UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029
4/9/2001

Mr. David E. Hess, Acting Secretary
Pennsylvania Department of Environmental Protection
Rachel Carson State Office Building
400 Market Street
Harrisburg, PA 17101

Re: Shamokin Creek Watershed Acid Mine Drainage
Total Maximum Daily Load (TMDL)

Dear Mr. Hess:

The U. S. Environmental Protection Agency (EPA) Region III is pleased to approve the Shamokin Creek Watershed Total Maximum Daily Load (TMDL), submitted to EPA by the Pennsylvania Department of Protection (PADEP) by letter dated March 9, 2001. The TMDL was established and submitted in accordance with Section 303(d)(1)(c) and (2) of the Clean Water Act. The TMDL was established to address impairment of water quality as identified in Pennsylvania's 1996 Section 303(d) list. Pennsylvania identifies the impairment for this water quality limited waterbody based on excessive metals. Shamokin Creek Watershed is located in eastern Northumberland and western Columbia Counties, Pennsylvania.

In accordance with Federal regulations found in 40 CFR §130.7, a TMDL must: be designed to meet water quality standards; include, as appropriate, both wasteload allocations for point sources and load allocations for nonpoint sources; consider the impacts of background pollutant contributions; take critical stream conditions into account (the conditions when water quality is most likely to be violated); consider seasonal variations; include a margin of safety (which accounts for any uncertainties in the relationship between pollutant loads and instream water quality); and be subject to public participation. The enclosure to this letter describes how the Shamokin Creek Watershed TMDL satisfies each of these requirements.

Following the approval of this TMDL, PADEP shall incorporate it into the state's Water Quality Management Plan pursuant to 40 CFR §130.7(d)(2). As you know, any new or revised National Pollution Discharge Elimination System permits with applicable effluent limits must be consistent with the TMDL's wasteload allocation pursuant to 40 CFR §122.44(d)(1)(vii)(B)(2).

Any such permit should be submitted to EPA for review consistent with EPA's letter dated October 1, 1998. Please note that PADEP determined there are currently no permitted point source dischargers in the Shamokin Creek Watershed. If you have any questions or concerns, please call me or have your staff contact Mr. Thomas Henry, the TMDL Program Manager, at (215) 814-5752.

Sincerely,

/s/

Rebecca W. Hanmer, Director
Water Protection Division

Enclosure

cc: Mr. Lawrence Tropea, Jr., PADEP
Mr. Terry Fabian, PADEP
Mr. Fred Marrocco, PADEP
Mr. Edward Brezina, PADEP

Decision Rationale
Total Maximum Daily Loads
Shamokin Creek Watershed
For Acid Mine Drainage Affected Segments

I. Introduction

The Clean Water Act (CWA) requires a Total Maximum Daily Load (TMDL) be developed for those water bodies identified as impaired by the state where technology-based and other controls will not provide for attainment of water quality standards. A TMDL is a determination of the amount of a pollutant from point, nonpoint, and natural background sources, including a margin of safety, that may be discharged to a water quality-limited water body.

This document sets forth the United States Environmental Protection Agency's (EPA) rationale for approving the TMDLs for metals and pH in the Shamokin Creek watershed. The TMDL was established to address impairment of water quality, caused by mine drainage, as identified in Pennsylvania's 1996 and 1998 Section 303(d) list. The Pennsylvania Department of Environmental Protection (PADEP) submitted the *Shamokin Creek Watershed TMDL*, dated March 2, 2001, was submitted to EPA for final Agency review on March 9, 2001. This TMDL addresses six segments on Pennsylvania's 1996 Section 303(d) list and one unlisted segment.

EPA's rationale is based on the TMDL Report and information contained in the Appendicies to the report. Based on the review of this information, EPA agrees with Pennsylvania's overall approach and methodology in the development of these TMDLs for acid mine drainage. However, based on the date EPA received this TMDL and the number of TMDLs currently under review by EPA in Pennsylvania and other states, EPA has not been able to fully verify the state's underlying calculations supporting this TMDL. In some cases, EPA has found discrepancies and inconsistencies in the state's supporting information. However, those inconsistencies in the supporting information do not materially undermine Pennsylvania's final TMDL calculation. Furthermore, the proposed level of reductions necessary to attain water quality standards (some as high as 90 to almost 100%) and the margin of safety are adequate to account for any additional uncertainty raised by such discrepancies and inconsistencies.

Our review determined that the TMDL meets the following eight regulatory requirements pursuant to 40 CFR Part 130.

1. The TMDLs are designed to implement the applicable water quality standards.
2. The TMDLs include a total allowable load as well as individual waste load allocations and load allocations.
3. The TMDLs consider the impacts of background pollutant contributions.
4. The TMDLs consider critical environmental conditions.
5. The TMDLs consider seasonal environmental variations.
6. The TMDLs include a margin of safety.
7. There is reasonable assurance that the proposed TMDLs can be met.
8. The TMDLs have been subject to public participation.

II. Summary

Table 1 presents the 1996, 1998, and proposed 2000 Section 303(d) listing information for the water quality limited waters.

Table 1 - Section 303(d) Listing Information

State Water Plan (SWP) Subbasin 6-B Lower Central Susquehanna River								
Year	**Miles**	**Segment ID**	**PADEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	34.7	7088	18489	Shamokin Creek	WWF	305(b) Report	RE	Metals
1998	32.8	7088	18489	Shamokin Creek	WWF	SWMP	AMD	Metals
2000*	32.78	No additional assessment data collected		Shamokin Creek				
1996	3.7	7089	18647	Carbon Run	CWF	305(b) Report	RE	Metals
1998	3.8	7089	18647	Carbon Run	CWF	SWMP	AMD	Metals
2000*	3.8	No additional assessment data collected		Carbon Run				
1996	3.0	7090	18651	Coal Run	CWF	305(b) Report	RE	Metals
1998	4.7	7090	18651	Coal Run	CWF	SWMP	AMD	Metals

