Parks Run Watershed TMDL:
For the Effects of Acid Mine Drainage

Prepared by Pennsylvania Department of Environmental Protection

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Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for the Parks Run segment in the upper 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. The impairment was caused by depressed pH. The impairment resulted from acid drainage from abandoned coal mines and the natural condition of ground water associated with an absence or paucity of alkaline producing material in the flow path of the water. The TMDL addresses acidity to assure that the standards for Ph are met. More information is available in Attachment C.

Table 1. 303(d) Sub-List

State Water Plan (SWP) Subbasin: 17-B Clarion River Basin

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	1		49789	Parks Run	HQ-CWF	SWMR	Resource Extraction	pH
1998	1.12	5398	49789	Parks Run	HQ-CWF	SWMR	AMD	pH
2000	No additional assessment data collected			Parks Run				

HQ-CWF – High Quality Cold Water Fishes
SWMR – Surface Water Monitoring Report

Directions to the Parks Run Watershed

The Parks Run watershed is located in Jefferson County in northwest Pennsylvania (Attachment A). It flows into Mill Creek.

Access to the mouth of Parks Run can be gained by taking Exit #12 (Corsica) of Interstate 80. Take PA Rt. 949 North 4.2 miles to LR33082. Turn Right (East) 0.5 miles to T355 (Park Rd.) bear to the left (NE) to where the road crosses Mill Creek. Walk upstream ⅛th of a mile to monitoring point at the mouth of Parks Run (Parks Run #1).

Access to the headwaters can be gained by taking Exit #12 (Corsica) of Interstate 80. Take PA Rt. 949 North 6.2 miles to T350 (Oakdale Rd.). Turn right (SE) go ½ mile to headwaters Parks Run monitoring point Parks Run #13

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.

All of Parks Run, including the stream segment evaluated in this TMDL, has the designation of High Quality Cold Water Fishes (HQ-CWF). The designation for this stream segment can be found in PA Title 25 Chapter 93.

Watershed History

The Parks Run watershed, stream code 49789 in Basin 17-B of the State Waterplan, has a drainage area of 1.25 sq. miles. The segment identified as impaired (ID# 5398) is 1.12 miles in length and flows through the north central most area of the main bituminous coal region in northwestern Pennsylvania. It is located on the Cooksburg, Sigel, Corsica, and Brookville quadrangles of the 7½-minute series topographic maps. (Attachment A)

This area was only sporadically mined from the late 19^{th} to the late 20^{th} centuries. There are no active mining permits in this watershed. The only permits issued in the watershed were P & C Coal permit# 16649 issued on 4/23/57, Robert Park MDP# 3066BSM6 issued 1/19/66, Fairview Coal Company MDP# 3875SM7 issued 6/16/76, and Doverspike Bros. Coal Company MDP# 38(a) 77SM40 issued 4/3/78. Only the latter permit has a post-mining discharge associated with it. In addition to these permitted mine sites there are two pre-permitting drift mines that were utilized for house coal.

On August 1, 1999, Doverspike Bros. Coal Company, which had been was capturing and treating the toe of spoil discharges from their mine site, filed for Chapter 7 bankruptcy protection.

All of the Parks Run Watershed has low bufering capacity and cannot 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. The following table shows the applicable water-quality criterion for pH.

Table 2 Applicable Water Quality Criteria

Parameter	Criterion value (mg/l)	Total Recoverable/ Dissolved
PH**	6 - 9	NA

- ** - 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 that includes tunnel discharges, seeps (although none were specifically identified), 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.

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.

Because LAs in this watershed were all on Parks Run, the data set was edited to include only samples that were collected on the same day. The edited data set provided a closer approximation of natural conditions present in the watershed by eliminating problems observed in unpaired flow data.

Data analysis was conducted on each data point to determine the relationship between flow and concentration for pH, alkalinity, and acidity was evaluated. There are no significant correlations between source flows and pollutant concentrations. Analyses of the data could not determine a critical flow at any sample point.

The following Table 3 shows the R Square (R^2) computed for the sample points with greater than 15 samples.

Table 3. R^2 -Flow Correlation

Point Identification	Flow vs.			Number of Samples
	pH	Alkalinity	Acidity	
Entire Data Set				
Parks Run #5	0.072532384	0.002051646	0.029440552	55
Parks Run #12A	0.129477979	0.023903561	0.605706614	37
Parks Run #9	0.089440177	0.005675753	0.080584996	66
Data Set Used For Calculation of TMDL				
Parks Run #5	0.02958028	0.11520492	0.01997973	15
Parks Run #12A	0.00962010	0.01685113	0.15446439	15
Parks Run #9	0.04593010	0.00745864	0.00003338	15

Analysis of available data for pH, alkalinity, and acidity indicates that there are no single "critical" flow conditions for pollutant sources.

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

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 99^{th} 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

Over the past fifteen years there has been a large amount of data collected for Parks Run, however, the data was not collected in a manner specifically designed for TMDL development .

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

Map 1**,** Parks Run Sample Points, shows existing sample locations.

