LAUREL RUN WATERSHED
FINAL TMDL
Fayette County

Prepared for:

Pennsylvania Department of Environmental Protection

February 27, 2003

TABLE OF CONTENTS

TABLES

ATTACHMENTS

[1]TMDL
Laurel Run Watershed
Fayette County, Pennsylvania

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for stream segments in the Laurel Run Watershed (Attachment A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers one segments on this list (shown in Table 1). High levels of metals and in some areas elevated sulfates and suspended solids caused these impairments. All impairments resulted from acid drainage from abandoned coal mines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum), suspended solids, and sulfates.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 19-E Indian Creek								
Year	**Miles**	**Segment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	2.7	4787	38491	Laurel Run	CWF	305(b) Report	RE	Metals & Other Inorganics
1998	2.59	4787	38491	Laurel Run	CWF	SWMP	AMD	Metals & Other Inorganics
2000	1.41	980714-0850-ATP	38491	Laurel Run	CWF	SWMP	AMD	Metals & Suspended Solids
2002	No additional assessment							

Resource Extraction=RE
Cold Water Fishes=CWF
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD
See Attachment E, *Excerpts Justifying Changes Between the 1996, 1998 and Draft 2000 Section 303(d) Lists.*
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

[1] Pennsylvania's 1996 and 1998 Section 303(d) lists were approved by the Environmental Protection Agency (EPA). The 2000 Section 303(d) list was not required by U. S. Environmental Protection Agency. The 1996 Section 303(d) list provides the basis for measuring progress under the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Directions to the Laurel Run Watershed

The Laurel Run Watershed is approximately 4.3 square miles in area and is located in southwestern Pennsylvania, occupying a small section of the east-central portion of Fayette County. The watershed is found on the USGS Ohiopyle and Fort Necessity 7.5-minute Quadrangles. From Donegal, exit the Pennsylvania Turnpike and follow State Route 31 east to State Route 711 south for approximately 11 miles to the town of Normalville. From there, follow State Route 381 south for an additional ten miles to Ohiopyle. Continue through Ohiopyle. Approximately 0.6 miles after crossing the bridge over Meadow Run south of the town, turn left onto State Route SR-2011. Travel an additional 1.1 miles, passing Ohiopyle State Park main offices, to an intersection at the Oak Grove School. Turn left onto Township Road TR-415. Proceed approximately 0.75 miles. At that point the road will cross over Laurel Run; the Kaiser and Walker surface mines lie just ahead on either side of the road.

Segments addressed in this TMDL

There are no active mining operations in the watershed. There is an NPDES permit (PA0202851) for the Kaiser Refractories treatment discharges. These discharges will be treated as point sources. All remaining 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 Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See 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)[2] 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.

---

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

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 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

Laurel Run is a relatively small watershed, totaling approximately 5.2 miles of stream in the Youghiogheny River watershed. The Laurel Run watershed lies on the eastern flank of Laurel Ridge, which rises to more than 2850 feet, immediately south of the headwaters of the stream. The Laurel Run watershed is primarily wooded with moderate to steep slopes and is sparsely populated. The upper two-thirds of the stream trends east-southeast to west-northwest where it then turns abruptly due north for the remainder of its flow path. Laurel Run then becomes a tributary to Meadow Run, to the Youghiogheny River.

Mining activities have been confined to the lower third of the watershed, on the eastern side of the stream. Surface mining occurred primarily on the Lower Kittanning underclay, and Lower Kittanning Coal on two sites; Harbison-Walker Refractories, MDP 2969BSM24A, Smith Mine

(120± acres) to the north and Kaiser Aluminum, MDP 2966BMS50, Potato Ridge Site (143± acres) to the south (located on map in Attachment A). Active mineral removal on both sites was completed over several decades ago; both sites have been regraded and revegetated with grasses, legumes, and/or evergreens, although the Harbison-Walker site contains several steep unvegetated outslopes. Chemically, the spoil material at both sites is predominately acidic; the bedrock in unmined areas of the watershed is primarily neutral to acidic.

TMDL Endpoints

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

Because 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. 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 TMDLs are expressed at total recoverable as the iron data used for this analysis was reported as total recoverable. The following table shows the water quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

Parameter	***Criterion Value (mg/l)***	***Total Recoverable/Dissolved***
Aluminum (Al)	0.75	Total Recoverable
Iron (Fe)	1.50 0.3	30-day average; Total Recoverable Dissolved
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A
Sulfates**	250	Total Recoverable

*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).
**In accordance with Pennsylvania Title 25 Chapter 96.3(d)

Other Inorganics

The cause of inorganic impairment as listed on the 1996 Section 303(d) list is sulfates. Due to Title 25 Chapter 96.3(d) a TMDL to address sulfates is not necessary. The nearest potable water withdrawal to Laurel Run occurs approximately 17 miles downstream of the mouth at the North Fayette County Municipal Authority (#5260019) located on the Youghiogheny River. Sulfate data from WQN0707, located approximately 2 miles downstream of the water supply intake at the Crawford Avenue Bridge in Connellsville, has an eight-year average sulfate concentration of 35.73 mg/l. The data shows that the Youghiogheny River provides the proper dilution for the sulfates in Laurel Run and water quality criterion of 250 mg/L will not be exceeded at the water supply intake. 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.