Table 1 - Section 303(d) Listing Information

2000*	4.7	No additional assessment data collected		Coal Run				
1996	1.3	7091	18652	Quaker Run	CWF	305(b) Report	RE	Metals
1998	1.29	7091	18652	Quaker Run	CWF	SWMP	AMD	Metals
2000*	1.29	No additional assessment data collected		Quaker Run				
1996	1.6	7092	18655	Locust Creek	CWF	305(b) Report	RE	Metals
1998	1.69	7092	18655	Locust Creek	CWF	SWMP	AMD	Metals
2000*	1.69	No additional assessment data collected		Locust Creek				
1996	4.6	Not placed on GIS.	18657	North Branch Shamokin Creek	CWF	305(b) Report	RE	Metals
1998	4.6	On Section C of list	18657	North Branch Shamokin Creek	CWF	SWMP	AMD	Metals
2000*	Not on list			North Branch Shamokin Creek				

Table 1 - Section 303(d) Listing Information					
Not currently on 303(d) list	Buck Run Watershed	CWF	USGS Data	AMD	Metals

CWF = Cold Water Fishes; WWF = Warm Water Fishery AMD = Abandoned Mine Drainage; RE = Resource Extraction
SWMP = Surface Water Monitoring Program; USGS = U.S. Geological Survey
* The Proposed 2000 Section 303(d) List has not been submitted to EPA for approval but is available on DEP's web site at http://www.dep.state.pa.us/dep/deputate/watermgt/Wqp/WQStandards/303_water00_narr.htm

The TMDLs were developed using a statistical procedure to ensure that water quality standards are met 99 percent of the time as required by Pennsylvania's water quality standards. Table 2 summarizes the TMDLs for the Shamokin Creek watershed as determined by PADEP.

Table 2 - TMDL Summary

Station	Parameter	TMDL (lbs/day)	WLA[1] (lbs/day)	LA[2] (lbs/day)	MOS[3] (lbs/day)
Mid Valley	Iron	2.1	0	2.1	implicit
	Manganese	21.6	0	21.6	implicit
	Aluminum	13.6	0	13.6	implicit
	Acidity	0.0	0	0.0	implicit
	Alkalinity*	-----	-----	-----	-----
NB1	Iron	9.9	0	9.9	implicit
	Manganese	16.5	0	16.5	implicit
	Aluminum	2.8	0	2.8	implicit
	Acidity	6.4	0	6.4	implicit
	Alkalinity*	-----	-----	-----	-----
SC1	Iron	40.3	0	40.3	implicit
	Manganese	25.0	0	25.0	implicit
	Aluminum	-----	0	-----	implicit
	Acidity	201.6	0	201.6	implicit
	Alkalinity*	-----	-----	-----	-----
	Iron	8.2	0	8.2	implicit
	Manganese	31.8	0	31.8	implicit

	Aluminum	15.9	0	15.9	implicit
	Acidity	91.3	0	91.3	implicit
	Alkalinity*	-----	-----	-----	-----
Corbin	Iron	0.0	0	0.0	implicit
	Manganese	5.9	0	5.9	implicit
	Aluminum	5.1	0	5.1	implicit
	Acidity	0.0	0	0.0	implicit
	Alkalinity*	-----	-----	-----	-----
Scott	Iron	17.0	0	17.0	implicit
	Manganese	21.5	0	21.5	implicit

Table 2 - TMDL Summary					
	Aluminum	-----	-----	-----	implicit
	Acidity	276.9	0	276.9	implicit
	Alkalinity*	-----	-----	-----	-----
Colbert	Iron	1.4	0	1.4	implicit
	Manganese	7.6	0	7.6	implicit
	Aluminum	1.0	0	1.0	implicit
	Acidity	58.0	0	58.0	implicit
	Alkalinity*	-----	-----	-----	-----

Maysville	Iron	2.3	0	2.3	implicit
	Manganese	12.3	0	12.3	implicit
	Aluminum	1.5	0	1.5	implicit
	Acidity	-----	-----	-----	-----
	Alkalinity*	-----	-----	-----	-----
QR1	Iron	9.6	0	9.6	implicit
	Manganese	53.1	0	53.1	implicit
	Aluminum	10.3	0	10.3	implicit
	Acidity	-----	-----	-----	-----
	Alkalinity*	-----	-----	-----	-----
Big Mountain	Iron	5.1	0	5.1	implicit
	Manganese	4.6	0	4.6	implicit
	Aluminum	3.4	0	3.4	implicit
	Acidity	23.5	0	23.5	implicit
	Alkalinity*	-----	-----	-----	-----
SC2	Iron	160.9	0	160.9	implicit
	Manganese	114.0	0	114.0	implicit
	Aluminum	33.5	0	33.5	implicit
	Acidity	415.7	0	415.7	implicit
	Alkalinity*	-----	-----	-----	-----
Royal Oak	Iron	0.0	0	0.0	implicit
	Manganese	0.1	0	0.1	implicit
	Aluminum	0.0	0	0.0	implicit
	Acidity	0.5	0	0.5	implicit
	Alkalinity*	-----	-----	-----	-----
Stirling	Iron	10.8	0	10.8	implicit
	Manganese	27.0	0	27.0	implicit
	Aluminum	10.8	0	10.8	implicit
	Acidity	324.4	0	324.4	implicit
	Alkalinity*	-----	-----	-----	-----
CAR1	Iron	5.5	0	5.5	implicit
	Manganese	28.5	0	28.5	implicit
	Aluminum	4.6	0	4.6	implicit
	Acidity	-----	-----	-----	-----
	Alkalinity*	-----	-----	-----	-----

SC3	Iron	57.6	0	57.6	implicit
	Manganese	128.0	0	128.0	implicit
	Aluminum	121.6	0	121.6	implicit
	Acidity	2471.1	0	2471.1	implicit
	Alkalinity*	-----	-----	-----	-----

