FINAL

STUMP CREEK WATERSHED TMDL
Jefferson and Clearfield Counties

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

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[1]TMDL
Stump Creek Watershed
Jefferson and Clearfield Counties, Pennsylvania

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 17-D Stump Creek								
Year	**Miles**	**Segment ID Assessment ID**	**DEP Stream Code**	**Stream Name**	**Designated Use**	**Data Source**	**Source**	**EPA 305(b) Cause Code**
1996	3.6	5291	47922	Stump Creek	CWF	RE	AMD	Metals
1996	0.7	5292	47922	Stump Creek	CWF	SWMP	AMD	Suspended solids
1996	0.7	7215	47922	Stump Creek	CWF	SWMP	AMD	*Other inorganics
1998	1.86	5291	47922	Stump Creek	CWF	SWMP	AMD	Metals *Other inorganics
1998	1.14	5292	47922	Stump Creek	CWF	SWMP	AMD	Metals
1998	0.84	7215	47922	Stump Creek	CWF	SWMP	AMD	Metals
2002	1.9	5291	47922	Stump Creek	CWF	SWMP	AMD	Metals *Other inorganics
2002	1.2	5292	47922	Stump Creek	CWF	SWMP	AMD	Metals
2002	0.8	7215	47922	Stump Creek	CWF	SWMP	AMD	Metals
2002	0.4	981013-1315-DSB	47952	Sugarcamp Run	CWF	SWMP	AMD	Metals
2004	1.2	5292	47922	Stump Creek	CWF	SWMP	AMD	Metals *Other inorganics Suspended solids
2004	0.4	7215	47922	Stump Creek	CWF	SWMP	AMD	Suspended solids *Other inorganics Metals
2004	1.9	5291	48023	Stump Creek	CWF	SWMP	AMD	Suspended solids *Other inorganics Metals
2004	0.5	981013-1315-DSB	47952	Sugarcamp Run	CWF	SWMP	AMD	Metals

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

Resource Extraction = RE
Cold Water Fishery = CWF
Resource Extraction = RE
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD
See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists.*
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93
*Other Inorganics listing is not included on 2006 Integrated List.

Introduction

This Total Maximum Daily Load (TMDL) calculation has been prepared for segments in the Stump Creek Watershed (Table 1). It was done to address the impairments noted on the 1996 Pennsylvania 303(d) list, required under the Clean Water Act. High levels of metals and in some areas depressed pH, as well as suspended solids caused these impairments. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Directions to the Stump Creek Watershed

The Stump Creek Watershed is approximately 28.3 square miles in area and is located in Henderson and Winslow Townships, Jefferson County and Brady and Sandy Townships, Clearfield County. The watershed can be located on the U. S. Geological Service (USGS) 7.5-minute quadrangles of DuBois, Luthersburg and McGees Mills. Stump Creek flows approximately 8.7 miles in a westerly direction from its headwaters near the town of Luthersburg in Brady Township, Clearfield County to the town of Sykesville in Winslow Township, Jefferson County. From Sykesville, Stump Creek flows approximately 8.2 miles south near the town of Big Run, Henderson Township, Jefferson County, where it converges with the East Branch Mahoning Creek. Stump Creek and East Branch Mahoning Creek form Mahoning Creek at this point. Major tributaries to Stump Creek include Limestone Run, Sugarcamp Run and Poose Run.

To access Stump Creek, take exit 97 (Dubois) from Interstate 80 (I-80). Travel off the exit ramp approximately 0.4 miles and merge onto Route 219 South. Travel south on Route 219 for approximately 4.7 miles and merge right onto Route 119 South. Travel south on Route 119 for approximately 10.9 miles to the town of Big Run. In Big Run, turn left onto Filtering Plant Road. You will immediately drive over a bridge crossing over Mahoning Creek. Approximately 2500 feet upstream from this bridge, the East Branch Mahoning Creek and Stump Creek converge to form Mahoning Creek.

The headwaters and Clearfield County portions of Stump Creek can be reached by traveling to Sykesville. Sykesville is easily accessed from Interstate 80 by traveling south on State Route 219 (6 miles) to State Route 119 south (5 miles) to Sykesville. State Route 119 passes through the town of Sykesville and runs parallel to Stump Creek for several miles.

Hydrology of Stump Creek Watershed

The area within the watershed consists of 28 square miles. The Stump Creek Watershed consists of a main stem and the following named tributaries: Poose Run, Limestone Run and Sugarcamp Run. Stump Creek flows from and elevation of 1880 feet above sea level in its headwaters to 1260 feet above sea level at its confluence with East Branch Mahoning Creek. Stump Creek drains the area from the northeast to the southwest. The watershed is part of the Allegheny River watershed.

Geology of Stump Creek Watershed

The Stump Creek watershed lies within the Appalachian Plateaus Physiographic Province. The watershed area is comprised of Pennsylvanian aged rocks. The Caledonia Syncline passes through the center of the watershed. The axial bearing of the syncline is northeast-southwest. The strata in the watershed generally have a northeast-southwest trend and dip (towards the synclinal axis) to the southeast in the northwest portion of the watershed and dip (towards the synclinal axis) to the northwest in the southeast portion of the watershed.

Older Pennsylvanian rocks of the Allegheny Group are exposed in the valleys and sidehills of the watershed and the younger Pennsylvanian aged rocks of the Conemaugh Group are on the hilltops and ridges surrounding the watershed. The coals are confined to the Allegheny Group.

Segments addressed in this TMDL

Stump Creek is affected by pollution from AMD. This pollution has caused high levels of metals in the watershed. There is one active small noncoal (industrial minerals) surface mining permit issued in the Jefferson County portion of the Stump Creek watershed and an active reclamation project in Clearfield County. There are three active NPDES permits in the Stump Creek Watershed. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See 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 U.S. 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 non-point 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, many 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 non-point source Best Management Practices (BMPs), etc.).

These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

Prior to developing TMDLs for specific waterbodies, there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d) list. With guidance from the 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

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

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 stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates, habitat surveys, and measurements of pH, temperature, conductivity, dissolved oxygen, and alkalinity. Benthic macroinvertebrates are identified to the family level in the field.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the 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 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 period on draft TMDL;
6. Submittal of final TMDL to EPA.
7. EPA approval of the TMDL.

Watershed History

The Stump Creek Watershed has been extensively mined by both deep and strip mining methods. Coal mining has been documented since the early 1800s and continued until the late 1990s and was conducted mainly on the Upper and Lower Freeport Coal seams. Deep mining of the expansive Lower Freeport coal seam occurred during the early 1900s and some of the largest mines in the United States were located in the area during this time. Up until the 1920s, much of the coal produced was consumed in the nearby coke ovens. From then, coal produced from the deep mines was moved from the area by railroads. With exception to the Northwest Mining Exchange Kramer mine, deep mining operations ceased when this large Lower Freeport coal seam was depleted around the 1950s. From then, surface mining operations took over and the last permit in the watershed was issued in 1982.

Documented deep mines in the Stump Creek Watershed include (Operation Scarlift SL-173):

Helvetia Mine and Stanley Mine – Rochester and Pittsburgh Coal Company
Cascade Mine and B&S Mine – Buffalo and Susquehanna Coal Company
Powhattan Mine – Powhattan Coal and Coke Company
Hamilton Mine – R&P Coal and Iron Company
Eriton Mine, Sykes Mine and Cramer Mine – Northwest Mining and Exchange Company
Sykesville Mine – Cascade Coal and Coke Company

The following provides a brief outline of what information is available for surface mining permits in the Stump Creek watershed. None of the files exist anymore however some of the information has been saved through microfiche:

R.E.M. Coal Company, Inc. SMP#3875SM20 (Cramer Strip Mine): Issued on October 31, 1975 for 70 acres of which 55 acres were to be mined. The coal seams listed for this site include the Harlem and Mahoning. No additional information is available.
Sky Haven Coal Company, Inc. SMP#3877SM10 (Rimer #1): Issued January 31, 1978 for 69 acres of which 55 acres were to be mined. The coal seam listed for this site is Brush Creek. No additional information is available.

Glacial Minerals, Inc. SMP#33820210 (Stump Creek) – Permit originally received as Vendale Coal Company, Inc. SMP#33810702. This surface mining application was withdrawn on September 20, 1982 and repermitted under Glacial Minerals, Inc. SMP#33820210. Permit issued October 12, 1982 for 54.9 acres of which 28.4 were to be affected. This permit consisted of the reprocessing of a gob pile (coal refuse) from the old Kramer Deep mines. The refuse was reclaimed and Stage III bond release occurred on November 8, 1990.

Esquire Fuel Company, SMP#33820107 (Cherpesh Mine): Permit issued June 10, 1983 for 40 acres of which 32.8 were to be mined. The coal seams listed for this site include the Lower and Upper Freeport. The site was mined and reclaimed and Stage III bond release occurred on November 23, 1992.

Doverspike Brothers Coal Co. SMP#33830106 (Big Run Mine): Permit issued October 5, 1984 for 64.4 acres of which 42.51 were to be mined. The coal seam listed for this site is the Lower Freeport. The site was mined and reclaimed and Stage III bond release occurred on November 30, 1990.

The Department of Environmental Resources contracted with Delta Associates to perform an acid mine drainage abatement study on the Mahoning Creek Watershed in the area above Big Run. The ensuing report called the Mahoning Creek Mine Drainage Pollution Abatement Project, Operation Scarlift Report SL-173, was completed on March 15, 1973. The report established 105 sampling and flow measurement stations in the headwaters of the Mahoning Creek Watershed, including the Big Run, Stump Creek and East Branch Mahoning Creek Watersheds. 105 sources of mine drainage were identified during this investigation. The report

indicated that the most significant contributors of acid loading in the study area were from abandoned deep mines located in the Sugarcamp Run Watershed. Plans for the complete abatement of pollution from mine drainage in the headwaters of Mahoning Creek were also included. For the location of the sampling points and project areas refer to the map contained in the ScarLift SL-173 Report.
http://www.amrclearinghouse.org/Sub/SCARLIFTReports/Mahoning/ZZMahoning.htm

In the mid 1980's, the Bureau of Abandoned Mine Reclamation (BAMR) contracted with Earth Satellite Corp. to complete a statewide abandoned mine lands inventory. This comprehensive photo interpretive inventory known as NALIS identified 5290 "Problem Areas" statewide with a total of 15 of these "Problem Areas" including 53 discharge points and 27 features, within the Stump Creek Watershed. The Knox District office reassessed all of the "Problem Areas" and this information has been put into a BDMO/BAMR shared database and will be used in reclamation project development.

In September 1997, the Jefferson County Department of Development, with assistance from the Jefferson County Conservation District, completed a Rivers Conservation Plan for the Upper Mahoning Creek Watershed. The Plan was developed through a grant received from the Department of Conservation and Natural Resources (DCNR) Rivers Conservation Program under the Keystone Recreation, Park and Conservation Fund Act. The Plan identified various issues and concerns within the watershed along with management options with a timetable and potential funding sources to address the issues and concerns.

The Jefferson County Conservation District received a $13,893.00 Growing Greener grant in 2001 in order to assist in the formation of the Upper Mahoning Creek Watershed Association in the Mahoning Creek Watershed in Jefferson, Clearfield and Indiana Counties.

The Upper Mahoning Creek Watershed Association (UMCWA) received a $58,530.15 Technical Assistance Grant (TAG) through the Growing Greener Program in order to assist the UMCWA in developing priorities for AMD remediation projects in the watershed. The UMCWA decided to focus their efforts on the Sugarcamp Run discharge. Recommendations for treatment alternatives for the Sugarcamp Run discharge were developed. A Growing Greener application for the investigation and design for a treatment system for this discharge was also included under this TAG grant.

In 2005, the Jefferson County Conservation District received a Growing Greener grant for $82,555.00 to perform a feasibility study that would investigate using the Sugarcamp Run deep mine discharge for a municipal water supply for the Sykesville Borough. A detailed investigation of the mine pool feeding the discharge will be followed by the development of a conceptual design for an AMD treatment system to remediate this discharge. The effluent from this system would then be used as an intake for a proposed potable water treatment system. L. Robert Kimball & Associates was chosen as the consultant for this project based on an RFP submitted in 2004.

Much of the Stump Creek watershed has been heavily mined by pre-law operations. Most of the mining took place in the headwaters areas of the watershed. Underground mining was conducted from the 1800's into the early 1900's. Many of these mines were left abandoned. In the mid 1900's strip mining became the prevalent method of mining. Mining companies whose names have long ago been forgotten mined the land with little or no reclamation. All of the abandoned mines in the watershed have led to the degradation of the Stump Creek watershed. Today some of these sites are being remined and reclaimed which helps reduce the amount of spoils exposed to the weather and eliminates abandoned deep mines in the watershed.

MINING

There is currently one active reclamation project within the watershed. The project is located at an old coal tipple near Helvetia (41-02-36/78-46-20). Rob Holland Enterprises', Helvetian #1 Operation (GFCC 17-04-09), will remove 42,300 tons of coal refuse and reclaim 3.5 acres of abandoned mine land near the headwaters of Stump Creek. Reclamation of the site began in August of 2006 and the project is to be completed by 2009. There is no NPDES permit for this site. The reclamation of this site will help reduce sediment entering Stump Creek and eliminate the ponding of water on the coal refuse.

