

# **FINAL UNNAMED TRIBUTARY TO GEORGES CREEK WATERSHED TMDL Fayette County**

For Acid Mine Drainage Affected Segments



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**TMDL<sup>1</sup>**  
**Unnamed tributary to Georges Creek Watershed**  
**Fayette County, Pennsylvania**

**Introduction**

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the unnamed tributary to Georges Creek 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. The unnamed tributary to Georges Creek 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.

<b>Table 1. 303(d) Listed Segments</b>										
State Water Plan (SWP) Subbasin: 19G										
HUC: 05020005										
Year	Miles	Use Designation	Assessment ID	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	1.1	*	*	4923	41381	Unnamed tributary to Georges Creek	WWF	305(b) Report	RE	Metals
1998	1.18	*	*	4923	41340	Georges Creek Watershed	WWF	SWMP	AMD	Metals
2002	1.2	*	*	4923	41381	Georges Creek Watershed	WWF	SWMP	AMD	Metals
2004	1.2	*	*	4923	41381	Georges Creek, Unt (41381)	WWF	SWMP	AMD	Metals
2006	1.17	Aquatic Life	7622	*	41381	Georges Creek, Unt (41381)	WWF	SWMP	AMD	Metals

Resource Extraction=RE

Warm Water Fish = WWF

Surface Water Monitoring Program = SWMP

Abandoned Mine Drainage = AMD

See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists and the 2004 and 2006 Integrated Water Quality Report*. The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

<sup>1</sup> 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*.

## **Directions to the unnamed tributary to Georges Creek Watershed**

The unnamed tributary to Georges Creek Watershed is located in southwestern Pennsylvania, in Springhill Township in Fayette County near the town of Outcrop. The unnamed tributary to Georges Creek can be accessed by traveling Route 119 South from Uniontown and turning left onto State Road 3009.

## **Hydrology and Geology**

The unnamed tributary to Georges Creek (41381) is part of the Monongahela Basin. It is tributary to Georges Creek which in turn is tributary to the Monongahela River. The watershed is located in the Pittsburgh Low Plateau Section of the Appalachian Plateau Physiographic Province. The province is characterized by smooth to irregular undulating surface; narrow, relatively shallow valleys; strip mines and reclaimed land. The watershed of approximately 0.79 square miles surrounds the town of Outcrop, PA in Springhill Township, Fayette County. State Route 119 parallels the northwest side of this almost square shaped watershed.

The watershed is located in the Uniontown Syncline that parallels the unnamed tributary approximately 1000 feet to the east. The Uniontown Syncline averages North 60 degrees East and plunges an average of 0.4 % southwest. The elevation of the watershed varies from a low of 920 to a high of 1240 feet. The stream flows in a north-northeast direction with no major branches. The Pittsburgh & Redstone coal seams outcrop around the 1100 feet elevation mark. Below 1100 feet elevation the watershed is 60% pastureland & residential land uses; at and above 1100 feet is either forestland or strip mined land.

Only the Pittsburgh & Redstone coal seams outcrop and are mineable in the watershed from the surface. The Kittannings & Freeports underlie the watershed at depth. The Sewickley has been eroded away. No active strip or deep mines exist in the watershed; however, many reclaimed surface mines and a few closed deep mines into the Pittsburgh coal almost ring the unnamed tributary.

## **Segments addressed in this TMDL**

The unnamed tributary to Georges Creek is affected by pollution from AMD. This pollution has caused high levels of metals and low pH in the watershed. Currently there are no operations that have NPDES discharge points in the unnamed tributary to Georges Creek Watershed. The discharges that are contributing to the degradation in the unnamed tributary to Georges Creek water quality are associated with either long abandoned deep and surface mines and are not being treated. The TMDLs will be expressed as long-term averages. 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 D 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)<sup>2</sup> 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 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.

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<sup>2</sup> Section 305(b) of the Clean Water Act requires a biannual description of the water quality of the waters of the state.

## 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<sup>3</sup> 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:

$$PR = \text{maximum } \{0, (1-Cc/Cd)\} \text{ where} \quad (1)$$

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

$$Cd = \text{RiskLognorm}(\text{Mean}, \text{Standard Deviation}) \text{ where} \quad (1a)$$

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<sup>3</sup>@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:

$$\text{LTA} = \text{Mean} * (1 - \text{PR99}) \text{ where} \quad (2)$$

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). The following table shows the applicable water-quality criteria for the selected parameters.

