THOMPSON RUN WATERSHED
FINAL TMDL
Allegheny County

Prepared for:

Pennsylvania Department of Environmental Protection

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Introduction

A Total Maximum Daily Load (TMDL) document was developed for stream segments in the Thompson Run Watershed (Attachment A), originally listed on the 1996 Pennsylvania Section 303(d), list of impaired waters. This report supersedes and replaces the Thompson Run Watershed TMDL report approved by the U.S. Environmental Protection Agency (EPA), Region 3 on April 9, 2003. The 2014 Pennsylvania Integrated Water Quality Monitoring and Assessment Report, Streams, Category 4a and 5 Waterbodies, Pollutants Requiring a TMDL (Integrated List) identified high levels of metals (primarily aluminum and iron) associated with abandoned mine drainage as causes of impairment (Table 1).

Table 1. Impaired Waters List for the Anderson Creek

2014 Pennsylvania Integrated Water Quality Monitoring and Assessment Report - Streams, Category 4a and 5 Waterbodies, Pollutants Requiring a TMDL

Stream Name / HUC / Use Assessed (Assessment ID) - Miles / Source	Cause	Date Listed	TMDL Date
Hydrologic Unit Code: 05020005-Lower Monongahela			
Thompson Run / HUC: 05020005 / Aquatic Life (7591) - 4.31 miles / Abandoned Mine Drainage	Metals	1996	2009
Thompson Run Unnamed To (ID:134839836) / HUC: 05020005 / Aquatic Life (7591) - 0.57 miles / Abandoned Mine Drainage	Metals	1996	2009
Thompson Run Unnamed To (ID:99407928) / HUC: 05020005 / Aquatic Life (7591) - 0.68 miles / Abandoned Mine Drainage	Metals	1996	2009
Thompson Run Unnamed To (ID:99408016) / HUC: 05020005 / Aquatic Life (7591) - 0.57 miles / Abandoned Mine Drainage	Metals	1996	2009

Directions to the Thompson Run Watershed

The Thompson Run Watershed is approximately 5.5 square miles in area. It is located in southern Allegheny County, about 11 miles southeast of Pittsburgh, Pennsylvania. Thompson Run can be accessed by taking State Highway 837 South from Pittsburgh about one third of a mile past Kennywood Amusement Park, where it crosses over Thompson Run near the confluence with the Monongahela River.

Segments addressed in this TMDL

All discharges in the watershed from abandoned mines will be treated as non-point sources. All NPDES permitted discharges will be treated as point sources and assigned wasteload allocations (WLAs). These NPDES permittees in the Thompson Run Watershed are listed in Table 3 (page 8). Table 4 (page 9) presents the TMDLs and estimated reductions identified for all allocation points in the watershed, while Attachment D gives detailed TMDLs by segment analysis for each allocation point.

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 Thompson Run segment in Category 5the Section 303(d) list will be addressed as in this TMDL. TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment D for TMDL calculations.

Clean Water Act Requirements

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

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

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);
- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;
- States to submit the list of waters to USEPA every two years (April 1 of the even numbered years);
- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and nonpoint sources; and
- USEPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

Despite these requirements, states, territories, authorized tribes, and USEPA have not developed many TMDLs since 1972. Beginning in 1986, organizations in many states filed lawsuits against the USEPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While USEPA has entered into consent agreements with the plaintiffs in several states, many lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require USEPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.). These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA*.

Section 303(d) Listing Process

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

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

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

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

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

two pollutants, two TMDLs must be developed for that stream segment. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

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

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculate TMDL for the waterbody using USEPA approved methods and computer models;
3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;
5. Submit draft report for public review and comments; and
6. USEPA approval of the TMDL.

Watershed History

Thompson Run is part of the Ohio River Basin in Allegheny County and drains directly into the Monongahela River. Allegheny County is located in the Appalachian Plateaus Province, which consists of ridge tops about 1200 feet in elevation. Thompson Run originates at approximately 1040 feet in elevation and enters the Monongahela River at approximately 820 feet in elevation.

The land area of Thompson Run and that along the Monongahela River is mainly intensive industrial, commercial, and residential uses. The tributaries of Thompson Run originate in semi-rural and residential areas and flow through some light industrial areas. Some small lengths of these tributaries are piped under developed areas, but the majority of Thompson Run and its tributaries are not piped. The main branch of Thompson Run flows alongside the Union Railroad tracks and their rail yard. A lot of this area has been disturbed by slag disposal, as labeled and shown on the map in Attachment A in a purple stipple pattern. This slag dump is currently being studied for a reclamation project. Just before Thompson Run empties into the Monongahela River, it runs alongside a heavy industrial area.

Much of the soil has been greatly altered and is covered by buildings and other urban structures. Areas beyond the intensively used urban core are under continuing suburban development. There are no areas of subsidence within the watershed. Depth to bedrock, seasonably high water table, and susceptibility to landslides are common limitations to suburban development.

The Pittsburgh coal seam has been extensively deep mined in this area in the early 1900's to the 1950's. Not much surface mining has occurred in this area due to such congested land development. Both types of mining have affected ground and surface water in the area.

TMDL Endpoints

One of the major components of a TMDL is the establishment of an instream numeric endpoint, which is used to evaluate the attainment of applicable water quality. An instream numeric endpoint, therefore, represents the water quality goal that is to be achieved by implementing the load reductions specified in the TMDL. The endpoint allows for comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards. Table 2 shows the applicable numeric criteria for the selected parameters considered during the TMDL development process to address the metals impairment of AMD-affected stream segments.

Because of the nature of the pollution sources in the watershed, the TMDLs component makeup will be load allocations that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. The aluminum criterion is located in Pennsylvania Title 25 Chapter 16.102 and is expressed as an instantaneous maximum value. The endpoint for each segment is the long-term average determined using Monte Carlo simulation as discussed in Attachment B. The calculations of the long-term averages for each stream segment is included in Attachment D. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pennsylvania Title 25 Chapter 96.3(c) specifies that the water quality standards must be met 99% of the time.

The iron criterion is located in [insert citation] and is expressed as a 30-day average. The iron TMDLs are expressed at total recoverable as the iron data used for this analysis was reported as total recoverable. Therefore, the Monte Carlo simulation run for aluminum, which generates a long term allowable concentration meant to ensure that in-stream concentrations don't exceed the criterion, is not appropriate for iron as the water quality criterion is expressed as a 30-day average. The long term average allowable daily concentrations necessary to ensure meeting a 30-day average criterion is really the actual water quality criterion. In other words, a 1.5 mg/l long term allowable daily concentration will also ensure meeting a 30-day average of 1.5 mg/l. To be conservative, a 20% MOS will be taken on the allowable load calculations for iron.

Table 2. Applicable Water Quality Criteria

Parameter	*Criterion Value (mg/l)*	*Total Recoverable/Dissolved*
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50	30-day average; Total
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission).

TMDL Elements (WLA, LA, MOS)

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to nonpoint sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load).

Manganese

The 2003 Thompson Run TMDL included TMDLs for Mn in the Thompson Run watershed. This was done in error as the potable water supply (PWS) use has been deleted from Thompson Run and Mn is a PWS parameter. Those TMDLs have been removed from Thompson Run in this 2015 TMDL revision.

Other Inorganics

There currently is no entry for Thompson Run on the Pa Section 303(d) list for impairment due to sulfates. Although water quality data indicates high sulfate concentrations in Thompson Run, no TMDL will be completed for sulfates. The nearest potable water supply intake is located approximately 8 miles downstream of the mouth of Thompson Run at the PA-American Water Company Pittsburgh Plant (PWSID #5020039)), which intakes its water from the Monongahela River. Water Quality data from WQN Station 701 located approximately 3 miles downstream of Thompson Run shows that sulfate criteria of 250 mg/L is not exceeded. The average sulfate concentration, calculated from 10 years of WQN sulfate data is 105 mg/L. Due to Title 25 Chapter 96.3(d) a TMDL to address sulfates is not necessary. A map of the water supply intake and WQN Station is located in Appendix A and sulfate data for the WQN Station is located in Appendix F, Allocation Summary. Additionally, the PWS use has been deleted from Thompson Run and sulfate is a PWS criterion.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions.Table 3 is a summary of NPDES point sources receiving allocations in the Thompson Run Watershed. Table 4 presents the estimated reductions identified for all points in the watershed. Attachment D gives detailed TMDLs by segment analysis for each allocation point.