Table 4. Major Junctions in Parks Run Watershed	
Station	Location
Parks Run #1	Parks Run at the confluence with Mill Creek 1475 MSL
Parks Run #5	At headwaters of main stream at 1675 MSL above any mining
Parks Run #9	Parks Run below confluence with the eastern and western sections 1590MSL
Parks Run #12	Parks Run below confluence from effluent from treatment system 1600MSL
Doverspike "G" Final discharge	Final effluent from Doverspike Bros. Coal Company treatment system before entering Parks Run
Parks Run #12A	Parks Run just above confluence from effluent from treatment system
Parks Run 13	South of T350 crosses 1630 – 1635 MSL some influence from I, J, & K

The flows for all of the points in the watershed were determined by using the average flows at the monitored points in the watershed. The following section shows the flow for/at each of the points used in the TMDL analysis. They will be shown in the order from downstream to upstream: Parks Run #9, Parks Run #12A, and Parks Run #5. The table identifies how the flow at each point has been determined. All of these points can be located on Map 1. The determination method is shown as either the average from sample data and the @Risk software. Data were edited to include only data that was collected at all three sample points the same day. This was necessary in order to accurately reflect the natural condition in the watershed.

Table 5. Flow at Major Junction Points in the Parks Run Watershed				
Point Identification	Average Long Term average Flow (gpm)	Determination Method	# of Samples	Date Range
Parks Run #9	154.8	Measured/monitoring data	15	7/87 to 5/91
Parks Run #12A	72.7	Measured/monitoring data	15	7/87 to 5/91
Parks Run #5	44.8	Measured/monitoring data	15	7/87 to 5/91

Parks Run Watershed (Parks Run #5, #12A, and #9)

Parks Run is listed on the 303(d) list as impaired due to pH. The "depressed pH problem" has previously been attributed to acid mine drainage (AMD) discharges in the watershed. The primary sources of AMD are the Doverspike Bros. Coal Company toe of spoil discharges (final discharge G, entering the stream between Parks Run #12A and Parks Run #12) and the influence of discharges from a very small abandoned house coal drift mine (entering into the unnamed tributary between Parks Run #6 and Parks Run #14). It is also evident that areas that are not directly affected by mining discharges have unusually low pH as well.

Although Parks Run may have been affected by abandoned discharges and seeps, the sample data shows that this stream had a depressed (< 6) pH in the headwaters above the Doverspike Bros. Coal Co. discharge. The source of the acid producing material in the headwaters does not appear to be associated with Pyrite reduction commonly found with AMD due to the low sulfate and iron values in the sample data.

TMDL Calculations Parks Run #5

Parks Run is currently on the Pa 303(d) list for impairment due to pH. Although the source of the acid producing material in the headwaters is unknown, up-stream sample data available at Parks Run #5 establishes an upstream pH of 3.7 to 8.0. pH will be addressed as part of this TMDL because the cause of impairment for the Parks Run is pH. The objective is to reduce acid loading to the stream, which will in turn raise the pH. 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.

An allowable long-term average in-stream concentration was determined at point Parks Run #5 for alkalinity 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. Table 6 shows the load allocations for this stream segment

Table 6 presents the estimated reductions needed to meet water quality standards in the Parks Run headwaters area.

Table 6. Parks Run #5

		Measured Sample Data		Allowable		Reduction Identified
Station Parks Run #5	Parameter	Conc (mg/l)	Load (lbs/day)	Conc (mg/l)	load (lbs/day)	%
	Acidity	4.60	2.47	1.47	0.79	68%
	Alkalinity	16.20	8.71			

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

The allowable loading values shown in Table 6 represent load allocations made at point Parks Run #5.

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. The average flow was used at this point to derive loading values for the TMDL.

TMDL Calculations Parks Run #12A

There are three major contributors to the impairments of Parks Run. The major contributor is the Doverspike Bros. Coal Company (Parks Run Raw) abandoned surface mine discharge. The Unnamed tributary which confluences with Parks Run just below Parks Run #12 is the 2nd largest contributor of AMD loading to the Parks Run basin. Other discharges have an influence on Parks Run and enter Parks Run just upstream of Parks Run #13. These are very small and most of the time do not reach Parks Run via the surface but may contribute some base flow.

Parks Run is currently on the Pa 303(d) list for impairment due to pH. Sample data at point Parks Run #12A shows pH ranging between 5.0 and 7.6; pH will be addressed as part of this TMDL because the cause of impairment for the Parks Run is pH. The objective is to reduce acid loading to the stream, which will in turn raise the pH. 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.

An allowable long-term average in-stream concentration was determined at point Parks Run #12A for Alkalinity 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, five thousand 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. Table 7 shows the load allocations for this stream segment.

Table 7. Parks Run #12A

	Measured Sample Data		Allowable	
Parameter	Conc (mg/l)	Load (lbs/day)	Conc (mg/l)	load (lbs/day)
Acidity	5.47	4.77	1.42	1.24
Alkalinity	12.40	10.83		

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

Allocations made at Parks Run #5 directly affect allocations made to Parks Run #12A. In an effort to determine if there is a need for any allocations at sampling point Parks Run #12A the following procedure was used.

The loading reductions for Parks Run #5 show the total load that was removed from upstream sources as shown in Table 8. This value, for each parameter, was then subtracted from the existing load at point Parks Run #12A. This value was then compared to the allowable load at point Parks Run #12A. Reductions at point Parks Run #12A are necessary if the allowable load is exceeded. Table 8. shows a summary of all loads and Table 9 illustrates the necessary reductions at point Parks Run #12A. The results of this analysis show that no additional reductions are necessary at Parks Run #12A.