Cameron Air	Iron	6.0	0	6.0	implicit
	Manganese	7.6	0	7.6	implicit
	Aluminum	2.4	0	2.4	implicit
	Acidity	44.3	0	44.3	implicit
	Alkalinity[*]	-----	-----	-----	-----
Cameron Drift	Iron	3.5	0	3.5	implicit
	Manganese	5.4	0	5.4	implicit
	Aluminum	3.0	0	3.0	implicit
	Acidity	48.9	0	48.9	implicit
	Alkalinity[*]	-----	-----	-----	-----
SC4	Iron	123.6	0	123.6	implicit
	Manganese	197.1	0	197.1	implicit
	Aluminum	130.3	0	130.3	implicit
	Acidity	1125.9	0	1125.9	implicit
	Alkalinity[*]	-----	-----	-----	-----
SC5	Iron	299.0	0	299.0	implicit
	Manganese	264.5	0	264.5	implicit
	Aluminum	164.8	0	164.8	implicit
	Acidity	0.0	0	0.0	implicit
	Alkalinity[*]	-----	-----	-----	-----
SC6	Iron	359.9	0	359.9	implicit
	Manganese	258.4	0	258.4	implicit
	Aluminum	156.9	0	156.9	implicit
	Acidity	2293.0	0	2293.0	implicit
	Alkalinity[*]	-----	-----	-----	-----
SC7	Iron	151.3	0	151.3	implicit
	Manganese	442.8	0	442.8	implicit
	Aluminum	156.9	0	156.9	implicit
	Acidity	582.9	0	582.9	implicit
	Alkalinity[*]	-----	-----	-----	-----
SC8	Iron	55.3	0	55.3	implicit
	Manganese	207.3	0	207.3	implicit
	Aluminum	124.4	0	124.4	implicit
	Acidity	760.2	0	760.2	implicit
	Alkalinity[*]	-----	-----	-----	-----

[1] WLA = Waste Load Allocation
[2] LA = Load Allocation
[3] MOS = Margin of Safety
[*] Alkalinity not subject to TMDL.

The TMDL is a written plan and analysis established to ensure that a waterbody will attain and maintain water quality standards. The TMDL is a scientifically-based strategy which considers current and foreseeable conditions, the best available data, and accounts for uncertainty with the inclusion of a "margin of safety" value. Conditions, available data and the understanding of the natural processes can change more than anticipated by the margin of safety. The option is always available to refine the TMDL for re-submittal to EPA for approval. The unassessed waters protocol, a method of conducting biological assessments of Pennsylvania's waters, was developed in 1996 and began implementation in 1997. PADEP's goal is a statewide assessment of surface waters in Pennsylvania. After completion of the initial assessments, the long-range goal is to re-assess all waters on a five-year cycle. Therefore, while the TMDL should not be modified at the expense of achieving water quality standards expeditiously, the TMDL may be modified when warranted by additional data or other information.

III. Background

The Shamokin Creek watershed (see Figure in Attachment A) is a 137-square-mile watershed located in eastern Northumberland and western Columbia Counties, Pennsylvania . This watershed is classified Warm Water Fishery(WWF) in certain segments and Cold Water Fishery (CWF) in other segments.

Shamokin Creek has a long history of mining. Today, anthracite coal mining, once the mainstay of watershed economy, continues, but at a lesser rate. The watershed headwaters area of about 51.5 square miles situated south of the crest of Big Mountain is underlain by a portion of the Western Middle Field. Although significant amounts of coal remain, mining is not expected to increase substantially in the near future. Past mining has flooded many deep mines leaving the remaining coal in now inactive major underground mines. Significant amounts of coal still exist in 34 coal veins. Virtually all these 34 coal veins have been deep or strip-mined to some extent.

The methods used for deep mining in the watershed were largely dependent on the orientation of the coal veins, which pitch steeply as deep as 2,600 feet beneath the ground surface from their outcrops along watershed ridges. Slope entries were driven down the steeply pitching veins for a few hundred feet where tunnels were driven through intervening rock to intercept other coal veins. Several veins were mined from that level to the ground surface through those tunnels and slopes. Where mining was extended too close to the ground surface, subsidence into the underlying voids occurred. When the mineable coal had been removed from that area, the slopes were extended to deeper levels where the same procedures were repeated. In some instances shafts were constructed at strategic places throughout the rock. As deep mining was extended throughout the area, a system of interconnected slopes, shafts, and rock tunnels was formed. Barriers of unmined coal, called barrier pillars, were left between mines being

developed by different owners. Thus, originally each mine had its own system of shafts, slopes, and rock tunnels connecting the veins being mined.

As deep mining developed and continued in the various mines, surface water and groundwater were encountered. This water flowed down the mined veins to the levels being worked. It became necessary to pump the water to the surface. Eventually the mine operators established pump relay stations to remove water in stages from the deepest levels. Therefore, some mine operators decided to discontinue mining because of increased costs from pumping, the depressed market for coal, and other reasons. These discontinued mines began to fill with water.

As the large mine operators discontinued mining, independent miners opened small operations within the large mines to recover the remaining coal. In some instances, coal left in barrier pillars was removed, thus allowing mines and their waters to come in contact with one another. In addition, coal left as ground support by the large mine operators was removed, causing more surface subsidence and creating additional locations through which surface water could enter the mine workings. Vast underground pools have formed in these mines since water could flow from one mine to another through various interconnections. These pools have found relief to surface streams through openings in the ground surface and old mining structures (slope and shaft openings, etc.).

Historical records indicate that in certain areas along the perimeter of the watershed headwaters areas, precipitation (through infiltration into the mine pools) is conveyed both into and out of the watershed. This condition results from deep mine workings extending under the watershed divide. In a 1972 study done by Gannett Fleming Corddry and Carpenter, water in the Shamokin Creek watershed was determined to be discharging into Mahanoy Creek through the Douteyville, Helfenstein, Locust Gap, and Centralia Discharges. It is disputed if all of these discharges are still actively draining mine pools from Shamokin Creek into Mahanoy Creek. The Douteyville Tunnel, one of the pathways between the two watersheds, has historically discharged water from the Shamokin Creek watershed. However, it is unknown if this tunnel continues to deliver drainage to the Mahanoy Creek watershed. According to the Gannett Fleming Corddry Carpenter report, drainage from the Mahanoy Creek Watershed is reported to flow into connected mine workings to become a part of the overflow from the Henry Clay Stirling Discharge. More study would be necessary to determine the current status of interconnections through mine workings between the two watersheds.