Allegheny Enterprises, Inc., Helvetia #2 Operations (NPDES No. PA0256374) and Bloom Operation (NPDES No. PA0256471) are currently permitted mining operations in the Stump Creek Watershed. Dominion Transmission, Inc. discharges treated wastewater into Stump Creek Watershed. Iron and TSS wasteloads have been included in this TMDL.

AMD Methodology

A two-step approach is used for the TMDL analysis of 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, 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)

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

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

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.

In low 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 total acidity. Net alkalinity is alkalinity minus acidity, both in units of milligrams per liter (mg/l) $CaCO_3$. 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 may not represent 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.

Method to Quantify Treatment Pond Pollutant Load

Calculating Waste Load Allocations for Active Mining in the TMDL Stream Segment.

The end product of the TMDL report is to develop Waste Load Allocations (WLA) and Load Allocations (LA) that represent the amount of pollution the stream can assimilate while still achieving in-stream limits. The LA is the load from abandoned mine lands where there is no NPDES permit or responsible party. The WLA is the pollution load from active mining that is permitted through NPDES.

In preparing the TMDL, calculations are done to determine the allowable load. The actual load measured in the stream is equal to the allowable load plus the reduced load.

$$\text{Total Measured Load} = \text{Allowed Load} + \text{Reduced Load}$$

If there is active mining or anticipated mining in the near future in the watershed, the allowed load must include both a WLA and a LA component.

Allowed Load (lbs/day) = WLA (lbs/day) + LA (lbs/day)

The following is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits.

Surface coalmines remove soil and overburden materials to expose the underground coal seams for removal. After removal of the coal the overburden is replaced as mine spoil and the soil is replaced for revegetation. In a typical surface mining operation the overburden materials is removed and placed in the previous cut where the coal has been removed. In this fashion, an active mining operation has a pit that progresses through the mining site during the life of the mine. The pit may have water reporting to it, as it is a low spot in the local area. Pit water can be the result of limited shallow groundwater seepage, direct precipitation into the pit, and surface runoff from partially regarded areas that have been backfilled but not yet revegetated. Pit water is pumped to nearby treatment ponds where it is treated to the required treatment pond effluent limits. The standard effluent limits are as follows, although stricter effluent limits may be applied to a mining permit's effluent limits to insure that the discharge of treated water does not cause in-stream limits to be exceeded.

Standard Treatment Pond Effluent Limits:
Alkalinity > Acidity
6.0 <= pH <= 9.0
Fe < 3.0 mg/l
Mn < 2.0 mg/l
Al < 2.0 mg/l

Discharge from treatment ponds on a mine site is intermittent and often varies as a result of precipitation events. Measured flow rates are almost never available. If accurate flow data are available, they can be used to quantify the WLA. The following is an approach that can be used to determine a waste load allocation for an active mining operation when treatment pond flow rates are not available. The methodology involves quantifying the hydrology of the portion of a surface mine site that contributes flow to the pit and then calculating waste load allocation using NPDES treatment pond effluent limits.

The total water volume reporting to ponds for treatment can come from two primary sources: direct precipitation to the pit and runoff from the unregraded area following the pit's progression through the site. Groundwater seepage reporting to the pit is considered negligible compared to the flow rates resulting from precipitation.

In an active mining scenario, a mine operator pumps pit water to the ponds for chemical treatment. Pit water is often acidic with dissolved metals in nature. At the treatment ponds, alkaline chemicals are added to increase the pH and encourage dissolved metals to precipitate and settle. Pennsylvania averages 41.4 inches of precipitation per year (Mid-Atlantic River

Forecast Center, National Weather Service, State College, PA, 1961-1990, http://www.dep.state.pa.us/dep/subject/hotopics/drought/PrecipNorm.htm). A maximum pit dimension without special permit approval is 1500 feet long by 300 feet wide. Assuming that 5 percent of the precipitation evaporates and the remaining 95 percent flows to the low spot in the active pit to be pumped to the treatment ponds, results in the following equation and average flow rates for the pit area.

41.4 in. precip./yr x 0.95 x 1 ft./12/in. x 1500'x300'/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. =

= 21.0 gal/min average discharge from direct precipitation into the open mining pit area.

Pit water can also result from runoff from the unregraded and revegetated area following the pit. In the case of roughly backfilled and highly porous spoil, there is very little surface runoff. It is estimated that 80 percent of precipitation on the roughly regarded mine spoil infiltrates, 5 percent evaporates, and 15 percent may run off to the pit for pumping and potential treatment (Jay Hawkins, Office of Surface Mining, Department of the Interior, Personal Communications 2003). Regrading and revegetation of the mine spoil is conducted as the mining progresses. DEP encourages concurrent backfilling and revegetation through its compliance efforts and it is in the interest of the mining operator to minimize the company's reclamation bond liability by keeping the site reclaimed and revegetated. Experience has shown that reclamation and revegetation is accomplished two to three pit widths behind the active mining pit area. DEP uses three pit widths as an area representing potential flow to the pit when reviewing the NPDES permit application and calculating effluent limits based on best available treatment technology and insuring that in-stream limits are met. The same approach is used in the following equation, which represents the average flow reporting to the pit from the unregraded and unrevegetated spoil area.

41.4 in. precip./yr x 3 pit areas x 1 ft./12/in. x 1500'x300'/pit x 7.48 gal/ft^3 x 1yr/365days x 1day/24hr. x 1hr./60 min. x 15 in. runoff/100 in. precipitation =

= 9.9 gal./min. average discharge from spoil runoff into the pit area.

The total average flow to the pit is represented by the sum of the direct pit precipitation and the water flowing to the pit from the spoil area as follows:

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

Total Average Flow = 21.0 gal./min + 9.9 gal./min. = 30.9 gal./min.

The resulting average waste load from a permitted treatment pond area is as follows.

Allowable Iron Waste Load Allocation:
30.9 gal./min. x 3 mg/l x 0.01202 = 1.1 lbs./day

Allowable Manganese Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

Allowable Aluminum Waste Load Allocation:
30.9 gal./min. x 2 mg/l x 0.01202 = 0.7 lbs./day

(Note: 0.01202 is a conversion factor to convert from a flow rate in gal/min. and a concentration in mg/l to a load in units of lbs./day.)

There is little or no documentation available to quantify the actual amount of water that is typically pumped from active pits to treatment ponds. Experience and observations suggest that the above approach is very conservative and overestimates the quantity of water, creating a large margin of safety in the methodology. County specific precipitation rates can be used in place of the long-term state average rate, although the margin of safety is greater than differences from individual counties. It is common for many mining sites to have very “dry” pits that rarely accumulate water that would require pumping and treatment.

Also, it is the goal of DEP’s permit review process to not issue mining permits that would cause negative impacts to the environment. As a step to insure that a mine site does not produce acid mine drainage, it is common to require the addition of alkaline materials (waste lime, baghouse lime, limestone, etc.) to the backfill spoil materials to neutralize any acid-forming materials that may be present. This practice of ‘alkaline addition’ or the incorporation of naturally occurring alkaline spoil materials (limestone, alkaline shale or other rocks) may produce alkaline pit water with very low metals concentrations that does not require treatment. A comprehensive study in 1999 evaluated mining permits issued since 1987 and found that only 2.2 percent resulted in a post-mining pollution discharge (Evaluation of Mining Permits Resulting in Acid Mine Drainage 1987-1996: A Post Mortem Study, March 1999). As a result of efforts to insure that acid mine drainage is prevented, most mining operations have alkaline pit water that often meets effluent limits and requires little or no treatment.

While most mining operations are permitted and allowed to have a standard, 1500’ x 300’ pit, most are well below that size and have a corresponding decreased flow and load. Where pit dimensions are greater than the standard size or multiple pits are present, the calculations to define the potential pollution load can be adjusted accordingly. Hence, the above calculated Waste Load Allocation is very generous and likely high compared to actual conditions that are generally encountered. A large margin of safety is included in the WLA calculations.

The allowable load for the stream segment is determined by modeling of flow and water quality data. The allowable load has a potential Waste Load Allocation (WLA) component if there is active mining or anticipated future mining and a Load Allocation (LA). So, the sum of the Load Allocation and the Waste Load Allocation is equal to the allowed load. The WLA is determined by the above calculations and the LA is determined by the difference between the allowed load and the WLA.

Allowed Load = Waste Load Allocation + Load Allocation
Or
Load Allocation = Allowed Load – Waste Load Allocation

This is an explanation of the quantification of the potential pollution load reporting to the stream from permitted pit water treatment ponds that discharge water at established effluent limits. This allows for including active mining activities and their associated Waste Load in the TMDL calculations to more accurately represent the watershed pollution sources and the reductions necessary to achieve in-stream limits. When a mining operation is concluded its WLA is available for a different operation. Where there are indications that future mining in a watershed are greater than the current level of mining activity, an additional WLA amount may be included in the allowed load to allow for future mining.

TMDL Endpoints

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

Because all of the pollution sources in the watershed are nonpoint sources, the TMDL is expressed as 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

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

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

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a wasteload allocation, load allocation and a margin of safety. The wasteload allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to 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. Table 3 contains the TMDL component summary for each point evaluated in the watershed. Refer to the maps in Attachment A.

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 achieved and also take into account all upstream reductions. Attachment C 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 margin of safety (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 flow and a conversion factor at each sample point. The allowable load is the TMDL and each TMDL includes upstream loads.

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. There currently are no permitted discharges in the Stump Creek Watershed. The difference between the TMDL and the WLA 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 to the area upstream of the point 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. Stump Creek Watershed Summary Table

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
SC03 - Stump Creek headwaters						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	ND	NA	0	NA	NA	NA
Manganese(lbs/day)	ND	NA	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
SC04- Unnamed Tributary 47973 of Stump Creek						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	ND	NA	0	NA	NA	NA
Manganese(lbs/day)	ND	NA	0	NA	NA	NA
Acidity (lbs/day)	4.02	4.02	0	NA	NA	NA

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
SC05 - Unnamed Tributary 47972 of Stump Creek						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	ND	NA	0	NA	NA	NA
Manganese(lbs/day)	0.42	0.42	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
SC02 - Unnamed Tributary 47971 of Stump Creek						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	ND	NA	0	NA	NA	NA
Manganese(lbs/day)	1.44	1.44	0	NA	NA	NA
Acidity (lbs/day)	82.07	54.04	0	54.04	28.03	34%
SC01A - Stump Creek near Helvetia						
Aluminum (lbs/day)	ND	NA	1.4	NA	NA	NA
Iron (lbs/day)	14.04	14.04	2.2	NA	NA	NA
Manganese(lbs/day)	16.59	15.84	1.4	14.44	0.75	5%
Acidity (lbs/day)	353.39	276.60	0	276.60	48.76	15%
SC13 - Stump Creek Above confluence with Sugarcamp Run						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	104.68	103.05	0	103.05	1.63	2%
Manganese(lbs/day)	28.16	28.16	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
SR1 – Mouth of Sugarcamp Run						
Aluminum (lbs/day)	44.96	9.84	0	9.84	35.12	78%
Iron (lbs/day)	478.17	18.99	0	18.99	459.18	96%
Manganese(lbs/day)	17.13	13.02	0	13.02	4.11	24%
Acidity (lbs/day)	861.50	744.86	0	744.86	116.64	14%
SC11 - Stump Creek above S Park Street Bridge						
Aluminum (lbs/day)	137.90	59.66	0	59.66	43.12	42%
Iron (lbs/day)	1389.92	125.36	0	125.36	700.70	85%
Manganese(lbs/day)	67.65	67.65	0	NA	NA	NA
Acidity (lbs/day)	1544.05	1308.36	0	1308.36	119.05	8%
BRD2 – Mine discharge into Buck Run under foundation						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	35.63	4.74	0	4.74	30.89	87%
Manganese(lbs/day)	1.77	1.77	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
BRD1 – Mine discharge into Buck Run						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	20.31	3.61	0	3.61	16.70	82%
Manganese(lbs/day)	1.03	1.03	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
BR1 – Buck Run at Mouth						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	12.43	12.43	0	NA	NA	NA
Manganese(lbs/day)	1.19	1.19	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
PRD1 – Mine Discharge to Poose Run						
Aluminum (lbs/day)	9.03	2.04	0	2.04	6.99	77%
Iron (lbs/day)	63.38	6.99	0	6.99	56.39	89%
Manganese(lbs/day)	7.27	7.27	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
PR1 – Poose Run below discharge						
Aluminum (lbs/day)	10.80	3.88	0	3.88	0	0%*
Iron (lbs/day)	77.69	16.13	0	16.13	5.17	24%
Manganese(lbs/day)	8.68	8.68	0	NA	NA	NA
Acidity (lbs/day)	98.91	98.91	0	NA	NA	NA
SC08 - Stump Creek upstream of Tributary 47940						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	963.22	211.82	0	211.82	0.00	0%*
Manganese(lbs/day)	94.68	94.68	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
SC07 - Stump Creek below SR 2008 Bridge						
Aluminum (lbs/day)	71.58	34.07	0	34.07	37.51	52%
Iron (lbs/day)	852.64	177.79	0	177.79	9.71	5%
Manganese(lbs/day)	90.95	90.95	0	NA	NA	NA
Acidity (lbs/day)	2905.35	1704.73	0	1704.73	1200.62	41%
UNT11 – Unnamed Tributary 47939 to Stump Creek						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	1.28	0.96	0	0.96	0.32	25%
Manganese(lbs/day)	0.97	0.97	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
UNT12 – Unnamed Tributary 47938 to Stump Creek						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	ND	NA	0	NA	NA	NA
Manganese(lbs/day)	ND	NA	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
UNT9 – Unnamed Tributary 47936 to Stump Creek						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	14.58	5.61	0	5.61	8.97	62%
Manganese(lbs/day)	4.99	2.87	0	2.87	2.12	42%

Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	% Reduction
Acidity (lbs/day)	ND	NA	0	NA	NA	NA
SC01 – Mouth of Stump Creek						
Aluminum (lbs/day)	ND	NA	0	NA	NA	NA
Iron (lbs/day)	425.21	176.57	0.29	176.28	0	0%*
Manganese(lbs/day)	95.25	95.25	0	NA	NA	NA
Acidity (lbs/day)	ND	NA	0	NA	NA	NA

* Total of loads affecting this segment is less than the allowable load calculated at this point, therefore no reduction is necessary.
NA = not applicable

In the instance that the allowable load is equal to the measured load (e.g. manganese at SC01, Table 3), the simulation determined that water quality standards are being met instream and therefore no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point. This is denoted as "NA" in the above table.