Table 8. Summary of All Loads that Affect Parks Run #12A

	Acidity (#/day)	Flow (gpm)	Flow (mgd)
Parks Run #5			
existing load=	2.47	44.8	0.06
allowable load=	0.79		
load reduction=	1.68		

Table 9. Necessary Reductions at Sample Point Parks Run #12A	
	Acidity (lbs/day)
Existing Loads at Parks Run #12A	4.77
Total Load Reduction @ Parks Run #5	1.68
Remaining Load (Existing Loads at Parks Run #12A – TLR Parks Run #5)	3.09
Allowable Loads at Parks Run #12A	1.24
Percent Reduction	60%
Additional Removal Required at Parks Run #12A	1.85

The load allocation for this stream segment was computed using water-quality sample data collected at point Parks Run #12A and the allowable loads from Parks Run #5. The average flow, measured at sample point Parks Run #12A, is used for these computations. The Percent Reduction in Table 9, above, is calculated (refer to Table 9):

$$\left[1-\left(\frac{\text{Allowable Loads at Parks Run 12A}}{\text{Remaining Load (Existing Loads at Parks Run 12A - Parks Run 5}}\right)\right]\times 100\,\%$$

The TMDL for Parks Run #12A consists of load allocations for all of the parameters for the area between sampling points Parks Run #12A and Parks Run #5.

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. The average flow method was used at this point to derive loading values for the TMDL.

TMDL Calculations Parks Run #9

Since there are no active point source discharges in the watershed between Parks Run #9 and Parks Run #1 (at the confluence with Mill Creek), and because there is an absence of data for Parks Run#1, the TMDL for Parks Run consists of a load allocation at point Parks Run #9.

Parks Run is currently on the Pa 303(d) list for impairment due to pH. Sample data at point Parks Run #9 shows pH ranging between 4.0 and 8.0; pH will be addressed as part of this TMDL because the cause of impairment for the Parks Run is pH. The objective is to reduce acid loading to the stream, which will in turn raise the pH. 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.

An allowable long-term average in-stream concentration was determined at point Parks Run #12A for Alkalinity 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, five thousand 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. Table 10 shows the load allocations for this stream segment.

Table 10. Parks Run #9

		Measured Sample Data		Allowable	
Station Parks Run #9	Parameter	Conc (mg/l)	Load (lbs/day)	Conc (mg/l)	load (lbs/day)
	Acidity	3.00	5.58	1.47	2.73
	Alkalinity	13.33	24.79		

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

Allocations made at Parks Run #5 and 12A directly affect allocations made to Parks Run #9. In an effort to determine if there is a need for any allocations at sampling point Parks Run #9 the following procedure was used.

The loading reductions for Parks Run #5 and Parks Run #12A show the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point Parks Run #9. This value was then compared to the allowable load at point Parks Run #9. Reductions at point Parks Run #9 are necessary for any parameter that exceeded the allowable load at this point. Table 11 shows a summary of all loads and Table 12 illustrates the necessary reductions at point Parks Run #9. The results of this analysis show that additional reductions are necessary at Parks Run #9.

Table 11. Summary of All Loads that Affect Park #9

	Acidity (#/day)	Flow (gpm)	Flow (mgd)
Park 5			
existing load=	2.47	44.8	.06
allowable load=	.79		
load reduction=	1.68		
Additional Reduction Required at Park 12A			
existing load=	4.77	72.7	.1
allowable load=	1.24		
reduction accounted for at Park 5	1.68		
additional load reduction=	1.85		

Table 12. Necessary Reductions at Sample Point Parks Run #9

	Acidity (lbs/day)
Existing Loads at Parks Run #9	5.58
Total Load Reduction (Sum of Parks Run #5 and Parks Run #12A)	3.53
Remaining Load (Existing Loads at Parks Run #9 – TLR Sum)	2.05
Allowable Loads at Parks Run #9	2.73
Percent Reduction	0%
Additional Removal Required at Parks Run #9	0

The load allocation for this stream segment was computed using water-quality sample data collected at point Parks Run #9 and the allowable loads from Parks Run #5 and 12A. The average flow, measured at sample point Parks Run #9, is used for these computations. The Percent Reduction in Table 11, above, is calculated (refer to Table 11):

$$\left[1-\left(\frac{\text{Allowable Loads at Parks Run 9}}{\text{Remaining Load (Existing Loads at Parks Run 9 - TLR Sum Parks Run 5 and 12 A}}\right)\right]\times 100\%$$

The TMDL for Parks Run #9 consists of load allocations for all of the parameters for the area between sampling points Parks Run #9 and Parks Run #12A.

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. The average flow method was used at this point to derive loading values for the TMDL.

Summary of Allocations

Natural amelioration to date has made significant improvements in water quality in the McGourvey Run Watershed. 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.

Table 13. Summary Table – Parks Run Watershed				
Measured Sample Data	Allowable		Reduction Identified	
Parameter	Conc (mg/l)	load (lbs/day)	load (lbs/day)	%
In-stream monitoring point located at Parks Run # 5				
Acidity	1.47	0.79	1.68	68%
Alkalinity				
In-stream monitoring point located at Parks Run #12A				
Acidity	1.42	1.24	1.85	60%
Alkalinity				
In-stream monitoring point located at Parks Run #9				
Acidity	1.47	2.73	0	0%
Alkalinity				

All allocations are load allocations to non-point sources. The margin of safety for all points is applied implicitly through the methods used in the computations.