**Table 2. Applicable Water Quality Criteria**

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

\*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality.

**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.

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 3. Unnamed tributary to Georges Creek 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
<b>GRGE02 – Unnamed tributary to Georges Creek in headwaters</b>						
<b>Aluminum (lbs/day)</b>	53.65	0.11	-	0.11	53.54	99.8%
<b>Iron (lbs/day)</b>	50.96	0.20	-	0.20	50.76	99.6%
<b>Manganese(lbs/day)</b>	3.16	0.22	-	0.22	2.94	93%
<b>Acidity (lbs/day)</b>	619.5	0	-	0	619.5	100%
<b>GRGE01 – Unnamed tributary to Georges Creek at mouth</b>						
<b>Aluminum (lbs/day)</b>	82.14	0.66	-	0.66	28.83	98%*
<b>Iron (lbs/day)</b>	39.9	1.20	-	1.20	38.86	97%*
<b>Manganese(lbs/day)</b>	8.03	1.69	-	1.69	3.40	67%*
<b>Acidity (lbs/day)</b>	757.2	0	-	0	0	0%*

NA = not applicable ND = not detected

\* Takes into account load reductions from upstream sources.

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, aluminum allocations for GRGE01 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 GRGE01	
GRGE01	Al (Lbs/day)
Existing Load @ GRGE01	82.14
Allowable Load @ GRGE01	0.66

Allowable Load = 0.66 lbs/day

Load input = 29.49 lbs/day  
(Difference between existing loads at GRGE01 and GRGE02)

ALLOCATIONS GRGE01	
GRGE01	Al (Lbs/day)
Existing Load @ GRGE01	82.14
Difference in measured Loads between the loads that enter and existing GRGE01 (GRGE01-GRGE02)	29.49
Additional load tracked from above samples	0.11
Total load tracked between GRGE02 and GRGE01	29.60
Allowable Load @ GRGE01	0.66
Load Reduction @ GRGE01	28.83
% Reduction required at GRGE01	98%

Allowable Load = 0.66 lbs/day

The allowable aluminum load tracked from GRGE02 was 0.11 lbs/day. The existing load at GRGE02 was subtracted from the existing load at GRGE01 to show the actual measured increase of aluminum load that has entered the stream between these upstream sites and GRGE01 (29.49 lbs/day). This increased value was then added to the calculated allowable load from GRGE02 to calculate the total load that was tracked between GRGE02 and GRGE01 (allowable loads @ GRGE02 + the difference in existing load between GRGE02 and GRGE01). This total load tracked was then subtracted from the calculated allowable load at GRGE01 to determine the amount of load to be reduced at GRGE01. This total load value was found to be 29.60 lbs/day; it was 26.83 lbs/day greater than the GRGE01 allowable load of 0.66 lbs/day. Therefore, a 98% aluminum reduction at GRGE01 is necessary.

## Recommendations

The unnamed tributary is affected by acid mine drainage from deep mine sources likely emanating from old deep mine entries that existed in the watershed. Even the minor contributory stream branch near Rich Hill is polluted with acid mine drainage. Since most of the strip mineable coal has been taken, re-mining would not be an option to remediate the AMD problem. Sufficient area for passive treatment exists around the mouth of the unnamed tributary before it flows into Georges Creek.

Various methods to eliminate or treat pollutant sources and to provide a reasonable assurance that the proposed TMDLs can be met exist in Pennsylvania. 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 available that are currently being used for projects designed to achieve TMDL reductions include the Environmental Protection Agency (EPA) 319 grant program and Pennsylvania's Growing Greener Program. Federal funding is through the Department the Interior, Office of Surface Mining (OSM), for reclamation and mine drainage treatment through the Appalachian Clean Streams Initiative and through Watershed Cooperative Agreements.

OSM reports that nationally, of the \$8.5 billion of high priority (defined as priority 1&2 features or those that threaten public health and safety) coal related AML problems in the AML inventory, \$6.6 billion (78%) have yet to be reclaimed; \$3.6 billion of this total is attributable to Pennsylvania watershed costs. Almost 83 percent of the \$2.3 billion of coal related environmental problems (priority 3) in the AML inventory are not reclaimed.