Waste load allocation was assigned to three permitted discharges contained in the Stump Creek Watershed. The Dominion Transmission, Inc. (NPDES No. PA0101656) has iron included as a parameter in its permit. The WLA is being evaluated at sample point SC01 on Stump Creek. All necessary reductions are assigned to non-point sources.

Table 4 Waste Load Allocation for Dominion Transmission,Inc.			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Dominion			
Fe	3.5	0.01008	0.29

Allegheny Enterprises, Inc., Helvetia #2 Operations (NPDES No. PA0256374) and Bloom Operation (NPDES No. PA0256471) have iron, manganese and aluminum parameters included in their permits. These waste load allocations are calculated using the flow calculated in the Method to Quantify Treatment Pond Pollutant Load multiplied by the permitted BAT limits. The WLAs for the Allegheny Enterprises Inc. discharges are being evaluated at sample point SC01A. No required reductions of permit limits are needed at this time. All necessary reductions are assigned to non-point sources.

These calculated waste load allocations are evaluated downstream at sample point SC01A. Calculated allowable loads at SC01A show that no reductions are necessary for iron and all aluminum sample data was less than detection. Since these parameters are attaining, the impact from upstream sources is negligible. Therefore, no reductions to the present waste load allocations are necessary at this time.

Table 5. Waste Load Allocations for Allegheny Enterprises, Inc.			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Hel01			
Al	2	0.0445	0.743
Fe	3	0.0445	1.114
Mn	2	0.0445	0.743
Blo01			
Al	2	0.0445	0.743
Fe	3	0.0445	1.114
Mn	2	0.0445	0.743

Following is an example of how the allocations, presented in Table 3, for a stream segment are calculated. For this example, iron allocations for SC07 of Stump Creek 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 SC08	
SC08	Fe (Lbs/day)
Existing Load @ SC08	963.22
Allowable load @ SC08	211.82

SC08

Allowable Load = 211.82 lbs/day

Stump reek

Load output = 110.58 lbs/day
(Difference between existing loads at SC07
And SC08)

SC07

Allocations SC07	
SC07	Fe (Lbs/day)
Existing Load @ SC07	852.64
Difference in measured Loads between the loads that enter and existing SC07	-110.58
Percent loss due calculated at SC07	11.5%
Additional load tracked from above samples	211.82
Percentage of upstream loads that reach the SC07	88.5%
Total load tracked between SC08 and SC07	187.50
Allowable Load @ SC07	177.79
Load Reduction @ SC07	9.71
% Reduction required at SC07	5%

Allowable Load = 177.79 lbs/day

The allowable load tracked from upstream (SC08) was 211.82 lbs/day. The existing load from SC08 was subtracted from the existing load at SC07 to show the actual measured decrease of iron load that has left the stream between these two sample points (110.58 lbs/day). The percentage of the upstream loads that reached SC07 was then multiplied to the allowable loads from SC08 to calculate the total load that was tracked between SC08 and SC07 (allowable loads @ SC08 + the difference in existing load between SC08 and SC07). This total load tracked was then subtracted from the calculated allowable load at SC07 to determine the amount of load to be reduced at SC07. This total load value was found to be 187.50 lbs/day; it was 9.71 lbs/day greater then the SC07 allowable load of 177.79 lbs/day. Therefore, a 5% iron reduction at SC07 is necessary.

Impairment due to suspended solids

The suspended solids/siltation impairment noted in the Stump Creek Watershed is due to runoff from un-reclaimed abandoned mine lands, and large refuse piles from historic mining. The overwhelming majority of the sediment contribution comes from abandoned mine land, croplands and transitional lands. An existing sediment load was computed using the GWLF model. This model is being used by the Department to address sedimentation problems in other watersheds throughout the Commonwealth. A reference watershed approach is used to determine the sediment load reduction needed for this watershed. Beaverdam Run was selected for use as the reference watershed. Beaverdam Run does not have a sediment problem, and is an appropriate reference for this purpose. The sediment reduction goal for the TMDL is based on setting the watershed-loading rate of the impaired Stump Creek equal to the watershed-loading rate in the un-impaired Beaverdam Run. The load reduction for sediment in the Stump Creek Watershed was assigned to croplands, coalmines and transitional lands.

The TMDL for sediment is 11,118,323 lbs/day, which results in a 78% reduction in croplands, a 50% reduction in coal, a 50% reduction in quarry and a 55% reduction in transitional land loading. A waste load is also included for TSS from the Dominion Transmission Corporation. A more detailed explanation of sediment calculations is contained in Attachment D.

Recommendations

Two primary programs provide maintenance and improvement of water quality in the watershed. DEP’s efforts to reclaim abandoned mine lands, coupled with its duties and responsibilities for issuing NPDES permits, will be the focal points in water quality improvement.

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

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

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

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

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

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

The coal industry, through DEP-promoted remining efforts, can help to eliminate some sources of AMD and conduct some of the remediation identified in the above recommendations through the permitting, mining, and reclamation of abandoned and disturbed mine lands. Special consideration should be given to potential remining projects within these areas, as the environmental benefit versus cost ratio is generally very high.

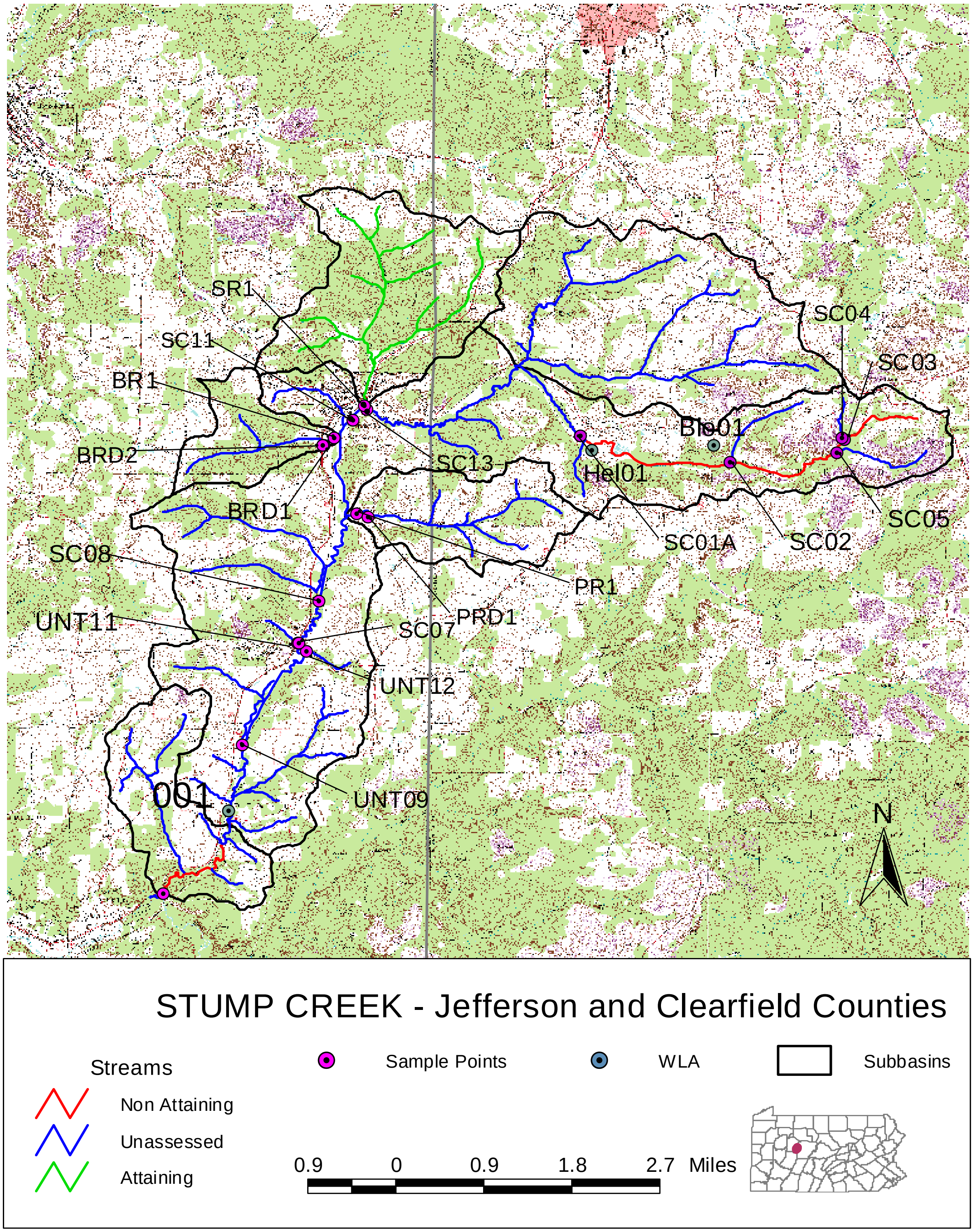
The Jefferson County Conservation District and the Upper Mahoning Creek Watershed Association will continue to pursue AMD reclamation and remediation projects in the Stump Creek Watershed.

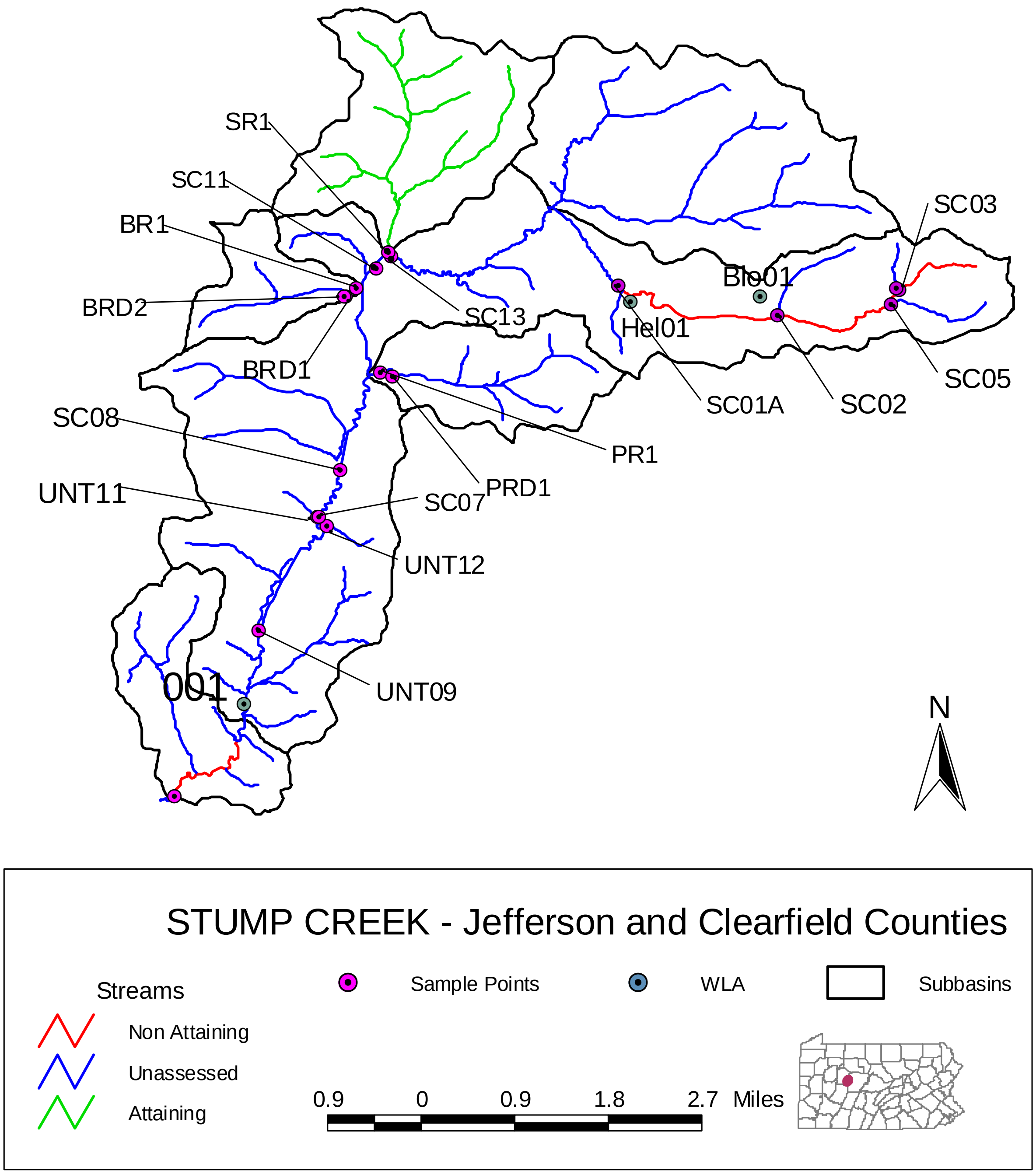
Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* and *The Progress,* to foster public comment on the allowable loads calculated. A public meeting was held on February 7, 2007 at the Moshannon District Mining Office, to discuss the proposed TMDL.