Recommendations

Although the water quality in the Parks Run Watershed does not appear significantly different now than it was in 1975 prior to any mining, this TMDL identifies numerical reduction targets. As changes occur in the watershed, the TMDL may be re-evaluated to reflect current conditions.

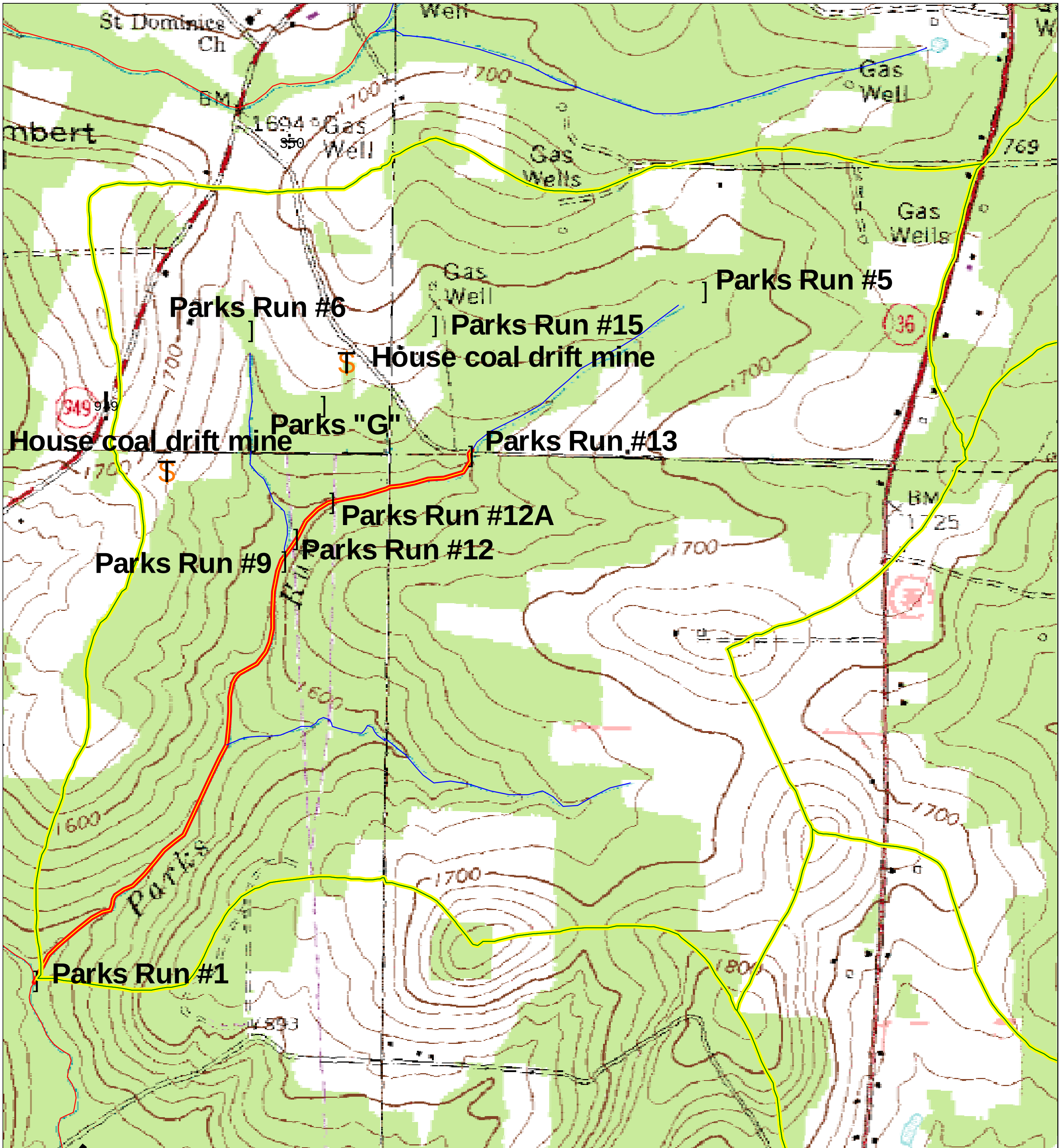
An alkalinity generating system, e.g. a diversion well, or ALD or vertical flow (SAP) treatment system constructed in the headwaters of Parks Run and near the confluence of the Parks Run Raw Final Discharge between Parks Run #12A and 12 would provide alkalinity and buffering capacity and raise the pH. Installation of these types of systems would depend upon available funding. Since there are no abandoned highwalls or unreclaimed abandoned mine lands requiring regrading and/or replanting, the only potential remediation would be to implement passive treatment of the Parks Run Raw discharge.

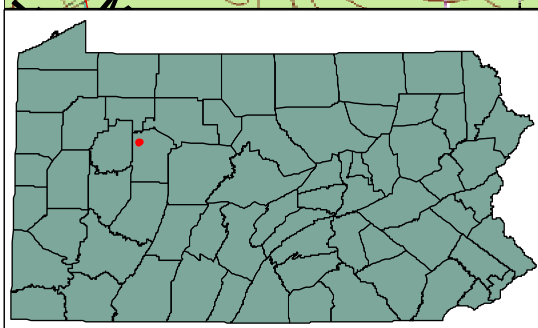
Public Participation

The public comment period on the draft TMDL document was open for 60 days, from December 16, 2000 until February 13, 2001. The Department of Environmental Protection held a public meeting on January 10, 2001 at 5:00 pm at the Holiday Inn, Exit 9 of I-80 in Clarion, to discuss and accept comments on proposed TMDL. The meeting date and comment period were published in the *Pennsylvania Bulletin* and the *Jeffersonian Democrat,* Brookville, Jefferson County, PA.

