GLADE RUN
WATERSHED TMDL
Fayette County

For Acid Mine Drainage Affected Segments

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TMDL[1]
Glade Run Watershed
Fayette County, Pennsylvania

Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Glade 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 segment on that list and additional segments on later lists/reports (Attachment B). Glade Run was listed as impaired for metals. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Directions to the Glade Run Watershed

The Glade Run Watershed lied in the southeastern portion of Fayette County. It is bounded on the south by the village of Deer Lake, on the east by Ohiopyle State Park, on the west by the village of Jumonville and on the north by Glade Run. Slightly over half of the watershed lays in Wharton Township; the other half of Glade Run lies in Dunbar Township. The watershed can be found on the southwestern corner portion of the Fort Necessity 7 ½" quadrangle.

The most direct access to the watershed is gained by driving south from Uniontown on Route 40, turning east at the village of Chalkhill for about on mile to the village of Deer Lake. Approximately 200 feet past the bridge over Deer Lake, turn left and travel north for slightly over one mile to the State Game Lands #51 boundary. At this point, the gamelands boundary serves as the watershed divide for the Glade Run Watershed.

Hydrology and Geology

Much of the watershed lies within State Game Lands #51. The remainer of the land through which the watershed flows is privately held. Over 90% of the watershed is forested. Land use is primarily forestland with small percentages of the watershed covered by abandoned mine lands. Glade Run flows through its 5.2 mi^2 watershed from south to north, eventually flowing into Dunbar Creek approximately 3.5 miles east of the village of Lemont Furnace. Glade Run at its confluence with Dunbar Creek supports some fishing but has been severely degraded by past mining activities.

The watershed straddles two Appalachian Physiographic Provinces. The majority of the watershed lies in the Allegheny Mountain Section of the Appalchian Plateau Physiographic Province. The area at the mouth of Glade Run lies within the Pittsburgh Lower Plateau Section

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[1] Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists and the 2004 and 2006 Integrated Water Quality Report were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

of the same province. Both sections are strongly dissected by stream valleys. The position of the Dunbar Creek to the north has helped determine base level for local groundwater systems. The mouth of Glade Run lies at an elevation of approximately 1495’ mean sea level (MSL). The areas of highest elevation within the study area lie at the southwestern and southern ends of the watersheds area at approximately 2430’ MSL.

Bedrock geology exposed within the area is composed primarily of members of the upper portion of the Burgoon Sandstone, the Mauch Chunk Formation, the Allegheny Group, and the entire Pottsville Group, located at the highest elevations within the watershed. Stratigraphically, the lowest series exposed, the Burgoon Sandstone, is exposed at the extreme northern end of the watershed, where Glade Run has cut deeply into the underlying bedrock prior to emptying into Dunbar Creek. Structurally, the Elliotsville/Ligonier Syncline parallels Glade Run throughout most of its extent. The Chestnut Ridge Anticline lies approximately one mile to the east a splay of the Chestnut Ridge Anticline (Dulaney) lies approximately one-half mile to the west of the watershed. With the synclinal structure primarily superimposed on top of the main stem of Glade Run, local strata will essentially dip from either side of the watershed toward the stream itself in most cases at less then 5%.

Segments addressed in this TMDL

Glade Run is affected by pollution from AMD. This pollution has caused high levels of metals, and in some cases low pH, in the watershed. There are no active mining operations in the watershed. The 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 Table 3 for TMDL calculations and see Attachment C for TMDL explanations.

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 Environmental Protection Agency’s (EPA) 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 EPA 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

- EPA to approve or disapprove state lists and TMDLs within 30 days of final submission.

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

In the cases that have been settled to date, the consent agreements require EPA 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 1997 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 EPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (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. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the assessed stream segment can vary between sites. All the

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

biological surveys included kick-screen sampling of benthic macroinvertebrates and habitat evaluations. 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 habitat scores and a series of narrative biological statements used to evaluate the benthic macroinvertebrate community. 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 source and cause. A TMDL must be developed for the stream segment and each pollutant. 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. Calculating the TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

The Glade Run Watershed reflects the hydrologic impacts by past surface mining operations. In addition, field studies show that some limited logging has been occurring along the eastern and southeastern portions of the watershed. Surface mining occurred along the eastern and southeastern portion of the watersheds; limited surface mining took place immediately adjacent to the stream near the extreme southern end of the watersheds. The Clarion coal crops out on the eastern portion of the watershed (~2100 feet) and dips to the west toward Glade Run. The Upper Kittanning and upper Freeport coals crop out along the southeastern portions of the watershed at higher elevations (~2250 feet) and also dip to the west at several percent. Small-scale surface mining on the Clarion or Brookville coal occurred along the mainstream of Glade Run at its southernmost extent.

All of the surface mining operations within the watershed are now abandoned or have been completed and have received bond release. No NPDES-permitted discharges exist in the watershed.

AMD Methodology

A two-step approach is used for the TMDL analysis of AMD impaired stream segments. The first step uses a statistical method for determining the allowable instream concentration at the point of interest necessary to meet water quality standards. This is done at each point of interest (sample point) in the watershed. The second step is a mass balance of the loads as they pass through the watershed. Loads at these points will be computed based on average annual flow.

The statistical analysis described below can be applied to situations where all of the pollutant loading is from non-point sources as well as those where there are both point and non-point sources. The following defines what are considered point sources and non-point sources for the purposes of our evaluation; point sources are defined as permitted discharges or a discharge that has a responsible party, non-point sources are then any pollution sources that are not point sources. For situations where all of the impact is due to non-point sources, the equations shown below are applied using data for a point in the stream. The load allocation made at that point will be for all of the watershed area that is above that point. For situations where there are point-source impacts alone, or in combination with non-point 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.

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. 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 the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards,* 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)

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

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)

LTA = allowable LTA source concentration in mg/l

Once the allowable concentration and load for each pollutant is determined, mass-balance accounting is performed starting at the top of the watershed and working down in sequence. This mass-balance or load tracking is explained below.

Load tracking through the watershed utilizes the change in measured loads from sample location to sample location, as well as the allowable load that was determined at each point using the @Risk program.

There are two basic rules that are applied in load tracking; rule one is that if the sum of the measured loads that directly affect the downstream sample point is less than the measured load at the downstream sample point it is indicative that there is an increase in load between the points being evaluated, and this amount (the difference between the sum of the upstream and downstream loads) shall be added to the allowable load(s) coming from the upstream points to give a total load that is coming into the downstream point from all sources. The second rule is that if the sum of the measured loads from the upstream points is greater than the measured load at the downstream point this is indicative that there is a loss of instream load between the evaluation points, and the ratio of the decrease shall be applied to the load that is being tracked (allowable load(s)) from the upstream point.

Tracking loads through the watershed gives the best picture of how the pollutants are affecting the watershed based on the information that is available. The analysis is done to insure that water quality standards will be met at all points in the stream. The TMDL must be designed to meet standards at all points in the stream, and in completing the analysis, reductions that must be made to upstream points are considered to be accomplished when evaluating points that are lower in the watershed. Another key point is that the loads are being computed based on average annual flow and should not be taken out of the context for which they are intended, which is to depict how the pollutants affect the watershed and where the sources and sinks are located spatially in the watershed.

For pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and hot acidity. Statistical procedures are 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 streams affected by low pH from AMD may not be a true reflection of acidity. This method assures that Pennsylvania's standard for pH is met when the acid concentration reduction is met.

Information for the TMDL analysis performed using the methodology described above is contained in the "TMDLs by Segment" section of this report.

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 a comparison between observed instream conditions and conditions that are expected to restore designated uses. The endpoint is based on either the narrative or numeric criteria available in water quality standards.

Because the pollution sources in the watershed are nonpoint sources, the TMDLs' component makeup will be load allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). For high quality waters, applicable water-quality criteria are determined using the unimpaired segment of the TMDL water or the 95th percentile of a reference Water Quality Network (WQN) stream. For segments in the Glade Run Watershed, WQN870 on Clear Shade Creek (SWP18E) is used as the reference water. The following table shows the criteria used in the Glade Run TMDL. Attachment E explains how to select a reference stream for HQ TMDL development.