Attachment A

Stump Creek Watershed Maps


SR1
SC11
BR1
BRD2
BRD1
SC13
SC08
UNT11
SC07
PRD1
PR1
UNT12
UNT09
001
SC04
SC03
Blo01
Hel01
SC01A
SC02
SC05
N
STUMP CREEK - Jefferson and Clearfield Counties
Streams
Non Attaining
Unassessed
Attaining
Sample Points
WLA
Subbasins
0.9
0
0.9
1.8
2.7
Miles


SR1
SC11
BR1
BRD2
SC13
BRD1
SC08
UNT11
SC07
PRD1
PR1
UNT12
UNT09
001
Blo01
Hel01
SC01A
SC02
SC03
SC05
N
STUMP CREEK - Jefferson and Clearfield Counties
Streams
Non Attaining
Unassessed
Attaining
Sample Points
WLA
Subbasins
0.9
0
0.9
1.8
2.7
Miles

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 EPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

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

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

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

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

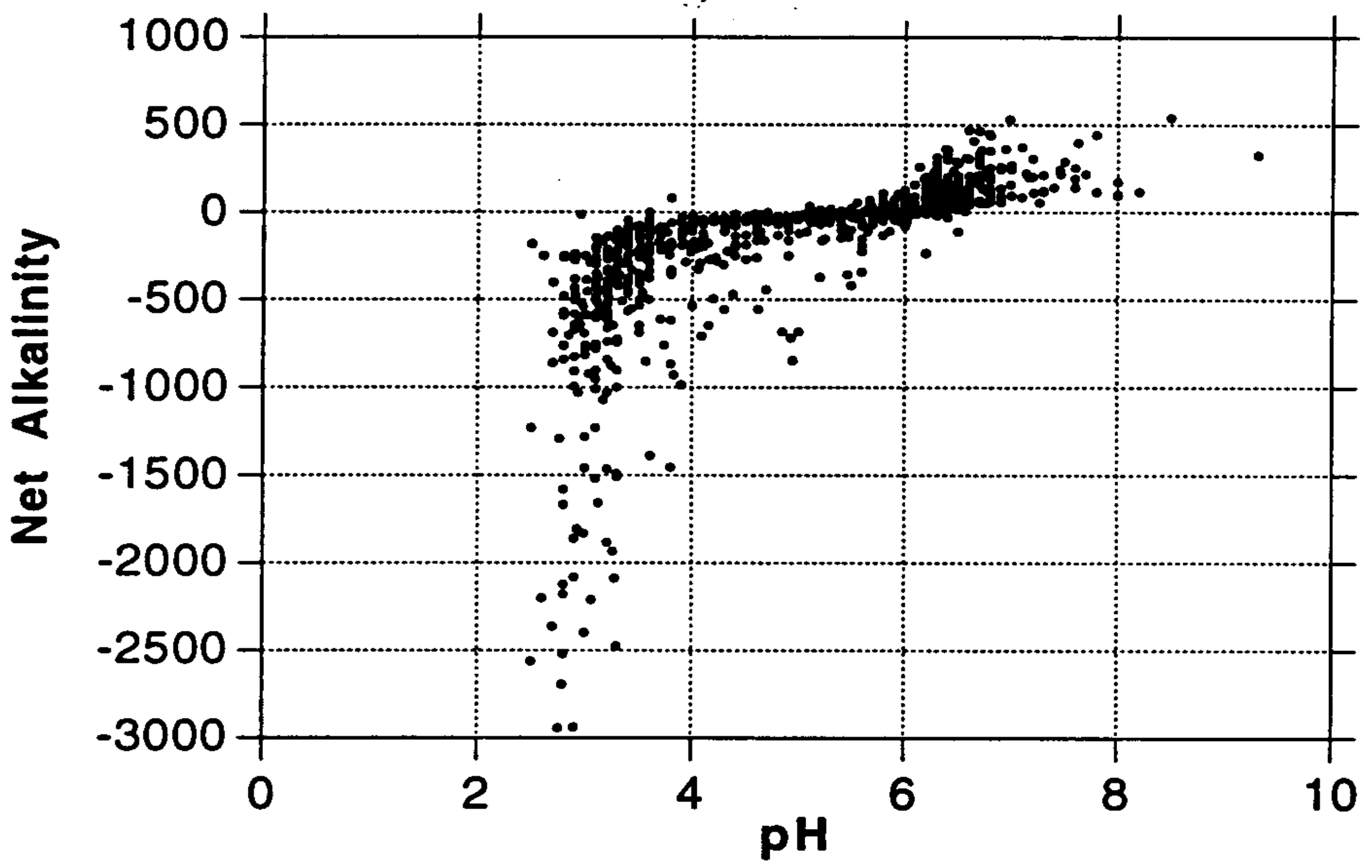


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

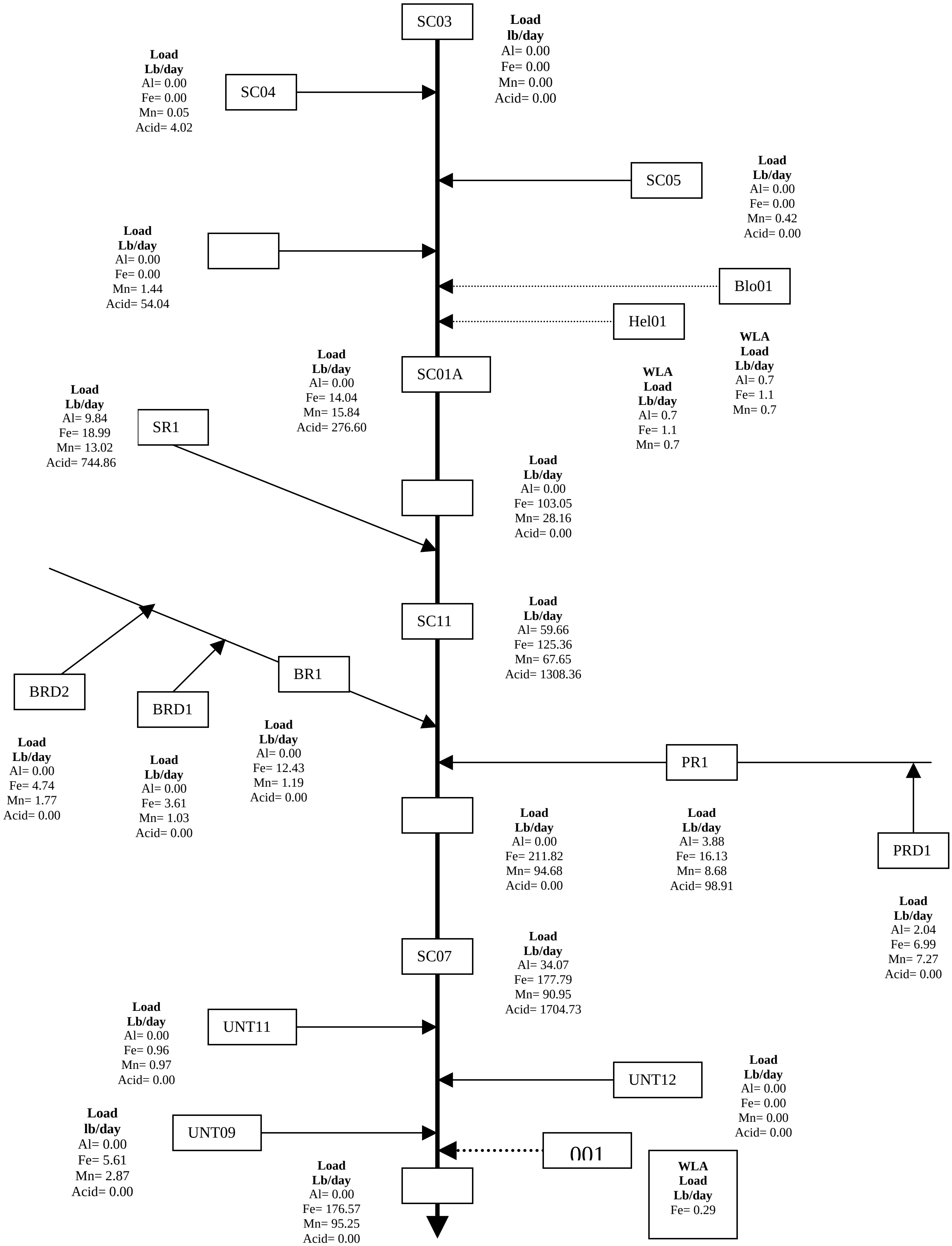
TMDLs By Segment

Stump Creek

The TMDL for Stump Creek consists of load allocations to seven sampling sites along Stump Creek (SC03, SC01A, SC13, SC11, SC08, SC07 and SC01), six sampling sites on unnamed tributaries of Stump Creek (SC05, SC04, SC02, UNT12, UNT11 and UNT09), one site on Sugarcamp Run (SR1), one site on Buck Run (BR1), one site on Poose Run (PR1) and three discharges, two on Buck Run (BRD2 and BRD1) and one on Poose Run (PRD1). Sample data sets in Clearfield County were collected during 2004 and 2005. Sample data sets in Jefferson County were collected during 2003 and 2004. Stream flow values were calculated for all sample points except for the discharges using a unit area method. By having a known flow and area at a given sample site (SC13), the remaining flow values can be calculated based on land area. All sample points are shown on the maps included in Attachment A as well as on the loading schematic presented on the following page.

Stump Creek is listed on the 1996 PA Section 303(d) list for metals and suspended solids from AMD as being the cause of the degradation to this stream. This TMDL will focus on metals analysis to the Stump Creek watershed. pH will also be considered in the TMDL process. The objective is to reduce acid loading to the stream, which will in turn raise the pH to the desired range and keep a net alkalinity above zero, 99% of the time. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL 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.



SC03
Load lb/day Al= 0.00 Fe= 0.00 Mn= 0.00 Acid= 0.00
SC04
Load Lb/day Al= 0.00 Fe= 0.00 Mn= 0.05 Acid= 4.02
SC05
Load Lb/day Al= 0.00 Fe= 0.00 Mn= 0.42 Acid= 0.00
Load Lb/day Al= 0.00 Fe= 0.00 Mn= 1.44 Acid= 54.04
Blo01
Hel01
WLA Load Lb/day Al= 0.7 Fe= 1.1 Mn= 0.7
WLA Load Lb/day Al= 0.7 Fe= 1.1 Mn= 0.7
SC01A
Load Lb/day Al= 0.00 Fe= 14.04 Mn= 15.84 Acid= 276.60
SR1
Load Lb/day Al= 9.84 Fe= 18.99 Mn= 13.02 Acid= 744.86
Load Lb/day Al= 0.00 Fe= 103.05 Mn= 28.16 Acid= 0.00
SC11
Load Lb/day Al= 59.66 Fe= 125.36 Mn= 67.65 Acid= 1308.36
BR1
BRD2
BRD1
Load Lb/day Al= 0.00 Fe= 4.74 Mn= 1.77 Acid= 0.00
Load Lb/day Al= 0.00 Fe= 3.61 Mn= 1.03 Acid= 0.00
Load Lb/day Al= 0.00 Fe= 12.43 Mn= 1.19 Acid= 0.00
PR1
PRD1
Load Lb/day Al= 0.00 Fe= 211.82 Mn= 94.68 Acid= 0.00
Load Lb/day Al= 3.88 Fe= 16.13 Mn= 8.68 Acid= 98.91
Load Lb/day Al= 2.04 Fe= 6.99 Mn= 7.27 Acid= 0.00
SC07
Load Lb/day Al= 34.07 Fe= 177.79 Mn= 90.95 Acid= 1704.73
UNT11
Load Lb/day Al= 0.00 Fe= 0.96 Mn= 0.97 Acid= 0.00
UNT12
Load Lb/day Al= 0.00 Fe= 0.00 Mn= 0.00 Acid= 0.00
UNT09
Load lb/day Al= 0.00 Fe= 5.61 Mn= 2.87 Acid= 0.00
001
WLA Load Lb/day Fe= 0.29
Load Lb/day Al= 0.00 Fe= 176.57 Mn= 95.25 Acid= 0.00

TMDL calculations- SC03- Stump Creek downstream of Golden Yoke Road bridge and above unnamed tributary 47973

The TMDL for sample point SC03 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 Stump Creek was computed using water-quality sample data collected at point SC03. The average flow, measured using a unit area method for SC03 (0.57 MGD), is used for these computations. The allowable loads calculated at SC03 will directly affect the downstream point SC01.