The Bureau of Abandoned Mine Reclamation, Pennsylvania's primary bureau in dealing with abandoned mine reclamation (AMR) issues, 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](http://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 DEP, 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 Appendix B to the Comprehensive Plan).
- 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.

In addition to the abandoned mine reclamation program, regulatory programs also 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 treatment agreements were initialized for facilities/operators who need to assure treatment of post-mining discharges or discharges they degraded which 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".

The Commonwealth is exploring all 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:

- Project XL - The Pennsylvania Department of Environmental Protection ("PADEP"), has proposed this XL Project to explore a new approach to encourage the remining and reclamation of abandoned coal mine sites. The approach would be based on compliance with in-stream pollutant concentration limits and implementation of best management practices ("BMPs"), instead of National Pollutant Discharge Elimination System ("NPDES") numeric effluent limitations measured at individual discharge points. This XL project would provide for a test of this approach in up to eight watersheds with significant acid mine drainage ("AMD") pollution. The project will collect data to compare in-stream pollutant concentrations versus the loading from individual discharge points and provide for the evaluation of the performance of BMPs and this alternate strategy in PADEP's efforts to address AMD.
- 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 will 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 Commission into the Upper West Branch Susquehanna River), and the Wadesville Deep Mine Pool (Excelon Generation in Schuylkill County).

The Georges Creek Clearwater Cooperative Initiative is a watershed organization interested in the Georges Creek Watershed. It is recommended that agencies support local interests to implement remediation projects in the watershed to abate effects of AMD pollution.

Candidate or federally-listed threatened and endangered species may occur in or near the watershed. While implementation of the TMDL should result in improvements to water quality, they could 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 Department'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* and *The Herald Standard* on January 9, 2008 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from January 9, 2008 to March 19, 2008. A public meeting was held on January 23, 2008 at the Fayette County Health Center 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.

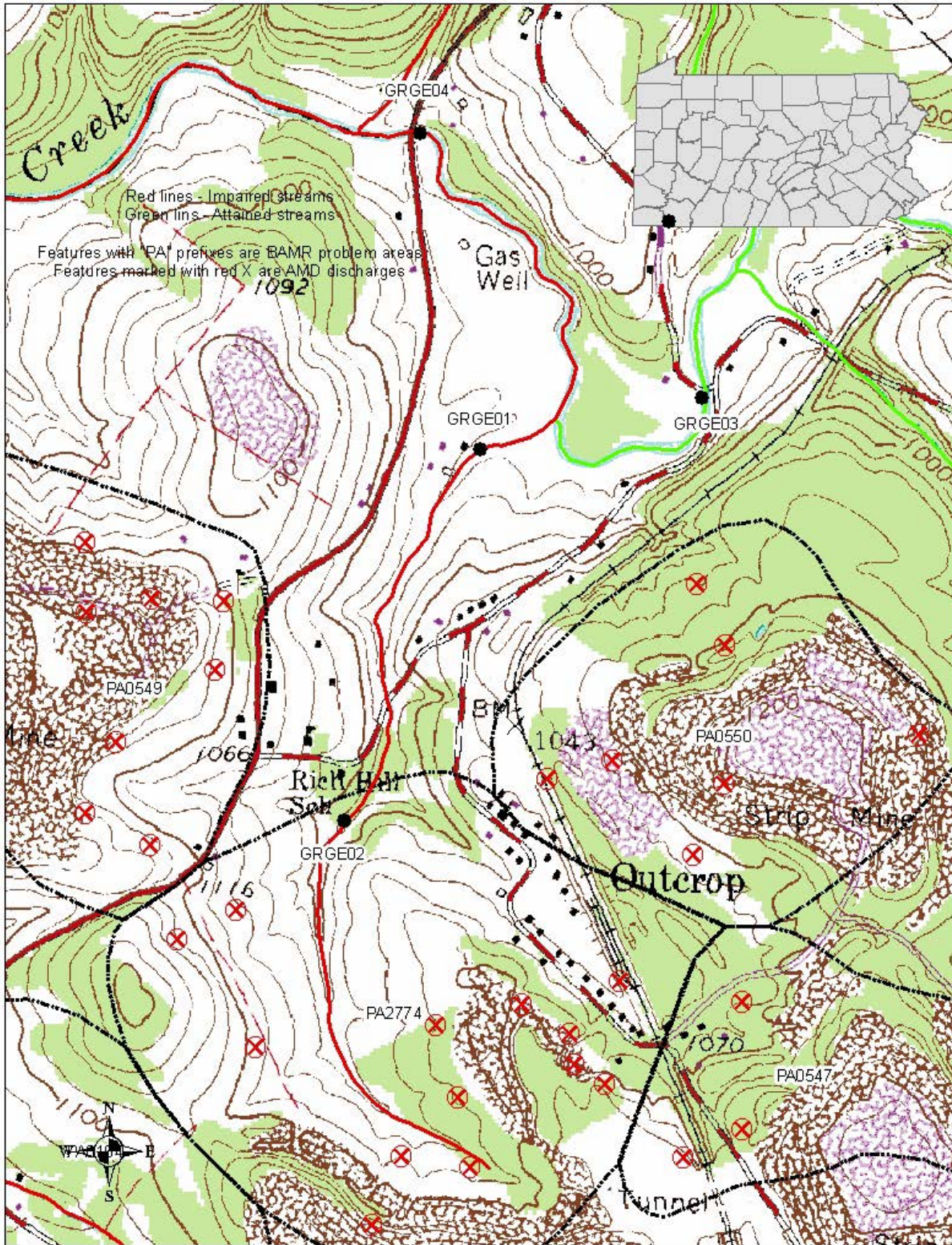
### **Changes in TMDLs That May Not Require EPA Approval**