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).

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 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 Table–Laurel Run Watershed

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)	Percent
134		Laurel Upstream of Impairments (Reference Point)				
	Al	0.04	0.6	0.04	0.6	0
	Fe	0.10	1.4	0.10	1.4	0
	Mn	0.02	0.3	0.02	0.3	0
	Acidity	4.50	61.9	4.50	61.9	0
	Alkalinity	33.37	459.2			
133		Near Mouth of Peck Run				
	Al	0.44	1.3	0.20	0.6	53
	Fe	0.40	1.2	0.32	1.0	20
	Mn	0.08	0.2	0.08	0.2	0
	Acidity	4.44	13.3	0.40	1.2	91
	Alkalinity	1.30	3.9			
132		Laurel Downstream of Confluence w/ Peck Run				
	Al	0.34	6.8	0.34	6.8	0
	Fe	0.82	16.5	0.64	10.4	36
	Mn	2.23	44.8	0.36	5.6	88
	Acidity	9.25	186.3	9.25	186.3	0
	Alkalinity	24.72	497.9			

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)	Percent
131		Mouth of Laurel Run				
	Al	0.57	12.6	0.29	6.4	46
	Fe	1.18	26.0	0.54	11.9	40
	Mn	2.90	63.9	0.49	10.9	56
	Acidity	10.50	231.5	6.20	136.6	38
	Alkalinity	21.58	475.7			

Waste load allocations are being assigned to the two permitted discharges for iron and manganese from the Kaiser Refractories site which discharge to Laurel Run upstream of Sample Point 132. Aluminum and acidity are not included in the permit so no waste load allocation is assigned for these parameters. The waste load allocations are based on measured flow data and the permit limits, which are Best Available Technology (BAT) limits. No required reduction of these permits is necessary at this time because there are non-point contributions upstream of Sample Point 132 and downstream of Sampling Points 133 and 134 that when reduced will satisfy the TMDL. All necessary reductions are assigned to the non-point sources. Table 4 contains the waste load allocations for the two permitted discharges, 11 and 2M. Flow data for these discharges is located in Appendix F.

Table 4. Waste Load Allocation of Permitted Discharges

Parameter	Allowable Average Monthly Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Discharge 11			
Fe	3.0	0.045	1.1
Mn	2.0	0.045	0.7
Discharge 2M			
Fe	3.0	0.055	1.4
Mn	2.0	0.055	0.9

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.

Passive treatment is the construction of wetlands and other treatment facilities that do not require intensive maintenance. They add alkalinity to water and/or remove metals. These types of systems can be installed if space requirements are available. They do not provide dramatic increases in water quality, but are relatively inexpensive to build and maintain.

Chemical treatment is the addition of neutralizing agents to the acid mine drainage which increases the alkalinity in the water and the pH and it also precipitates significant amount of the metals dissolved in mine drainage. This type of treatment can be very effective but it can be expensive and the treatment facilities need regular maintenance.

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.

On November 1, 1999 Stream Restoration, Inc. was awarded an AMD Watershed Restoration and Partnership Program Grant (Project No. WR11, ME#359394) for $261,294.00. The grant was for the construction of a passive treatment system to treat the Laurel Run No. 12 and 13 discharges. These discharges are located along the east side of Laurel Run, on an area between the Kaiser site and the Harbison Walker site. Final construction of the passive treatment system was completed in May 2000. The treatment system consists of an anoxic collection system, an anoxic limestone drain, a vertical flow pond, and a series of settling ponds and aerobic wetland ponds. The system reduces the acidity and metals loading to Laurel Run.