Because of past inadequate restoration, abandoned strip mines serve as catch basins, which collect precipitation, surface runoff, and communicate with groundwater. These considerable volumes of water enter underlying deep mine workings, into which the strip mines have cut through direct contact with mine workings or through fissures in the intervening rock. Partial restoration and sedimentation within portions of some strip mines allow some water to collect in the pits from which overflows to adjacent surface streams sometimes occur, as is the case with the Excelsior Strip Pit Overflow. In certain watershed areas, almost all water that would flow on the surface as stream flow has been intercepted by surface mines and interconnected deep mines.

Water collected in this way comes in contact with acid-producing materials in the mines before being discharged as mine drainage to streams.

Little or no aquatic life associated with unpolluted streams exists in the watershed headwaters area. Carbon Run, one of the AMD-impacted tributaries to Shamokin Creek, was found to contain only one fish species in an ecological survey of the stream conducted by the USGS in October 1999. The North Branch Shamokin Creek and Quaker Run were found to contain no fish in the survey. Several tributary streams in Shamokin Creek's middle and lower reaches, including Trout Run, Buddys Run, Millers Run, Lick Creek, and those locally known as Kulps Run, Sunnyside Run, and Elysburg Run have historically supported healthy aquatic communities. Shamokin Creek's mainstem does not support such aquatic life above its confluence with Carbon Run in Shamokin. Shamokin Creek supports six species of fish downstream of the USGS near SC6 and eleven species of fish near the mouth in Sunbury. It is assumed that some of the fish community members migrate into and out of Shamokin Creek according to prevailing water quality. According to the Pennsylvania Fish and Boat Commission, Little Shamokin Creek is the only stream in the watershed that is stocked. The North Branch of Shamokin Creek, Quaker Run, Coal Run, and Carbon Run all are not stocked by the Fish and Boat Commission due to either small size or pollution. A sportsman's club supports a small hatchery operation on Trout Run, a tributary not impaired by AMD. In areas of heavy deposition of metals onto the streambed (Quaker Run, North Branch Shamokin Creek, Carbon Run, Coal Run, and in parts of the mainstem), conditions are inhospitable for macroinvertebrate life. Large areas of the headwaters are assumed to support little, if any, macroinvertebrate life based on the coating of the bottom surfaces with metals.

State Game Land No. 165 is located primarily on the south side but extends onto the north side of Little Mountain a few miles west of Shamokin. The area on the north side of Little Mountain is located within the watershed, while the remainder lies in the Zerbe Run drainage area, part of the Mahanoy Creek watershed. This 3,314-acre tract provides considerable hunting for both small and large game.

Though abandoned mine drainage (AMD) is the most obvious source of pollution in the upper section of the Shamokin Creek watershed, producing biological impairment miles downstream from the source, there are other concerns in the watershed. The first of these concerns is sewage. It is common in areas of Pennsylvania where AMD has significantly impaired streams for problems from wildcat sewage and malfunctioning septic tanks to be masked. The USGS collected bacteriological data from select locations during their assessment of the watershed that may be useful in locating problem areas for sewage. The second concern is agricultural impairment. Most of the land use in the lower portion of the Shamokin Creek watershed is for agriculture. The watershed has not yet been assessed using the PADEP Unassessed Waters Protocol; however, it is anticipated that when the area is assessed, streams in the lower section of the watershed will show impairment due to nutrients, sediment, and low levels of dissolved oxygen. The final concern is water management after reclamation. Stream channels in some areas of the watershed, such as Shamokin Creek and Butternut Creek in Mount Carmel, have experienced little flow other than stormwater for many years due to extensive

mining activities that have altered the natural hydrology of the area. One of the probable effects of remediation activities would be the return of normal hydrologic patterns to the watershed (water would flow in the stream channels rather than be intercepted and routed into underground mine pools). However, because of the current state of many of the channels, this increased flow could cause the likelihood of flooding of areas in the natural floodplain to increase. One project in Mount Carmel will widen and deepen the existing channel, reinforce man-made sections of the channel to withstand larger flows, and improve the existing stormwater delivery network. Many other similar projects may be necessary to handle the increased stream flow as reclamation is accomplished in the watershed.

The Surface Mining Control and Reclamation Act (SMCRA) of 1977 limited liability for mined areas that were left without adequate reclamation prior to 1977. For areas mined subsequent to that date, the applicant is required to post a performance bond that is sufficient to ensure completion of the reclamation plan. There are no reclaimed surface mines listed in the report and there is currently no active mining in the watershed.

The 1997 consent decree requires that Pennsylvania, or the Environmental Protection Agency (EPA) if Pennsylvania fails to, develop, by April 9, 2001, TMDLs for 10 percent of water quality-limited segments included on the 1996 Section 303(d) list where the source of the impairment is mine drainage. EPA's approval of the TMDLs for the three listed water quality-limited segments identified on the 1996 Section 303(d) list partially fulfills that condition of the consent decree.

Computational Procedure

The TMDLs were developed using a statistical procedure to ensure that water quality standards are met 99 percent of the time as required by Pennsylvania's water quality standards.

Regressions for flow and each parameter were calculated for Shamokin Creek. Evaluation of available data for point SC6 for metals indicated there is no single critical flow conditions for pollutant sources and there are no significant correlations between source flows and pollutant concentrations. It was assumed that the no correlation relationship between flow and concentration pertained to the entire watershed. PADEP felt that the available data for the other parameters in this watershed did not have enough paired flow/parameter data to calculate correlations.

TMDLs for each parameter were determined using Monte Carlo simulation, @RISK[1]. For each source and pollutant, it was assumed that the observed data are log-normally distributed. Each pollutant source was evaluated separately using @RISK.

The existing and allowable long-term average loads were computed using the mean concentration from @RISK multiplied by the average flow. Using the sample parameters, mean and standard deviation, based on collected data, the simulation performs 5000 iterations and predicts an existing long-term average concentration. This existing concentration shows that

water quality standards are exceeded. A second simulation of 5000 iterations is performed to calculate the percent reduction necessary to meet the criteria 99 percent of the time. Finally, using the calculated percent reductions, a final simulation is run to confirm that the target value for a long-term average concentrations will result in meeting water quality criteria 99 percent of the time.