Table 3. Summary of Point Sources Receiving Allocations in the Thompson Run

NPDES Pemits in the Thompson Run Watershed

Site	Segment	Permit #	Township	Outfalls	Receiving Stream	Aluminum WLA	Iron WLA
Pittsburgh Storm Sewer MS4	**151**	PAI136133	Pittsburgh	008	Stormwater	0.08	0.14
Lafarge - Duquesne Slag	**151**	PA0004278	West Mifflin	001	Treated Abandoned Mine Disch.	1.03	2.95
				002	Proposed Stormwater		
				003	Proposed Stormwater		
Allegheny County Airport	**151**	PAR806134	West Mifflin	007	Stormwater	0.38	0.75
				008	Stormwater		
				009	Stormwater		
				013	Stormwater		
				014	Stormwater		
				016	Stormwater		
Allegheny Co. Port Authority	**151**	PA0093882	West Mifflin	001	Stormwater	0.19	0.38
				003	Stormwater		
				004	Stormwater		
Keywell Metals	**151**	PAG036124	West Mifflin	001		0.70	1.40
West Mifflin Boro. Storm Sewer MS4	**151**	PAG136166	West Mifflin	001		0.50	0.50
TOTAL 151						**2.88**	**6.12**
U.S. D.O.E. - Bettis Atomic Power Lab	**152**	PA0000914	West Mifflin	006	Stormwater	0.20	0.22
TOTAL 152						**0.20**	**0.22**
West Mifflin Boro. Storm Sewer MS4	**155**	PAG136166	West Mifflin	478	Stormwater	4.75	10.00
Thompson Run STP	**155**	PA0026506	West Mifflin	001	Treated Sewage	0.03	0.06
				102	Stormwater		
				103	Stormwater		
				104	Stormwater		
TOTAL 155						**4.78**	**10.06**
Duquesne STP	**156**	PA0026981	Duquesne	001	Treated Sewage	0.03	0.06
				SW - 010	Stormwater		
				CSO - 004	Combined Sewage Overflow		
				CSO - 005	Combined Sewage Overflow		
Transtar - Maint. Of Way	**156**	PAR806280	Duquesne	002A	Stormwater	4.08	7.13
				002B	Stormwater		
TOTAL 156						**4.11**	**7.19**

The permits shown above in Table 3 are within the boundaries of the Thompson Run Watershed, with most receiving individual wasteload allocations in this TMDL. In determining appropriate WLAs for certain point source dischargers that may only discharge the pollutants of concern in negligible amounts, 2% of the total allowable load for that segment was set-aside for each outfall to account for any trace amounts of the pollutants of concern from the discharges. In making the determination that the pollutants of concern are discharged in negligible amounts, DEP considered one or more of the following: 1) This class of discharge is not a significant contributor pollutants concern as addressed in the TMDL, 2) The discharge concentration is at or below the level of the instream water quality criterion value for the parameters of concern, 3) The discharge does not cause or contribute to a downstream impairment, or 4) The discharge has been evaluated via the reasonable potential analysis to discharge the pollutants of concern at current levels. These types of discharges generally fall into one of two categories: 1) permits with non-numeric effluent limitations; and 2) permits that have numeric effluent limitations for some parameters but do not contain numeric effluent limits for the parameters of concern addressed in this TMDL document.

Table 4. Estimated Reductions Identified For TMDL Points in the Thompson Run

Instream Point	*Parameter*	*Measured Data*		*Allowable*				*Reduction*	*Identified*
		Conc. (mg/l)	*Existing Load (lbs./day)*	*LTA Conc. (mg/l)*	*TMDL Load (lbs./day*	*WLA lbs./day*	*LA lbs./day*	*Load lbs./day*	*Percent*
151						**Thompson Run In-stream Monitoring Point**			
	Al	2.60	13.6	0.57	3.0	(2.88 PS WLA + 0.06 Future Growth) 2.94	0.06	10.6	78
	Fe	3.55	18.6	1.2	6.3	(6.12 PS WLA + 0.13 Future Growth) 6.25	0.05	12.3	66
	Acidity	20.00	104.5	20.00	104.5				0
152						**Thompson Run In-stream Monitoring Point**			
	Al	3.81	45.7	0.50	5.9	0.20 PS WLA + 0.12 Future Growth) 0.32	5.58	39.8	87
	Fe	0.86	10.3	1.2	14.4	0.22 PS WLA + 0.29 Future Growth) 0.51	13.89	0	0
	Acidity	6.61	79.4	6.61	79.4				0
153							**Mouth of Tributary 37452**		
	Al	2.72	0.20	0.11	0.01	0.0002	0.0098	0.19	95
	Fe	4.88	0.35	1.2	0.09	0.0018	0.0882	0.26	74
	Acidity	30.67	2.4	30.67	2.4				0
155							**Thompson Run In-stream Monitoring Point**		
	Al	2.06	83.1	0.12	5.0	(4.78 WLA) + 0.10 Future Growth) 4.88	0.12	78.1	94
	Fe	0.77	31.2	1.2	48.4	(10.06 WLA + 0.97 Future Growth) 11.03	37.37	0	0
	Acidity	14.50	585.5	14.50	585.5				0
156							**Thompson Run In-stream Monitoring Point**		
	Al	1.27	46.1	0.38	13.8	(4.11 PS WLA + 0.28 Future Growth) 4.39	9.41	32.3	70

Instream Point	***Parameter***	***Measured Data***		***Allowable***				***Reduction***	***Identified***
		Conc. (mg/l)	***Existing Load (lbs./day)***	***LTA Conc. (mg/l)***	***TMDL Load (lbs./day***	***WLA lbs./day***	***LA lbs./day***	***Load lbs./day***	***Percent***
	Fe	0.55	20.0	1.2	43.4	(7.19 PS WLA + 0.87 Future Growth) 8.06	35.34	0	0
	Acidity	10.50	380.8	10.50	380.8				0

Recommendations

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

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

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

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

Mine reclamation and well plugging refers to the process of cleaning up environmental pollutants and safety hazards associated with a site and returning the land to a productive condition, similar to DEP's Brownfields program. Since the 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphaned wells. Realizing this task is no small order, DEP has developed concepts to make abandoned mine reclamation easier. These concepts, collectively called Reclaim PA, include legislative, policy land management initiatives designed to enhance mine operator, volunteer land DEP reclamation efforts.

Reclaim PA has the following four objectives:

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

Located within the watershed are two small reclamation projects under the Government Financed Construction Contract (GFCC) program. Both of these contracts will remine abandoned Pittsburgh coal seam deep mines and close deep mine voids to reduce the amount of acid mine drainage produced in the immediate area. The first contract, located in West Homestead Borough, will remine approximately 4.3 acres of the Pittsburgh coal seam while reclaiming 4.3 acres of subsidence and spoil. This contract will also eliminate 800 feet of and abandoned highwall. The second contract, located in Munhall Borough, will remine approximately 2.1 acres of the Pittsburgh coal seam.

There currently is no watershed association in the Thompson Run watershed. It is recommended that agencies work with local interests to form a watershed organization. This watershed organization could then work to implement projects to achieve the reductions recommended in this TMDL document.