Attachment A

Location and Watershed Map of Parks Run





Parks Run Watershed

Watershed Boundary

Abandoned Mine Land Discharge

Sample Site Location

Impaired Streram Segment

Unassessed Stream Segment

Attaining Stream Segment

0.1 0 0.1 0.2 0.3 0.4 Miles

N

Attachment B

Available Data

Data Used in TMDL for PARK 5				
DATE	FLOW	5 pH	ALK	HOT A
7/8/1987	5.0	7.21	44	1
11/16/1987	9.0	6.00	1	12
3/9/1988	42.0	4.78	1	4
4/20/1988	5.0	6.00	4	1
9/22/1988	1.0	6.59	34	1
11/16/1988	5.0	5.57	30	6
3/16/1989	15.0	5.94	22	1
6/19/1989	80.0	5.04	22	6
11/20/1989	20.0	5.10	24	6
2/21/1990	80.0	8.03	26	1
5/14/1990	65.0	4.95	8	4
8/16/1990	70.0	5.64	10	2
11/19/1990	85.0	4.77	4	10
2/12/1991	60.0	4.36	1	10
5/10/1991	130.0	6.02	12	4
Data Used in TMDL for PARK 12A				
7/8/1987	132.0	7.62	24	1
11/16/1987	22.5	5.85	1	16
3/9/1988	113.0	5.30	1	4
4/20/1988	63.0	6.35	4	1
9/22/1988	5.0	6.23	12	2
11/16/1988	75.0	5.81	26	4
3/16/1989	100.0	6.09	30	6
6/19/1989	300.0	5.14	10	16
11/20/1989	40.0	5.43	6	4
2/21/1990	60.0	5.63	10	4
5/14/1990	60.0	5.86	14	4
8/16/1990	20.0	5.20	12	10
11/19/1990	40.0	5.51	6	4
2/12/1991	20.0	6.30	12	4
5/10/1991	40.0	5.76	18	2
Data Used in TMDL for PARK 9				
7/8/1987	157.0	7.26	28	1
11/16/1987	27.5	5.58	1	8
3/9/1988	176.0	5.60	1	4
4/20/1988	84.0	6.11	6	1
9/22/1988	7.0	6.16	10	2
11/16/1988	126.0	7.96	34	1
3/16/1989	125.0	6.02	24	1
6/19/1989	250.0	5.46	12	6
11/20/1989	60.0	5.56	18	4
2/21/1990	150.0	4.96	8	4
5/14/1990	200.0	5.07	14	4
8/16/1990	120.0	5.94	20	2
11/19/1990	140.0	6.51	4	1
2/12/1991	400.0	5.39	2	2
5/10/1991	300.0	5.98	18	4

Parks Run #5 Additional Data				
DATE	FLOW	pH	ALK	HOT A
4/9/1980		5.63	12.1	6.2
7/10/1980	14	6.25	6	49
9/18/1980	95	5.30	2	16
12/4/1980	340	5.05	2	41
3/2/1981	364	4.78	14	6
5/5/1981	376	4.90	14	1
8/3/1981	2	6.26	24	1
11/2/1981	160	4.87	6	1
2/8/1982		4.95	10	6
5/17/1982	12	5.51	8	1
8/24/1982	2	6.33	16	1
11/9/1982	7	7.17	6	6
3/7/1983	4	5.86	12	8
5/17/1983	32	6.12	14	1
9/9/1983	2	6.41	38	6
11/21/1983	335	5.28	32	14
1/31/1984		5.32	15	4
6/12/1984	8	6.88	6	4
7/30/1984	2.0	5.07	6	2
8/30/1984	2.0	5.07	6	2
9/28/1984	1.5	6.24	14	2
10/25/1984	1.5	5.29	12	4
11/1/1984	3.0	5.85	5	6
11/30/1984	5.0	4.46	1	5
12/11/1984	17.5	4.76	6	4
1/22/1985	3.0	6.21	10	1
2/29/1985	24.0	5.21	10	2
3/6/1985	24.0	5.21	10	2
3/22/1985	10.0	6.36	10	8
4/30/1985	10.0	6.70	12	1
5/29/1985	2.0	6.41	10	4
6/30/1985	3.0	6.16	6	1
9/18/1985	3.0	6.04	24	1
12/17/1985	42.0	5.24	18	8
3/21/1986		5.79	12	92
4/30/1986		4.24	1	10
6/20/1986	3.0	4.35	1	14
7/28/1986	5.0	3.73	1	20
11/21/1986	94.0	5.31	2	4
1/22/1987	0.0	6.50	4	1
2/12/1987	0.0	7.36	10	1
3/17/1987	5.0	6.37	8	1
4/9/1987	22.5	5.03	10	6
5/28/1987	2.5	4.59	6	52
6/4/1987	2.0	4.54	6	14
7/8/1987	5.0	7.21	44	1
11/16/1987	9.0	6.00	1	12