---

[1]@RISK - Risk Analysis and Simulation Add-in for Microsoft Excel®, Palisade Corporation, Newfield, NY.

IV. Discussions of Regulatory Requirements

EPA has determined that these TMDLs are consistent with statutory and regulatory requirements and EPA policy and guidance.

1. The TMDLs are designed to implement the applicable water quality standards.

All of the stream segments evaluated in the Shamokin Creek watershed have the designation of either high quality cold water fishery (HQCWF) or cold water fishery (CWF). The designations for these stream segments can be found at PA Title 25 Chapter 93.9m. The applicable water quality criteria are shown in Table 3. PA Title 25 Chapter 93.5(b) specifies that a minimum 99 percent level of protection is required. All metal analysis results are total recoverable; no dissolved values for dissolved iron were available.

Table 3 - Applicable Water Quality Criteria

Parameter	Criterion Value (mg/L)	Duration	Total Recoverable/ Dissolved
Iron (Fe)	1.50 0.3	One-day average Maximum	Total Recoverable Dissolved
Manganese (Mn)	1.00	Maximum	Total Recoverable
Aluminum (Al)	0.1 of the 96-hour LC_{50}[1] (0.75 mg/L)	Maximum	Total Recoverable
pH	6 - 9	Inclusive	N/A

[1] The 96-hour LC_{50} is that concentration of the pollutant being tested at which 50 percent of the organisms being tested die within 96 hours.

The statistical/Monte Carlo method used to develop the TMDLs used 5000 iterations where each iteration is independent of all other iterations. Therefore, averages cannot be calculated and total recoverable iron TMDL was developed as if the criterion duration were a maximum value instead of a one-day average.

PADEP used the EPA acute fish and aquatic life criterion for aluminum of 0.75 mg/L as the appropriate level of protection in developing these TMDLs. PADEP used the national criterion because it has recommended adopting the EPA criterion and is awaiting final promulgation. EPA finds that these TMDLs will attain and maintain the applicable narrative and numerical water quality standards.

The pH values shown were used as the TMDL endpoint for these TMDLs. In the case of freestone streams with little or no buffering capacity, the allowable TMDL endpoint for pH may be the natural background water quality. These values are typically as low as 5.4 (Pennsylvania Fish and Boat Commission). PADEP, however, chose to use the pH standards of 6 to 9 inclusive. This condition is presumed to be met when the net alkalinity is maintained above zero. This presumption is based on the relationship between net alkalinity and pH. PADEP uses a methodology based on this relationship to address pH in the watershed. A summary of the methodology is presented as follows.

The parameter of pH, a measurement of hydrogen ion acidity presented as a negative logarithm of effective hydrogen ion concentration, is not conducive to standard statistics. Additionally, pH does not measure latent acidity that can be produced from hydrolysis of metals. For these reasons PADEP 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 partially dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values which would result from treatment of acid mine drainage. Therefore, net alkalinity will be used to evaluate pH in these TMDL calculations. This methodology assures that the standard for pH will be met because net alkalinity is able to measure the reduction of acidity. When acidity in a stream is neutralized or is restored to natural levels, pH will be acceptable (>6.0). Therefore, the measured instream alkalinity at the point of evaluation in the stream will serve as the goal for reducing total acidity at that point. The methodology that is applied for alkalinity (and therefore, pH) is the same as that used for other parameters such as iron, aluminum, and manganese that have numeric water quality criteria. EPA finds this approach to pH reasonable.

2. *The TMDLs include a total allowable load as well as individual waste load allocations and load allocations*.

For purposes of these TMDLs only, point sources are identified as permitted discharge points and nonpoint sources are identified as other discharges from abandoned mine lands which include tunnel discharges, seeps (although none were specifically identified), and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as nonpoint sources because there are no National Pollutant Discharge Elimination System (NPDES) permits associated with these areas. As such, the discharges associated with these land uses were assigned load allocations (as opposed to wasteload 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 unpermitted point source discharges within these land uses. In addition, by approving these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements. There are no permitted

dischargers in the watershed, therefore, the allocations are to nonpoint sources only.

PADEP allocated only to nonpoint sources as there are no current mining operations within the watershed. EPA has requested during public comment periods for other TMDLs, confirmation that if additional mining is pursued within the watershed, the mining company will be required to meet water quality standards noted in Table 2, Applicable Water Quality Criteria (PA Title 25, Chapter 93, § 93.7), for any discharges from the mine site. Previously, PADEP's response was, "Yes, see Chapter 87.102." Chapter 87.102 are the technology-based effluent limits for coal mining operations. Federal regulations require that subsequent to TMDL development and approval, point sources permitted effluent limitations be water quality-based[2]. In addition, PA Title 25, Chapter 96, Section 96.4(d) requires that WLAs shall serve as the basis for determination of permit limits for point source discharges regulated under Chapter 92 (relating to NPDES permitting, monitoring and compliance). Therefore, no new mining may be permitted within the watershed without re-allocation of the TMDL.

The instream TMDLs were calculated from the sampling point located downstream of all mining influences. PADEP assumes that the portion of the stream located downstream of that sampling point will achieve water quality standards once the instream TMDLs are achieved.

PADEP assumed that if all upstream segments and impacts achieve water quality standards, then Shamokin Creek itself will achieve water quality standards. PADEP performed a Monte Carlo simulation on Shamokin Creek to determine the allowable load for each parameter that would meet water quality standards 99 percent of the time. Then, the allowable loads for the upstream segments were summed. This load was compared to the calculated allowable load for a segment downstream in Shamokin Creek or the diversion. If this load was less than the calculated load for the downstream segment, a reduction was identified for that segment, in addition to the reductions necessary in the upstream segments and the discharges. Ultimately, the allowable load in the most downstream segment of Shamokin Creek is compared to the sum of the upstream segments and an additional reduction is calculated if the upstream load is greater than the allowable load at this point. Table 3 presents a summary of the location of the sample points and Table 4 presents a summary of the allowable loads for the Shamokin Creek Watershed.