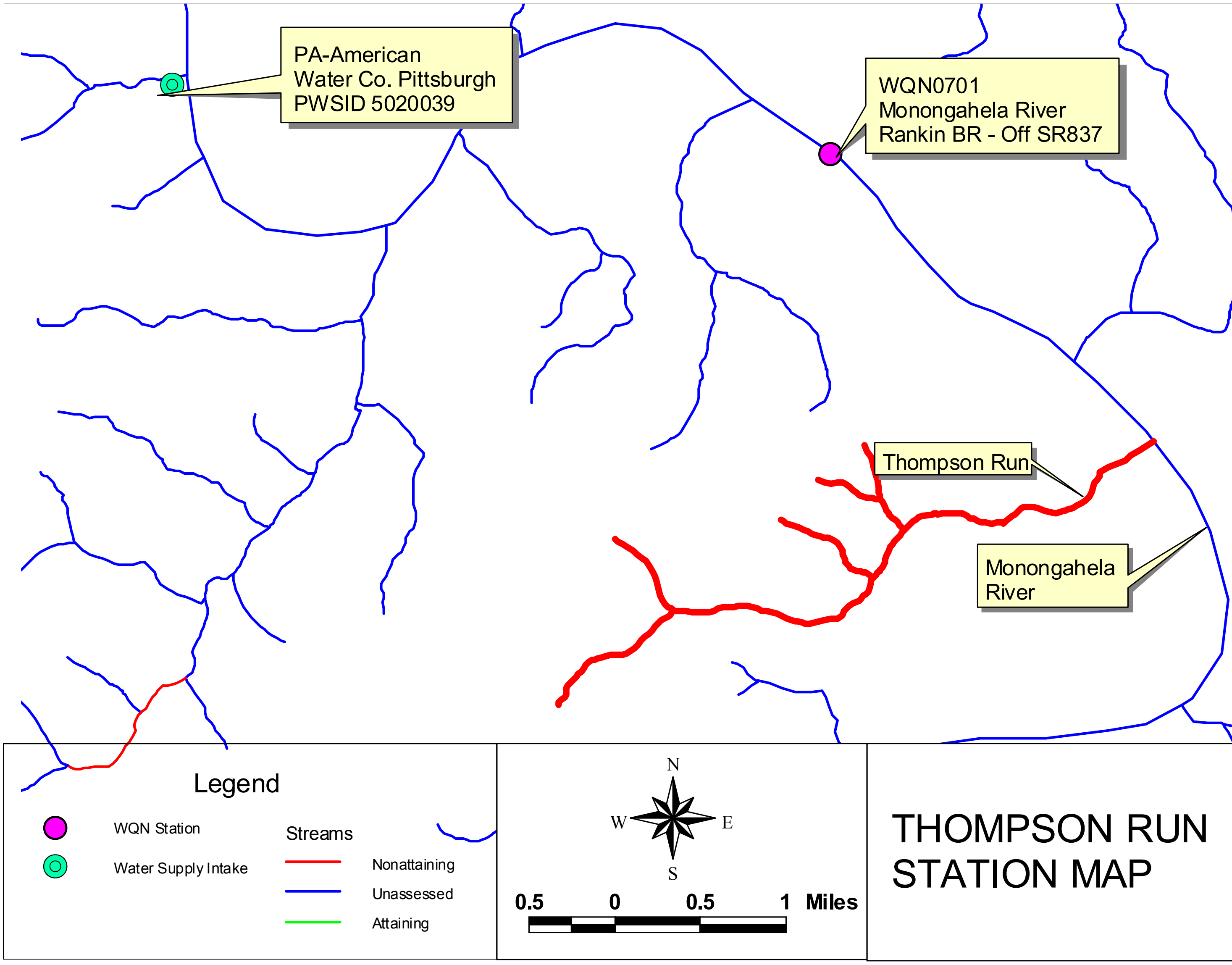
Public Participation

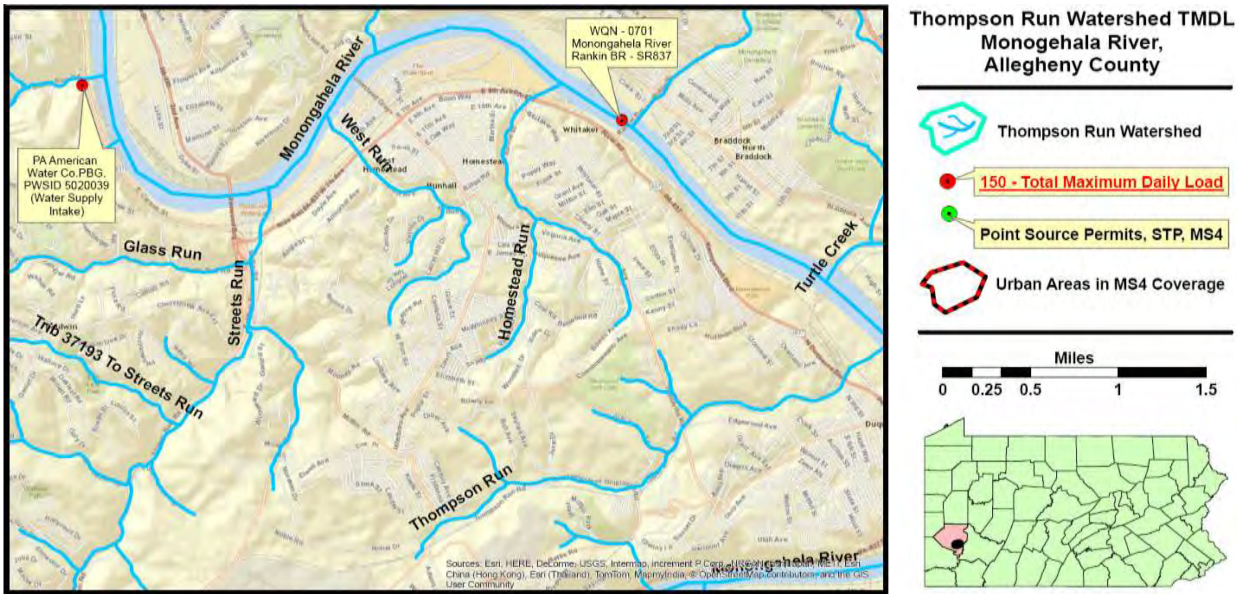
Public notice of the draft TMDL was originally published in the *Pennsylvania Bulletin* on December 21, 2002 and the *Pittsburgh Post Gazette* on January 16, 2003, to foster public comment on the allowable loads calculated. A public meeting was held on January 23, 2003, at 7 pm at the West Mifflin Municipal Building in West Mifflin, PA, to discuss the proposed Thompson Run Watershed TMDL report. The report was then approved by the U.S. Environmental Protection Agency (EPA), Region 3 on June 6, 2003.

The Thompson Run Watershed TMDL was then revised as of August 2015, to update and incorporate current waste load allocations. Since this new report supersedes and replaces the old TMDL report (2003), a draft was published in the *Pennsylvania Bulletin* on August 29, 2015 to foster public comment on the allowable loads calculated. The Department will consider all comments in developing the final TMDLs, which will be submitted to EPA for approval. They must be postmarked by 30 days, after publication in the PA Bulletin. Any comments and responses will be placed in Appendix G, page 46.

Attachment A

Thompson Run Watershed Maps


PA-American
Water Co. Pittsburgh
PWSID 5020039
WQN0701
Monongahela River
Rankin BR - Off SR837
Thompson Run
Monongahela
River
Legend
WQN Station
Water Supply Intake
Streams
Nonattaining
Unassessed
Attaining
N
W
E
S
0.5 0 0.5 1 Miles
THOMPSON RUN
STATION MAP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Thompson Run Watershed
150 - Total Maximum Daily Load
Point Source Permits, STP, MS4
Urban Areas in MS4 Coverage
Miles
0 0.25 0.5 1 1.5
WQN - 0701
Monongahela River
Rankin BR - SR837
PA American Water Co.PBG. PWSID 5020039 (Water Supply Intake)
Monongahela River
West Run
Glass Run
Streets Run
Trib 37193 To Streets Run
Homestead Run
Thompson Run
Turtle Creek


BALDWIN
MUNHALL
WEST MIFFLIN
NORTH VERSAILLES
PITTSBURGH
DUQUESNE
DRAVOSBURG
MCKEESPORT
Duquesne STP
Transtar - Maintenance ROW
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150 - Total Maximum Daily Load
Point Source Permits, STP, MS4
Urban Areas in MS4 Coveraage
(The whole watershed is included)
Miles
0 0.25 0.5 1 1.5
WQN - 0701
Monongahela River
Rankin BR - SR837
PA American
Water Co.PBG.
PWSID 5020039
(Water Supply
Intake)
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West Run
Glass Run
Streets Run
Trib 37193 To Streets Run
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Thompson Run STP
Transtar - Maintenance ROW
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Attachment B

AMD Methodology, the pH Method, and Surface Mining Control and Reclamation Act

AMD Methodology

Two approaches are used for the TMDL analysis of AMD-affected stream segments. Both of these approaches use the same statistical method for determining the instream allowable loading rate at the point of interest. The difference between the two is based on whether the pollution sources are defined as discharges that are permitted or have a responsible party, which are considered point sources. Nonpoint sources are then any pollution sources that are not point sources.