Parks Run #5 Additional Data				
DATE	FLOW	pH	ALK	HOT A
3/9/1988	42.0	4.78	1	4
4/20/1988	5.0	6.00	4	1
9/22/1988	1.0	6.59	34	1
11/16/1988	5.0	5.57	30	6
3/16/1989	15.0	5.94	22	1
6/19/1989	80.0	5.04	22	6
11/20/1989	20.0	5.10	24	6
2/21/1990	80.0	8.03	26	1
5/14/1990	65.0	4.95	8	4
8/16/1990	70.0	5.64	10	2
11/19/1990	85.0	4.77	4	10
2/12/1991	60.0	4.36	1	10
5/10/1991	130.0	6.02	12	4

Parks Run # 12a Additional Data				
DATE	FLOW	pH	ALK	HOT A
7/8/1987	132.00	7.62	24	1
11/16/1987	22.50	5.85	1	16
3/9/1988	113.00	5.3	1	4
4/20/1988	63.00	6.35	4	1
9/22/1988	5.00	6.23	12	2
11/16/1988	75.00	5.81	26	4
3/16/1989	100.00	6.09	30	6
6/19/1989	300.00	5.14	10	16
8/9/1989	15.00	6.23	14	1
11/20/1989	40.00	5.43	6	4
2/21/1990	60.00	5.63	10	4
5/14/1990	60.00	5.86	14	4
8/16/1990	20.00	5.2	12	10
11/19/1990	40.00	5.51	6	4
2/12/1991	20.00	6.3	12	4
4/11/1991		5	6	18.6
5/10/1991	40.00	5.76	18	2
8/7/1991	2.00	5.62	6	2
2/5/1992	20.00	6.53	12	1
4/20/1992	400.00	5.17	20	120
8/26/1992	12.00	6.51	18	1
11/11/1992	14.00	6.79	14	1
2/9/1993	7.00	7.09	32	1
5/12/1993	8.00	7.56	40	1
12/29/1993	1.00	5.27	12	6
3/15/1994	15.00	5.04	8	10
8/18/1994	18.00	7	42	1
11/10/1994	15.00	6.73	44	1
2/10/1995	3.00	6.84	20	1
4/21/1995	4.00	6.53	26	1
8/1/1995	0.50	6.62	32	1
10/25/1995	0.50	6.7	26	1
2/8/1996	7.50	6.73	34	1
1/5/1998	4.00	6.79	50	1
4/16/1998	9.00	5.76	24	14
8/24/1998	7.00	6.58	24	1
10/5/1998	2.00	6.52	34	1
1/28/1999	4.00	5.5	8	6
6/21/1999		6	8.4	0
12/9/1999		5.4	9.4	2.4

Parks Run #9 Additional Data				
DATE	**FLOW**	**pH**	**ALK**	**HOT A**
2/14/1978		5.5	2	2
7/10/1980	55.00	5.85	20.00	33.00
9/18/1980	140.00	5.30	3.00	15.00
12/4/1980	386.00	5.30	3.00	22.00
3/2/1981	840.00	4.98	6.00	5.00
5/5/1981	1306.00	5.09	16.00	4.00
8/3/1981	15.00	6.10	20.00	1.00
11/2/1981	235.00	5.06	8.00	1.00
2/8/1982		5.08	6.00	1.00
5/17/1982	22.00	5.24	8.00	1.00
8/24/1982	10.00	5.51	10.00	1.00
11/9/1982	15.00	5.96	8.00	4.00
3/7/1983	20.00	5.87	6.00	4.00
5/17/1983	101.00	4.94	12.00	4.00
9/9/1983	3.00	6.75	34.00	6.00
11/21/1983	67.00	5.23	14.00	10.00
1/31/1984		5.43	11.00	6.00
6/12/1984	20.00	6.52	6.00	4.00
7/30/1984	30.00	7.48	36.00	1.00
8/30/1984	36.00	5.61	10.00	2.00
9/28/1984	5.00	5.49	10.00	4.00
10/25/1984	12.50	5.45	8.00	2.00
10/31/1984		5.30	7.00	6.00
11/1/1984	35.00	6.46	8.00	4.00
11/30/1984	88.00	4.37	1.00	14.00
12/11/1984	101.00	4.91	6.00	2.00
1/22/1985	40.00	6.21	7.00	2.00
2/28/1985	72.00	5.60	10.00	2.00
3/22/1985	47.00	6.20	14.00	1.00
4/30/1985	28.00	6.69	6.00	5.00
5/29/1985	22.00	6.23	8.00	2.00
6/30/1985	16.00	5.44	8.00	4.00
7/2/1985		6.00	9.00	71.00
8/19/1985	30.00	6.04	16.00	4.00
9/19/1985		6.00	9.00	6.00
9/20/1985	30.00	5.76	20.00	2.00
10/14/1985	20.00	5.87	10.00	10.00
10/29/1985		5.60	8.00	10.00
11/5/1985		5.20	7.00	6.00
11/11/1985	120.00	5.34	6.00	8.00
11/21/1985		5.30	9.00	14.00
12/30/1985		6.60	40.00	0.00
1/9/1986		5.40	12.00	24.00
1/20/1986	60.00	6.52	56.00	1.00
2/26/1986		5.50	8.00	6.00
2/28/1986		5.30	14.00	4.00