Table 1. Reference Clear Shade Creek Criteria

Parameter	Criterion Value
Aluminum (Al)	0.231mg/L
Iron (Fe)	0.212 mg/L
Manganese (Mn)	1.0 mg/L
Area	16 square miles
Alkalinity	4.8 mg/L

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS). The waste load allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point 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). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 3 for each segment are based on the assumption that all upstream allocations are implemented and take into account all upstream reductions. Attachment D contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit MOS based on conservative assumptions in the analysis is included in the TMDL calculations.

The allowable LTA concentration in each segment is calculated using Monte Carlo Simulation as described previously. The allowable load is then determined by multiplying the allowable concentration by the average flow and a conversion factor at each sample point. The allowable load is the TMDL at that point.

Waste load allocations have also been included at some points for future mining operations. The difference between the TMDL and the WLA at each point is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced from nonpoint sources within a segment in order for water quality standards to be met at the point.

In some instances, instream processes, such as settling, are taking place within a stream segment. These processes are evidenced by a decrease in measured loading between consecutive sample points. It is appropriate to account for these losses when tracking upstream loading through a segment. The calculated upstream load lost within a segment is proportional to the difference in the measured loading between the sampling points.

Table 2. Glade Run Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	NPS Load Reduction (lbs/day)	NPS % Reduction
GLAD7 – Glade Run in headwaters						
Aluminum (lbs/day)	4.57	0.31	-	0.31	4.26	96%
Iron (lbs/day)	7.74	0.23	-	0.23	7.51	97%
Manganese(lbs/day)	13.54	3.66	-	3.66	9.88	73%
Acidity (lbs/day)	143.88	8.63	-	8.63	135.25	94%
GLAD6 – Flat Rock Run at mouth						
Aluminum (lbs/day)	2.59	0.31	-	0.31	2.28	88%
Iron (lbs/day)	0.87	0.21	-	0.21	0.66	76%
Manganese(lbs/day)	0.57	0.57	NA	NA	NA	NA
Acidity (lbs/day)	49.37	2.47	-	2.47	46.90	95%
GLAD5 – Southern unnamed tributary to Big Piney Run (local name)						
Aluminum (lbs/day)	11.34	1.36	-	1.36	9.98	88%
Iron (lbs/day)	2.31	2.31	NA	NA	NA	NA
Manganese(lbs/day)	6.70	6.70	NA	NA	NA	NA
Acidity (lbs/day)	170.23	37.45	-	37.45	132.78	78%
GLAD4 – Northern unnamed tributary to Big Piney Run (local name)						
Aluminum (lbs/day)	3.22	0.39	-	0.39	2.83	88%
Iron (lbs/day)	1.06	0.40	-	0.40	0.66	62%
Manganese(lbs/day)	1.64	1.64	NA	NA	NA	NA
Acidity (lbs/day)	59.42	5.94	-	5.94	53.48	90%
GLAD3 – Rock Run at mouth						
Aluminum (lbs/day)	0.79	0.29	-	0.29	0.50	64%
Iron (lbs/day)	0.39	0.11	-	0.11	0.28	73%
Manganese(lbs/day)	0.13	0.13	NA	NA	NA	NA
Acidity (lbs/day)	5.22	1.93	-	1.93	3.29	63%
GLAD2 – Little Piney Run at mouth (local name)						
Aluminum (lbs/day)	0.83	0.12	-	0.12	0.71	85%
Iron (lbs/day)	0.26	0.08	-	0.08	0.18	70%
Manganese(lbs/day)	0.19	0.19	NA	NA	NA	NA
Acidity (lbs/day)	4.58	1.69	-	1.69	2.89	63%
GLAD1 – Glade Run near mouth						
Aluminum (lbs/day)	8.96	1.17	-	1.17	0*	0%*
Iron (lbs/day)	3.53	0.74	-	0.74	0.20*	21%*
Manganese(lbs/day)	4.41	4.41	NA	NA	NA	NA
Acidity (lbs/day)	50.43	8.57	-	8.57	0*	0%*

NA = not applicable
* Takes into account load reductions from upstream sources.

In the instance that the allowable load is equal to the existing load (e.g. manganese point GLAD2, Table 3), the simulation determined that water quality standards are being met instream

99% of the time and no TMDL is necessary for the parameter at that point. This is denoted as "NA" in the above table.

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, aluminum allocations for GLAD1 of Glade Run are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains maps of the sampling point locations for reference.

Allocations GLAD1	
GLAD1	Al (Lbs/day)
Existing Load @ GLAD1	8.96
Allowable Load @ GLAD1	1.17

Glade Run

Allowable Load = 1.17 lbs/day

Load input =-14.38 lbs/day
(Difference between existing loads at GLAD2-7
And GLAD1)

ALLOCATIONS GLAD1	
GLAD1	Al (Lbs/day)
Existing Load @ GLAD1	8.96
Difference in measured Loads between the loads that enter and existing GLAD1 (GLAD1–(GLAD2-7))	-14.38
Additional load tracked from above samples	2.78
Total load tracked between GLAD2-7 and GLAD1	1.06
Allowable Load @ GLAD1	1.17
Load Reduction @ GLAD1	0
% Reduction required at GLAD1	0%

Allowable Load = 1.17 lbs/day

The allowable aluminum load tracked from GLAD1 was 1.17 lbs/day. The existing load GLAD2-7 was subtracted from the existing load at GLAD1 to show the actual measured decrease of aluminum load that has been deposited in the stream between these upstream sites and GLAD1 (-14.38 lbs/day). The percentage of the total upstream load that remained was then multiplied by the additional load tracked from the upstream points to calculate the total load that was tracked between GLAD2-7 and GLAD1 (allowable loads @ GLAD2-7 * the percentage of the total upstream load that tracked to GLAD1). This total load tracked was then subtracted from the calculated allowable load at GLAD1 to determine the amount of load to be reduced at GLAD1. This total load value was found to be 0 lbs/day; therefore, a no reduction in aluminum at GLAD1 is necessary.

Recommendations

The mine drainage impacting the Glade Run Watershed is attributable to the abandoned mine discharges throughout the watershed. For the last six years, groups such as Chestnut Ridge

Chapter of Trout Unlimited have been successful in using the addition of alkaline material to Glade Run in an attempt to increase the alkalinity and buffering capacity of the stream. Prior to the addition of this alkaline sand, the main stem of Glade Run was net acidic with some elevated metals. Glade Run and its tributaries received additions of alkaline sand as recently as spring, summer, and fall of 2008. In addition, a treatment system has been installed in the headwaters area in an effort to provide alkalinity to the watershed.

Since the 1960s, Pennsylvania has been a national leader in establishing laws and regulations to ensure mine reclamation and well plugging occur after active operation is completed. Mine reclamation and well plugging refer 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 PADEP's Brownfields Program. Pennsylvania is striving for complete reclamation of its abandoned mines and plugging of its orphan wells. These concepts include legislative, policy, and land management initiatives designed to enhance mine operator/volunteer/PADEP reclamation efforts.

Various methods to eliminate or treat pollutant sources provide a reasonable assurance that the proposed TMDLs can be met. These methods include PADEP's primary efforts to improve water quality through reclamation of abandoned mine lands (for abandoned mining) and through the National Pollution Discharge Elimination System (NPDES) permit program (for active mining). Funding sources that are currently being used for projects designed to achieve TMDL reductions include the USEPA 319 grant program and Pennsylvania's Growing Greener Program. Federal funding is through the Department of the Interior's Office of Surface Mining (OSM) for reclamation and mine drainage treatment through the Appalachian Clean Streams Initiative and through Watershed Cooperative Agreements.

The PADEP Bureau of District Mining Operations (DMO) administers an environmental regulatory program for all mining activities, including mine subsidence regulation, mine subsidence insurance, and coal refuse disposal. PADEP DMO also conducts a program to ensure safe underground bituminous mining and protect certain structures from subsidence; administers a mining license and permit program; administers a regulatory program for the use, storage, and handling of explosives; and provides for training, examination, and certification of applicants' blaster's licenses. In addition, PADEP Bureau of Mining & Reclamation administers a loan program for bonding anthracite underground mines and for mine subsidence, the Small Operator's Assistance Program (SOAP), and the Remining Operator's Assistance Program (ROAP).