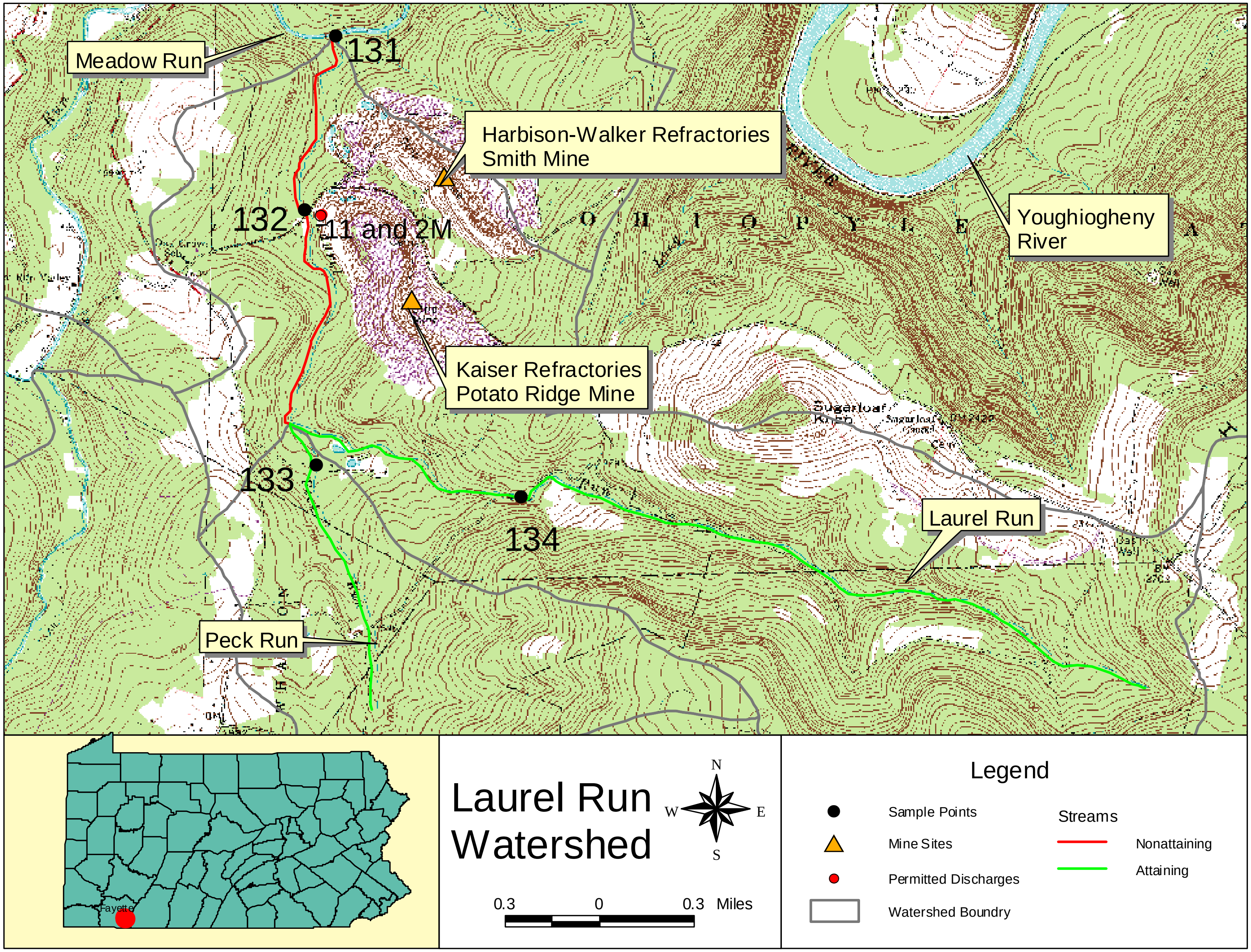
On April 18, 2000 Stream Restoration, Inc. was awarded a Round 1 Growing Greener Grant for $1,196,659.04. The grant was for the construction of a passive treatment system to treat the A/C discharges and the B seeps on the Harbison Walker site. Three separate treatment systems were constructed, one for the A/C discharges, one for the B1 discharge, and one for the B3 discharge. The treatment systems consists of a series of vertical flow ponds, settling ponds, flushing ponds, wetland ponds, channel wetlands, and horizontal flow limestone beds. A diversion well was also installed on Tributary C, which is an unnamed tributary to Laurel Run. Treatment system construction was completed during Spring 2001. The project also included the regrading and revegetation of several acres of steep slope barren areas. The treatment systems reduce the acidity and metals loading to Laurel Run. The PA DCNR, Bureau of State Parks, operates the Harbison Walker site. Kaiser Aluminum is currently treating discharges from its site utilizing both passive and chemical treatment.