Sample data at point SC03 shows that this upstream, impaired segment of Stump Creek has a pH ranging between 7.2 and 7.7. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

The measured sample data for aluminum, iron and manganese was below detection limits. Acidic data showed that no reductions are necessary. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum, iron, manganese and acidity parameters at SC03 in Table C1 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C1 shows the measured and allowable concentrations and loads at SC03.

Table C1		Measured		Allowable	
Flow (gpm)=	397.19	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	ND	NA	ND	NA
ND = non detection	Manganese	ND	NA	ND	NA
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	50.70	241.84		

TMDL calculations- SC04- unnamed tributary 47973 to Stump creek

The TMDL for sample point SC04 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this unnamed tributary segment of Stump Creek was computed using water-quality sample data collected at point SC04. The average flow, measured using a unit area method for SC04 (0.20 MGD), is used for these computations. This is the most upstream point of this segment and the allowable load allocations calculated at SC04 will directly affect the downstream point SC01.

Sample data at point SC04 shows that this tributary of Stump Creek has a pH ranging between 7.0 and 7.3. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

All measured sample data for aluminum was below detection limits. Some sample data for iron and manganese were above detection limits but still below criteria. The acidic data showed that no reductions are necessary. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and iron parameters at SC04 in Table C2 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C2 shows the measured and allowable concentrations and loads at SC04.

Table C2		Measured		Allowable	
Flow (gpm)=	139.59	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	ND	NA	ND	NA
ND = non detection	Manganese	ND	NA	ND	NA
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	33.65	23.1		

TMDL calculations- SC05- Second unnamed tributary 47972 to Stump Creek

The TMDL for sample point SC05 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary of Stump Creek was computed using water-quality sample data collected at point SC05. The average flow, measured using a unit area method for SC05 (0.58 MGD), is used for these computations. The allowable loads calculated at SC05 will directly affect the downstream point SC01.

Sample data at point SC05 shows that this tributary of Stump Creek has a pH ranging between 7.4 and 7.9. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

All measured data for aluminum and iron was below detection limits. Sample data for manganese was above detection limits but still below criteria. The acidic data showed that no reductions are necessary. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum, iron and acidity parameter at SC05 in Table C3 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C3 shows the measured and allowable concentrations and loads at SC05.

Table C3		Measured		Allowable	
Flow (gpm)=	403.33	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA

	Iron	ND	NA	ND	NA
ND = non detection	Manganese	0.09	0.4	0.09	0.4
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	66.30	254.4		

TMDL calculations- SC02- Unnamed tributary 47971 north of Stump Creek east of T344 Road

The TMDL for sample point SC02 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary of Stump Creek was computed using water-quality sample data collected at point SC02. The average flow, measured using a unit area method for SC02 (0.55 MGD), is used for these computations. The allowable loads calculated at SC02 will directly affect the downstream point SC01.

Sample data at point SC02 shows that this tributary of Stump Creek has a pH ranging between 6.7 and 6.9. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL has been calculated for acidity. All measured data for aluminum and iron was below detection limits. Sample data for manganese was above detection limits but still below criteria. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and iron parameters at SC02 in Table C4 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C4 shows the measured and allowable concentrations and loads at SC02. Table C5 shows the acidic reductions necessary at SC02.

Table C4		Measured		Allowable	
Flow (gpm)=	378.62	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	ND	NA	ND	NA
ND = non detection	Manganese	0.32	1.2	0.32	1.2
NA = not applicable	Acidity	18.05	82.1	11.88	54.0
	Alkalinity	20.15	91.6		

Table C5. Allocations SC02	
SC02	Acidity (Lbs/day)
Existing Load @ SC02	82.07
Allowable Load @ SC02	54.04
Load Reduction @ SC02	28.03
% Reduction required @ SC02	34%

Waste Load Allocations –
Allegheny Enterprises Inc.,Helvetia #2 Operation NPDES No. PA0256374
Allegheny Enterprises Inc., Bloom Operation NPDES No. PA0256471

The Allegheny Enterprise Inc. has permitted discharges that are evaluated in the calculated allowable loads at SC01A. Waste load allocations are calculated using the flow calculated in the Method to Quantify Treatment Pond Pollutant Load and the permitted BAT limits for aluminum, iron and manganese. The following table shows the waste load allocation for these discharges.

These calculated waste load allocations are evaluated downstream at sample point SC01A. Calculated allowable loads at SC01A show that no reductions are necessary for aluminum and iron. Since these parameters are attaining, the impact from upstream sources is negligible. Therefore, no reductions to the present waste load allocation are necessary at this time.

Table C6. Waste Load Allocations for Allegheny Enterprises Inc.			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Hel01			
Al	2	0.0445	0.743
Fe	3	0.0445	1.114
Mn	2	0.0445	0.743
Blo01			
Al	2	0.0445	0.743
Fe	3	0.0445	1.114
Mn	2	0.0445	0.743

TMDL calculations- SC01A- Stump Creek at LR17010 road bridge

The TMDL for sampling point SC01A 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 was computed using water-quality sample data collected at point SC01A. The average flow, measured using a unit area method for SC01A (4.82 MGD), is used for these computations. The allowable loads calculated at SC01A will directly affect the downstream point SC13.

Sample data at point SC01A shows pH ranging between 6.9 and 7.3; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point SC01A 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 SC04/ SC03/SC05/SC02 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points SC04/ SC03/SC05/SC02 and SC01A to determine a total load tracked for the segment of stream between SC01A and SC04/ SC03/SC05/SC02. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at SC01A.

A TMDL for manganese and acidity at SC01A has been calculated. The measured sample data for aluminum was below detection limits. Sample data for iron was found to be above detection limits but still below water quality standards. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum parameter at SC01A in Table C7 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C7 shows the measured and allowable concentrations and loads at SC01A. Table C8 shows the percent reduction for manganese and acidity needed at SC01A.

Table C7		Measured		Allowable	
Flow (gpm)=	3343.79	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.35	14.0	0.35	14.0
ND = non detection	Manganese	0.41	16.6	0.39	15.8
NA = not applicable	Acidity	8.80	353.5	6.89	276.6
	Alkalinity	37.30	1497.9		

Table C8. Allocations SC01A		
SC01A	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ SC01A	16.59	353.39
Difference in measured Loads between the loads that enter and existing SC01A	14.73	267.30
Additional load tracked from above samples	1.86	58.06
Total load tracked between SC04/SC03/SC05/SC02 and SC01A	16.59	325.36
Allowable Load @ SC01A	15.84	276.60
Load Reduction @ SC01A	0.75	48.76
% Reduction required @ SC01A	5%	15%

There is a 14.73 lbs/day increase of manganese at SC01A compared to the sum of measured loads from upstream segments. The total manganese load measured was 0.75 lbs/day greater than the calculated allowable manganese load of 15.84 lbs/day, resulting in a 5% manganese reduction at this point. The total acidic load tracked between SC04/SC03/SC05/SC02 and SC01A was determined to be 353.39 lbs/day. The calculated acidic allowable load is 276.60 lbs/day, which requires a 48.76 lbs/day, 15% reduction from the total acidic load tracked throughout the impaired segment of Stump Creek.

TMDL calculations- SC13- Stump Creek Above Confluence With Sugarcamp Run

The TMDL for sampling point SC13 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 was computed using water-quality sample data collected at point SC13. The average flow, measured at the sampling point SC13 (14.93 MGD), is used for these computations. The complete flow set for SC13 was used as a component of the unit area method used to establish flows at many of the other sample sites in this watershed. The allowable loads calculated at SC13 will directly affect the downstream point SC11.

Sample data at point SC13 shows pH ranging between 6.8 and 7.5; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point SC13 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 point SC01A shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points SC01A and SC13 to determine a total load tracked for the segment of stream between SC01A and SC13. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at SC13.

A TMDL for iron at SC13 has been calculated. The measured sample data for aluminum was below detection limits. Sample data for manganese was found to be above detection limits but still below water quality standards. The acidic data showed that no reductions are necessary. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and acidity parameters at SC13 in Table C9 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C9 shows the measured and allowable concentrations and loads at SC13. Table C10 shows the percent reduction for iron needed at SC13.

Table C9		Measured		Allowable	
Flow (gpm)=	10366.67	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	0.84	104.7	0.83	103.1
ND = non detection	Manganese	0.23	28.1	0.23	28.1
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	50.33	6266.5		

Table C10. Allocations SC13	
SC13	Fe (Lbs/day)
Existing Load @ SC13	104.68
Difference in measured Loads between the loads that enter and existing SC13	90.64
Additional load tracked from above samples	14.04
Total load tracked between SC01A and SC13	104.68

Allowable Load @ SC13	103.05
Load Reduction @ SC13	1.63
% Reduction required at SC13	2%

There is a 90.64 lbs/day increase of iron at SC13 compared to the sum of measured loads from upstream segments. The total iron load measured was 1.63 lbs/day greater than the calculated allowable iron load of 103.05 lbs/day, resulting in a 2% iron reduction at this point.

TMDL calculations- SR1- Mouth of Sugarcamp Run

The TMDL for sample point SR1 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for Sugarcamp Run was computed using water-quality sample data collected at point SR1. The average flow, measured using a unit area method for SR1 (4.60 MGD), is used for these computations. The allowable loads calculated at SR1 will directly affect the downstream point SC11.

Sample data at point SR1 shows that Sugarcamp Run has a pH ranging between 6.2 and 6.6. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL has been calculated for aluminum, iron, manganese and acidity.

Table C11 shows the measured and allowable concentrations and loads at SR1. Table C12 shows the aluminum, iron, manganese and acidic reductions necessary at SR1.

Table C11		Measured		Allowable	
Flow (gpm)=	3192.91	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	1.17	45.0	0.26	9.8
	Iron	12.47	478.2	0.50	19.0
	Manganese	0.45	17.1	0.34	13.0
	Acidity	22.47	861.5	19.42	744.9
	Alkalinity	53.57	2054.0		

Table C12. Allocations SR1				
SR1	Al (Lbs/day)	Fe (Lbs/day)	Mn (Lbs/day)	Acidity (Lbs/day)
Existing Load @ SR1	44.96	478.17	17.13	861.50
Allowable Load @ SR1	9.84	18.99	13.02	744.86
Load Reduction @ SR1	35.12	459.18	4.11	116.64
% Reduction required @ SR1	78%	96%	24%	14%

TMDL calculations- SC11- Stump Creek above S. Park St. Bridge

The TMDL for sampling point SC11 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 was computed using water-quality sample data collected at point SC11. The average flow, measured using a unit area method for SC11 (19.70 MGD), is used for these computations. The allowable loads calculated at SC11 will directly affect the downstream point SC08.

Sample data at point SC11 shows pH ranging between 6.3 and 6.7; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point SC11 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 SC13/SR1 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points SC13/SR1 and SC11 to determine a total load tracked for the segment of stream between SC11 and SC13/SR1. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at SC11.

A TMDL for aluminum, iron and acidity at SC11 has been calculated. Sample data for manganese was found to be above detection limits but still below water quality standards. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated.

Table C13 shows the measured and allowable concentrations and loads at SC11. Table C14 shows the percent reduction for aluminum, iron and acidity needed at SC11.

Table C13		Measured		Allowable	
Flow (gpm)=	13677.46	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.84	137.9	0.36	59.7
	Iron	8.46	1389.9	0.76	125.4
	Manganese	0.41	67.7	0.41	67.7
	Acidity	9.40	1544.1	7.97	1308.4
	Alkalinity	48.93	8037.8		

Table C14. Allocations SC11			
SC11	Al (Lbs/day)	Fe (Lbs/day)	Acidity (Lbs/day)
Existing Load @ SC11	137.90	1389.92	1544.05
Difference in measured Loads between the loads that enter and existing SC11	92.94	807.07	682.55
Additional load tracked from above samples	9.84	18.99	744.86
Total load tracked between SR1/SC13 and SC11	102.78	826.06	1427.41

Allowable Load @ SC11	59.66	125.36	1308.36
Load Reduction @ SC11	43.12	700.70	119.05
% Reduction required at SC11	42%	85%	8%

There is a 92.94 lbs/day increase of aluminum at SC11 compared to the sum of measured loads from upstream segments. The total aluminum load measured was 43.12 lbs/day greater than the calculated allowable aluminum load of 59.66 lbs/day, resulting in a 42% aluminum reduction at this point. The total iron load tracked between SR1/SC13 and SC11 is 826.06 lbs/day. 700.70 lbs/day of iron needs to be reduced to meet the calculated allowable load of 125.36 lbs/day. An 85% reduction of existing iron is needed. The total acidic load tracked between SR1/SC13 and SC11 was determined to be 1427.41 lbs/day. The calculated acidic allowable load is 1308.36 lbs/day, which requires a 119.05 lbs/day, 8% reduction from the total acidic load tracked throughout this impaired segment of Stump Creek.