Data for sites SC1, SC2, SC3, SC5, and SC7 did not include measurements of flow. Flow for these points was determined using the average flow from point SC6. The watershed was delineated to determine watershed areas upstream of the above points and for SC6. The flow for the above sites was then calculated using an area approach with the following equation:

{{Flow ~ Point~ X} OVER {Watershed~Area~Point~X}}{~\=~}{{Flow~SC6} over {Watershed~Area~SC6}}
„ „

Note: The reduction identified for Shamokin Creek is the reduction necessary after upstream reductions have been made. Also, some values in the submitted TMDL were incorrect and have been correctly included and indicated in Table 4.

[2] It should be noted that technology-based permit limits may be converted to water quality-based limits according to EPA's *Technical Support Document For Water Quality-based Toxics Control,* March 1991, recommendations.

Table 3 - Location Table for Shamokin Creek Watershed	
Sample Point	**Approximate Location**
Mid Valley Discharge	Receives drainage from the Mid Valley Colliery.
NB1	Begins at the mouth of the North Branch Shamokin Creek subwatershed and extends upstream, covering the entire subwatershed except the Mid Valley Discharge
SC1	Begins above the confluence of Shamokin Creek and Locust Creek and extends upstream to the confluence of Shamokin Creek and the North Branch Shamokin Creek, excluding the watershed of the North Branch Shamokin Creek.
Excelsior Discharge	Receives drainage from the Reliance, Alaska, Enterprise and Excelsior-Corbin Collieries.
Corbin Discharge	Drains the Excelsior-Corbin Colliery. Flows in Shamokin Creek upstream of its confluence with Quaker Run.
Scott Ridge Discharge	Receives drainage from the Morris Ridge, Sayre, Stuartsville, Sioux, Richards, Greenough, Pennsylvania, Scott, and Natalie Collieries. Located approximately 1.2 miles upstream of the mouth of Quaker Run and drains into a tributary locally known as Dark Run.
Colbert Discharge	Receives drainage from the Morris Ridge, Sayre, Stuartsville, Sioux, Richards, Greenough, Pennsylvania, Scott, and Natalie Collieries. Located approximately 1.0 mile upstream of the mouth of Quaker Run and drains directly into a tributary locally known as Dark Run.
Maysville Discharge	Receives drainage from the Maysville Colliery and is located approximately 0.3 miles upstream of the mouth of Quaker Run. It emerges from a bank and enters directly into Quaker Run.
QR1	Area associated with this pint begins at the mouth of Quaker Run, extends upstream and covers the entire subwatershed. Located near the Boroughs of Kuplmont and Marion Heights.
Big Mountain Discharge	Receives drainage from the Bid Mountain, Burnside, and Enterprise Collieries. It makes up a tributary locally called Buck Run.
SC2	Area associated with this point begins downstream of the confluence with the tributary locally known as Buck Run and extends up the mainstem of Shamokin Creek to SC1, including the Locust Creek subwatershed.
Royal Oak Discharge	Receives drainage from the Buck Ridge #1 and Luke Fidler Collieries and is located approximately 0.7 miles upstream of the mouth of Coal Run.
Stirling Discharge	Henry Clay Stirling Slope Discharge receives drainage from the Henry Clay Stirling, Neilson, Bear Valley, Burnside, Royal Oak, and Buck Ridge Collieries. It is located approximately 1.5 miles upstream of the mouth of Carbon Run.
CAR1	Begins at the mouth of Carbon Run and extends upstream to cover the entire subwatershed.
CLR1	Coal Creek subwatershed joins with Shamokin Creek upstream of point SC3. It is located at the mouth of Coal Creek.
SC3	The area associated with this point begins upstream of the Cameron Air Shaft Discharge and continues up the mainstem of Shamokin creek to SC2, including the Coal Creek Subwatershed. Load allocation is all areas of Shamokin Creek between SC2 and SC3.

Cameron Air Shaft Discharge	First in a pair of discharges flowing from the Glen Burn Colliery Complex. This discharge receives drainage from the Hickory Ridge, Colbert, Hickory Swamp, Cameron, Glen Burn, Natalie, and Luke Fidler Collieries, and is located approximately 0.3 mils upstream of SC4.
Cameron Drift Discharge	Second in a pair of discharges flowing from the Glen Burn Colliery Complex. This is a drift opening receiving drainage from the Hickory Ridge, Colbert, Hickory Swamp, Cameron, Glen Burn, Natalie, and Luke Fidler Collieries.
SC4	Area associated with this point begins below the Cameron Drift Discharge and extends up the mainstem of Shamokin Creek to SC3.
SC5	Area associated with this point begins upstream of the confluence of Bennys Run and Shamokin Creek and continues up the mainstem to SC4.
SC6	Area associated with this point begins downstream of the USGS gage on Shamokin Creek located near the Wayside Inn and extend up the mainstem of Shamokin Creek to SC5. Receives water from Bennys Run and Millers Run.
SC7	Area associated with this point begins below the village of Snydertown and continues up the mainstem to SC6. Receives water from various tributaries in this reach, including Lick Creek Elysburg Creek, and other unnamed tributaries.
SC8	Area associated with this point begins at the mouth of Shamokin Creek into the Susquehanna River near the city of Sunbury and extends up the mainstem to SC7. Receives water from Little Shamokin Creek, Plum Creek, and other unnamed tributaries.