For situations where all of the impact is due to nonpoint sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are only point-source impacts or a combination of point and nonpoint sources, the evaluation will use the point-source data and perform a mass balance with the receiving water to determine the impact of the point source.

TMDLs and load allocations for each pollutant were determined using Monte Carlo simulation. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[2] by performing 5,000 iterations to determine any required percent reduction so that the water quality criteria will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

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

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

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

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

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

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

LTA = Mean * (1 – PR99) where (2)
LTA = allowable LTA source concentration in mg/l

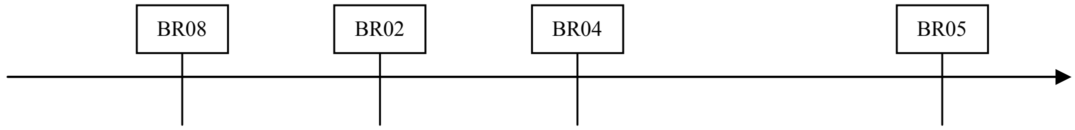
Once the required percent reduction for each pollutant source was determined, a second series of Monte Carlo simulations were performed to determine if the cumulative loads from multiple sources allow instream water quality criteria to be met at all points at least 99 percent of the time. The second series of simulations combined the flows and loads from individual sources in a step-wise fashion, so that the level of attainment could be determined immediately downstream of each source. Where available data allowed, pollutant-source flows used were the average flows. Where data were insufficient to determine a source flow frequency distribution, the average flow derived from linear regression was used.

In general, these cumulative impact evaluations indicate that, if the percent reductions determined during the first step of the analysis are achieved, water quality criteria will be achieved at all upstream points, and no further reduction in source loadings is required.

Where a stream segment is listed on the Section 303(d) list for pH impairment, the evaluation is the same as that discussed above; the pH method is fully explained in Attachment B. An example calculation from the Swatara Creek TMDL, including detailed tabular summaries of the Monte Carlo results, is presented for the Lorberry Creek TMDL in Attachment C. Information for the TMDL analysis performed using the methodology described above is contained in the TMDLs by segment section of this report in Attachment D.

Accounting for Upstream Reductions in AMD TMDLs

In AMD TMDLs, sample points are evaluated in headwaters (most upstream) to stream mouth (most downstream) order. As the TMDL evaluation moves downstream the impact of the previous, upstream, evaluations must be considered. The following examples are from the Beaver Run AMD TMDL (2003):



In the first example BR08 is the most upstream sample point and BR02 is the next downstream sample point. The sample data, for both sample points, are evaluated using @Risk (explained above) to calculate the existing loads, allowable loads, and a percentage reduction for aluminum, iron, manganese, and acidity (when flow and parameter data are available).

Any calculated load reductions for the upstream sample point, BR08, must be accounted for in the calculated reductions at sample point BR02. To do this (see table A) the allowable load is subtracted from the existing load, for each parameter, to determine the total load reduction.

Table A	Alum.	Iron	Mang.	Acidity
BR08	(#/day)	(#/day)	(#/day)	(#/day)
existing load=	3.8	2.9	3.5	0.0
allowable load=	3.8	2.9	3.5	0.0
TOTAL LOAD REDUCTION=	**0.0**	**0.0**	**0.0**	**0.0**

In table B the Total Load Reduction BR08 is subtracted from the Existing loads at BR02 to determine the Remaining Load. The Remaining Load at BR02 has the previously calculated Allowable Loads at BR02 subtracted to determine any load reductions at sample point BR02. This results in load reductions for aluminum, iron and manganese at sample point BR02.

Table B. Necessary Reductions at Beaver Run BR02

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR02	13.25	38.44	21.98	6.48
Total Load Reduction BR08	0.00	0.00	0.00	0.00
Remaining Load (Existing Load at BR02 - BR08)	13.25	38.44	21.98	6.48
Allowable Loads at BR02	2.91	9.23	7.03	6.48
Percent Reduction	78.0%	76.0%	68.0%	NA
Additional Removal Required at BR02	10.33	29.21	14.95	0.00

At sample point BR05 this same procedure is also used to account for calculated reductions at sample points BR08 and BR02. As can be seen in Tables C and D this procedure results in additional load reductions for iron, manganese and acidity at sample point BR04.

At sample point BR05 (the most downstream) no additional load reductions are required, see Tables E and F.

Table C	Alum.	Iron	Mang.	Acidity
BR08 & BR02	(#/day)	(#/day)	(#/day)	(#/day)
Total Load Reduction=	**10.33**	**29.21**	**14.95**	**0.0**

Table E	Alum.	Iron	Mang.	Acidity
BR08 BR02 &BR04	(#/day)	(#/day)	(#/day)	(#/day)
Total Load Reduction=	10.3	29.2	14.9	0.0

Table D. Necessary Reductions at Beaver Run BR04

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR04	12.48	138.80	54.47	38.76
Total Load Reduction BR08 & BR02	10.33	29.21	14.95	0.00
Remaining Load (Existing Load at BBR04 - TLR Sum	2.15	109.59	39.53	38.76
Allowable Loads at BR04	8.99	19.43	19.06	38.46
Percent Reduction	NA	82.3%	51.8%	0.8%
Additional Removal Required at BR04	0.00	90.16	20.46	0.29

Table F. Necessary Reductions at Beaver Run BR05

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR05	0.0	31.9	22.9	4.1
Total Load Reduction BR08, BR02 & BR04	10.3	119.4	35.4	0.3
Remaining Load (Existing Load at BBR05 - TLR Sum	NA	NA	NA	3.8
Allowable Loads at BR05	0.0	20.4	15.1	4.1
Percent Reduction	NA	NA	NA	NA
Additional Removal Required at BR05	0.0	0.0	0.0	0.0

Although the evaluation at sample point BR05 results in no additional removal this does not mean there are no AMD problems in the stream segment BR05 to BR04. The existing and allowable loads for BR05 show that iron and manganese exceed criteria and, any abandoned mine discharges in this stream segment will be addressed.