Regulatory programs are assisting in the reclamation and restoration of Pennsylvania's land and water. PADEP has been effective in implementing the NPDES program for mining operations throughout the Commonwealth. This reclamation was done through the use of remining permits that have the potential for reclaiming abandoned mine lands, at no cost to the Commonwealth or the federal government. Long-term agreements were initialized for facilities/operators that need to assure treatment of post-mining discharges or discharges they degraded. These agreements will provide for long-term treatment of discharges. According to OSM, "PADEP is conducting a program where active mining sites are, with very few exceptions, in compliance with the approved regulatory program." Acidity loads from abandoned discharges have been observed to decrease by an average of 61 percent when remined (Smith, Brady, and Hawkins, 2002. "Effectiveness of Pennsylvania's remining program in abating abandoned mine drainage: water quality impacts" in Transactions of the Society for Mining, Metallurgy, and Exploration, Volume 312, p. 166-170).

PADEP BAMR, which administers the program to address the Commonwealth's abandoned mine reclamation program, has established a comprehensive plan for abandoned mine reclamation throughout the Commonwealth to prioritize and guide reclamation efforts for throughout the state to make the best use of valuable funds (www.dep.state.pa.us/dep/deputate/minres/bamr/complan1.htm). In developing and implementing a comprehensive plan for abandoned mine reclamation, the resources (both human and financial) of the participants must be coordinated to insure cost-effective results. The following set of principles is intended to guide this decision making process:

- Partnerships between the PADEP, watershed associations, local governments, environmental groups, other state agencies, federal agencies, and other groups organized to reclaim abandoned mine lands are essential to achieving reclamation and abating acid mine drainage in an efficient and effective manner.

- Partnerships between AML interests and active mine operators are important and essential in reclaiming abandoned mine lands.

- Preferential consideration for the development of AML reclamation or AMD abatement projects will be given to watersheds or areas for which there is an approved rehabilitation plan (guidance is given in Attachment G).

- Preferential consideration for the use of designated reclamation moneys will be given to projects that have obtained other sources or means to partially fund the project or to projects that need the funds to match other sources of funds.

- Preferential consideration for the use of available moneys from federal and other sources will be given to projects where there are institutional arrangements for any necessary long-term operation and maintenance costs.

- Preferential consideration for the use of available moneys from federal and other sources will be given to projects that have the greatest worth.

- Preferential consideration for the development of AML projects will be given to AML problems that impact people over those that impact property.

- No plan is an absolute; occasional deviations are to be expected.

A detailed decision framework is included in the plan that outlines the basis for judging projects for funding, giving high priority to those projects whose cost/benefit ratios are most favorable and those in which stakeholder and landowner involvement is high and secure.

The Commonwealth is exploring all identified options to address its abandoned mine problem. During 2000-2006, many new approaches to mine reclamation and mine drainage remediation have been explored and projects funded to address problems in innovative ways. These include:

- Awards of grants for: (1) proposals with economic development or industrial application as their primary goal and which rely on recycled mine water and/or a site that has been made suitable for the location of a facility through the elimination of existing Priority 1 or 2 hazards; and (2) new and innovative mine drainage treatment technologies that provide waters of higher purity that may be needed by a particular industry at costs below conventional treatment costs as in common use today or reduce the costs of water treatment below those of conventional lime treatment plants. Eight contracts totaling $4.075 M were awarded in 2006 under this program.

- Projects using water from mine pools in an innovative fashion, such as the Shannopin Deep Mine Pool (in southwestern Pennsylvania), the Barnes & Tucker Deep Mine Pool (the Susquehanna River Basin into the Upper West Branch Susquehanna River), and the Wadesville Deep Mine Pool (Exelon Generation in Schuylkill County).

Candidate or federally-listed threatened and endangered species may occur in or near the watershed. While implementation of the TMDL may result in improvements to water quality, inadvertently destroy habitat for candidate or federally-listed species. TMDL implementation projects should be screened through the Pennsylvania Natural Diversity Inventory (PNDI) early in their planning process, in accordance with the PADEP's policy titled Policy for Pennsylvania Natural Diversity Inventory (PNDI) Coordination During Permit Review and Evaluation (Document ID# 400-0200-001).

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on November 29, 2008, to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from November 29, 2008 to January 23, 2009. A public meeting was held on January 14, 2009 at the Knights of Columbus in Uniontown, PA to discuss the proposed TMDL.

Future TMDL Modifications

In the future, the Department may adjust the load and/or wasteload allocations in this TMDL to account for new information or circumstances that are developed or discovered during the implementation of the TMDL when a review of the new information or circumstances indicate that such adjustments are appropriate. Adjustment between the load and wasteload allocation will only be made following an opportunity for public participation. A wasteload allocation adjustment will be made consistent and simultaneous with associated permit(s) revision(s)/reissuances (i.e., permits for revision/reissuance in association with a TMDL revision will be made available for public comment concurrent with the related TMDLs availability for public comment). New information generated during TMDL implementation may include, among other things, monitoring data, BMP effectiveness information, and land use information.

All changes in the TMDL will be tallied and once the total changes exceed 1% of the total original TMDL allowable load, the TMDL will be revised. The adjusted TMDL, including its LAs and WLAs, will be set at a level necessary to implement the applicable WQS and any adjustment increasing a WLA will be supported by reasonable assurance demonstration that load allocations will be met. The Department will notify EPA of any adjustments to the TMDL within 30 days of its adoption and will maintain current tracking mechanisms that contain accurate loading information for TMDL waters.

Changes in TMDLs That May Require EPA Approval

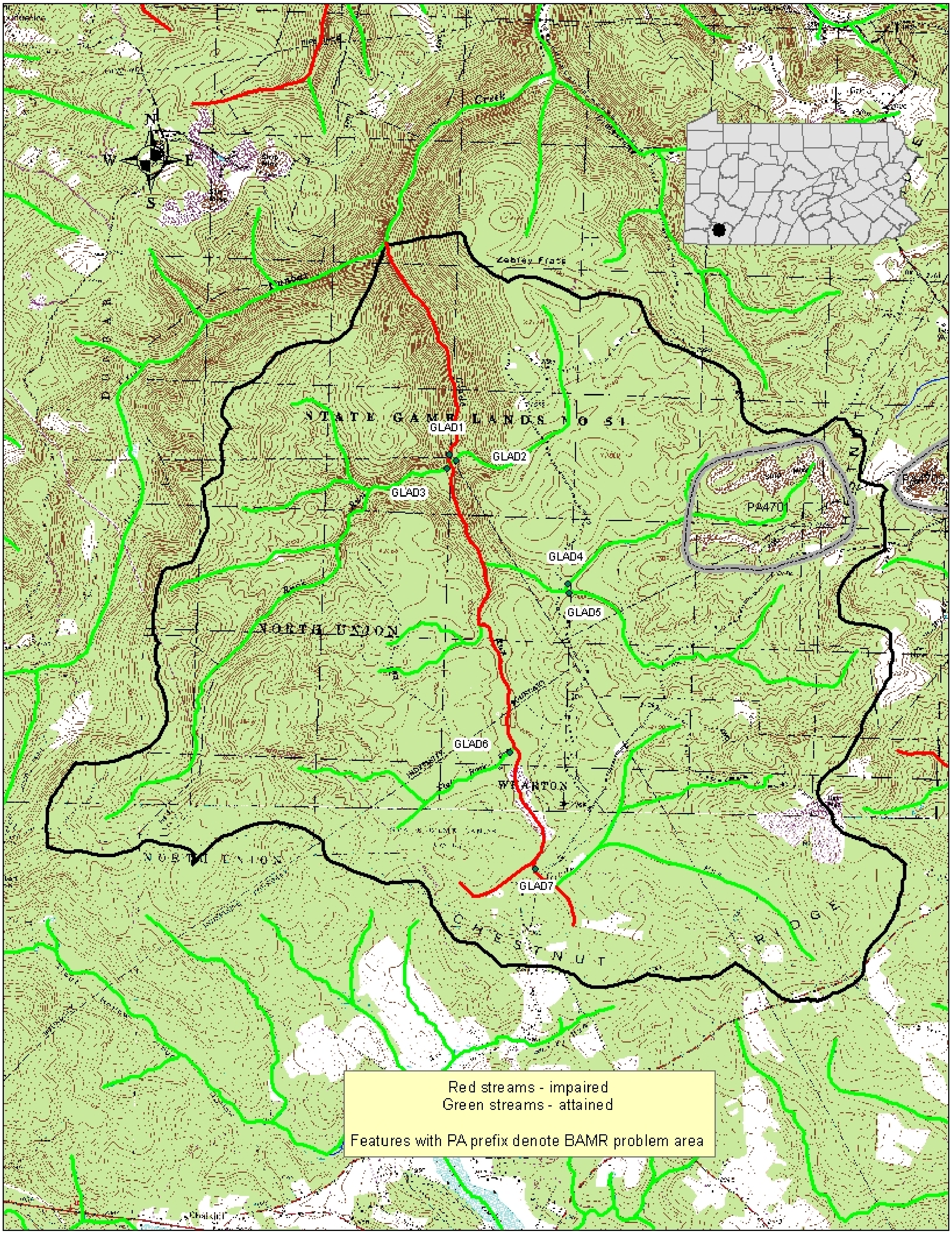
- Increase in total load capacity.
- Transfer of load between point (WLA) and nonpoint (LA) sources.
- Modification of the margin of safety (MOS).
- Change in water quality standards (WQS).
- Non-attainment of WQS with implementation of the TMDL.
- Allocations in trading programs.