Table 4 - Summary Table for Shamokin Creek Watershed						
Station	**Parameter**	**Measured Sample Data**		**Allowable**		**Reduction Identified**
		Conc. (mg/L)	**Load (lb/day)**	**LTA Conc. (mg/L)**	**Load (lb/day)**	**Percent (%)**
Mid Valley	Fe	11.43	263.1	0.09	2.1	99
	Mn	2.19	50.4	0.94	21.6	57
	Al	4.21	96.9	0.59	13.6	86
	Acidity	113.25	2606.8	0	0	100
	Alkalinity	0	0	-----	-----	-----
NB1	Fe	9.74	247.8	0.39	9.9	0**
	Mn	2.72	69.2	0.65	16.5	59**
	Al	5.66	144.0	0.11	2.8	96**
	Acidity	81.88	2082.8	0.25	6.4	0**
	Alkalinity	1.54	39.2	-----	-----	-----
SC1	Fe	1.32	126.7	0.42	40.3	0**
	Mn	0.26	25.0	0.26	25.0	0**
	Al	Not enough data to perform analysis.				
	Acidity	3.00	288.0	2.10	201.6	0**
	Alkalinity	15.60	1497.5	-----	-----	-----
Excelsior	Fe	21.25	1089.9	0.16	8.2	99
	Mn	2.80	143.6	0.62	31.8	78
	Al	1.48	75.9	0.31	15.9	79
	Acidity	59.52	3052.8	1.78	91.3	97
	Alkalinity	18.17	932.0	-----	-----	-----
Corbin	Fe	40.80	282.1	0	0	100
	Mn	4.71	32.6	0.85	5.9	82
	Al	8.23	56.9	0.74	5.1	91
	Acidity	180.25	1246.2	0	0	100
	Alkalinity	0	0	-----	-----	-----
	Fe	25.88	843.9	0.52	17.0	98
	Mn	3.88	126.5	0.66	21.5	83
	Al	1.53	49.9	-----	------	------
	Acidity	36.89	1203.0	8.49	276.9	77
	Alkalinity	38.15	1244.0	-----	-----	-----
Colbert	Fe	27.85	229.2	0.17	1.4	99
	Mn	3.70	30.5	0.92	7.6	75
	Al	0.12	1.0	0.12	1.0	0
	Acidity	100.50	827.3	7.04	58.0	93
	Alkalinity	31.00	255.2	-----	-----	-----
Maysville	Fe	21.45	286.2	0.17	2.3	99
	Mn	2.78	37.1	0.92	12.3	67
	Al	0.11	1.5	0.11	1.5	0

Table 4 - Summary Table for Shamokin Creek Watershed						
		Measured Sample Data		**Allowable**		**Reduction Identified**
	Acidity	106.00	1414.5	Not applicable		
	Alkalinity	109.25	1457.8	-----	-----	-----
QR1	Fe	16.05	1183.3	0.13	9.6	0**
	Mn	3.13	230.8	0.72	53.1	32**
	Al	0.14	10.4	0.14	10.3	1**
	Acidity	11.50	847.8	Not applicable		
	Alkalinity	22.37	1649.2	-----	-----	-----
					Big Mountain	Fe
	Mn	6.11	76.4	0.37	4.6	94
	Al	6.87	85.9	0.27	3.4	96
	Acidity	93.82	1173.7	1.88	23.5	98
	Alkalinity	8.18	102.3	-----	-----	-----
SC2	Fe	17.90	4000.9	0.72	160.9	86**
	Mn	3.62	809.1	0.51	114.0	73**
	Al	2.51	561.0	0.15	33.5	91**
	Acidity	46.50	10393.3	1.86	415.7	92**
	Alkalinity	6.00	1341.1	-----	-----	-----
Royal Oak	Fe	5.49	1.2	0.11	0.02	98
	Mn	1.87	0.4	0.21	0.05	89
	Al	5.66	1.3	0.06	0.01	99
	Acidity	51.53*	11.60*	2.06	0.5	96
	Alkalinity	11.97	2.7	-----	-----	-----
Stirling	Fe	27.54	1061.1	0.28	10.8	99
	Mn	3.52	135.6	0.70	27.0	80
	Al	0.46	17.7	0.28	10.8	40
	Acidity	24.80	955.6	8.42	324.4	66
	Alkalinity	61.11	2354.6	-----	-----	----

CAR1	Fe	14.57	670.8	0.12	5.5	0**
	Mn	3.25	149.6	0.62	28.5	31**
	Al	0.43	19.8	0.10	4.6	64**
	Acidity	14.33	659.7	Not applicable		
	Alkalinity	31.00	1427.1	-----	-----	-----
SC3	Fe	18.50	5921.7	0.18	57.6	96**
	Mn	3.09	989.1	0.40	128.0	26**
	Al	1.16	371.3	0.38	121.6	0**
	Acidity	24.91	7973.4	7.72	2471.1	0**

Table 4 - Summary Table for Shamokin Creek Watershed

		Measured Sample Data		Allowable		Reduction Identified
	Alkalinity	22.95	7346.0	-----	-----	-----
Cameron Air	Fe	42.61	732.1	0.35	6.0	99
	Mn	4.94	84.9	0.44	7.6	91
	Al	1.96	33.7	0.14	2.4	93
	Acidity	128.91	2214.7	2.58	44.3	98
	Alkalinity	20.26	348.1	-----	-----	-----
Cameron Drift	Fe	48.39	577.1	0.29	3.5	99
	Mn	4.99	59.5	0.45	5.4	91
	Al	0.56	6.7	0.25	3.0	55
	Acidity	136.82	1631.7	4.10	48.9	97
	Alkalinity	27.95	333.3	-----	-----	-----
SC4	Fe	18.58	6207.6	0.37	123.6	0**
	Mn	3.28	1095.8	0.59	197.1	0**
	Al	1.21	404.3	0.39	130.3	0**
	Acidity	30.62	10230.2	3.37	1125.9	0**
	Alkalinity	14.32	4784.3	-----	-----	-----
SC5	Fe	19.55	7493.6	0.78	299.0	79**
	Mn	3.62	1387.6	0.69	264.5	46**
	Al	2.15	824.1	0.43	164.8	70**
	Acidity	47.07	18042.2	0.00	0.0	100**
	Alkalinity	5.20	13492.4	-----	-----	-----
SC6	Fe	13.08	6034.7	0.78	359.9	0**
	Mn	2.67	1231.9	0.56	258.4	0**
	Al	1.41	650.5	0.34	156.9	0**
	Acidity	21.60	9965.6	4.97	2293.0	0**
	Alkalinity	11.88	5481.1	-----	-----	-----
	Fe	8.93	5004.8	0.27	151.3	0**
	Mn	3.42	1916.7	0.79	442.8	53**
	Al	1.35	756.6	0.28	156.9	40**
	Acidity	34.83	19520.4	1.04	582.9	95**
	Alkalinity	3.83	2146.5	-----	-----	-----
SC8	Fe	1.05	725.7	0.08	55.3	0**
	Mn	2.01	1389.2	0.30	207.3	0**
	Al	0.37	255.7	0.18	124.4	0**
	Acidity	12.23	8452.6	1.10	760.2	0**
	Alkalinity	5.77	3987.9	-----	-----	-----

LTA = Long Term average

* This value has been corrected from the value in the submitted TMDL report dated March 2, 2001.