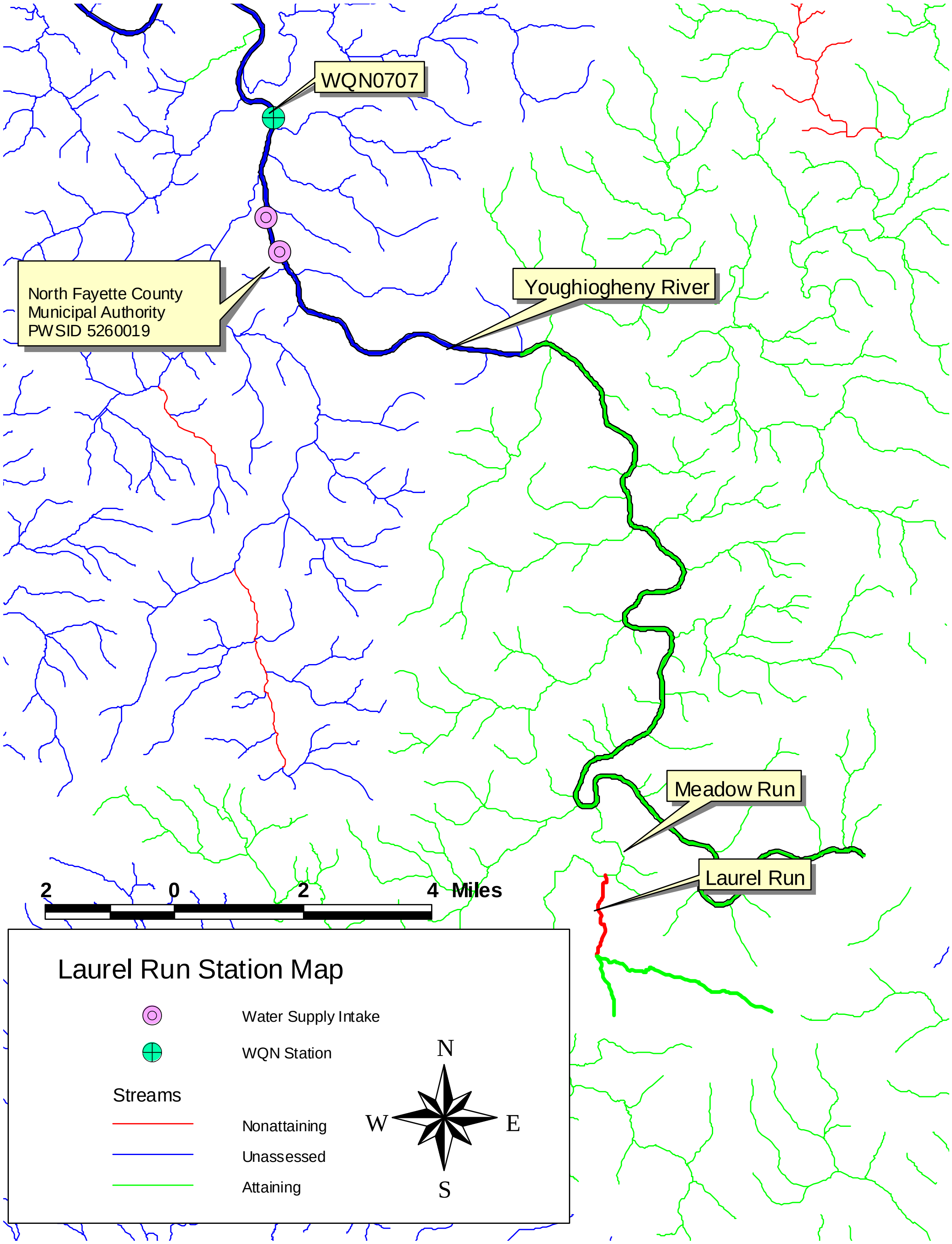
Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on December 21, 2002 and the *The Herald Standard* on January 10, 2003 to foster public comment on the allowable loads calculated. A public meeting was held on January 15, 2003 at the Stewart Township Community Building in Ohiopyle at 7:00 pm to discuss the proposed TMDL.

Attachment A

Laurel Run Watershed Map


Meadow Run
131
Harbison-Walker Refractories
Smith Mine
132
11 and 2M
Youghiogheny
River
Kaiser Refractories
Potato Ridge Mine
133
134
Laurel Run
Peck Run
Sugarloaf
Knob
Fayette
Laurel Run
Watershed
N
W
E
S
0.3
0
0.3
Miles
Legend
Sample Points
Mine Sites
Permitted Discharges
Watershed Boundry
Streams
Nonattaining
Attaining


WQN0707
North Fayette County
Municipal Authority
PWSID 5260019
Youghiogheny River
Meadow Run
Laurel Run
2
0
2
4 Miles
Laurel Run Station Map
Water Supply Intake
WQN Station
Streams
Nonattaining
Unassessed
Attaining
N
W
E
S

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[3] 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

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

LTA = Mean * (1 – PR99) where (2)

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

LTA = allowable LTA source concentration in mg/l

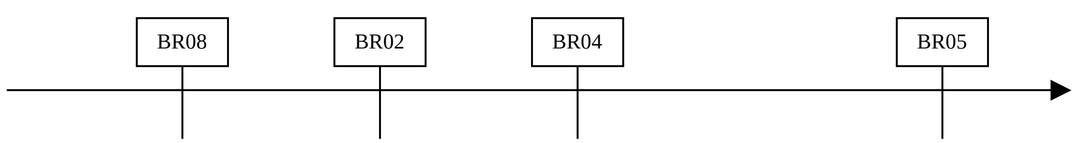
Once the required percent reduction for each pollutant source was determined, a second series of Monte Carlo simulations were performed to determine if the cumulative loads from multiple sources allow instream water quality criteria to be met at all points at least 99 percent of the time. The second 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.*