TMDL calculations- BRD2- Mine Discharge into Buck Run

The TMDL for sample point BRD2 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this discharge was computed using water-quality sample data collected at point BRD2. The average flow, measured at the sampling point BRD2 (0.66 MGD), is used for these computations. The allowable loads calculated at BRD2 will directly affect the downstream point BR1.

Sample data at point BRD2 shows that this discharge has a pH ranging between 6.8 and 7.2. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL has been calculated for iron. All measured data for aluminum was below detection limits. Sample data for manganese was above detection limits but still below criteria. Acidic data collected shows that no reductions are necessary at BRD2. Because water quality standards are met, a TMDL for these parameters isn’t necessary and is not calculated. The existing and allowable loads for the aluminum and acidity parameters at BRD2 in Table C15 will be denoted as “NA”. The concentrations will be denoted as “ND”.

Table C15 shows the measured and allowable concentrations and loads at BRD2. Table C16 shows the iron reductions necessary at BRD2.

Table C15		Measured			
Flow (gpm)=	455.60	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	6.51	35.6	0.87	4.7
ND = non detection	Manganese	0.32	1.8	0.32	1.8
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	215.76	1180.6		

Table C16. Allocations BRD2	
BRD2	Fe (Lbs/day)
Existing Load @ BRD2	35.63
Allowable Load @ BRD2	4.74
Load Reduction @ BRD2	30.89
% Reduction required @ BRD2	87%

TMDL calculations- BRD1- Mine Discharge into Buck Run

The TMDL for sample point BRD1 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this discharge was computed using water-quality sample data collected at point BRD1. The average flow, measured at the sampling point BRD1 (0.32 MGD), is used for these computations. The allowable loads calculated at BRD1 will directly affect the downstream point BR1.

Sample data at point BRD1 shows that this discharge has a pH ranging between 6.8 and 6.9. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL has been calculated for iron. All measured data for aluminum was below detection limits. Sample data for manganese was above detection limits but still below criteria. Acidic data collected shows that no reductions are necessary at BRD1. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and acidity parameters at BRD1 in Table C17 will be denoted as “NA”. The concentrations will be denoted as “ND”.

Table C17 shows the measured and allowable concentrations and loads at BRD1. Table C18 shows the iron reductions necessary at BRD1.

Table C17		Measured		Allowable	
Flow (gpm)=	224.40	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	7.54	20.3	1.34	3.6
ND = non detection	Manganese	0.38	1.0	0.38	1.0
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	182.48	491.8		

Table C18 Allocations BRD1	
BRD1	Fe (Lbs/day)
Existing Load @ BRD1	20.31
Allowable Load @ BRD1	3.61
Load Reduction @ BRD1	16.70
% Reduction required @ BRD1	82%

TMDL calculations- BR1- Mouth of Buck Run

The TMDL for sampling point BR1 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 was computed using water-quality sample data collected at point BR1. The average flow, measured using a unit area method for BR1 (1.45 MGD), is used for these computations. The allowable loads calculated at BR1 will directly affect the downstream point SC08.

Sample data at point BR1 shows pH ranging between 7.1 and 7.5; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point BR1 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 BRD1/BRD2 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points BRD1/BRD2 and BR1 to determine a total load tracked for the segment of stream between BR1 and BRD1/BRD2. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at BR1.

No TMDLs have been calculated at BR1. All sample data for aluminum was found to be at less then detection limits. Sample data for iron and manganese was found to be above detection limits but still below water quality standards. Acidic data collected at BR1 shows no reductions necessary. Because water quality standards are met, a TMDL for these parameters isn’t necessary and is not calculated. The existing and allowable loads for the aluminum and acidity parameters at BR1 in Table C19 will be denoted as “NA”. The concentrations will be denoted as “ND”.

Table C19 shows the measured and allowable concentrations and loads at BR1.

Table C19		Measured		Allowable	
Flow (gpm)=	1004.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	1.03	12.43	1.03	12.43

ND = non detection	Manganese	0.10	1.19	0.10	1.19
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	87.93	1060.27		

TMDL calculations- PRD1- Mine Discharge into Poose Run

The TMDL for sample point PRD1 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this discharge was computed using water-quality sample data collected at point PRD1. The average flow, measured at the sampling point PRD1 (1.21 MGD), is used for these computations. The allowable loads calculated at PRD1 will directly affect the downstream point PR1.

Sample data at point PRD1 shows that this discharge has a pH ranging between 6.1 and 6.6. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL has been calculated for aluminum and iron at PRD1. Sample data for manganese was above detection limits but still below criteria. Acidic data collected shows that no reductions are necessary at PRD1. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the acidity parameters at PRD1 in Table C20 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C20 shows the measured and allowable concentrations and loads at PRD1. Table C21 shows the aluminum and iron reductions necessary at PRD1.

Table C20		Measured		Allowable	
Flow (gpm)=	843.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.89	9.0	0.20	2.0
	Iron	6.26	63.4	0.69	7.0
ND = non detection	Manganese	0.72	7.3	0.72	7.3
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	97.13	983.4		

Table C21. Allocations PRD1		
PRD1	Al (Lbs/day)	Fe (Lbs/day)
Existing Load @ PRD1	9.03	63.38
Allowable Load @ PRD1	2.04	6.99
Load Reduction @ PRD1	6.99	56.39
% Reduction required @ PRD1	77%	89%

TMDL calculations- PR1- Poose Run below PRD1 discharge

The TMDL for sampling point PR1 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 was computed using water-quality sample data collected at point PR1. The average flow, measured using a unit area method for PR1 (2.52 MGD), is used for these computations. The allowable loads calculated at PR1 will directly affect the downstream point SC08.

Sample data at point PR1 shows pH ranging between 6.3 and 6.7; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point PR1 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 PRD1 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points PRD1 and PR1 to determine a total load tracked for the segment of stream between PR1 and PRD1. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at PR1.

A TMDL for aluminum and iron at PR1 has been calculated. Sample data for manganese was found to be above detection limits but still below water quality standards. Acidic data at PR1 showed that no reductions were necessary. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated.

Table C22 shows the measured and allowable concentrations and loads at PR1. Table C23 shows the percent reduction for aluminum and iron needed at PR1.

Table C22		Measured		Allowable	
Flow (gpm)=	1752.32	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.51	10.8	0.18	3.9
	Iron	3.69	77.7	0.77	16.1
	Manganese	0.41	8.7	0.41	8.7
	Acidity	4.70	98.9	4.70	98.9
	Alkalinity	70.63	1486.5		

Table C23. Allocations PR1		
PR1	Al (Lbs/day)	Fe (Lbs/day)
Existing Load @ PR1	10.80	77.69
Difference in measured Loads between the loads that enter and existing PR1	1.77	14.31
Additional load tracked from above samples	2.04	6.99

Total load tracked between PRD1 and PR1	3.81	21.30
Allowable Load @ PR1	3.88	16.13
Load Reduction @ PR1	-0.07	5.17
% Reduction required at PR1	0%	24%

There is a 1.77 lbs/day increase of aluminum at PR1 compared to the sum of measured loads from upstream segments. The total aluminum load measured was 0.07 lbs/day less than the calculated allowable aluminum load of 3.88 lbs/day, resulting in no aluminum reduction necessary at this point. The total iron load tracked between PRD1 and PR1 is 21.30 lbs/day. 5.17 lbs/day of iron needs to be reduced to meet the calculated allowable load of 16.13 lbs/day. A 24% reduction of existing iron is needed.

TMDL calculations- SC08- Stump Creek Below Unnamed Tributary 47941

The TMDL for sampling point SC08 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 was computed using water-quality sample data collected at point SC08. The average flow, measured using a unit area method for SC08 (28.11 MGD), is used for these computations. The allowable loads calculated at SC08 will directly affect the downstream point SC07.

Sample data at point SC08 shows pH ranging between 6.8 and 7.0; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point SC08 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 SC11/BR1/PR1 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points SC11/BR1/PR1 and SC08 to determine a total load tracked for the segment of stream between SC11/BR1/PR1 and SC08. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at SC08.

A TMDL for iron at SC08 has been calculated. The measured sample data for aluminum was below detection limits. Sample data for manganese was found to be above detection limits but still below water quality standards. The acidic data showed that no reductions are necessary. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and acidity parameters at SC08 in Table C24 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C24 shows the measured and allowable concentrations and loads at SC08. Table C25 shows the percent reduction for iron needed at SC08.

Table C24		Measured		Allowable	
Flow (gpm)=	19523.90	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	4.11	963.2	0.90	211.8
ND = non detection	Manganese	0.40	94.7	0.40	94.7
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	54.20	12708.5		

Table C25. Allocations SC08	
SC08	Fe (Lbs/day)
Existing Load @ SC08	963.22
Difference in measured Loads between the loads that enter and existing SC08	-516.82
Percent loss due calculated at SC08	34.9%
Additional load tracked from above samples	153.92
Percentage of upstream loads that reach the SC08	65.1%
Total load tracked between SC11/BR1/PR1 and SC08	100.17
Allowable Load @ SC08	211.82
Load Reduction @ SC08	-111.65
% Reduction required at SC08	0%

There is a 516.82 lbs/day decrease of iron at SC08 compared to the sum of measured loads from the upstream segments SC11/PR1/BR1. The total iron load measured was 111.65 lbs/day less than the calculated allowable iron load of 211.82 lbs/day, resulting in no iron reduction at this point.

TMDL calculations- SC07- Stump Creek below SR 2008 Bridge

The TMDL for sampling point SC07 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 was computed using water-quality sample data collected at point SC07. The average flow, measured using a unit area method for SC07 (29.03 MGD), is used for these computations. The allowable loads calculated at SC07 will directly affect the downstream point SC01.

Sample data at point SC07 shows pH ranging between 6.2 and 7.1; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point SC07 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 SC08 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points SC08 and SC07 to determine a total load tracked for the segment of stream between SC07 and SC08.

This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at SC07.

A TMDL for aluminum, iron and acidity at SC07 has been calculated. Sample data for manganese was found to be above detection limits but still below water quality standards. Because water quality standards are met, a TMDL for this parameter isn't necessary and is not calculated.

Table C26 shows the measured and allowable concentrations and loads at SC07. Table C27 shows the percent reduction for aluminum, iron and acidity needed at SC07.

Table C26		Measured		Allowable	
Flow (gpm)=	20159.91	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	0.30	71.6	0.14	34.1
	Iron	3.52	852.6	0.73	177.8
	Manganese	0.38	91.0	0.38	91.0
	Acidity	12.00	2905.4	7.04	1704.7
	Alkalinity	50.20	12154.1		

Table C27. Allocations SC07			
SC07	Al (Lbs/day)	Fe (Lbs/day)	Acidity (Lbs/day)
Existing Load @ SC07	71.58	852.64	2905.35
Difference in measured Loads between the loads that enter and existing SC07	71.58	-110.58	2905.35
Percent loss due calculated at SC07	NA	11.5%	NA
Additional load tracked from above samples	0.00	211.82	0.00
Percentage of upstream loads that reach the SC07	NA	88.5%	NA
Total load tracked between SC08 and SC07	71.58	187.50	2905.35
Allowable Load @ SC07	34.07	177.79	1704.73
Load Reduction @ SC07	37.51	9.71	1200.62
% Reduction required at SC07	52%	5%	41%

There is a 71.58 lbs/day increase of aluminum at SC07 compared to the sum of measured loads from upstream segments. The total aluminum load measured was 37.51 lbs/day greater than the calculated allowable aluminum load of 34.07 lbs/day, resulting in a 52% aluminum reduction necessary at this point. The total iron load tracked between SC08 and SC07 is 187.50 lbs/day. 9.71 lbs/day of iron needs to be reduced to meet the calculated allowable load of 177.79 lbs/day. A 5% reduction of existing iron is needed. 1200.62 lbs/day of acidity needs to be removed to meet the calculated allowable acidic loading of 1704.73 lbs/day. This will require a 41% reduction from the measured acidic load.

TMDL calculations- UNT11- Unnamed Tributary 47939 to Stump Creek Below SC07

The TMDL for sample point UNT11 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point UNT11. The average flow, measured using a unit area method for UNT11 (0.15 MGD), is used for these computations. The allowable loads calculated at UNT11 will directly affect the downstream point SC01.

Sample data at point UNT11 shows that this discharge has a pH ranging between 6.7 and 7.7. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL has been calculated for iron at UNT11. All sample data for aluminum was found to be at less than detection limits. Sample data for manganese was above detection limits but still below criteria. Acidic data collected shows that no reductions are necessary at UNT11. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and acidity parameters at UNT11 in Table C28 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C28 shows the measured and allowable concentrations and loads at UNT11. Table C29 shows the iron reductions necessary at UNT11.

