions as a result of the combining the loads. No additional reductions were necessary.

4. The mass balance was expanded to include the Shadle discharge (L-1). It was estimated that BAT requirements for the Shadle discharge were adequate for iron and manganese. There is no BAT requirement for aluminum. A wasteload allocation was necessary for aluminum at point L-1.

There are no other known sources below the L-1 discharge. However, there is additional flow from overland runoff and one unnamed tributary not impacted by mining. We believe it is reasonable to assume the additional flow provides assimilation capacity below the L-1 discharge and no further analysis is needed downstream.

The calculations are detailed in the following section and Table 9 shows the allocations made on Lorberry Creek

1. A series of 4 equations were used to determine if a reduction was needed at point Swat-04, and, if so the magnitude of the reduction.

Table 1. Equations Used for Rowe Tunnel Analysis

	Field Description	Equation	Explanation
1	Swat-04 initial Concentration Value (equation 1A)	= Risklognorm(mean,StDev)	This simulates the exisitng concentration of the sampled data.
2	Swat-04 % Reduction (from the 99th percentile of PR)	= (input a percentage based on reduction target)	This is the percent reduction for the discharge.
3	Swat-04 Final Concentration Value	= Sampled Value x (1 - %reduction)	This applies the given percent reduction to the initial concentration.

4	Swat-04 Reduction Target (PR)	= maximum(0, 1-Cd/Cc)	This computes the necessary reduction, if needed, each time a value is sampled. The final reduction target is the 99th percentile value of this computed field.

2. The reduction target (PR) was computed taking the 99th percentile value of 5000 iterations of the equation in row 4 of Table 9. The targeted percent reduction is shown, in boldface type, in the following table.

Table 2. Swat-04 Estimated Target Reductions			
Name	**Swat-04 Aluminum**	**Swat-04 Iron**	**Swat-04 Manganese**
Minimum =	0	0.4836	0
Maximum =	0.8675	0.9334	0.8762
Mean =	0.2184	0.8101	0.4750
Std Deviation =	0.2204	0.0544	0.1719
Variance =	0.0486	0.0030	0.0296
Skewness =	0.5845	-0.8768	-0.7027
Kurtosis =	2.0895	4.3513	3.1715
Errors Calculated =	0	0	0
Targeted Reduciton % =	**72.2%**	**90.5%**	**77.0%**
Target #1 (Perc%)=	99%	99%	99%

3. This PR value was then used as the % reduction in the equation in row 3. It was tested by checking that the water quality criterion for each metal was achieved at least 99% of the time. This is how the estimated percent reduction necessary for each metal was verified. The following table shows, in boldface type, the percent of the time criteria for each metal was achieved during 5000 iterations of the equation in row 3 of Table 9.

Table 3. Swat-04 Verification of Target Reductions			
Name	**Swat-04 aluminum**	**Swat-04 iron**	**Swat-04 manganese**
Minimum =	0.0444	0.2614	0.1394
Maximum =	1.5282	2.0277	1.8575
Mean =	0.2729	0.7693	0.4871
Std Deviation =	0.1358	0.2204	0.1670
Variance =	0.0185	0.0486	0.0279
Skewness =	1.6229	0.8742	1.0996
Kurtosis =	8.0010	4.3255	5.4404
Errors Calculated =	0	0	0
Target #1 (value) (WQ Criteria)=	0.75	1.5	1
Target #1 (Perc%)=	**99.15%**	**99.41%**	**99.02%**

4. These same four equations were applied to point Swat-11. The result was that no reduction was needed for any of the metals. The following two tables show the reduction targets computed for, and the verification of, reduction targets for Swat-11.

Table 4. Swat-11 Estimated Target Reductions			
Name	**Swat-11 Aluminum**	**Swat-11 Iron**	**Swat-11 Manganese**
Minimum =	0.0000	0.0000	0.0000
Maximum =	0.6114	0.6426	0.0000
Mean =	0.0009	0.0009	0.0000
Std Deviation =	0.0183	0.0186	0.0000
Variance =	0.0003	0.0003	0.0000

Skewness =	24.0191	23.9120	0.0000
Kurtosis =	643.4102	641.0572	0.0000
Errors Calculated =	0	0	0
Targeted Reduciton % =	**0**	**0**	**0**
Target #1 (Perc%) =	99%	99%	99%

Table 5. Swat-11 Verification of Target Reductions			
Name	**Swat-11 Aluminum**	**Swat-11 Iron**	**Swat-11 Manganese**
Minimum =	0.0013	0.0031	0.0246
Maximum =	1.9302	4.1971	0.3234
Mean =	0.0842	0.1802	0.0941
Std Deviation =	0.1104	0.2268	0.0330
Variance =	0.0122	0.0514	0.0011
Skewness =	5.0496	4.9424	1.0893
Kurtosis =	48.9148	48.8124	5.1358
Errors Calculated =	0	0	0
WQ Criteria =	**0.75**	**1.5**	**1**
% of Time Criteria Achieved =	**99.63%**	**99.60%**	**100%**