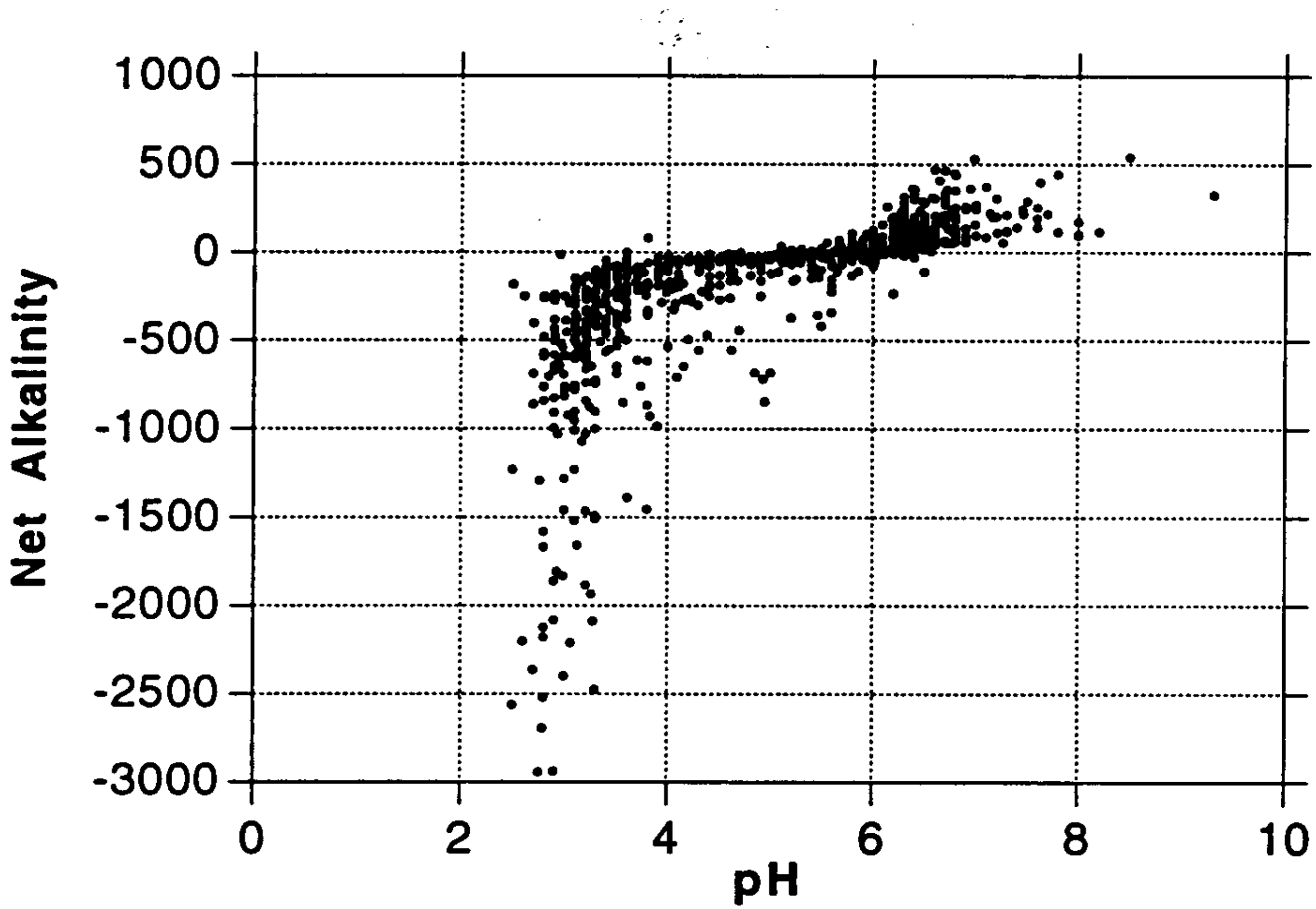


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

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 non-point 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 non-point 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 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. 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

LAUREL RUN

The TMDL for Laurel Run consists of load allocations of one tributary and three sampling sites along the stream and two waste load allocations to discharges from Kaiser Refractories (PA 0202851). Following is an explanation of the TMDL for each allocation point.

Laurel Run is listed for both high metals and suspended solids from AMD as being the cause of the degradation to the stream. The elevated suspended solids is due to metals precipitation, and therefore by removing the metals loading to the stream, the suspended solids will in turn be removed. The method and rationale for addressing pH is contained in Attachment B.

TMDL calculations- Laurel Run, Sampling Point 134

The TMDL for sample point 134 consists of a load allocation to all of the area above the point shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 134. The average flow, measured at the sampling point 134 (1.65 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 134 shows pH ranging between 7.38 and 7.78, pH will not be addressed in this TMDL. The method and rationale for addressing pH is contained in Attachment B.

No allowable long-term average in-stream concentration was determined at point 134 for aluminum, iron, manganese and acidity. The following table shows the load allocations for this stream segment.