Changes in TMDLs That May Not Require EPA Approval

- Total loading shift less than or equal to 1% of the total load.
- Increase of WLA results in greater LA reductions provided reasonable assurance of implementation is demonstrated (a compliance/implementation plan and schedule).
- Changes among WLAs with no other changes; TMDL public notice concurrent with permit public notice.
- Removal of a pollutant source that will not be reallocated.
- Reallocation between LAs.
- Changes in land use.

Attachment A

Glade Run Watershed Maps


N
S
W
E
STATE GAME LANDS NO 51
NORTH UNION
WHARTON
CHESTNUT RIDGE
GLAD1
GLAD2
GLAD3
GLAD4
GLAD5
GLAD6
GLAD7
PA4701
Red streams - impaired
Green streams - attained
Features with PA prefix denote BAMR problem area

Attachment B

Glade Run Integrated List Category 5 Report

Stream Name / Use Designation (Assessment ID) / Source	Cause	Date Listed	TMDL Date

Hydrologic Unit Code: 05020006 - Youghiogheny

Glade Run
HUC: 05020006

Aquatic Life (7005) - 0.18 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	1996	2009
Abandoned Mine Drainage	pH	2006	2019
Aquatic Life (7598) - 2.78 miles; 5 Segment(s)*			
Abandoned Mine Drainage	Metals	1996	2009
Aquatic Life (13092) - 0.63 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	2006	2019
Abandoned Mine Drainage	pH	2006	2019

Glade Run (Unt 38220)
HUC: 05020006

Aquatic Life (7005) - 0.46 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	1996	2009
Abandoned Mine Drainage	pH	2006	2019

Glade Run (Unt 38221)
HUC: 05020006

Aquatic Life (7005) - 0.23 miles; 1 Segment(s)*			
Abandoned Mine Drainage	Metals	1996	2009
Abandoned Mine Drainage	pH	2006	2019

Report Summary

Watershed Summary

	Stream Miles	Assessment Units	Segments (COMIDs)
Watershed Characteristics	21.11	3	37

Impairment Summary

Source	Cause	Miles	Assessment Units	Segments (COMIDs)
Abandoned Mine Drainage	Metals	4.29	3	9
Abandoned Mine Drainage	pH	1.51	2	4
		4.29 **	**3** **	**9** **

**Totals reflect actual miles of impaired stream. Each stream segment may have multiple impairments (different sources or causes contributing to the impairment), so the sum of individual impairment numbers may not add up to the totals shown.

Use Designation Summary

	Miles	Assessment Units	Segments (COMIDs)
Aquatic Life	4.29	3	9

*Segments are defined as individual COM IDs.

Attachment C

Method for Addressing Section 303(d) Listings for pH

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 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. 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. 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.