5. The following table shows variables used to express mass balance computations.

Table 6. Variable Descriptions for Lorberry Creek Calculations	
Description	**Variable shown**
Flow from Swat-04	Q_{swat04}
Swat-04 Final Concentration	C_{swat04}
Flow from Swat-11	Q_{swat11}
Swat-11 Final Concentration	C_{swat11}
Concentration below Stumps Run	C_{stumps}
Flow from L-1(shadle discharge)	Q_{L1}
Final Conc From L-1	C_{L1}
Concentration below L-1 discharge	C_{allow}

6. Swat-04 and Swat-11 were mass balanced in the following manner.

The majority of the sampling done at point Swat-11 was done in conjunction with point Swat-04 (20 matching sampling days). This allowed for the establishment of a significant correlation between the two flows, the R squared value was 0.85. Swat-04 was used as the base flow and a regression analysis on point Swat-11 provided an equation for use as the flow from Swat-11.

The flow from Swat-04 (Q_{swat04}) was set into an @RISK function so it could be used to simulate loading into the stream. The cumulative probability function was used for this random flow selection. The flow at Swat-04 is as follows

Q_{swat04} = RiskCumul(min,max,bin range,cumulative percent of occurrence)

The RiskCumul function takes 4 arguments: minimum value, maximum value, the bin range from the histogram, cumulative percent of occurrence)

The flow at Swat-11 was randomized using the equation developed by the regression analysis with point Swat-04.

$$Q_{swat11} = Q_{swat}04 \times 0.142 + 0.088$$

The mass balance equation is as follows:

$$Cstumps = ((Q_{swat04} * C_{swat04}) + (Q_{swat11} * C_{swat11}))/(Q_{swat04}+Q_{swat11})$$

This equation was simulated through 5000 iterations and the 99th percentile value of the data set was compared to the water quality criteria to determine if standards had been met. The results show there is no further reduction needed for any of the metals at either point. The simulation results are shown in the following table.

Table 7. Verification of Meeting WQ Standards below Stumps Run

Name	Below Stumps Run Aluminum	Below Stumps Run Iron	Below Stumps Run Manganese
Minimum =	0.0457	0.2181	0.1362
Maximum =	1.2918	1.7553	1.2751
Mean =	0.2505	0.6995	0.4404
Std Deviation =	0.1206	0.1970	0.1470
Variance =	0.0145	0.0388	0.0216
Skewness =	1.6043	0.8681	1.0371
Kurtosis =	7.7226	4.2879	4.8121
Errors Calculated =	0	0	0
WQ Criteria =	**0.75**	**1.5**	**1**
% of Time Criteria Achieved =	**99.52%**	**99.80%**	**99.64%**

4. The mass balance was then expanded to determine if any reductions would be necesssary at the L-1 (Shadle discharge).

The L-1 discharge originated in 1997 and there are very little data available for it. The discharge will have to be treated or eliminated. It is the current site of a USGS test remediation project. The data that were available for the discharge were collected at a point prior to a settling pond. We currently do not have data for effluent from the settling pond.

Modeling for iron and manganese will start with the BAT required concentration value. The current effluent variability based on limited sampling will be kept at its present level. There is no BAT value for aluminum, so the starting concentration for the modeling is arbitrary. The BAT values for iron and manganese are 6 mg/l and 4 mg/l. The following table shows the BAT adjusted values used for point L-1

Table 8 Shadle Adjusted BAT Concentrations

Parameter	Measured Value		BAT adjusted Value	
	Average Conc.	Standard Deviation	Average Conc.	Standard Deviation
Iron	538.00	19.08	6.00	0.21

Manganese	33.93	2.14	4.00	0.25

The average flow, 0.048 cfs, from the discharge will be used for modeling purposes. There was not any means to establish a correlation with point Swat-04.

The same set of four equations used for point Swat-04 were set up for point L-1. The following equation was used for evaluation of point L-1.

$$C_{allow} = ((Q_{swat04}*C_{swat04})+(Q_{swat11}*C_{swat11})+(Q_{L1}*C_{L1}))/(Q_{swat04}+Q_{swat11}+Q_{L1})$$

This equation was simulated through 5000 iterations and the 99th percentile value of the data set was compared to the water quality criteria to determine if standards had been met. It was estimated that an 81 % reduction in aluminum concentration is needed for point L-1.

The following table shows the simulation results of the equation above

Table 9. Verification of Meeting WQ Standards Below Point L-1

Name	Below L-1 / aluminum	Below L-1 / Iron	Below L-1 Manganese
Minimum =	0.0815	0.2711	0.1520
Maximum =	1.3189	2.2305	1.3689
Mean =	0.3369	0.7715	0.4888
Std Deviation =	0.1320	0.1978	0.1474
Variance =	0.0174	0.0391	0.0217
Skewness =	1.2259	0.8430	0.9635
Kurtosis =	5.8475	4.6019	4.7039
Errors Calculated =	0	0	0
WQ Criteria=	**0.75**	**1.5**	**1**
Percent of time achieved=	**99.02%**	**99.68%**	**99.48%**

Table 10 presents the estimated reductions needed to meet water quality standards at all points in Lorberry Creek.