Table D1. Load Allocations at Point 134

	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA conc. (mg/l)	Load (lbs/day)	%
Al	0.04	0.6	0.04	0.6	0
Fe	0.10	1.4	0.10	1.4	0
Mn	0.02	0.3	0.02	0.3	0
Acidity	4.50	61.9	4.50	61.9	0
Alkalinity	33.37	459.2			

TMDL Calculation – Peck Run near mouth, Sampling Point 133

The TMDL for sampling point 133 consists of a load allocation of the Peck Run tributary shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point 133. The average flow, measured at the sampling point 133 (0.36 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 133 shows pH ranging between 5.03 and 5.43, ph will be addressed in this TMDL. The objective is to reduce acid loading to the stream, which will in turn raise the pH and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoints section in the report, Table 2). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at point 133 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 133

	Measured Sample Data		Allowable		Reduction Identified
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA conc. (mg/l)	Load (lbs/day)	%
Al	0.44	1.3	0.20	0.6	53
Fe	0.40	1.2	0.32	1.0	20
Mn	0.08	0.2	0.08	0.2	0
Acidity	4.44	13.3	0.40	1.2	91
Alkalinity	1.30	3.9			

<u>Waste Load Allocation – Discharges 11 and 2M, Kaiser Refractories</u>

The waste load allocations for discharges 11 and 2M are determined from measured flow data and the monthly average permit limits for iron and manganese. The following table shows the waste load allocations for each discharge.

Table D3. Waste Load Allocations at Discharges 11 and 2M			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
Discharge 11			
Fe	3.0	0.045	1.1
Mn	2.0	0.045	0.7
Discharge 2M			
Fe	3.0	0.055	1.4
Mn	2.0	0.055	0.9

<u>TMDL Calculation – Laurel Run downstream of confluence w/ Peck Run, Sampling Point 132</u>

Sampling point 132 lies downstream of the Kaiser Aluminum Potato Ridge Mine. Any AMD affects from this site will be accounted for in the TMDL at point 132.

The TMDL for sampling point 132 consists of a load allocation of the area between sample points 132 and 133/134. The load allocation for this stream segment was computed using water-quality sample data collected at point 132. The average flow 2.42 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 132 shows pH ranging between 6.98 and 7.39; pH will not be addressed as part of this TMDL.

The existing and allowable loading for point 132 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 133 and 134 were subtracted from the existing load at point 132 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 132 for aluminum, iron, and manganese. 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. To account for the permitted discharges on this stream segment, the wastes load allocations are subtracted from the calculated allowable loads, "Fe = 12.9 – 1.1 – 1.4" and "Mn = 7.2 – 0.7 – 0.9". The following table shows the load allocations for this stream segment.

Table D4. Load Allocations at Point 132				
	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTAConc. (mg/l)	Load (lbs/day)
Al	0.34	6.8	0.34	6.8
Fe	0.82	16.5	0.64	10.4
Mn	2.23	44.8	0.36	5.6
Acidity	9.25	186.3	9.25	186.3
Alkalinity	24.72	497.9		

The loading reductions for points 133 and 134 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 132. This value was then compared to the allowable load at point 132. Reductions at point 132 are necessary for any parameter that exceeded the allowable load at this point. Table D5 shows a summary of all loads that affect point 132. Table D6 illustrates the necessary reductions at point 132. The results of this analysis show that reductions for iron and manganese are necessary at this point.

Table D5. Summary of All Loads that Affect Point 132				
	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Sample Points 134				
load reduction=	0.0	0.0	0.0	0.0
Sample Point 133				
load reduction=	0.7	0.2	0.0	12.1

Table D6. Necessary Reductions at Sample Point 132				
	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Existing Loads at 132	6.8	16.5	44.8	186.3
Total Load Reduction (Sum of 133 and 134)	0.7	0.2	0.0	12.1
Remaining Load (Existing Loads at 132-TLR Sum)	6.1	16.3	44.8	174.2
Allowable Loads at 132	6.8	10.4	5.6	186.3
Percent Reduction	0	36	88	0
Additional Removal Required at 132	0.0	5.9	39.2	0.0

The average flow, measured at sample point 132, is used for these computations. The TMDL for point 132 consists of load allocations for iron and manganese to all of the area upstream of point 132 shown in Attachment A. The percent reduction was calculated using below equation.

$$\left[1-\left(\frac{\text{Allowable Loads at 68}}{\text{Remaining Load (Existing Loads at 68 - TLR Sum}}\right)\right]\times 100\,\%$$

No additional loading reductions were necessary for aluminum or acidity.

<u>TMDL Calculation – Laurel Run near mouth, Sampling Point 131</u>

Sampling Point 131 is downstream of the Harbison-Walker Refractories Smith Mine. Any AMD affects from this site will be accounted for in the TMDL at point 131.

The TMDL for sampling point 131 shown in Attachment A consists of a load allocation of all the area between sampling points 132 and 131. The load allocation for this segment was computed using water-quality sample data collected at point 131. The average flow 2.64 MGD, measured at the sampling point, 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 131 shows pH ranging between 6.58 and 7.53; pH will not be addressed as part of this TMDL.