Parks Run #9 Additional Data				
DATE	FLOW	pH	ALK	HOT A
3/21/1986	34.00	6.12	18.00	4.00
3/25/1986		5.50	10.00	20.00
4/29/1986		5.90	9.00	12.00
4/30/1986	30.00	7.26	102.00	1.00
5/9/1986	24.00	4.50	1.00	20.00
5/13/1986		6.50	28.00	0.00
6/2/1986	20.00	6.00	22.00	8.00
6/18/1986		5.70	9.00	34.00
6/20/1986	20.00	5.22	10.00	4.00
7/22/1986		5.50	6.00	20.00
7/28/1986	25.00	4.95	12.00	8.00
9/4/1986		5.70	9.00	12.00
10/16/1986		5.30	8.00	10.00
11/21/1986	210.00	5.82	4.00	4.00
12/4/1986		5.10	8.00	12.00
1/22/1987	0.00	6.95	4.00	1.00
2/12/1987	0.00	6.08	4.00	1.00
3/17/1987	84.00	6.30	4.00	1.00
4/9/1987	251.00	3.97	1.00	6.00
5/28/1987		6.65	22.00	4.00
6/4/1987	63.00	6.47	14.00	12.00
7/8/1987	157.00	7.26	28.00	1.00
11/16/1987	27.50	5.58	1.00	8.00
11/25/1987		5.60	8.00	26.00
3/9/1988	176.00	5.60	1.00	4.00
4/20/1988	84.00	6.11	6.00	1.00
6/15/1988		5.90	10.00	20.00
9/22/1988	7.00	6.16	10.00	2.00
11/16/1988	126.00	7.96	34.00	1.00
3/16/1989	125.00	6.02	24.00	1.00
6/18/1989		5.60	9.00	16.00
6/19/1989	250.00	5.46	12.00	6.00
8/9/1989	60.00	6.03	20.00	2.00
11/20/1989	60.00	5.56	18.00	4.00
2/21/1990	150.00	4.96	8.00	4.00
5/14/1990	200.00	5.07	14.00	4.00
8/16/1990	120.00	5.94	20.00	2.00
11/19/1990	140.00	6.51	4.00	1.00
2/12/1991	400.00	5.39	2.00	2.00
4/10/1991		5.10	6.00	12.40
5/10/1991	300.00	5.98	18.00	4.00
7/25/1991		6.40	9.00	2.20
8/7/1991	7.50	6.29	10.00	2.00
11/20/1991		6.50	16.00	0.00
1/28/1992		5.90	8.00	8.60
2/5/1992		6.27	6.00	4.00
4/20/1992	600.00	5.34	22.00	96.00

Parks Run #9 Additional Data				
DATE	**FLOW**	**pH**	**ALK**	**HOT A**
6/17/1992		6.30	11.00	6.00
8/26/1992		5.19	10.00	32.00
9/17/1992		6.10	9.00	12.00
10/29/1992		5.70	5.00	5.40
11/11/1992		6.13	10.00	218.00
2/9/1993		5.50	10.00	2.00
4/6/1993		5.40	9.00	14.20
5/12/1993		6.76	12.00	1.00
5/20/1993		5.60	7.00	5.00
6/23/1993		6.20	12.00	4.80
7/30/1993	25.00	6.01	18.00	4.00
8/19/1993		6.20	12.00	4.40
10/14/1993		5.10	13.80	6.40
12/29/1993	350.00	4.95	10.00	10.00
3/15/1994	450.00	6.00	6.00	10.00
6/17/1994		5.76	6.00	26.00
8/18/1994		4.99	8.00	12.00
10/19/1994		6.10	11.80	0.00
11/10/1994		4.75	10.00	18.00
2/10/1995		5.70	12.00	20.00
3/7/1995		5.30	8.20	14.00
4/5/1995		5.20	8.00	14.40
4/21/1995		5.21	20.00	8.00
7/17/1995		6.20	13.60	4.40
10/10/1995		6.20	13.40	10.00
3/11/1996		5.60	7.80	4.40
5/21/1996		5.90	9.00	16.40
7/17/1996		6.00	10.40	1.00
5/5/1997		5.60	10.20	9.80
8/11/1997		6.00	12.20	0.20
10/23/1997		6.00	10.80	8.60
2/12/1998		5.50	7.80	3.00
12/18/1998		6.00	10.20	0.00
6/21/1999		6.20	13.20	0.00
12/9/1999		5.60	9.60	1.60
2/29/2000		5.10	8.00	3.20

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

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[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.