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.*

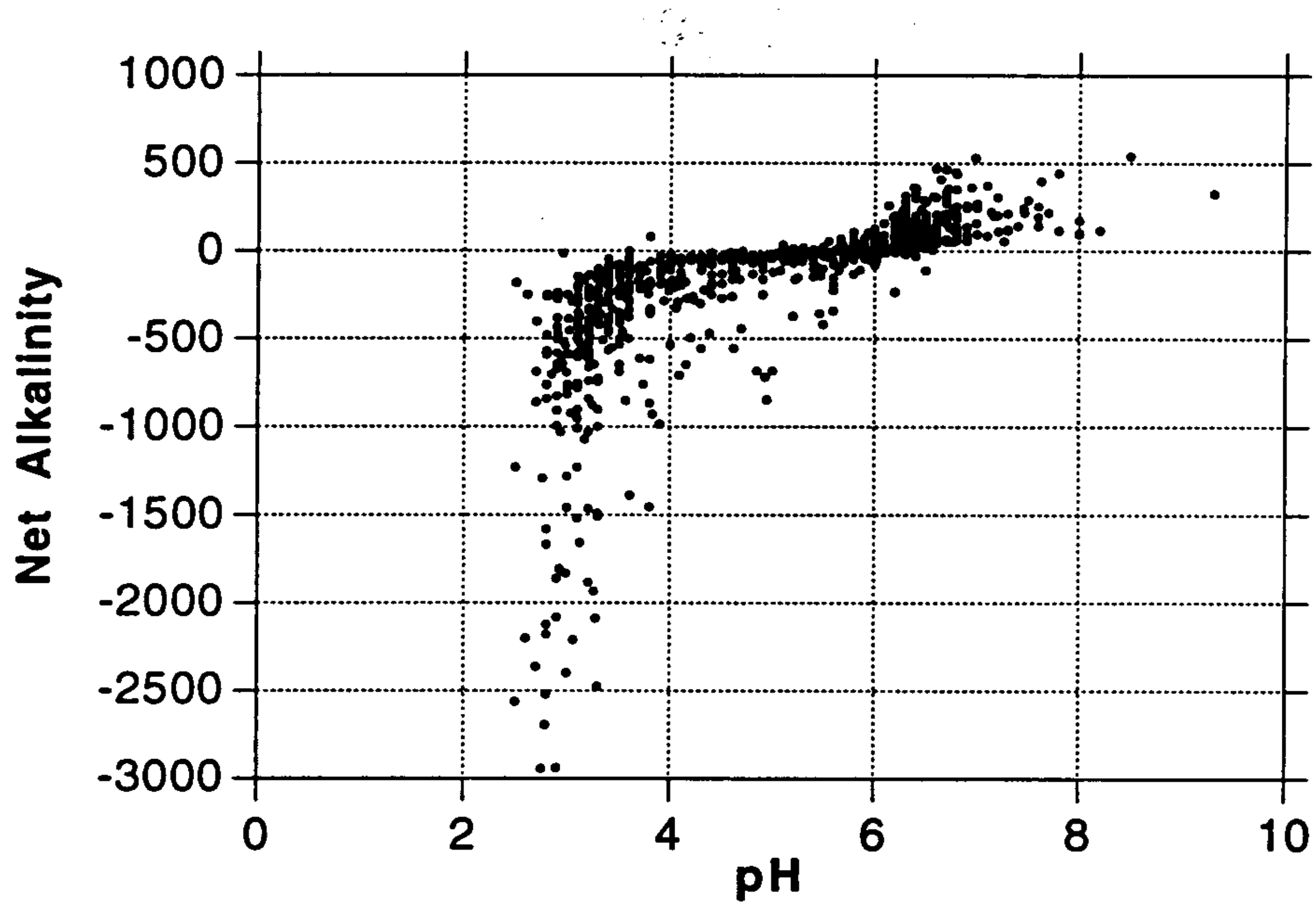


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment D

TMDLs By Segment

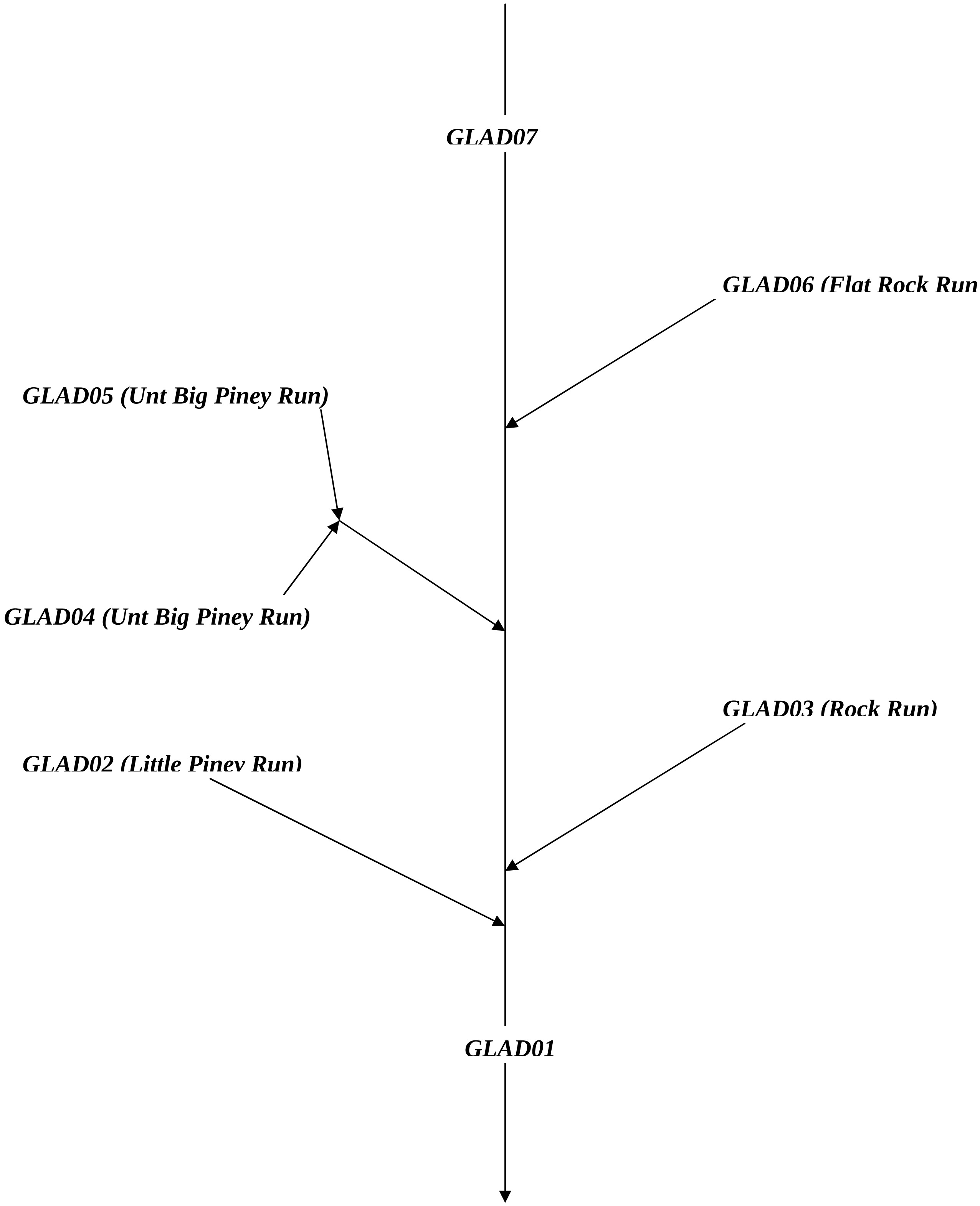
Glade Run

The TMDL for Glade Run consists of load allocations to two sampling sites on Glade Run (GLAD07, GLAD01) and five sites on tributaries of Glade Run (GLAD06-GLAD02). Sample data sets were collected in 2000 through 2008. All sample points are shown on the maps included in Attachment A as well as on the loading schematic presented on the following page.

Glade Run is listed on the 1996 PA Section 303(d) list for metals from AMD as being the cause of the degradation to this stream. Although this TMDL will focus primarily on metal loading to the Glade Run Watershed, acid loading analysis will be performed. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range (between 6 & 9) 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint 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 each sample point for metals 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 log normally 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. Following is an explanation of the TMDL for each allocation point.

Glade Run Sampling Station Diagram
Arrows represent direction of flow
Diagram not to scale



TMDL calculations- GLAD7 - Glade Run in headwaters

The TMDL for sample point GLAD consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for the headwaters of Glade Run was computed using water-quality sample data collected at point GLAD7. The average flow, measured at the sampling point GLAD7 (1.13 MGD), is used for these computations.

Sample data at point GLAD7 shows that the Glade Run headwaters segment has a pH ranging between 4.4 and 5.8. A TMDL for aluminum, iron and manganese has been calculated at this site.

Table D1 shows the measured and allowable concentrations and loads at GLAD7. Table D2 shows the percent reductions for aluminum, iron and manganese.

Table D1		Measured		Allowable	
Flow (gpm)=	782.09	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.49	4.57	0.033	0.31
	Iron	0.82	7.74	0.025	0.23
	Manganese	1.44	13.54	0.39	3.66
	Acidity	15.32	143.88	0.92	8.63
	Alkalinity	7.62	71.55		

Table D2. Allocations GLAD7				
GLAD7	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ GLAD7	4.57	7.74	13.54	143.88
Allowable Load @ GLAD7	0.31	0.23	3.66	8.63
Load Reduction @ GLAD7	4.26	7.51	9.88	135.25
% Reduction required @ GLAD7	96%	97%	73%	94%

TMDL calculations- GLAD6 – Flat Rock Run at mouth

The TMDL for sampling point GLAD6 consists of a load allocation to all of the area upstream of point GLAD6 shown in Attachment A. The load allocation for Flat Rock Run was computed using water-quality sample data collected at point GLAD6. The average flow, measured at the sampling point GLAD6 (0.33 MGD), is used for these computations.

Sample data at point GLAD6 shows pH ranging between 4.3 and 4.7; pH will be addressed as part of this TMDL. A TMDL for aluminum, iron, and manganese at GLAD6 has been calculated.

Table D3 shows the measured and allowable concentrations and loads at GLAD6. Table D4 shows the percent reduction for aluminum, iron, and manganese needed at GLAD6.

Table D3		Measured		Allowable	
Flow (gpm)=	230.29	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.94	2.59	0.11	0.31
	Iron	0.32	0.87	0.08	0.21
	Manganese	0.21	0.57	0.21	0.57
	Acidity	17.85	49.37	0.89	2.47
	Alkalinity	6.93	19.16		

Table D4. Allocations GLAD6			
GLAD6	Al (Lbs/day)	Fe (Lbs/day)	Acidity (Lbs/day)
Existing Load @ GLAD6	2.59	0.87	49.37
Allowable Load @ GLAD6	0.31	0.21	2.47
Load Reduction @ GLAD6	2.28	0.66	46.90
% Reduction required @ GLAD6	88%	76%	95%

TMDL calculations- GLAD5- Southern unnamed tributary to Big Piney Run (local name) at mouth

The TMDL for sampling point GLAD5 consists of a load allocation to all of the area upstream of point GLAD5 shown in Attachment A. The load allocation for this segment of the unnamed tributary to Big Piney Run was computed using water-quality sample data collected at point GLAD5. The average flow, measured at the sampling point GLAD5 (1.85 MGD), is used for these computations.

Sample data at point GLAD5 shows pH ranging between 4.4 and 4.6; pH will be addressed as part of this TMDL. A TMDL for aluminum, iron, and manganese at GLAD5 has been calculated.

Table D5 shows the measured and allowable concentrations and loads at GLAD5. Table D6 shows the percent reduction for aluminum, iron, and manganese needed at GLAD5.