- 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**

**Unnamed tributary to Georges Creek Watershed Maps**





# **Attachment B**

**Method for Addressing Section 303(d) Listings for pH**

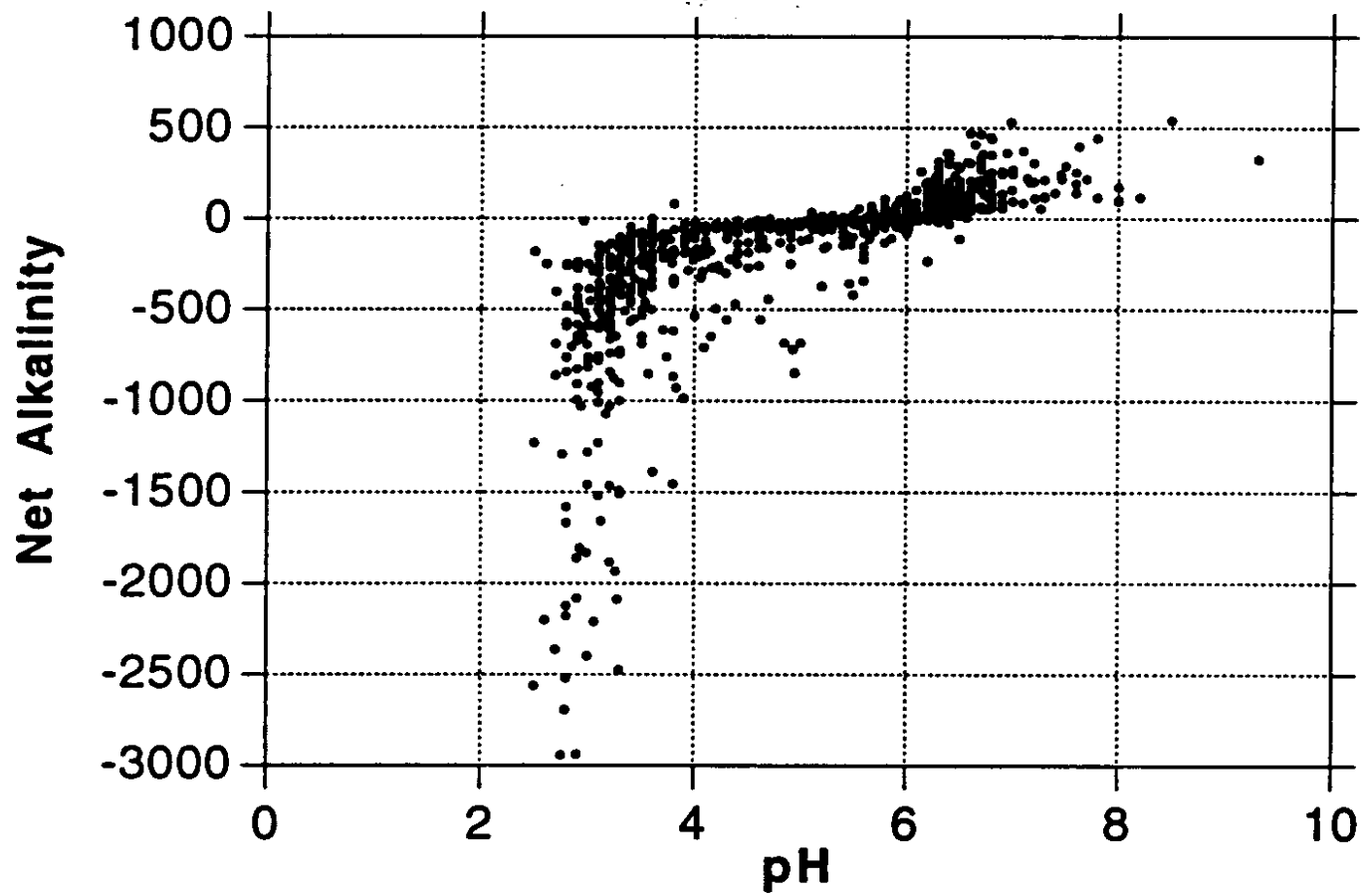
# Method for Addressing Section 303(d) Listings for pH