The existing and allowable loading for point 131 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 132 was subtracted from the existing load at point 131 and 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 131 for aluminum, iron, and manganese. 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 D7. Load Allocations at Point 131

	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTAConc. (mg/l)	Load (lbs/day)
Al	0.57	12.6	0.29	6.4
Fe	1.18	26.0	0.54	11.9
Mn	2.90	63.9	0.49	10.9
Acidity	10.50	231.5	6.20	136.6
Alkalinity	21.58	475.7		

The loading reductions for point 132 shows the total load that was removed from upstream sources. This value, for each parameter, was then subtracted from the existing load at point 131. This value was then compared to the allowable load at point 131. Reductions at point 131 are necessary for any parameter that exceeded the allowable load at this point. Table D8 shows a summary of all loads that affect point 131. Table D9 illustrates the necessary reductions at point 131. The results of this analysis show that reductions for aluminum, iron, and manganese are necessary at this point.

Table D8. Summary of All Loads that Affect Point 131				
	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Sample Point 132				
load reduction=	0.0	5.9	39.2	0.0
Sample Point 133				
load reduction=	0.7	0.2	0.0	12.1
Sample Point 134				
load reduction=	0.0	0.0	0.0	0.0

Table D9. Necessary Reductions at Sample Point 131				
	Al (#/day)	**Fe (#/day)**	**Mn (#/day)**	**Acidity (#/day)**
Existing Loads at 131	12.6	26.0	63.9	231.5
Total Load Reduction (132, 133, 134)	0.7	6.1	39.2	12.1
Remaining Load (Existing Loads at 131-TLR Sum)	11.9	19.9	24.7	219.4
Allowable Loads at 131	6.4	11.9	10.9	136.6
Percent Reduction	46	40	56	38
Additional Removal Required at 131	5.5	10.5	15.4	82.8

The average flow, measured at sample point 131, is used for these computations. The TMDL for 131 consists of load allocations for aluminum, iron, manganese, and acidity to all of the area upstream of 131 shown in Attachment A. The percent reduction was calculated using below equation.

$$\left[1-\left(\frac{\text{Allowable Loads at 54}}{\text{Remaining Load (Existing Loads at 54 - TLR Sum}}\right)\right]\times 100\,\%$$

Margin of Safety

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

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

- A MOS is also the fact that the calculations were performed with a daily Iron average instead of the 30-day average.

Seasonal Variation

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

Critical Conditions

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

Attachment 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)
80C	131	000626-1350-xjp	1009	7.53	8	30	7.5	0.39	1.4	3.9	228
73 E	131	000930-1300-ddk,rxs	869	7.28	21	30	3	0.55	1.90	3.40	169
25G	131	010118-1435-ddk,mdw	1757	6.58	8	14	5	0.39	0.89	1.80	82
5H	131	010331-1418-ddk,tm,eb	3708	6.86	5	13	7	0.96	0.52	2.50	111
Mean	131		**1836**	**7.06**	**11**	**22**	**5.6**	**0.57**	**1.18**	**2.90**	**148**
Stdev	131		**1308**	**0.42**	**7**	**9**	**2.1**	**0.27**	**0.60**	**0.93**	**65**

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)
85C	132	000626-1240-xjp	939	7.39	8	28	3	0.31	1.2	3.7	189
75 E	132	000930-1250-cam,jm	915	7.04	9	25	1.75	0.49	1.00	2.50	71
96E	132	010118-1420-jam,bp	1822	6.98	6	20	3.25	0.33	0.64	1.3	58
95G	132	010331-1400-ddk,tm,eb	3033	7.13	14	27	4.5	0.23	0.44	1.40	81
Mean	132		**1677**	**7.14**	**9**	**25**	**3.1**	**0.34**	**0.82**	**2.23**	**100**
Stdev	132		**998**	**0.18**	**3**	**4**	**1.1**	**0.11**	**0.34**	**1.12**	**60**

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)
68C	133	000626-1525-xjp	58	5.21	5	1	5.5	0.23	0.15	0.04	117
68 E	133	000930-1215-cam,jm	24	5.43	4	1	18.5	0.35	0.37	0.07	15
3G	133	010118-1450-jam,bp	319	5.03	8	1	31.5	0.90	0.94	0.14	13
98G	133	010331-1615-ddk,tm,eb	600	5.11	1	1	6.5	0.26	0.13	0.07	10
Mean	133		**250**	**5.20**	**4**	**1**	**15.5**	**0.44**	**0.40**	**0.08**	**39**
Stdev	133		**268**	**0.17**	**3**	**0**	**12.2**	**0.31**	**0.38**	**0.04**	**52**

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)
78C	134	000626-1435-xjp	609	7.78	4	38	2.5	0.02	0.04	0.02	7
74 E	134	000930-1130-ddk,cam,jm,rxs	786	7.50	5	35	-1	0.07	0.07	0.02	20
99E	134	010118-1515-jm,bp	1138	7.38	7	33	3.5	0.02	0.03	0.02	14
1H	134	010331-1540-ddk,tm,eb	2050	7.47	2	27	4	0.06	0.27	0.03	4
Mean	134		**1146**	**7.53**	**5**	**33**	**2.3**	**0.04**	**0.10**	**0.02**	**11**
Stdev	134		**642**	**0.17**	**2**	**5**	**2.3**	**0.03**	**0.11**	**0.01**	**7**