Method for Addressing Section 303(d) Listings for pH

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

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

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

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

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

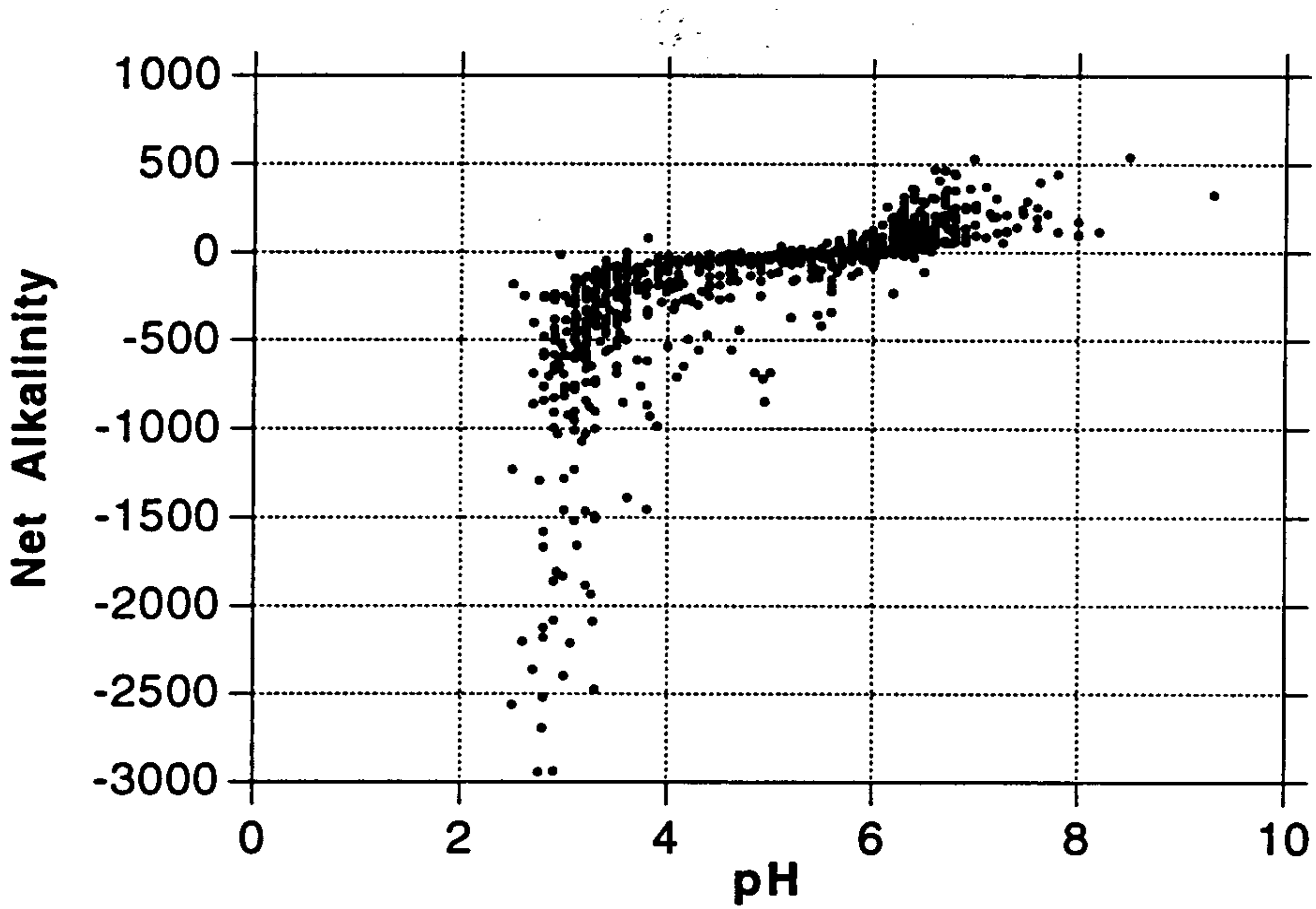


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Surface Mining Control and Reclamation Act

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to established a nationwide program to, among other things, protect the beneficial uses of land or water resources, and pubic health and safety from the adverse effects of current surface coal mining operations, as well as promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by the regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA, (often called "pre-law" mines) are not subject to the requirements of SMCRA.

Title IV of the Act is designed to provide assistance for reclamation and restoration of abandoned mines, while Title V states that any surface coal mining operations shall be required to meet all applicable performance standards. Some general performance standards include:

- Restoring the affected land to a condition capable of supporting the uses which it was capable of supporting prior to any mining,

- Backfilling and compacting (to insure stability or to prevent leaching of toxic materials) in order to restore the approximate original contour of the land with all highwalls being eliminated, and topsoil replaced to allow revegetation, and

- Minimizing the disturbances to the hydrologic balance and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by avoiding acid or other toxic mine drainage.

For purposes of these TMDLs, point sources are identified as NPDES-permitted discharge points, and nonpoint sources include discharges from abandoned mine lands, including but not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no NPDES permits associated with these areas. In the absence of an NPDES permit, the discharges associated with these land uses were assigned load allocations.

The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

Related Definitions

Pre-Act (Pre-Law) - Mines that ceased operating by the effective date of SMCRA and are not subject to the requirements of SMCRA.

Bond – A instrument by which a permittee assures faithful performance of the requirements of the acts, this chapter, Chapters 87-90 and the requirements of the permit and reclamation plan.

Postmining pollution discharge – A discharge of mine drainage emanating from or hydrologically connected to the permit area, which may remain after coal mining activities have been completed, and which does not comply with the applicable effluent requirements described in Chapters 87.102, 88.92, 88.187, 88.292, 89.52 or 90.102. The term includes minimal-impact postmining discharges, as defined in Section of the Surface Mining Conservation and Reclamation Act.

Forfeited Bond – Bond money collected by the regulatory authority to complete the reclamation of a mine site when a permittee defaults on his reclamation requirements.

Attachment C

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 percent 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. 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 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 best available technology (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 Shadle Discharge. However, there is additional flow from overland runoff and one unnamed tributary not impacted by mining. It is reasonable to assume that the additional flow provides assimilation capacity below point L-1, and no further analysis is needed downstream.

The calculations are detailed in the following section (Tables 1-8). Table 9 shows the allocations made on Lorberry Creek.

1. A series of four equations was 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 (SWAT 04)

	Field Description	Equation	Explanation
1	Swat-04 Initial Concentration Value (Equation 1A)	= Risklognorm (Mean, St Dev)	This simulates the existing concentration of the sampled data.
2	Swat-04 % Reduction (from the 99th percentile of percent reduction)	= (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-percent 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 5,000 iterations of the equation in row four of Table 1. 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 Reduction % =	**72.2**	**90.5**	**77.0**
Target #1 (Perc%)=	99	99	99

3. This PR value was used as the percent reduction in the equation in row three of Table 1. Testing was done to see that the water quality criterion for each metal was achieved at least 99 percent of the time. This verified the estimated percent reduction necessary for each metal. Table 3 shows, in boldface type, the percent of the time criteria for each metal was achieved during 5,000 iterations of the equation in row three of Table 1.

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. Tables 4 and 5 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 Reduction % =	**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. Table 6 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 Concentration From L-1	C_{L1}
Concentration below L-1	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 (Equation 1):

$$Q_{swat04} = \text{RiskCumul(min,max,bin range, cumulative percent of occurrence)} \quad (1)$$

The RiskCumul function takes four arguments: minimum value, maximum value, the bin range from the histogram, and cumulative percent of occurrence.

The flow at Swat-11 was randomized using the equation developed through the regression analysis with point Swat-04 (Equation 2).

$$Q_{swat11} = Q_{swat}04 \text{ x } 0.142 + 0.088 \quad (2)$$

The mass balance equation is as follows (Equation 3):

$$C_{stumps} = ((Q_{swat04} * C_{swat04}) + (Q_{swat11} * C_{swat11}))/(Q_{swat04}+Q_{swat11}) \quad (3)$$

This equation was simulated through 5,000 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 Table 7.

Table 7. Verification of Meeting Water Quality 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**

7. The mass balance was expanded to determine if any reductions would be necessary at point L-1.

The Shadle Discharge originated in 1997, and very few data are 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. Currently, no data for effluent from the settling pond are available.

Modeling for iron and manganese started with the BAT-required concentration value. The current effluent variability based on limited sampling was kept at its present level. There was no BAT value for aluminum, so the starting concentration for the modeling was arbitrary. The BAT values for iron and manganese are 6 mg/l and 4 mg/l, respectively. Table 8 shows the BAT-adjusted values used for point L-1.

Table 8. L-1 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 were not any means to establish a correlation with point Swat-04.

The same set of four equations used for point Swat-04 was used for point L-1. The equation used for evaluation of point L-1 is as follows (Equation 4):

$$C_{allow} = ((Q_{swat04}*C_{swat04})+(Q_{swat11}*C_{swat11})+(Q_{L1}*C_{L1}))/(Q_{swat04}+Q_{swat11}+Q_{L1}) \quad (4)$$

This equation was simulated through 5,000 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 percent reduction in aluminum concentration was needed for point L-1.

8. Table 9 shows the simulation results of the equation above.

Table 9. Verification of Meeting Water Quality 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**

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

Table 10. Lorberry Creek Summary						
		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	00%
	Mn	0.09	0.27	0.09	0.27	00%
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 be made to the Rowe Tunnel Discharge (Swat-04) for the three metals listed, and that a wasteload allocation is made to the Shadle Discharge (L-1) for aluminum. There is no TMDL for metals required for Stumps Run (Swat-11) at this time.

Margin of Safety

For the Al and Acidity TMDLs, where @Risk was used, 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 the Al and Acidity TMDLs include the following:

- None of the data sets were filtered by taking out extreme measurements. Because the 99 percent level of protection is designed to protect for the extreme event, it was 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. This 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 D
TMDLs By Segment

THOMPSON RUN

The TMDL for Thompson Run consists of load allocations of one tributary and four sampling sites along the stream. Following is an explanation of the TMDL for each allocation point. Sampling point 154 was not used in this TMDL because of insufficient data.