Table D5		Measured		Allowable	
Flow (gpm)=	1282.75	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.74	11.34	0.09	1.36
	Iron	0.15	2.31	0.15	2.31
	Manganese	0.44	6.70	0.44	6.70
	Acidity	11.05	170.23	2.43	37.45
	Alkalinity	5.85	90.12		

Table D6. Allocations GLAD5		
GLAD5	Al (Lbs/day)	Acidity (Lbs/day)
Existing Load @ GLAD5	11.34	170.23
Allowable Load @ GLAD5	1.36	37.45
Load Reduction @ GLAD5	9.98	132.78
% Reduction required @ GLAD5	88%	78%

TMDL calculations- GLAD4- Northern unnamed tributary to Big Piney Run (local name) at mouth

The TMDL for sample point GLAD4 consists of a load allocation to all of the area above point GLAD4 shown in Attachment A. The load allocation for the unnamed tributary of Big Piney Run was computed using water-quality sample data collected at point GLAD4. The average flow, measured at the sampling point GLAD4 (0.54 MGD), is used for these computations.

Sample data at point GLAD4 shows that this unnamed tributary of Big Piney Run has a pH ranging between 4.4 and 4.6. A TMDL for aluminum, iron, manganese and acidity has been calculated at this site.

Table D7 shows the measured and allowable concentrations and loads at GLAD4. Table D8 shows the percent reductions for aluminum, iron, manganese and acidity.

Table D7		Measured		Allowable	
Flow (gpm)=	376.25	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.71	3.22	0.086	0.39
	Iron	0.23	1.06	0.089	0.40
	Manganese	0.36	1.64	0.36	1.64
	Acidity	13.15	59.42	1.32	5.94
	Alkalinity	5.90	26.66		

Table D8. Allocations GLAD4			
GLAD4	Al (Lbs/day)	Fe (Lbs/day)	Acidity (Lbs/day)
Existing Load @ GLAD4	3.22	1.06	59.42
Allowable Load @ GLAD4	0.39	0.40	5.94
Load Reduction @ GLAD4	2.83	0.66	53.48
% Reduction required @ GLAD4	88%	62%	90%

TMDL calculations- GLAD3- Rock Run at mouth

The TMDL for sampling point GLAD3 consists of a load allocation to all of the area upstream of point GLAD3 shown in Attachment A. The load allocation for Rock Run was computed using water-quality sample data collected at point GLAD3. The average flow, measured at the sampling point GLAD3 (0.40 MGD), is used for these computations.

Sample data at point GLAD3 shows pH ranging between 4.9 and 6.9; pH will be addressed as part of this TMDL. A TMDL for aluminum, iron, manganese and acidity at GLAD3 has been calculated.

Table D9 shows the measured and allowable concentrations and loads at GLAD3. Table D10 shows the percent reduction for aluminum, iron, manganese and acidity needed at GLAD3.

Table D9		Measured		Allowable	
Flow (gpm)=	275.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.24	0.79	0.09	0.29
	Iron	0.12	0.39	0.03	0.11
	Manganese	0.04	0.13	0.04	0.13
	Acidity	1.58	5.22	0.59	1.93
	Alkalinity	10.97	36.23		

Table D10. Allocations GLAD3			
GLAD3	Al (Lbs/day)	Fe (Lbs/day)	Acidity (Lbs/day)
Existing Load @ GLAD3	0.79	0.39	5.22
Allowable Load @ GLAD3	0.29	0.11	1.93
Load Reduction @ GLAD3	0.50	0.28	3.29
% Reduction required @ GLAD3	64%	73%	63%

TMDL calculations- GLAD2- Little Piney Run (local name) at mouth

The TMDL for sampling point GLAD2 consists of a load allocation to all of the area upstream of point GLAD2 shown in Attachment A. The load allocation for Little Piney Run was computed using water-quality sample data collected at point GLAD2. The average flow, measured at the sampling point GLAD2 (0.22 MGD), is used for these computations.

Sample data at point GLAD2 shows pH ranging between 4.9 and 7.9; pH will be addressed as part of this TMDL. A TMDL for aluminum, iron, manganese and acidity at GLAD2 has been calculated.

Table D11 shows the measured and allowable concentrations and loads at GLAD2. Table D12 shows the percent reduction for aluminum, iron, manganese and acidity needed at GLAD2.

Table D11		Measured		Allowable	
Flow (gpm)=	150.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.46	0.83	0.07	0.12
	Iron	0.15	0.26	0.04	0.08
	Manganese	0.10	0.19	0.10	0.19
	Acidity	2.54	4.58	0.94	1.69
	Alkalinity	17.90	32.25		

Table D12. Allocations GLAD2			
GLAD2	Al (Lbs/day)	Fe (Lbs/day)	Acidity (Lbs/day)
Existing Load @ GLAD2	0.83	0.26	4.58
Allowable Load @ GLAD2	0.12	0.08	1.69
Load Reduction @ GLAD2	0.71	0.18	2.89
% Reduction required @ GLAD2	85%	70%	63%

TMDL calculations- GLAD1 – Glade Run downstream of GLAD2 and GLAD3

The TMDL for sample point GLAD1 consists of a load allocation to all of the area between GLAD1 and GLAD7 shown in Attachment A. The load allocation for this segment of Glade Run was computed using water-quality sample data collected at point GLAD1. The average flow, measured at the sampling point GLAD1 (2.74 MGD), is used for these computations.

Sample data at point GLAD1 shows that this segment of Glade Run segment has a pH ranging between 5.0 and 7.4. A TMDL for aluminum, iron, manganese and acidity has been calculated at this site.

Table D13 shows the measured and allowable concentrations and loads at GLAD1. Table D14 shows the percent reductions for aluminum, iron, manganese and acidity.

Table D13		Measured		Allowable	
Flow (gpm)=	1900.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.39	8.96	0.05	1.17
	Iron	0.16	3.53	0.03	0.74
	Manganese	0.19	4.41	0.19	4.41
	Acidity	2.21	50.43	0.38	8.57
	Alkalinity	15.43	352.09		

The measured and allowable loading for point GLAD1 for aluminum, iron, manganese and acidity 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 loads already specified from upstream sources. The additional load from points GLAD2-7 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points GLAD2-7 and GLAD1 to determine a total load tracked for the segment of stream between GLAD1 and GLAD2-7. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at GLAD1.

Table D14. Allocations GLAD1			
GLAD1	Al (Lbs/day)	Fe (Lbs/day)	Acidity (Lbs/day)
Existing Load @ GLAD1	8.96	3.53	50.43
Difference in measured loads between GLAD2-7 and GLAD1	-14.38	-9.10	-382.27
Percent loss due calculated at GLAD1	62%	72%	88%
Additional load tracked from above samples	2.78	3.34	58.11
Percentage of upstream loads that reach the GLAD1	38%	28%	12%
Total load tracked between GLAD2-7 and GLAD1	1.06	0.94	6.97
Allowable Load @ GLAD1	1.17	0.74	8.57
Load Reduction @ GLAD1	0	0.20	0
% Reduction required @ GLAD1	0%	21%	0%

Margin of Safety

For this study the margin of safety is applied implicitly. A MOS is implicit because 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:

- An additional MOS is provided because the calculations were done with a daily Fe 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

Use of Reference Stream Water Quality for High Quality Waters

Streams placed on the 1996 303 (d) list with a designated use of high quality (HQ) will be subject to Pennsylvania's anti degradation policy. Therefore, DEP must establish instream goals for TMDLs that restore the waterbody to existing (pre-mining) quality. This is accomplished by sampling an unaffected stretch of stream to use as a reference. This stretch typically is the headwaters segment of the high quality stream in question. If an unaffected stretch isn't available, a nearby-unimpaired stream will function as a surrogate reference. The reference stream data will be selected from statewide ambient Water Quality Network (WQN) stations. To determine which WQN station represents existing water quality appropriate for use in developing TMDLs for HQ waters, alkalinity and drainage area are considered.

1. First step is to match alkalinities of TMDL stream and WQN reference stream. If alkalinities for candidate stream are not available, use pH as a surrogate. As a last resort, if neither pH nor alkalinity are available match geologies using current geological maps.

2. The second consideration is drainage area.

3. Finally, from the subset of stations with similar alkalinity and drainage area select the station nearest the TMDL stream.

Once a reference stream is selected, the 95th percentile confidence limit on the median for aluminum, iron and manganese is used as the applicable water quality criteria and run the @Risk model.

Attachment F

Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists and Integrated Report/List (2004, 2006)

The following are excerpts from the Pennsylvania DEP Section 303(d) narratives that justify changes in listings between the 1996, 1998, 2002, 2004 and 2006 303(d) Lists and Integrated Report/List (2006). 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) 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).