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**



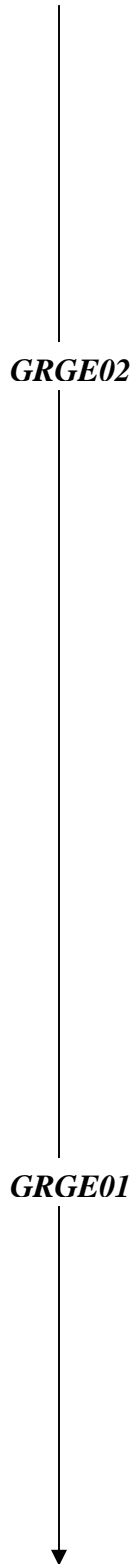
## **Unnamed tributary to Georges Creek**

The TMDL for the unnamed tributary to Georges Creek consists of load allocations to two sampling sites (GRGE01, GRGE02). Sample data sets were collected in 2006. All sample points are shown on the maps included in Attachment A as well as on the loading schematic presented on the following page.

The unnamed tributary to Georges Creek 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 unnamed tributary to Georges Creek 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 and 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.

**Unnamed tributary to Georges Creek Sampling Station Diagram**  
Arrows represent direction of flow  
Diagram not to scale



TMDL calculations- GRGE02 – Unnamed tributary to Georges Creek in headwaters

The TMDL for sample point GRGE02 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 the unnamed tributary to Georges Creek was computed using water-quality sample data collected at point GRGE02. The average flow, measured at the sampling point GRGE02 (0.0864 MGD), is used for these computations. The allowable load allocations calculated at GRGE02 will directly affect the downstream point GRGE01.

Sample data at point GRGE02 shows that the unnamed tributary to Georges Creek headwaters segment has a pH ranging between 2.4 and 3.2. A TMDL for aluminum, iron, manganese, and acidity has been calculated at this site.

Table D1 shows the measured and allowable concentrations and loads at GRGE02. Table D2 shows the percent reductions for aluminum, iron, manganese and acidity.

Table D1		Measured		Allowable	
Flow (gpm)=	60.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	74.46	53.65	0.15	0.11
	Iron	70.72	50.96	0.28	0.20
	Manganese	4.39	3.16	0.31	0.22
	Acidity	859.77	619.5	0	0
	Alkalinity	0	0		

Table D2. Allocations GRGE02				
GRGE02	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ GRGE02	53.65	50.96	3.16	619.5
Allowable Load @ GRGE02	0.11	0.20	0.22	0
Load Reduction @ GRGE02	53.54	50.76	2.94	619.5
% Reduction required @ GRGE02	99.8%	99.6%	93%	100%

TMDL calculations- GRGE01 – Unnamed tributary to Georges Creek at mouth

The TMDL for sampling point GRGE01 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this segment of the unnamed tributary to Georges Creek was computed using water-quality sample data collected at point GRGE01. The average flow, measured at the sampling point GRGE01 (0.36096 MGD), is used for these computations.