WQN0707	
Crawford Avenue Bridge	
Connellsville, PA	
Date	Sulfates (mg/L)
1/14/1980	22
2/13/1980	50
3/4/1980	60
4/16/1980	15
5/7/1980	18
6/2/1980	125
7/7/1980	42
8/12/1980	22
9/4/1980	12
10/7/1980	22
11/17/1980	50
12/9/1980	25
1/6/1981	45
2/9/1981	30
3/17/1981	28
5/13/1981	48
6/18/1981	30
7/23/1981	30
9/9/1981	12
10/1/1981	20
11/23/1981	28
12/10/1981	16
1/7/1982	24
2/1/1982	36
3/9/1982	32
4/5/1982	28
5/10/1982	68
6/8/1982	16
7/1/1982	36
8/2/1982	26
9/9/1982	18
10/6/1982	18
11/3/1982	22
12/1/1982	16
1/25/1983	22
2/9/1983	32
3/2/1983	32
4/6/1983	26
5/3/1983	25
6/2/1983	25
7/14/1983	54
8/3/1983	45

Date	Sulfates (mg/L)
9/14/1983	50
10/12/1983	35
11/22/1983	25
12/29/1983	50
1/12/1984	80
2/14/1984	37
3/27/1984	27
4/12/1984	25
5/1/1984	25
6/19/1984	50
7/16/1984	25
8/15/1984	36
9/12/1984	43
10/10/1984	43
11/7/1984	32
12/13/1984	33
2/19/1984	44
3/27/1985	37
4/22/1985	49
5/16/1985	48
6/12/1985	25
7/17/1985	29
9/18/1985	33
10/8/1985	38
11/19/1985	28
12/3/1985	29
1/7/1986	61
2/19/1986	31
3/17/1986	37
4/23/1986	26
5/15/1986	62
6/3/1986	50
7/10/1986	45
8/6/1986	32
9/17/1986	31
10/1/1986	41
11/6/1986	34
12/9/1986	34
1/6/1987	49
2/5/1987	27
3/3/1987	43
4/22/1987	32
5/26/1987	41
6/25/1987	48
7/7/1987	22
8/11/1987	45

Date	Sulfates (mg/L)
9/24/1987	35
10/5/1987	41
11/3/1987	30
12/8/1987	37
1/11/1987	62
Average	35.73118
St Dev	16.08209

Measured Flow for Discharges 11 and 2M		
Date	Discharge 11	Discharge 2M
	Flow (gpm)	Flow (gpm)
3/11/1999	57	
6/25/1999		9.5
9/27/1999		5.7
12/17/1999	44.8	57
3/14/2000	18.6	40
6/13/2000	25.8	52.6
9/28/2000	12.4	
12/21/2000	23	49
3/29/2001	35	53
Average	30.94285714	38.11428571
St Dev	15.66938173	21.52366361
Flow (mgd)	0.044558	0.054885

Attachment G
Comment and Response

The following comments were submitted by the United States Environmental Protection Agency, Region 3 on February 06, 2003 in regards to the proposed TMDL for Laurel Run.

1. Please verify whether or not the Kaiser Aluminum, MDP 2966BMS50, is treating water pursuant to the authority of the Clean Water Act. If so, then this TMDL Report needs to provide a waste load allocation (WLA) for them. The load allocation (LA) at Sampling Point 132 would need to be reduced to accommodate the WLA. Note that the WLA for Kaiser Aluminum does not need to meet water quality standards as long as the sum of the LA at Sampling Point 132 and the WLA will allow water quality standards to be met.

   There are currently two permitted discharges from the Kaiser Refractories site. Waste load allocations have been provided for both discharges. These WLAs are based on the BAT limits in the permit and measured flow data. The LA at Sampling Point 132 was subsequently reduced to accommodate for the WLAs. All reductions are assigned to the non-point sources. Through the reductions calculated for the non-point sources, the TMDL can be successfully implemented without reductions to the point sources. Information has been added to the report.

2. Please provide EPA with all water quality monitoring data, whether or not it is included in the TMDL Report. Since these TMDLs were developed based on four data points, it would increase confidence in the TMDLs if they were based on more data.

   Any additional water monitoring data can be obtained from the DEP Greensburg District Mining Office.

3. The data for Pecks Run, a tributary to Laurel Run, indicates very low total alkalinity, 1.3 mg/L average. It is understood that increasing instream alkalinity may be a low priority for PADEP and may not be specifically addressed when implementing TMDLs for metals and acidity. Therefore, EPA expects the alkalinity to be monitored after the metals and acidity TMDLs are implemented and, if necessary, the streams will be listed for alkalinity and TMDLs developed.

   Relisting will occur if monitoring, subsequent to TMDL implementation, shows a waterbody is not meeting alkalinity criteria and, is meeting criteria for previously listed parameters.

4. In *Attachment D*, page 27, please delete the duplicated last sentence in the last paragraph.

   Corrected.

5. In *Attachment D*, page 29, the total load reduction (sum of 133 and 134) for acidity should be 12.1 #/day, not 12.2 #/day.

Corrected.