Thompson Run is listed for high metals from AMD as being the cause of the degradation to the stream.

TMDL calculations- Thompson Run, Sampling Point 151

The TMDL for sample point 151 consists of a load allocation to all of the area above the point shown in Attachment A. The load allocation for this segment was computed using water-quality sample data collected at point 151. The average flow, measured at the sampling point 151 (0.63 MGD), is used for these computations.

There currently is no entry for this segment on the Pa 303(d) list for impairment due to pH. Sample data at point 151 shows pH ranging between 6.72 and 7.28; ph will not be addressed in this TMDL. The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at point 151 for aluminum, , and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards. The following table shows the load allocations for this stream segment.

As opposed to the water quality criterion for aluminum, which is expressed in Chapter 93 as a maximum concentration, the iron criterion is expressed as a 30-day average. Therefore, the Monte Carlo simulation run for aluminum, which generates a long term allowable concentration meant to ensure that in-stream concentrations don't exceed the criterion, is not appropriate for iron as the water quality criterion is expressed as a 30-day average. The long term average allowable daily concentrations necessary to ensure meeting a 30-day average criterion is really the actual water quality criterion. In other words, a 1.5 mg/l long term allowable daily concentration will also ensure meeting a 30-day average of 1.5 mg/l. To be conservative, a 20% MOS will be taken on the allowable load calculations for iron.

Table D1. - Load Allocations at Point 151

Instream Point	Parameter	Measured Sample Data		Allowable				Reduction Identified	
		Conc. (mg/l)	Existing Load (lbs./day)	LTA Conc. (mg/l)	TMDL Load (lbs./day)	WLA (lbs./day)	LA (lbs./day	Load (lbs./day)	Percent
151	Thompson Run In-stream Monitoring Point								
	Al	2.60	13.6	0.57	3.0	(2.88 PS WLA + 0.06 BULK) 2.94	0.06	10.6	78
	Fe	3.55	18.6	1.2	6.3	(6.12 PS WLA + 0.13 BULK) 6.25	0.05	12.3	66
	Acidity	20.00	104.5	20.00	104.5				0
	Alkalinity	69.90	365.4						

<u>TMDL Calculation – Thompson Run, Sampling Point 152</u>

The TMDL for sampling point 152 consists of a load allocation of the area between sample points 151 and 152. The load allocation for this segment was computed using water-quality sample data collected at point 152. The average flow, measured at the sampling point 152 (1.44 MGD), is used for these computations.

There currently is no entry for this segment on the Section Pa 303(d) list for impairment due to pH. Sample data at point 152 shows pH ranging between 6.51 and 7.12; pH will not be addressed as part of this TMDL. The method and rationale for addressing pH is contained in Attachment B.

The existing and allowable loading for point 152 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any load reductions already specified from upstream sources. The load reduction from point 151 was subtracted from the existing load at point 152 and was compared to the allowable load at 152 for each parameter to determine if any further reductions were needed at this point.

An allowable long-term average in-stream concentration was determined at point 152 for aluminum, iron, 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. The following table shows the load allocations for this stream segment.

Table D2. - Load Allocations at Point 152

Instream Point	*Parameter*	*Measured Sample Data*		*Allowable*				*Reduction Identified*	
		Conc. (mg/l)	*Existing Load (lbs./day)*	*LTA Conc. (mg/l)*	*TMDL Load (lbs./day)*	*WLA (lbs./day)*	*LA (lbs./day*	*Load (lbs./day)*	*Percent*
152	**Thompson Run In-stream Monitoring Point**								
	Al	3.81	45.8	0.50	5.9	(0.20 PS WLA + 0.12 BULK) 0.32	5.58	39.9	87
	Fe	0.86	10.3	1.2	14.4	(0.22 PS WLA + 0.29 BULK) 0.51	13.89	0	0
	Acidity	6.61	79.4	6.61	79.4				0
	Alkalinity	26.56	318.8						

The loading reductions for point 151, shows the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point 152. This value was then compared to the allowable load at point 152. Reductions at point 152 are necessary for any parameter that exceeded the allowable load at this point. Table D3 shows a summary of all loads that affect point 152. Table D4 illustrates the necessary reductions at point 152. The results of this analysis show that a reduction for aluminum is necessary at this point.

Table D3. Summary of All Loads that Affect Point 152			
	Al (#/day)	**Fe (#/day)**	**Acidity (#/day)**
Sample Point 151			
load reduction=	10.6	12.3	0.0

Table D4. Necessary Reductions at Sample Point 152			
	Al (#/day)	**Fe (#/day)**	**Acidity (#/day)**
Existing Loads at 152	45.7	10.3	79.4
Total Load Reduction (151)	10.6	12.3	0.0
Remaining Load (Existing Loads at 152-TLR	35.1	0.0	79.4
Allowable Loads at 152	5.9	14.4	79.4
Percent Reduction	83	0.0	0.0
Additional Removal Required at 152	29.2	0.0	0.0

The average flow, measured at sample point 152, is used for these computations. The TMDL for 152 consists of a load allocation for aluminum to all of the area upstream of 152 shown in Attachment A. The percent reduction was calculated using below equation.

$$\left[1 - \left(\frac{\text{Allowable Loads at 152}}{\text{Remaining Load (Existing Loads at 152 - TLR Sum}}\right)\right] \times 100\%$$

No additional loading reductions were necessary for iron, manganese, and acidity.

TMDL Calculation – Unt Tributary 37452, Sampling Point 153

The TMDL for sample point 153 consists of a load allocation to all of the area above the point shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point 153. The average flow, measured at the sampling point 153 (0.0093 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point 153 shows pH ranging between 6.82 and 8.24; pH will not be analyzed. The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at point 153 for aluminum, iron, 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. The following table shows the load allocations for this stream segment.

Table D5. - Load Allocations at Point 153

Instream Point	Parameter	Measured Sample Data		Allowable				Reduction Identified	
		Conc. (mg/l)	Existing Load (lbs./day)	LTA Conc. (mg/l)	TMDL Load (lbs./day)	WLA (lbs./day)	LA (lbs./day	Load (lbs./day)	Percent
153									**Mouth of Tributary 37452**
	Al	2.72	**0.20**	**0.11**	**0.01**	**0.0002**	**0.0098**	**0.19**	**95**
	Fe	4.88	**0.35**	**1.2**	**0.09**	**0.0018**	**0.0882**	**0.26**	**74**
	Acidity	30.67	2.4	30.67	2.4				0
	Alkalinity	108.98	8.40						

<u>TMDL Calculation – Thompson Run, Sampling Point 155</u>

The TMDL for sampling point 155 consists of a load allocation to all of the area between sampling points 152, 153, and 155 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 155. The average flow, measured at the sampling point 155 (4.84 MGD), is used for these computations.

There currently is no entry for this segment on the Pa Section 303(d) list for impairment due to pH. Sample data at point 155 shows pH ranging between 6.82 and 6.92; pH will not be addressed as part of this TMDL. The method and rationale for addressing pH is contained in Attachment B.

The existing and allowable loading for point 155 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any load reductions already specified from upstream sources. The load reductions from points 151, 152, and 153 were subtracted from the existing load at point 155 and were compared to the allowable load for each parameter to determine if any further reductions were needed.

An allowable long-term average in-stream concentration was determined at point 155 for aluminum, iron, 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. The following table shows the load allocations for this stream segment.