Sample data at point GRGE01 shows pH ranging between 2.9 and 4.1. A TMDL for aluminum, iron, manganese and acidity at GRGE01 has been calculated.



Table D3 shows the measured and allowable concentrations and loads at GRGE01. Table D4 shows the percent reduction for aluminum, iron, manganese, and acidity needed at GRGE01

Table D3		Measured		Allowable	
Flow (gpm)=	250.67	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	27.29	82.14	0.22	0.66
	Iron	13.26	39.9	0.40	1.20
	Manganese	2.67	8.03	0.56	1.69
	Acidity	251.53	757.2	0	0
	Alkalinity	0	0		

The measured and allowable loading for point GRGE01 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 GRGE02 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points GRGE02 and GRGE01 to determine a total load tracked for the segment of stream between GRGE02 and GRGE01. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at GRGE01.

	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
GRGE01				
Existing Load @ GRGE01	82.14	39.9	8.03	251.53
Difference in measured loads between the loads that enter and existing GRGE01	29.49	-11.06	4.87	-367.97
Additional load tracked from above samples	0.11	0.16	0.22	0
Total load tracked between GRGE02 and GRGE01	29.60	40.06	5.09	0
Allowable Load @ GRGE01	0.66	1.20	1.69	0
Load Reduction @ GRGE01	28.83	38.86	3.40	0
% Reduction required at GRGE01	98%	97%	67%	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 that 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**

**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 manage 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 F**

*Water Quality Data Used In TMDL Calculations*

	Date	FLOW, gpm	pH	Alkalinity, mg/L	Hot Acidity, mg/L	Total Iron, mg/L	Total Manganese, mg/L	Total Aluminum, mg/L	TSS, mg/L
GRGE01	5/17/2006	309	3.3	0	178.2	13.1	2.47	21	<u>1.5</u>
GRGE01	6/28/2006	394	3.6	0	103.2	5.83	2.05	13.8	12
GRGE01	8/8/2006	30	2.9	0	489.6	21.3	3.27	46.9	8
GRGE01	9/20/2006	17	2.9	0	442.2	23.02	3.668	50.64	<u>1.5</u>
GRGE01	10/25/2006	82	3.2	0	218.8	12	2.69	20.8	<u>1.5</u>
GRGE01	11/2/2006	672	4.1	4.2	77.2	4.277	1.857	10.58	4
	<i>Average</i>	<i>250.67</i>	<i>3.33</i>	<i>0.70</i>	<i>251.53</i>	<i>13.25</i>	<i>2.67</i>	<i>27.29</i>	<i>4.75</i>
	<i>StDev</i>	<i>258.15</i>	<i>0.46</i>	<i>1.71</i>	<i>174.28</i>	<i>7.71</i>	<i>0.70</i>	<i>17.16</i>	<i>4.37</i>

	Date	FLOW, gpm	pH	Alkalinity, mg/L	Hot Acidity, mg/L	Total Iron, mg/L	Total Manganese, mg/L	Total Aluminum, mg/L	TSS, mg/L
GRGE02	5/17/2006	51	2.8	0	586.8	62.2	3.8	56.2	26
GRGE02	6/28/2006	76	3	0	284.4	24.8	2.04	27.9	<u>1.5</u>
GRGE02	8/8/2006	11	2.4	0	1692	131	6.25	117	10
GRGE02	9/20/2006	11	2.4	0	1717.6	182.4	8.53	169.1	16
GRGE02	10/25/2006	38	2.8	0	692	6.27	3.94	56.6	6
GRGE02	11/2/2006	173	3.2	0	185.8	17.66	1.777	19.95	8
	<i>Average</i>	<i>60.00</i>	<i>2.77</i>	<i>0.00</i>	<i>859.77</i>	<i>70.72</i>	<i>4.39</i>	<i>74.46</i>	<i>11.25</i>
	<i>StDev</i>	<i>60.65</i>	<i>0.32</i>	<i>0.00</i>	<i>680.65</i>	<i>71.07</i>	<i>2.59</i>	<i>57.55</i>	<i>8.66</i>

Underlined values are included at half the detection limit.

# **Attachment G**

## **Comment and Response**



No public comments were received on the Unnamed Tributary to Georges Creek Watershed TMDL.