Migration to National Hydrography Data (NHD)

New to the 2006 report is use of the 1/24,000 National Hydrography Data (NHD) streams GIS layer. Up until 2006 the Department relied upon its own internally developed stream layer. Subsequently, the United States Geologic Survey (USGS) developed 1/24,000 NHD streams layer for the Commonwealth based upon national geodatabase standards. In 2005, DEP contracted with USGS to add missing streams and correct any errors in the NHD. A GIS contractor transferred the old DEP stream assessment information to the improved NHD and the old DEP streams layer was archived. Overall, this marked an improvement in the quality of the streams layer and made the stream assessment data compatible with national standards but it necessitated a change in the Integrated Listing format. The NHD is not attributed with the old DEP five digit stream codes so segments can no longer be listed by stream code but rather only by stream name or a fixed combination of NHD fields known as reachcode and ComID. The NHD is aggregated by Hydrologic Unit Code (HUC) watersheds so HUCs rather than the old State Water Plan (SWP) watersheds are now used to group streams together. The map in

Appendix E illustrates the relationship between the old SWP and new HUC watershed delineations. A more basic change was the shift in data management philosophy from one of "dynamic segmentation" to "fixed segments". The dynamic segmentation records were proving too difficult to mange from an historical tracking perspective. The fixed segment methods will remedy that problem. The stream assessment data management has gone through many changes over the years as system requirements and software changed. It is hoped that with the shift to the NHD and OIT's (Office of Information Technology) fulltime staff to manage and maintain SLIMS the systems and formats will now remain stable over many Integrated Listing cycles.

Attachment G

Water Quality Data Used In TMDL Calculations

Point	Date	Flow	pH	Alkalinity	Hot Acidity	Total Fe	Total Mn	Total Al
7	5/30/2006	925	4.5	5.6	7.4	0.882	1.02	0.25
7	8/2/2006	240	4.4	5.6	12.8	2.86	1.24	0.25
7	4/22/2008	1888	4.8	6.8	9.4	0.326	0.679	0.25
7	8/19/2008	75.35	4.9	7.4	6.8	0.586	1.955	0.25
GR1	2/2/2000		4.6	7.8	24	5.25	1.81	1.5
GR1	2/17/2000		4.6	7.2	10.6	0.119	0.581	0.521
GR1	3/21/2000		4.4	5.8	9.6	0.415	0.732	0.771
GR1	4/25/2000		4.6	7.8	10.4	0.194	0.782	0.432
GR1	5/28/2000		4.5	6.8	9.8	0.391	1.24	0.471
GR1	7/20/2000		4.7	6.6	6.6	0.334	1.69	0.217
GR1	8/29/2000		5	9.6	8.4	0.714	2.04	0.193
GR1	9/17/2000		5.5	11	12.6	0.988	1.91	0.193
GR1	10/14/2000		5.8	10.6	2.4	0.724	1.55	0.193
GR1	11/14/2000		5	9.8	6	0.243	0.664	0.347
GR1	12/26/2000		4.9	8.4	6	0.212	1.01	0.443
GR1	1/29/2001		4.8	10.6	5.8	0.163	1.14	0.418
GR1	2/26/2001		4.8	8.2	9.8	0.183	1.23	0.531
GR1	4/29/2001		4.5	4.6	9.2	0.403	1.59	0.505
GR1	5/20/2001		4.6	7	9.2	0.394	2.57	0.2
GR1	6/30/2001		4.7	9	53.2	0.568	2.33	0.348
GR1	7/21/2001		4.4	6.2	51.8	0.689	2.94	0.258
GR1	8/31/2001		4.5	5.2	55.2	1.48	1.01	2.16
	Average	*782.09*	*4.75*	*7.62*	*15.32*	*0.82*	*1.44*	*0.49*
	StDev	*823.97*	*0.35*	*1.85*	*16.01*	*1.16*	*0.66*	*0.47*

Point	Date	Flow	pH	Alkalinity	Hot Acidity	Total Fe	Total Mn	Total Al
6	5/30/2006	30	4.5	5.8	7.6	0.15	0.135	0.79
6	8/2/2006	40	4.7	6.4	4.8	0.309	0.175	0.25
6	4/22/2008	821	4.6	6.6	11.8	0.15	0.143	1.11
6	8/19/2008	30.14	4.6	6.4	9.2	0.324	0.158	0.755
2FRR	3/21/2000		4.3	5.6	13.8	0.584	0.181	1.68
2FRR	4/25/2000		4.5	7.6	11.8	0.134	0.136	0.916
2FRR	5/28/2000		4.6	7.6	11.2	0.205	0.157	0.8
2FRR	7/20/2000		4.4	5.8	9.2	0.379	0.186	0.887
2FRR	8/29/2000		4.6	8.2	10.6	0.314	0.208	0.675
2FRR	9/17/2000		4.5	7	16.6	0.335	0.224	0.568
2FRR	10/14/2000		4.7	7	9.8	0.364	0.297	0.644
2FRR	11/14/2000		4.6	8.6	11	0.218	0.217	1
2FRR	12/26/2000		4.6	7.8	10.4	0.273	0.219	1.35
2FRR	2/26/2001		4.6	8.6	14.4	0.143	0.614	1.14
2FRR	3/29/2001		4.6	6.6	11.6	0.16	0.15	1.08
2FRR	4/29/2001		4.5	5.4	13.2	0.61	0.18	1.2
2FRR	6/30/2001		4.6	8	58.2	0.29	0.185	0.925
2FRR	7/27/2001		4.5	6.4	48	0.36	0.203	0.804
2FRR	8/13/2001		4.5	6.2	56	0.707	0.177	1.25

	Average	*230.29*	*4.55*	*6.93*	*17.85*	*0.32*	*0.21*	*0.94*
	StDev	*393.84*	*0.10*	*1.01*	*16.41*	*0.16*	*0.11*	*0.32*

Point	**Date**	**Flow**	**pH**	**Alkalinity**	**Hot Acidity**	**Total Fe**	**Total Mn**	**Total Al**
5	5/30/2006	550	4.5	6	7.6	0.15	0.394	0.738
5	8/2/2006	160	4.4	5.6	9	0.15	0.571	0.25
5	5/30/2007	200	4.6	5.6	15	0.15	0.393	0.886
5	4/22/2008	4221	4.6	6.2	12.6	0.15	0.382	1.07
	Average	*1282.75*	*4.53*	*5.85*	*11.05*	*0.15*	*0.44*	*0.74*
	StDev	*1966.65*	*0.10*	*0.30*	*3.37*	*0.00*	*0.09*	*0.35*

Point	**Date**	**Flow**	**pH**	**Alkalinity**	**Hot Acidity**	**Total Fe**	**Total Mn**	**Total Al**
4	5/30/2006	250	4.5	5.6	9	0.15	0.345	0.687
4	8/2/2006	90	4.4	6	5.6	0.326	0.403	0.25
4	5/30/2007	200	4.6	5.6	26.4	0.309	0.39	0.886
4	4/22/2008	965	4.5	6.4	11.6	0.15	0.313	1.03
	Average	*376.25*	*4.50*	*5.90*	*13.15*	*0.23*	*0.36*	*0.71*
	StDev	*398.15*	*0.08*	*0.38*	*9.17*	*0.10*	*0.04*	*0.34*