** Percent reductions required after upstream reductions have been made. The allowable LTA Concentration and load is what is allowed in that segment without including upstream reductions.

It is important to note that PADEP calculated the TMDLs using pollutant concentrations instead of loadings and determined the long-term average concentration that could occur and still attain and maintain water quality standards. The resultant concentration was converted to a long-term average load by multiplying by the 50^{th} percentile flow. Assuming the sample set is log normally distributed, the long-term average is related to the load allocation (or waste load allocation) by the coefficient of variation of the sample set. EPA finds this approach reasonable.

3. *The TMDLs consider the impacts of background pollutant contributions.*

The Shamokin Creek watershed is located in an area that was extensively mined. The TMDLs were developed using instream data which account for existing background conditions.

4. *The TMDLs consider critical environmental conditions.*

The lack of statistical correlation between flow and concentration for metal data sets from sample point SC6 indicated there is no critical flow concentration. EPA agrees that there is no one critical flow, *e.g.,* low flows or peak runoff flows.

5. The TMDLs consider seasonal environmental variations.

All sample sets included data points from various seasons, which together with the lack of correlations between flow and concentration, indicate that PADEP considered seasonal variations.

6. The TMDLs include a margin of safety.

The Clean Water Act and federal regulations require TMDLs to include a margin of safety (MOS) to take into account any lack of knowledge concerning the relationship between effluent limitations and water quality. EPA guidance suggests two approaches to satisfy the MOS requirement. First, it can be met implicitly by using conservative model assumptions to develop the allocations. Alternately, it can be met explicitly by allocating a portion of the allowable load to the MOS.

PADEP used an implicit MOS in these TMDLs by assuming the treated instream

concentration variability to be the same as the untreated stream's concentration variability. This is a more conservative assumption than the general assumption that a treated discharge has less variability than an untreated discharge. By retaining variability in the treated discharge, a lower average concentration is required to meet water quality standards 99 percent of the time than if the variability of the treated discharge is reduced.

With respect to iron, PADEP identified an additional implicit MOS in the analysis and TMDL development by treating the iron water quality criterion as if the 1.50 mg/L were a maximum value instead of a one-day average value.

With respect to pH, State water quality standards state that if the naturally occurring pH values are outside the water quality range, the naturally occurring pH becomes the standard for the waterbody. PADEP, however, based the required net alkalinity value using the water quality standard in lieu of the background value, which also provides an implicit MOS.

Contrary to the TMDL report's statement, running the @RISK for 5000 iterations does not increase the MOS as the mean and standard deviation of the population is determined by a small sample set.

7. There is reasonable assurance that the proposed TMDLs can be met.

The TMDL report section *Recommendations* highlights what can be done in the watershed to eliminate and or treat pollutant sources. There were four recommendations made in the submitted TMDL Report. A summary of these recommendations are: (1) remove abandoned highwalls in conjunction with filling in abandoned pits, (2) the removal or reduction of abandoned coal refuse deposits in conjunction with re-grading and replanting of these areas (includes the above abandoned pit areas), (3) complete individual assessments for passive treatment for those identified discharges in the watershed, and (4) plan, develop, and implement measures for controlling stormwater runoff, which will remain on the surface after reclamation and flow into or through existing drainage facilities that are likely not to be designed for such flows.

Some projects have started and/or completed with the above recommendations in mind. The Shamokin/Butternut Creek project in the town of Mount Carmel is working on identifying areas of concern. Some reclamation work has begun. Several private (non-industry) organizations, such as the Shamokin Creek Restoration Alliance, the Northumberland County Conservation District, and the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation, have received or have applied for grants, such as Growing Greener, to install treatment systems and weirs, and remediate and/or reclaim numerous areas within the watershed. Bucknell University and the U.S. Geological Survey, in cooperation, conducted a comprehensive watershed assessment complete with GIS coverages, water quality, and flow data.

Two passive treatment systems have been installed in the Shamokin Creek watershed. Both of these systems are located in the Carbon Run Subwatershed. One system, installed by the Shamokin Creek Restoration Alliance, consists of a series of settling ponds. The system will

provide enough retention time that precipitating metals, chiefly iron, will be able to settle out of the water and remain in the ponds. The second system, installed by the PADEP Bureau of Abandoned Mine Reclamation, Bucknell University, USGS, and OSM, not only settles out metals, but also adds alkalinity to the receiving water and therefore, helps to raise the pH of the water in the receiving stream. Other passive treatment systems are planned for the future, as funds are available for their installation and landowner permission is obtained.

Should these remediation and/or treatment efforts be accomplished, the reductions required in these TMDLs could be achieved.

8. *The TMDLs have been subject to public participation.*

PADEP public noticed the draft TMDLs in the *Pennsylvania Bulletin* and *The Shamokin News Item* newspapers with a 60-day comment period ending February 13, 2001. A public meeting with watershed residents was held on January 17, 2001 at the Mount Carmel Public Library in Mount Carmel, Pennsylvania to discuss the TMDLs. Two sets of comments were received on the draft TMDLs. This was provided along with PADEP's response document with the TMDL report. EPA made comments on transposition errors in the public noticed TMDL. There are still transposition errors in the final TMDL report which have been noted in this decision rationale. PADEP will post the notice of final TMDL approval on their web site.

Attachment A

Shamokin Creek Watershed

SC7
18489
18489