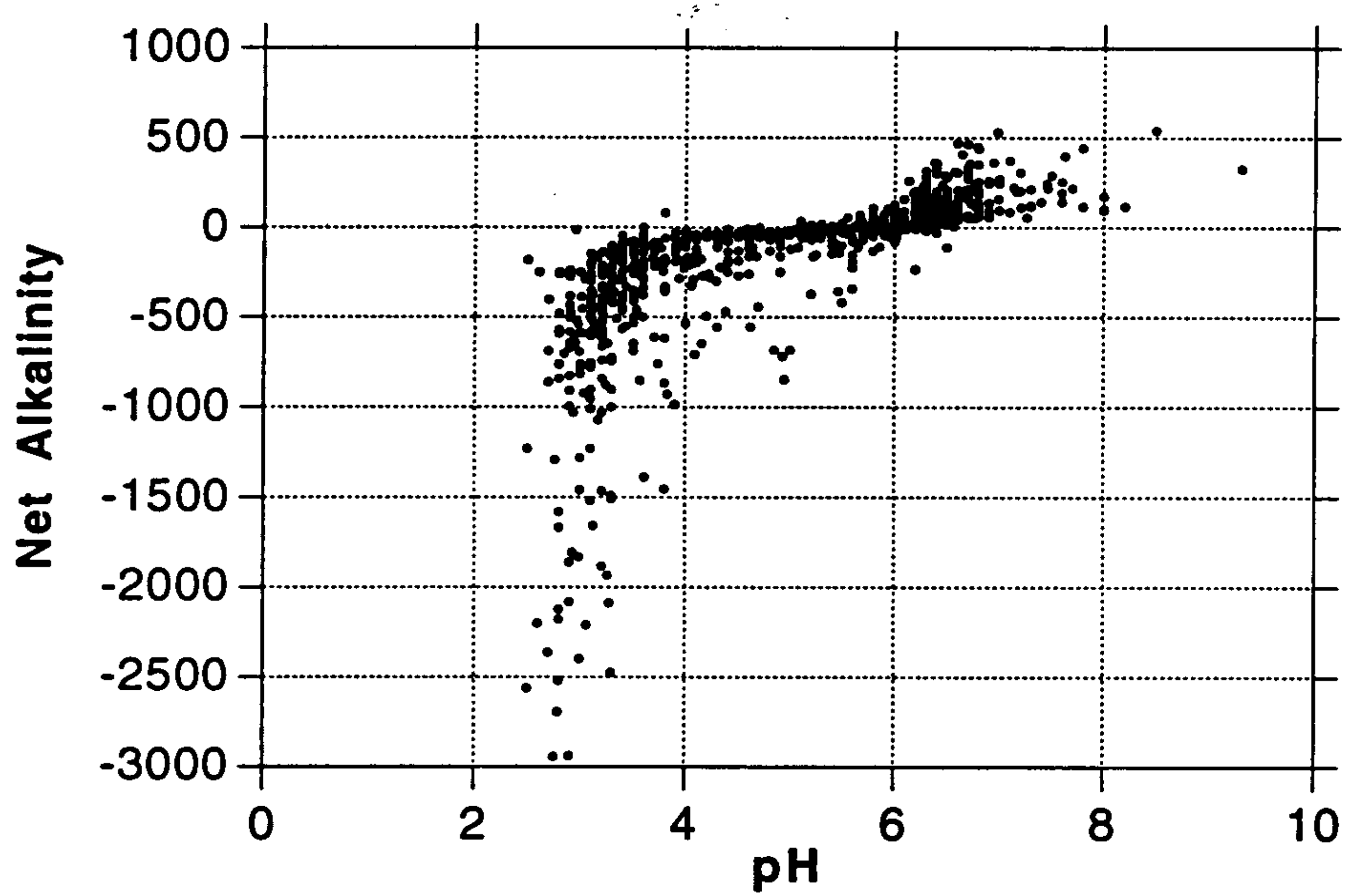

Figure 1.2, Graph C, net alkalinity vs. pH, page 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in PA

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.

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

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 Parks Run TMDL

EPA Region III Comments:

Comment:
The values for alkalinity existing concentration and loads in Tables 6, 7, and 10 are actually the values for acidity. The error seems to have occurred in the Park Risk.xls spreadsheet and it appears that all of these TMDLs are incorrectly calculated. The accuracy of the calculations must be verified.
Response:
These errors have been corrected, and the TMDL has been recalculated using the matched data as described in the TMDL. All tables have been corrected to reflect the recalculation of the TMDL.

The following comments must be addressed to confirm assumptions made during EPA's review of the TMDL report.

Comment:
For the Doverspike Bros. Company mining permit provide the effluent limits together with any monitoring data.
Response:
The following data were available for the Doverspike Bros. Company discharge.
Monitoring Data for the Doverspike Bros. Company Discharge

COLL	DATE	FLOW	pH	ALK	HOT A
	3/15/1994	55.00	4.81	8	12
	6/17/1994	14.00	5.74	8	24
	8/18/1994	17.00	6.3	12	12
	11/10/1994	17.00	5.71	12	12
	4/21/1995	14.00	4.93	10	6
	8/1/1995	1.50	4.58	32	26
	10/25/1995	0.50	5.03	10	24
	2/8/1996	15.20	4.12	20	20
4204-037	11/3/1999	0.50	6.8	94	0
4204-088	12/9/1999	1.50	5.8	58	146
4204-910	12/14/1999	5.00	5.8	60	134

Comment:
Table 4 and the TMDL Calculations Parks Run #12A section refer to discharges I, J, and K, please further describe and provide any existing data.
Response:
Data were not available for the discharges listed above, so the text was edited to not address the discharges specifically.

Comment:

Any remediation measures to address identified water quality problems may benefit certain threatened and endangered species in certain watersheds by improving water quality. However, in some instances, these measures have the potential to adversely affect federally listed species; therefore, further consultation will be necessary to identify and address these cases as described above.

Response:

Detailed remediation and implementation plans are not required as part of the TMDL submittal and have not been completed at this time. All current regulations will be followed and threatened and endangered species will be protected in developing a remediation plan for the watershed.