Point	**Date**	**Flow**	**pH**	**Alkalinity**	**Hot Acidity**	**Total Fe**	**Total Mn**	**Total Al**
3	6/1/2006	525	6.2	9.8	-0.4	0.15	0.025	0.25
3	8/2/2006	25	6.9	17.6	-6.2	0.15	0.115	0.25
7RR	2/17/2000		5.2	9.2	4.4	0.133	0.088	0.356
7RR	3/21/2000		4.9	7.2	2.4	0.37	0.138	0.706
7RR	4/25/2000		5.4	9	3.2	0.035	0.064	0.193
7RR	5/28/2000		6.1	10.4	0	0.04	0.023	0.23
7RR	7/20/2000		6.1	10.4	0.4	0.048	0.017	0.193
7RR	8/29/2000		6.2	14.2	0	*	0.01	0.193
7RR	9/17/2000		6.1	13.8	0	0.674	0.01	0.193
7RR	10/14/2000		6.5	14.2	0	0.019	0.01	0.193
7RR	11/14/2000		5.7	10.8	3.6	0.035	0.01	0.193
7RR	12/26/2000		5.9	9	0.6	0.019	0.023	0.193
7RR	1/29/2001		5.9	12.2	0.6	0.019	0.012	0.193
7RR	2/26/2001		5.8	9.8	2.2	0.022	0.052	0.193
7RR	3/29/2001		5.6	7.4	2.4	0.019	0.051	0.193
7RR	4/29/2001		5.7	7	6.6	0.064	0.04	0.193
7RR	5/20/2001		6.2	12.8	0	0.032	0.01	0.193
7RR	6/30/2001		6.1	11.6	4.4	0.069	0.021	0.193
7RR	7/27/2001		6.5	13.6	0	0.052	0.011	0.193
7RR	8/13/2001		5.8	9.4	7.4	0.32	0.065	0.312
	Average	*275.00*	*5.94*	*10.97*	*1.58*	*0.12*	*0.04*	*0.24*
	StDev	*353.55*	*0.46*	*2.76*	*2.96*	*0.17*	*0.04*	*0.12*

Point	Date	Flow	pH	Alkalinity	Hot Acidity	Total Fe	Total Mn	Total Al
2	6/1/2006	275	6.7	25.8	-15	0.15	0.025	0.25
2	8/2/2006	25	7.9	83.6	-69.2	0.15	0.025	0.25
2	8/20/2008		7.7	78	-72.6	0.15	0.025	0.25
9LP	2/17/2000		4.9	8.8	6.2	0.069	0.236	0.801
9LP	3/21/2000		4.9	7.8	5.2	0.424	0.236	1.26
9LP	4/25/2000		5.1	9.2	5	0.079	0.179	0.644
9LP	5/28/2000		6.1	10	0.4	0.098	0.092	0.359
9LP	7/20/2000		6.2	11.8	0	0.085	0.046	0.257
9LP	9/17/2000		5.9	12.8	0	0.061	0.036	0.193
9LP	10/14/2000		6.7	17.6	0	0.039	0.009	0.193
9LP	11/14/2000		5.4	10	2.8	0.052	0.134	0.234
9LP	12/26/2000		5.2	8.4	2.2	0.064	0.175	0.504
9LP	1/29/2001		5.2	12	3	0.27	0.14	0.415
9LP	2/26/2001		5.2	9.6	4.8	0.076	0.182	0.551
9LP	3/29/2001		4.9	7.2	4.8	0.042	0.179	0.674
9LP	4/29/2001		5	6.2	8	0.069	0.151	0.398
9LP	5/20/2001		6.4	15.4	0	0.076	0.023	0.193
9LP	6/30/2001		6.3	6.3	5.6	0.442	0.065	0.921
9LP	7/21/2001		6	11	2.8	0.068	0.06	0.21
9LP	8/13/2001		6.5	6.5	0	0.469	0.043	0.606
	Average	*150.00*	*5.91*	*17.90*	*-5.30*	*0.15*	*0.10*	*0.46*
	StDev	*176.78*	*0.91*	*22.01*	*22.92*	*0.14*	*0.08*	*0.29*

Point	Date	Flow	pH	Alkalinity	Hot Acidity	Total Fe	Total Mn	Total Al
1	6/1/2006	3400	6.5	15.4	-4.4	0.15	0.16	0.25
1	8/3/2006	400	7.4	31	-21.4	0.15	0.079	0.25
14GR	1/30/2000		6.6	36	0	0.019	0.009	0.193
14GR	2/15/2000		5.3	8.8	4	0.157	0.29	0.629
14GR	3/21/2000		5	7.2	4	0.382	0.307	0.948
14GR	4/25/2000		5.8	9.6	6.6	0.108	0.236	0.193
14GR	5/28/2000		6.3	11.8	4.4	0.614	0.293	1.42
14GR	7/20/2000		6.4	12.8	0	0.093	0.134	0.193
14GR	9/17/2000		6.4	24	0	0.029	0.009	0.193
14GR	10/14/2000		6.9	28	0	0.019	0.009	0.193
14GR	11/14/2000		5.9	14	0	0.054	0.146	0.193
14GR	12/26/2000		6.3	11.2	0	0.066	0.232	0.32
14GR	1/29/2001		6.2	13.6	0.8	0.041	0.259	0.266
14GR	2/26/2001		6.2	10.4	2.8	0.076	0.323	0.378
14GR	3/29/2001		5.8	8	2.8	0.07	0.308	0.464
14GR	4/29/2001		6.1	7.4	6	0.106	0.28	0.294
14GR	5/20/2001		6.3	13	0	0.039	0.211	0.193
14GR	6/30/2001		6.4	16.8	2	0.053	0.052	0.193
14GR	7/27/2001		7.2	19.8	0	0.033	0.011	0.193
14GR	8/13/2001		6	9.8	36.6	0.836	0.515	0.897

Average	*1900.00*	*6.25*	*15.43*	*2.21*	*0.15*	*0.19*	*0.39*
StDev	*2121.32*	*0.56*	*8.24*	*9.92*	*0.21*	*0.14*	*0.33*

Underlined values are included at 1/2 the value for the detection limit.
Flow is shown in gallons per minute (GPM); all other values are in mg/L

Attachment H

TMDLs and NPDES Permitting Coordination

NPDES permitting is unavoidably linked to TMDLs through waste load allocations and their translation, through the permitting program, to effluent limits. Primary responsibility for NPDES permitting rests with the District Mining Offices (for mining NPDES permits) and the Regional Offices (for industrial NPDES permits). Therefore, the DMOs and Regions will maintain tracking mechanisms of available waste load allocations, etc. in their respective offices. The TMDL program will assist in this effort. However, the primary role of the TMDL program is TMDL development and revision/amendment (the necessity for which is as defined in the Future Modifications section) at the request of the respective office. All efforts will be made to coordinate public notice periods for TMDL revisions and permit renewals/reissuances.

Load Tracking Mechanisms

The Department has developed tracking mechanisms that will allow for accounting of pollution loads in TMDL watersheds. This will allow permit writers to have information on how allocations have been distributed throughout the watershed in the watershed of interest while making permitting decisions. These tracking mechanisms will allow the Department to make minor changes in WLAs without the need for EPA to review and approve a revised TMDL. Tracking will also allow for the evaluation of loads at downstream points throughout a watershed to ensure no downstream impairments will result from the addition, modification or movement of a permit.

Options for Permittees in TMDL Watersheds

The Department is working to develop options for mining permits in watersheds with approved TMDLs.

Options identified

- Build excess WLA into the TMDL for anticipated future mining. This could then be used for a new permit. Permittee must show that there has been actual load reduction in the amount of the proposed permit or must include a schedule to guarantee the reductions using current data referenced to the TMDL prior to permit issuance.
- Use WLA that is freed up from another permit in the watershed when that site is reclaimed. If no permits have been recently reclaimed, it may be necessary to delay permit issuance until additional WLA becomes available.
- Re-allocate the WLA(s) of existing permits. WLAs could be reallocated based on actual flows (as opposed to design flows) or smaller than approved pit/spoil areas (as opposed to default areas). The "freed-up" WLA could be applied to the new permit. This option would require the simultaneous amendment of the permits involved in the reallocation.
- Non-discharge alternative.

Other possible options

The following two options have also been identified for use in TMDL watersheds. However, before recommendation for use as viable implementation options, a thorough regulatory (both state and federal) review must be completed. These options should not be implemented until the completion of the regulatory review and development of any applicable administrative mechanisms.

- Issue the permit with in-stream water quality criteria values as the effluent limits. The in-stream criteria value would represent the monthly average, with the other limits adjusted accordingly (e.g., for Fe, the limits would be 1.5 mg/L monthly average, 3.0 mg/L daily average and 4.0 instantaneous max mg/L).

- The applicant would agree to treat an existing source (point or non-point) where there is no responsible party and receive a WLA based on a portion of the load reduction to be achieved. The result of using these types of offsets in permitting is a net improvement in long-term water quality through the reclamation or treatment of an abandoned source.

Attachment I
Comment and Response

No comments were received on the Glade Run Watershed TMDL.