Table D6. - Load Allocations at Point 155

Instream Point	*Parameter*	*Measured Sample Data*		*Allowable*				*Reduction Identified*	
		Conc. (mg/l)	*Existing Load (lbs./day)*	*LTA Conc. (mg/l)*	*Load (lbs./day)*	*WLA (lbs./day)*	*LA (lbs./day*	*Load (lbs./day)*	*Percent*
155	**Thompson Run In-stream Monitoring Point**								
	Al	**2.06**	**83.1**	**0.12**	**5.0**	**(4.78 WLA instead of current 5.0?) + 0.10 BULK) 4.88**	**0.12**	**78.1**	**94**
	Fe	**0.77**	**31.2**	**1.2**	**48.4**	**(10.06 WLA + 0.97 BULK) 11.03**	**37.37**	**0**	**0**
	Acidity	**14.50**	**585.5**	**14.50**	**585.5**				**0**
	Alkalinity	**42.92**	**1733.1**						

The loading reduction for points 151, 152, and 153 shows the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point 155. This value was then compared to the allowable load at point 155. Reductions at point

155 are necessary for any parameter that exceeded the allowable load at this point. Table D7 shows a summary of the load that affects point 155. Table D8 illustrates the necessary reductions at point 155. The results of this analysis show that a reduction for aluminum is necessary at this point.

Table D7. Summary of All Loads that Affect Point 155

	Al (#/day)	Fe (#/day)	Acidity (#/day)
Sample Point 151			
load reduction=	10.6	12.3	0.0
Sample Point 152			
load reduction=	39.8	0.0	0.0
Sample Point 153			
load reduction=	0.2	0.3	0.0

Table D8. Necessary Reductions at Sample Point 155

	Al (#/day)	Fe (#/day)	Acidity (#/day)
Existing Loads at 155	83.1	31.2	585.5
Total Load Reduction (Sum of 151, 152, 153)	50.6	12.6	0.0
Remain Load (Existing Loads at 155- Sum)	32.6	18.6	585.5
Allowable Loads at 155	5.0	48.4	585.5
Percent Reduction	85	0	0
Additional Removal Required at 155	27.5	0	0.0

The average flow, measured at sample point 155, is used for these computations. The TMDL for point 155 consists of a load allocation for aluminum to all of the area upstream of point 155 shown in Attachment A. The percent reduction was calculated using below equation.

$$\left[1-\left(\frac{\text{Allowable Loads at 155}}{\text{Remaining Load (Existing Loads at 155 - TLR Sum}}\right)\right]\times 100\%$$

No additional reductions are necessary for iron, manganese, and acidity.

<u>TMDL Calculation – Thompson Run, Sampling Point 156</u>

The TMDL for sampling point 156 consists of a load allocation of the area between sample points 156 and 155. The load allocation for this stream segment was computed using water-quality sample data collected at point 156. The average flow 4.35 MGD, measured at the sampling point, is used for these computations.

There currently is no entry for this segment on the Pa 303(d) list for impairment due to pH. Sample data at point 156 shows pH ranging between 7.14 and 7.64; pH will not be addressed as part of this TMDL. The method and rationale for addressing pH is contained in Attachment B.

The existing and allowable loading for point 156 for all parameters was computed using water-quality sample data collected at the point. This was based on the sample data for the point and did not account for any load reductions already specified from upstream sources. The load reduction from points 151, 152, 153, and 155 were subtracted from the existing load at point 156 and was then compared to the allowable load for each parameter to determine if any further reductions were needed at this point.

An allowable long-term average in-stream concentration was determined at point 156 for aluminum, iron, 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. The following table shows the load allocations for this stream segment.

Table D9. Load Allocations at Point 156

Instream Point	Parameter	Measured Sample Data Conc. (mg/l)	Measured Sample Data Existing Load (lbs./day)	Allowable LTA Conc. (mg/l)	Allowable Load (lbs./day)	WLA (lbs./day)	LA (lbs./day	Reduction Identified Load (lbs./day)	Reduction Identified Percent
156									Thompson Run In-stream Monitoring Point
	Al	1.27	46.1	0.38	13.8	(4.11 PS WLA + 0.276 BULK) 4.39	9.41	32.3	70
	Fe	0.55	20.0	1.2	43.4	7.19 PS WLA + 0.87 BULK) 8.06	35.34	0	0
	Acidity	10.50	380.8	10.50	380.8				0
	Alkalinity	40.86	1481.70						

The loading reductions for points 151, 152, 153, and 155 were summed to show the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point 156. This value was then compared to the allowable load at point 156. Reductions at point 156 are necessary for any parameter that exceeded the allowable load at this point. Table D10 shows a summary of all loads that affect point 156. Table D11 illustrates the necessary reductions at point 156. The results of this analysis show that there are no necessary reductions at this point.

Table D10. Summary of All Loads that Affect Point 156

	Al (#/day)	Fe (#/day)	Acidity (#/day)
Sample Points 151			
load reduction=	10.6	12.3	0.0
Sample Point 152			
load reduction=	39.8	0.0	0.0
Sample Point 153			
load reduction=	0.2	0.3	0.0
Sample Point 155			
load reduction=	78.1	0.0	0.0

Table D11. Necessary Reductions at Sample Point 156			
	Al (#/day)	**Fe (#/day)**	**Acidity (#/day)**
Existing Loads at 156	46.1	20.0	380.8
Total Load Reduction (Sum of 151, 152, 153, and 155)	128.7	12.8	0.0
Remaining Load (Existing Loads at 156-TLR Sum)	0.0	7.4	380.8
Allowable Loads at 156	13.8	43.4	380.3
Percent Reduction	0	0	0
Additional Removal Required at 156	0.0	0.0	0.0

The average flow, measured at sample point 156, is used for these computations.

No additional loading reductions were necessary for aluminum, iron, manganese, and acidity.

Margin of Safety

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

For Fe, a 20% explicit MOS was taken. Averaging 1.2 mg/l on a long term daily basis will ensure that the 1.5 mg/l 30-day average in Fe criterion is met 99% of the time.

Seasonal Variation

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

Critical Conditions

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

Attachment E

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

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

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

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

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

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

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

Attachment F

Water Quality Data Used In TMDL Calculations

Bottle ID	Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	TSS (mg/L)	Al (ppm)	Fe (ppm)	Mn (ppm)	SO4 (ppm)
42C	151	000630-1310-xdd	324	6.72	16	36	29	2.7	2	0.92	648
63 E	151	001001-1340-ddk,rxs	411	7.17	18	95	17.5	2.90	2.60	1.10	655
94E	151	010113-1730-ddk,mdw	273	7.28	24	86	30.5	2.20	7.50	1.30	580
47G	151	010401-1430-ddk,tm,eb	733	6.75	22	62	20	2.60	2.10	0.90	423
Mean	151		**435**	**6.98**	**20**	**70**	**24.3**	**2.60**	**3.55**	**1.06**	**577**
Stdev	151		**207**	**0.29**	**4**	**26**	**6.5**	**0.29**	**2.65**	**0.19**	**108**

Bottle ID	Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	TSS (mg/L)	Al (ppm)	Fe (ppm)	Mn (ppm)	SO4 (ppm)
51C	152	000630-1140-xdd	849	6.65	0	11	20	3.3	0.66	0.62	641
59 E	152	001001-1415-cam,rxs	880	7.08	9	39	31.5	3.25	0.89	0.73	555
12E	152	010118-1735-jam,bp	751	7.12	9	37	19	3.90	0.96	0.83	496
97G	152	010401-1445-ddk,dmr,eb	1517	6.51	8	19	34.5	4.80	0.91	0.66	389
Mean	152		**999**	**6.84**	**7**	**27**	**26.2**	**3.81**	**0.86**	**0.71**	**520**
Stdev	152		**350**	**0.31**	**4**	**14**	**7.9**	**0.72**	**0.13**	**0.09**	**106**

Bottle ID	Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	TSS (mg/L)	Al (ppm)	Fe (ppm)	Mn (ppm)	SO4 (ppm)
77C	153	000630-1420-xdd	2	6.82	36	152	372.25	6.9	14	0.77	480
54 E	153	001001-ddk,jm	1	7.66	49	117	7.5	0.17	0.56	0.22	241
96G	153	010401-1500-ddk,dmr,eb	16	8.24	7	58	11.5	1.10	0.09	0.37	206
Mean	153		**6**	**7.57**	**31**	**109**	**130.4**	**2.72**	**4.88**	**0.45**	**309**
Stdev	153		**8**	**0.71**	**22**	**47**	**209.4**	**3.65**	**7.90**	**0.28**	**149**