Table C28		Measured		Allowable	
Flow (gpm)=	104.56	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	1.02	1.3	0.76	1.0
ND = non detection	Manganese	0.08	0.1	0.08	0.1
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	256.10	321.6		

Table C29. Allocations UNT11	
UNT11	Fe (Lbs/day)
Existing Load @ UNT11	1.28
Allowable Load @ UNT11	0.96
Load Reduction @ UNT11	0.32
% Reduction required @ UNT11	25%

TMDL calculations- UNT12- Unnamed Tributary 47938 to Stump Creek

The TMDL for sample point UNT12 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point UNT12. The average flow, measured using a unit area method for UNT12 (0.25 MGD), is used for these computations. The allowable loads calculated at UNT12 will directly affect the downstream point SC01.

Sample data at point UNT12 shows that this discharge has a pH ranging between 7.2 and 7.7. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

The measured sample data for aluminum, iron and manganese was below detection limits. Acidic data showed that no reductions are necessary. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum, iron, manganese and acidity parameters at UNT12 in Table C30 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C30 shows the measured and allowable concentrations and loads at UNT12.

Table C30		Measured		Allowable	
Flow (gpm)=	175.80	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	ND	NA	ND	NA
ND = non detection	Manganese	ND	NA	ND	NA
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	59.45	125.5		

TMDL calculations- UNT09- Unnamed Tributary 47936 to Stump Creek

The TMDL for sample point UNT09 consists of a load allocation to all of the area at and above this point shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point UNT09. The average flow, measured using a unit area method for UNT09 (1.07 MGD), is used for these computations. The allowable loads calculated at UNT09 will directly affect the downstream point SC01.

Sample data at point UNT09 shows that this discharge has a pH ranging between 7.0 and 7.6. There currently is not an entry for this segment on the Pa Section 303(d) list for impairment due to pH.

A TMDL has been calculated for iron and manganese at UNT09. All sample data for aluminum was found to be at less than detection limits. Acidic data collected shows that no reductions are necessary at UNT09. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and acidity parameters at UNT09 in Table C31 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C31 shows the measured and allowable concentrations and loads at UNT09. Table C32 shows the iron and manganese reductions necessary at UNT09.

Table C31		Measured		Allowable	
Flow (gpm)=	745.00	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	1.63	14.6	0.63	5.6
ND = non detection	Manganese	0.56	5.0	0.32	2.9
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	71.08	636.0		

Table C32. Allocations UNT09		
UNT09	Fe (Lbs/day)	Mn (Lbs/day)
Existing Load @ UNT09	14.58	4.99
Allowable Load @ UNT09	5.61	2.87
Load Reduction @ UNT09	8.97	2.12
% Reduction required @ UNT09	62%	42%

Waste Load Allocation – Dominion Transmission, Inc., NPDES PA0101656

The Dominion Transmission Inc., NPDES permit no. PA0101656 has a permitted discharge that is evaluated in the calculated allowable loads at SC01. Waste load allocations are calculated using the proposed flow multiplied by the permitted limit for iron. The following table shows the waste load allocation for this discharge.

This calculated waste load allocation is evaluated downstream at sample point SC01. No reductions to the present waste load allocation are necessary at this time.

Table C33. Waste Load Allocations for Dominion Transmission Inc.			
Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
001			
Fe	3.5	0.01008	0.29

TMDL calculations- SC01- Stump Creek Above Confluence with East Branch Mahoning Creek

The TMDL for sampling point SC01 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 was computed using water-quality sample data collected at point SC01. The average flow, measured using a unit area method for SC01 (36.53 MGD), is used for these computations.

Sample data at point SC01 shows pH ranging between 6.7 and 7.4; pH will be addressed as part of this TMDL. There currently is not an entry for this segment on the Section Pa 303(d) list for impairment due to pH.

The measured and allowable loading for point SC01 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 SC07/UNT12/UNT11/UNT09 shows the total load that was permitted from upstream sources. This value was added to the difference in existing loads between points SC07/UNT12/UNT11/UNT09 and SC01 to determine a total load tracked for the segment of stream between SC07/UNT12/UNT11/UNT09 and SC01. This load will be compared to the allowable load to determine if further reductions are needed to meet the calculated TMDL at SC01.

A TMDL for iron at SC01 has been calculated. The measured sample data for aluminum was below detection limits. Sample data for manganese was found to be above detection limits but still below water quality standards. The acidic data showed that no reductions are necessary. Because water quality standards are met, a TMDL for these parameters isn't necessary and is not calculated. The existing and allowable loads for the aluminum and acidity parameters at SC01 in Table C34 will be denoted as "NA". The concentrations will be denoted as "ND".

Table C34 shows the measured and allowable concentrations and loads at SC01. Table C35 shows the percent reduction for iron needed at SC01.

Table C34		Measured		Allowable	
Flow (gpm)=	25365.64	Concentration	Load	Concentration	Load
		mg/L	lbs/day	mg/L	lbs/day
	Aluminum	ND	NA	ND	NA
	Iron	1.40	425.2	0.58	176.6
ND = non detection	Manganese	0.31	95.3	0.31	95.3
NA = not applicable	Acidity	ND	NA	ND	NA
	Alkalinity	56.63	17252.3		

Table C35. Allocations SC01	
SC01	Fe (Lbs/day)
Existing Load @ SC01	425.21
Difference in measured Loads between the loads that enter and existing SC01	-443.29
Percent loss due calculated at SC01	51.0%
Additional load tracked from above samples	184.36
Percentage of upstream loads that reach the SC01	49.0%
Total load tracked between SC07/UNT12/UNT11/UNT09 and SC01	90.26
Allowable Load @ SC01	176.57
Load Reduction @ SC01	-86.31
% Reduction required at SC01	0%

There is a 443.29 lbs/day decrease of iron at SC01 compared to the sum of measured loads from the upstream segments SC07/UNT12/UNT11/UNT09. The total iron load measured was 86.31 lbs/day less than the calculated allowable iron load of 176.57 lbs/day, resulting in no iron reduction at this point.

Margin of Safety

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

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

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

Seasonal Variation

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

Critical Conditions

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

Attachment D
Stump Creek Sediment Calculations

Stump Creek Sediment TMDL Calculations

The AVGWLF model produced information on watershed size, land use, and sediment loading. The sediment loads represent an annual average over the 23 years simulated by the model (1975 to 1998). This information was then used to calculate existing unit area loading rates for the Stump Creek and Beaverdam Run Watersheds.

Table A. Existing Loading Values for Stump Creek (impaired)			
Source	Area (ac)	Sediment (lbs.)	Unit Area Load (lb/ac/yr)
HAY/PAST	2,634	553,800	232
CROPLAND	4,181	12,751,000	3,362
FOREST	9,187	94,600	11
QUARRY	175	68,800	433
COAL_MINES	12	8,800	782
UNPAVED_RD	20	129,600	7,219
TRANSITION	665	6,230,600	10,332
LO_INT_DEV	808	110,400	221
HI_INT_DEV	32	200	13
Stream Bank		3,515,538	
total	17,715	23,463,338	1,324

Table B. Existing Loading Values for Beaverdam Run Watershed (reference)			
Source	Area (ac)	Sediment (lbs.)	Unit Area Load (lb/ac/yr)
HAY/PAST	2,370	270,800	126
CROPLAND	3,101	3,477,400	1,236
FOREST	10,245	66,800	7
QUARRY	37	3,400	98
COAL_MINES	35	21,200	1,186
TURF_GRASS	232	21,000	100
UNPAVED_RD	22	91,600	4,546
TRANSITION	860	3,742,200	4,797
LO_INT_DEV	502	17,800	56
Stream Bank		3,210,744	
total	17,404	10,922,944	628

The TMDL target sediment load for Stump Creek is the product of the unit area sediment-loading rate in the reference watershed (Beaverdam Run) and the total area of the impaired watershed (Stump Creek). These numbers and the resulting TMDL target load are shown in Table C on the following page.

Table C. TMDL Total Load Computation			
Pollutant	Unit Area Loading Rate in Beaverdam Run Watershed (lbs/acre/yr)	Total Watershed Area in Stump Creek (acres)	TMDL Total Load (lbs/year)
Sediment	628	17,715	11,118,323

Targeted TMDL values were used as the basis for load allocations and reductions in the Stump Creek Watershed, using the following equation

1. TMDL = LA+WLA+MOS
2. LA = ALA-LNR

Where:

TMDL = Total Maximum Daily Load
LA = Load Allocation
ALA = Adjusted Load Allocation
LNR = Loads Not Reduced
WLA = Waste Load Allocation
MOS = Margin of Safety

Waste Load Allocation

Dominion Transmission Corporation has a suspended solids permit at 001 discharging into the Stump Creek. The WLA will be calculated as 920 lbs/year:

Table D. Suspended Solids Waste Load Allocations at Discharge 005			
Parameter	Average Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/year)
Discharge 005			
Suspended solids (total)	30	0.01008	920

Margin of Safety

The margin of safety (MOS) is that portion of the pollution loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. The Margin of Safety (MOS) for this analysis is explicit. Ten percent of the TMDL was reserved as the MOS.

MOS = 0.1 * 11,118,323

MOS = 1,111,832 lbs/yr

Load Allocation

The Load Allocation (LA), the portion of the load consisting of all nonpoint sources in the watershed, was computed by subtracting the Margin of Safety from the TMDL total load.

LA = TMDL – MOS - WLA

LA = 11,118,323 – 1,111,832 – 920

LA = 10,005,571 lbs/day

Adjusted Load Allocation

The adjusted load allocation (ALA) is the actual portion of the LA distributed among those non-point sources receiving reductions. It is computed by subtracting those non-point source loads that are not being considered for reductions (loads not reduced or LNR) from the LA. Reductions in the Stump Creek Watershed were applied to COAL_MINES/QUARRY, TRANSITIONAL LAND and CROPLAND sources for sediment. Those land uses/sources for which existing loads were not reduced (HAY/PAST, FOREST, UNPAVED_RD, LO_INT_DEV, HI_INT_DEV and Stream bank) kept their current loading values, Table E. The ALA for sediment is 5,601,433 lbs/yr.

Table E. Load Allocation, Loads Not Reduced and Adjusted Load Allocations for the Stump Creek Sediment TMDL	
	Sediment (lbs./yr)
Load Allocation	10,005,571
Loads Not Reduced	4,404,138
Hay/Past	553,800
FOREST	94,600
unpaved_rd	129,600
lo_int_dev	110,400
hi_int_dev	200
stream bank	3,515,538
Adjusted load allocation	5,601,433

TMDL

The sediment TMDL for the Stump Creek Watershed consists of a Load Allocation and a Margin of Safety (MOS). The individual components of the TMDL are summarized in Table F.

Table F. TMDL, WLA, MOS, LA, LNR and ALA for Stump Creek Sediment TMDL	
Component	Sediment (lbs/yr)
TMDL (Total Maximum Daily Load)	11,118,323
WLA (Waste Load Allocation)	920
MOS (Margin of Safety)	1,111,832

LA (Load Allocation)	10,005,571
LNR (Loads Not Reduced)	4,404,138
ALA (Adjusted Load Allocation)	5,601,433

Calculation of Sediment Load Reductions

Adjusted Load Allocations established in the previous section represents the sediment load that is available for allocation between contributing sources in the Stump Creek Watershed. Data needed for load reduction analysis, including land use distribution, were obtained by GIS analysis. The Equal Marginal Percent Reduction (EMPR) allocation method (Attachment F) was used to distribute the ALA between the appropriate contributing land uses.

Table G contains the results of the sediment EMPR analysis for the appropriate contributing land uses in the Stump Creek Watershed. The load allocation for each land use is shown, along with the percent reduction of current loads necessary.