Table 10. Lorberry Creek

		Measured Sample Data		Allowable		Reduction Identified
Station	Parameter	Conc (mg/l)	Load (lbs/day)	LTA Conc (mg/l)	load (lbs/day)	%
Swat 04						
	Al	1.01	21.45	0.27	5.79	73%
	Fe	8.55	181.45	0.77	16.33	91%
	Mn	2.12	44.95	0.49	10.34	77%
Swat 11						
	Al	0.08	0.24	0.08	0.24	0%
	Fe	0.18	0.51	0.18	0.51	0%
	Mn	0.09	0.27	0.09	0.27	0%
L-1						
	Al	34.90	9.03	6.63	1.71	81%
	Fe	6.00	1.55	6.00	1.55	0%

	Mn	4.00	1.03	4.00	1.03	0%

All values shown in this table are Long-Term Average Daily Values

The TMDL for Lorberry Creek requires that a load allocation is made to the Rowe Tunnel abandoned discharge for the three metals listed, and that a wasteload allocation is made to the L-1 discharge for aluminum. There is no TMDL for metals required for Stumps Run at this time.

Margin of safety

For this study the margin of safety is applied implicitly. 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:

- None of the data sets were filtered by taking out extreme measurements. The 99% level of protection is designed to protect for the extreme event so we felt it pertinent not to filter the data set.

- Effluent variability plays a major role in determining the average value that will meet water quality criteria over the long term. Our analysis maintained that the variability at each point would remain the same. The general assumption can be made that a treated discharge would be less variable than an untreated discharge. This implicitly builds in another margin of safety.

Attachment E

Comment \ Response

Comment/Response for the Whites Run TMDL

EPA Region III Comments:

Comment: The "Computational Methodology" and "Hydrology" sections descibe briefly that the average flow at monitoring point MP-1 was estimated by "evaluating the discharge from the Strattanville Mine Site which contributes approximately 80% of the stream flow at MP-1." Please elaborate and explain how the discharge was "evaluated" and how the average stream flow was estimated from this discharge flow. Include the Strattanville Mine discharge flow data and the final estimated average stream flow value at MP-1 in the final TMDL report.

Response: DEP provided additional data to justify this evaluation.

Comment: The "Watershed History" section and the map indicate that the monitoring point MP-1 is not downstream of all mining activities, and the "Whites Run" section states there are "three other surface mine discharges are located east of Whites Run" which need to be shown on the map. There is little confidence that MP-1 will provide an adequate TMDL. Please discuss how DEP ensured that an adequate TMDL load was developed. To develop a TMDL for less than the entire length requires a demonstration that water quality standards will be met along the entire length of the listed segment.

Response: Additional information was collected and the justification is provided as part of the TMDL. Flow data collected at a weir on the Strattanville Discharge is included as an attachment on the TMDL. The "other discharges" are plotted on the map. Sampling in February 2001 provides assurance that the discharge below MP1 has insignificant contributions to the impairment of Whites Run.

Comment: This TMDL does not apply to Whites Run UNT as a separate TMDL had not been developed for it. Indicate on the map, or describe in the text, which segment is the UNT.

Response: The loading contribution from the unnamed tributary to Whites Run was accounted for in the load allocation made at point MP1. At this time we are not making a specific allocation to the unnamed tributary. Whites Run UNT is stream code 49708.

Comment: The margin of safety (MOS) is intended to account for the uncertainty involved in developing the TMDL. As developing a TMDL without measured stream flows contributes a large degree of uncertainty, serious consideration should be given to using an explicit MOS.

Response: DEP feels confident that the estimation of flow at MP1 is conservative enough to account for a minimum 10% MOS.

Comment: Table 1. 303(d) Sub-List, is titled "State Water Plan (SWP) Subbasin:9-Central West Branch Susquehanna River" Please correct the title to state "State Water Plan (SWP) Subbasin:17-B: Central Allegheny River." It should be noted that the UNT is identified on the draft 2000 section 303(d) list as having been listed in 1996.

Response: This has been corrected.

Comment: The section titled "Whites Run (Segment ID #5386 Attachment A)" inadvertently states that Whites Run is not listed for impairment due to pH and metals. Please delete "and metals". This is precisely what the watershed is listed for.

Response: This has been corrected.
Comment: The "Summary of Allocations" section should either reiterate or refer to the allocations given in Table 3.

Response: This has been addressed and corrected in the TMDL.

Comment: The Public Participation section includes strike-out markings. Please delete these.

Response: This has been corrected.