Bottle ID	Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	TSS (mg/L)	Al (ppm)	Fe (ppm)	Mn (ppm)	SO4 (ppm)
76C	154	000630-1500-xdd	9	7.70	8	40	1.5	0.63	0.02	0.1	407
14H	154	010401-1530-ddk,dmr,eb	79	6.73	14	16	23	5.10	0.09	0.39	298
Mean	154		**44**	**7.22**	**11**	**28**	**12.3**	**2.87**	**0.06**	**0.25**	**353**
Stdev	154		**49**	**0.69**	**4**	**17**	**15.2**	**3.16**	**0.05**	**0.21**	**77**

Bottle ID	Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	TSS (mg/L)	Al (ppm)	Fe (ppm)	Mn (ppm)	SO4 (ppm)
53C	155	000630-1520-xdd	1933	6.84	26	46	29	3.2	1.6	0.32	471
56 E	155	001001-1330-cam,jm	2334	6.83	9	45	26	0.785	0.56	0.22	260
14G	155	010113-1655-ddk,bp	5647	6.82	14	50	14.00	0.65	0.26	0.21	151
3H	155	010401-1630-ddk,dmr,eb	3535	6.92	9	31	22	3.60	0.67	0.48	343
Mean	155		**3362**	**6.85**	**15**	**43**	**22.8**	**2.06**	**0.77**	**0.31**	**306**
Stdev	155		**1668**	**0.05**	**8**	**8**	**6.5**	**1.56**	**0.58**	**0.13**	**135**

Bottle ID	Site	date-time-samplerID	Flow (gpm)	pH	Acidity (mg/L)	Alk (mg/L)	TSS (mg/L)	Al (ppm)	Fe (ppm)	Mn (ppm)	SO4 (ppm)
36C	156	000630-1600-xdd	2447	7.62	11	40	10	0.98	0.43	0.14	436
52 E	156	001001-1500-ddk,rxs	1596	7.64	12	46	11	0.90	0.68	0.25	327
5F	156	010113-1730-ddk,bp	4600	7.14	14	36	21.50	1.70	0.64	0.39	259
40G	156	010401-1730-ddk,emr,eb	3435	7.39	5	42	17	1.50	0.46	0.32	269
Mean	156		**3020**	**7.45**	**11**	**41**	**14.9**	**1.27**	**0.55**	**0.28**	**323**
Stdev	156		**1294**	**0.23**	**4**	**4**	**5.4**	**0.39**	**0.13**	**0.11**	**81**

WQN0701 Monongahela River - Rankin BR Off SR837, Lock/Dam 2	
Date	SO4
	mg/L
1/10/1989	76
2/27/1989	80
3/23/1989	92
4/6/1989	86
5/25/1989	94
6/12/1989	97
7/26/1989	104
8/25/1989	87
9/26/1989	122
10/17/1989	107
11/7/1989	98
12/19/1989	98
1/24/1990	68
2/20/1990	98
3/26/1990	138
4/26/1990	104
5/24/1990	99
6/26/1990	112
7/26/1990	144
9/19/1990	121
10/24/1990	77
11/19/1990	101
12/17/1990	82
1/28/1991	90
2/5/1991	95
3/26/1991	63
4/15/1991	92
5/20/1991	151
6/26/1991	209
7/24/1997	318
8/19/1991	233
9/18/1991	193
10/23/1991	221
11/25/1991	171
1/6/1992	53
2/19/1992	81
3/5/1992	73
4/6/1992	87
5/5/1992	94
6/16/1992	138
7/9/1992	162

Date	SO4 (mg/L)
8/16/1992	65
9/1/1992	106
10/1/1992	118
11/12/1992	163
12/1/1992	119
1/6/1993	69
2/5/1993	96
3/11/1993	67
4/8/1993	64
5/13/1993	126
6/14/1993	151
7/14/1993	148
8/4/1993	162
9/8/1993	175
10/12/1993	124
11/22/1993	58
12/2/1993	54
1/13/1994	56
2/16/1994	55
3/8/1994	94
4/11/1994	77
5/9/1994	69
6/20/1994	163
7/7/1994	178
8/10/1994	66
9/12/1994	93
10/6/1994	111
11/14/1994	204
12/19/1994	67
1/9/1994	81
2/14/1995	107
3/7/1995	26
4/12/1995	95
5/10/1995	63
6/12/1995	86
7/19/1995	129
8/9/1995	169
9/18/1995	140
10/25/1995	143
11/27/1995	91
12/18/1995	67
1/29/1996	56
2/27/1996	71
4/18/1996	70

Date	SO4(mg/L)
6/24/1996	113
7/23/1996	42
8/21/1996	66
9/23/1996	56
10/17/1996	104
11/18/1996	59
12/10/1996	40
1/22/1997	118
2/18/1997	82
3/19/1997	60
4/23/1997	117
5/20/1997	69
6/16/1997	101
7/10/1997	166
8/14/1997	164
9/22/1997	121
10/16/1997	99
11/17/1997	63
12/11/1997	80
1/26/1998	44
2/10/1998	81
3/16/1998	70
4/29/1998	64
5/28/1998	104
6/18/1998	114
7/9/1998	35
8/19/1998	162
9/9/1998	120
10/14/1998	127
12/3/1998	232
Average	105
Standard Deviation	47.7

Attachment G
Comment and Response

The following comments were submitted by the United States Environmental Protection Agency, Region 3 on January 30, 2003 in regards to the proposed TMDL for Thompson Run.

1. Although the 2002 Section 303(d) list of impaired waters is not yet approved, please consider adding that information to Table 1. According to the streams.shp provided to EPA with the AVGWLF model, Thompson Run, segment ID 990102-1005-TVP, is not the same Thompson Run, segment ID 4715, for which these TMDLs are developed. Please verify and correct Table 1 as necessary.

   Thompson Run, segment ID 990102-1005-TVP, is a different stream from Thompson Run, segment ID 4715, and therefore is not included in this TMDL and was removed from Table 1. Information from the Draft 2002 Section 303(d) list was also added to Table 1.

2. Please consider using two significant digits when reporting load (lbs/day) in measured sample data in Table D5 on page 30 in Attachment D. Specifically, please consider reporting data for aluminum, iron, manganese, and acidity as 0.20, 0.35, 0.03, and 0.00 respectively. Other tables use two significant digits when reporting data.

   Corrected.

3. Minor editorial comments:

   a. In Attachment D, page 26, paragraph 4; please include a period at the end of the last sentence.

   b. In Attachment D, page 27, paragraph 2; please include a period at the end of the last sentence.

   Corrected.

4. Please consider adding the sulfate standard to Table 2 and note the proposed addition of sulfates to §96.3(d). Although Thompson Run is not listed for "other inorganics," i.e. sulfates, the most downstream Sampling Point 156 has sulfate concentrations of 269 to 436 mg/L, averaging 323mg/L, which is greater than the water quality standard. PADEP should address this in this TMDL report.

   See "Other Inorganics" section of the TMDL report.

5. This TMDL would benefit greatly from an improved, site-specific watershed description. In the second paragraph of the *Watershed History* section it is difficult to separate general information from watershed-specific information. For example, is the disturbed area shown on the map in purple strip mined areas or a construction disturbance? Are there

subsidence areas within the watershed? Is the stream piped prior to discharging to the Monongahela River as shown in the DeLorme Northeast Regional Series, ver. 2.0 map?

"Watershed History" section revised to include more site-specific information.

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on December 21, 2002 and the *Pittsburgh Post-Gazette* on January 16, 2003, to foster public comment on the allowable loads calculated. A public meeting was held on January 23, 2003, at 7 pm at the West Mifflin Municipal Building in West Mifflin, PA, to discuss the proposed Thompson Run Watershed TMDL report. The report was then approved by the U.S. Environmental Protection Agency (EPA), Region 3 on June 6, 2003.

The Thompson Run Watershed TMDL was then revised as of August 2015, to update and incorporate current waste load allocations. Since this new report supersedes and replaces the old TMDL report (2003), a draft was published in the *Pennsylvania Bulletin* on August 29, 2015 to foster public comment on the allowable loads calculated. The Department will consider all comments in developing the final TMDLs and added to this Appendix after the 30 day time frame. This will then be submitted to EPA for approval.