Table G. Sediment Load Allocations & Reductions for the Stump Creek Watershed

Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		Percent Reduction
		Current	Allowable	Current	Allowable	
COAL_MINE	12	709.68	352.40	8800	4370	50%
CROPLAND	4181	3049.75	665.37	12,751,000	2,781,910	78%
TRANSITIONAL	665	9373.55	4185.21	6,230,600	2,781,910	55%
QUARRY	175	392.25	194.77	68,800	34,163	50%
TOTAL				19,059,200	5,602,353	71%

Consideration of Critical Conditions

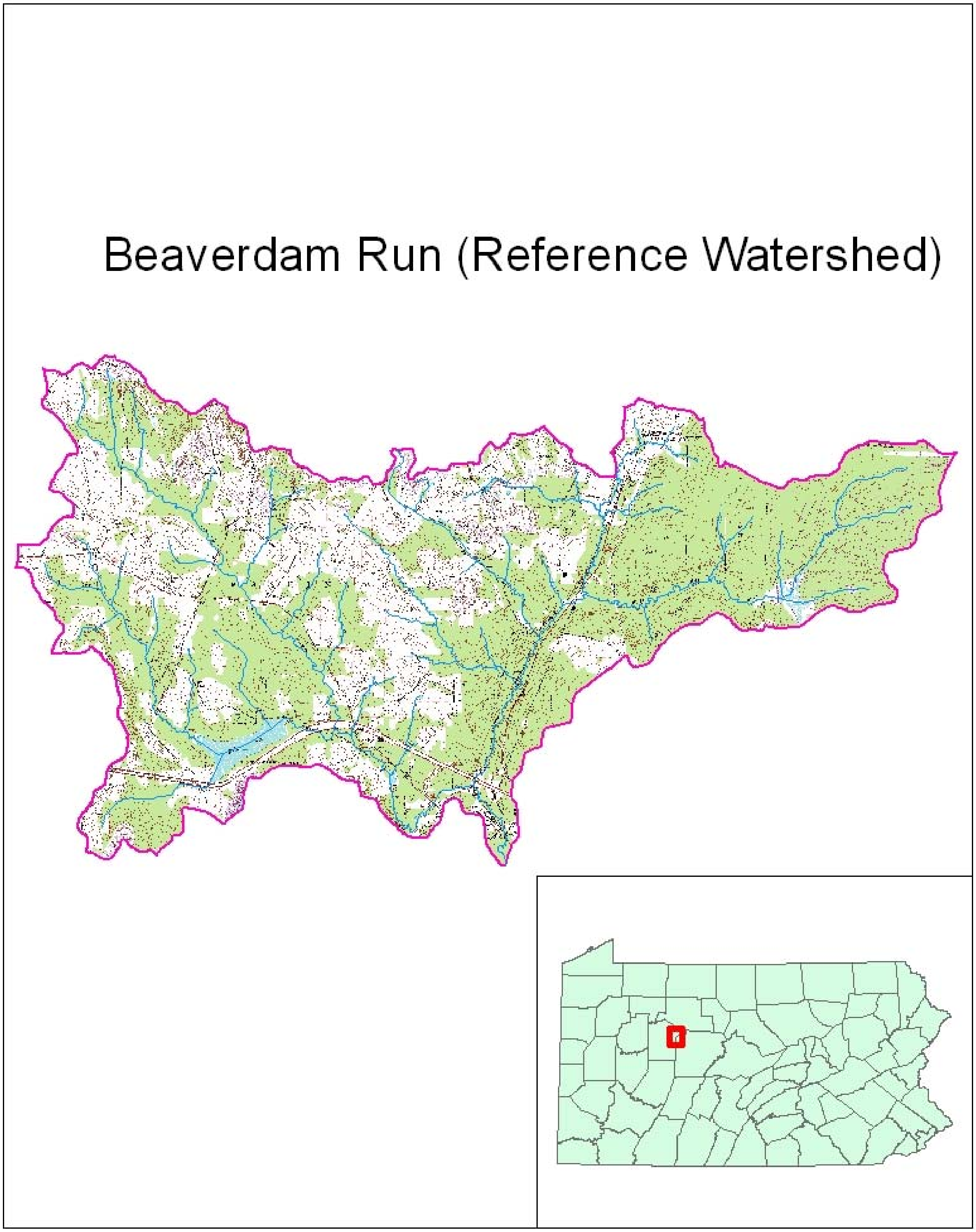
The AVGWLF model is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment loads based on the daily water balance accumulated to monthly values. Therefore, all flow conditions are taken into account for loading calculations. Because there is generally a significant lag time between the introduction of sediment to a waterbody and the resulting impact on beneficial uses, establishing these TMDLs using average annual conditions is protective of the waterbody.

Consideration of Seasonal Variations

The continuous simulation model used for this analysis considers seasonal variation through a number of mechanisms. Daily time steps are used for weather data and water balance calculations. The model requires specification of the growing season and hours of daylight for each month. The model also considers the months of the year when manure is applied to the land. The combination of these actions by the model accounts for seasonal variability.

Attachment E

Map of Reference Watershed Beaverdam Run


Beaverdam Run (Reference Watershed)

Attachment F

AVGWLF Model Overview & GIS-Based Derivation of Input Data

TMDLs for the Stump Creek Watershed were developed using the Generalized Watershed Loading Function or GWLF model. The GWLF model provides the ability to simulate runoff, sediment, and nutrient (N and P) loadings from watershed given variable-size source areas (e.g., agricultural, forested, and developed land). It also has algorithms for calculating septic system loads, and allows for the inclusion of point source discharge data. It is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment and nutrient loads, based on the daily water balance accumulated to monthly values.

GWLF is a combined distributed/lumped parameter watershed model. For surface loading, it is distributed in the sense that it allows multiple land use/cover scenarios. Each area is assumed to be homogenous in regard to various attributes considered by the model. Additionally, the model does not spatially distribute the source areas, but aggregates the loads from each area into a watershed total. In other words, there is no spatial routing. For sub-surface loading, the model acts as a lumped parameter model using a water balance approach. No distinctly separate areas are considered for sub-surface flow contributions. Daily water balances are computed for an unsaturated zone as well as a saturated sub-surface zone, where infiltration is computed as the difference between precipitation and snowmelt minus surface runoff plus evapotranspiration.

GWLF models surface runoff using the Soil Conservation Service Curve Number (SCS-CN) approach with daily weather (temperature and precipitation) inputs. Erosion and sediment yield are estimated using monthly erosion calculations based on the Universal Soil Loss Equation (USLE) algorithm (with monthly rainfall-runoff coefficients) and a monthly composite of KLSCP values for each source area (e.g., land cover/soil type combination). The KLSCP factors are variables used in the calculations to depict changes in soil loss erosion (K), the length slope factor (LS) the vegetation cover factor (C) and conservation practices factor (P). A sediment delivery ratio based on watershed size and transport capacities based on average daily runoff are applied to the calculated erosion to determine sediment yield for each source area. Surface nutrient losses are determined by applying dissolved N and P coefficients to surface runoff and a sediment coefficient to the yield portion for each agricultural source area. Point source discharges can also contribute to dissolved losses to the stream and are specified in terms of kilograms per month. Manured areas, as well as septic systems, can also be considered. Urban nutrient inputs are all assumed to be solid-phase, and the model uses an exponential accumulation and washoff function for these loadings. Sub-surface losses are calculated using dissolved N and P coefficients for shallow groundwater contributions to stream nutrient loads, and the sub-surface sub-model only considers a single, lumped-parameter contributing area. Evapotranspiration is determined using daily weather data and a cover factor dependent upon land use/cover type. Finally, a water balance is performed daily using supplied or computed precipitation, snowmelt, initial unsaturated zone storage, maximum available zone storage, and evapotranspiration values. All of the equations used by the model can be viewed in GWLF Users Manuel, available from the Department's Bureau of Water Supply and Wastewater Management, Division of Water Quality Assessment and Standards.

For execution, the model requires three separate input files containing transport-, nutrient-, and weather-related data. The transport (TRANSPRT.DAT) file defines the necessary parameters for each source area to be considered (e.g., area size, curve number, etc.) as well as global parameters (e.g., initial storage, sediment delivery ratio, etc.) that apply to all source areas. The nutrient (NUTRIENT.DAT) file specifies the various loading parameters for the different source areas identified (e.g., number of septic systems, urban source area accumulation rates, manure concentrations, etc.). The weather (WEATHER.DAT) file contains daily average temperature and total precipitation values for each year simulated.

The primary sources of data for this analysis were geographic information system (GIS) formatted databases. A specially designed interface was prepared by the Environmental Resources Research Institute of the Pennsylvania State University in ArcView (GIS software) to generate the data needed to run the GWLF model, which was developed by Cornell University. The new version of this model has been named AVGWLF (ArcView Version of the Generalized Watershed Loading Function).

In using this interface, the user is prompted to identify required GIS files and to provide other information related to "non-spatial" model parameters (e.g., beginning and end of the growing season, the months during which manure is spread on agricultural land and the names of nearby weather stations). This information is subsequently used to automatically derive values for required model input parameters, which are then written to the TRANSPRT.DAT, NUTRIENT.DAT and WEATHER.DAT input files needed to execute the GWLF model. For use in Pennsylvania, AVGWLF has been linked with statewide GIS data layers such as land use/cover, soils, topography, and physiography; and includes location-specific default information such as background N and P concentrations and cropping practices. Complete GWLF-formatted weather files are also included for eighty weather stations around the state. The following table lists the statewide GIS data sets and provides an explanation of how they were used for development of the input files for the GWLF model.

GIS Data Sets	
DATASET	DESCRIPTION
Censustr	Coverage of Census data including information on individual homes septic systems. The attribute *usew_sept* includes data on conventional systems, and *sew_other* provides data on short-circuiting and other systems.
County	The County boundaries coverage lists data on conservation practices, which provides C and P values in the Universal Soil Loss Equation (USLE).
Gwnback	A grid of background concentrations of N in groundwater derived from water well sampling.
Landuse5	Grid of the MRLC that has been reclassified into five categories. This is used primarily as a background.
Majored	Coverage of major roads. Used for reconnaissance of a watershed.
MCD	Minor civil divisions (boroughs, townships and cities).
Npdespts	A coverage of permitted point discharges. Provides background information and cross check for the point source coverage.
Padem	100-meter digital elevation model. This used to calculate landslope and slope length.
Palumrlc	A satellite image derived land cover grid that is classified into 15 different landcover categories. This dataset provides landcover loading rate for the different categories in the model.
Pasingle	The 1:24,000 scale single line stream coverage of Pennsylvania. Provides a complete network of streams with coded stream segments.
Physprov	A shapefile of physiographic provinces. Attributes *rain_cool* and *rain_warm* are used to set recession coefficient
Pointsrc	Major point source discharges with permitted N and P loads.
Refwater	Shapefile of reference watersheds for which nutrient and sediment loads have been calculated.
Soilphos	A grid of soil phosphorous loads, which has been generated from soil sample data. Used to help set phosphorus and sediment values.
Smallsheds	A coverage of watersheds derived at 1:24,000 scale. This coverage is used with the stream network to delineate the desired level watershed.
Statsgo	A shapefile of generalized soil boundaries. The attribute *mu_k* sets the k factor in the USLE. The attribute *mu_awc* is the unsaturated available capacity., and the *muhsg_dom* is used with landuse cover to derive curve numbers.
Strm305	A coverage of stream water quality as reported in the Pennsylvania's 305(b) report. Current status of assessed streams.
Surfgeol	A shapefile of the surface geology used to compare watersheds of similar qualities.
T9sheds	Data derived from a DEP study conducted at PSU with N and P loads.
Zipcode	A coverage of animal densities. Attribute *aeu_acre* helps estimate N & P concentrations in runoff in agricultural lands and over manured areas.
Weather Files	Historical weather files for stations around Pennsylvania to simulate flow.

Attachment G
Equal Marginal Percent Reduction (EMPR)

Equal Marginal Percent Reduction (EMPR) (An Allocation Strategy)

The Equal Marginal Percent Reduction (EMPR) allocation method was used to distribute Adjusted Load Allocations (ALAs) between the appropriate contributing nonpoint sources. The load allocation and EMPR procedures were performed using a MS Excel spreadsheet. The 5 major steps identified in the spreadsheet are summarized below:

Step 1: Calculation of the TMDL based on impaired watershed size and unit area loading rate of reference watershed.

Step 2: Calculation of Adjusted Load Allocation based on TMDL, Margin of Safety, and existing loads not reduced.

Step 3: Actual EMPR Process:

a. Each land use/source load is compared with the total ALA to determine if any contributor would exceed the ALA by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load of the receiving waterbody. If the contributor exceeds the ALA, that contributor would be reduced to the ALA. If a contributor is less than the ALA, it is set at the existing load. This is the baseline portion of EMPR.

b. After any necessary reductions have been made in the baseline, the multiple analyses are run. The multiple analyses will sum all of the baseline loads and compare them to the ALA. If the ALA is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analyses, the final reduction percentage for each contributor can be computed.

Step 4: Calculation of total loading rate of all sources receiving reductions.

Step 5: Summary of existing loads, final load allocations, and % reduction for each pollutant source.

Equal Marginal Percent Reduction Calculations in Lbs. for Stump Creek

Microsoft Excel - STUMP_EMPR.xls

E12 = =IF(C12>G2,"bad","good")

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Step 1:	TMDL Total Load				Step 2:	Adjusted LA = (MDL total load - ((MOS) - loads not reduced)						
2		Load = TP loading rate in ref. * Acres in Impaired					5602353	5602353					
3		11118323											
6			Annual Average					% reduction				Allowable	
7	Step 3:		Load	Load Sum	Check	Initial Adjust	Recheck	allocation	Load Reduction	Initial LA	Acres	Loading Rate	% Reduction
8		Coal	8800.0	18990400.0	good	8800	ADJUST	0.00	4430	4370	12	352.40	50.3%
9							5679953						
10		Cropland	12751000.0		bad	5602353		0.50	2820443	2781910	4181	665.37	78.2%
12		Transitional	6230600.0		bad	5602353		0.50	2820443	2781910	665	4185.21	55.4%
14		Quarry	68800.0		good	68800		0.01	34637	34163	175	194.77	50.3%
15						11282306		1.00		5602353			
17	Step 4:	All Ag. Loading Rate	664.44										
19				Allowable (Target)		Current							
20	Step 5:		Acres	loading rate	Final LA	Loading Rates	Current Load	% Red.					
21		Coal	12	352.40	4370	709.68	8800	50%					
23		Cropland	4181	665.37	2781910	3049.75	12751000	78%					
25		transitional	665	4185.21	2781910	9373.55	6230600	55%					
27		Quarry	175	194.77	34163	392.25	68800	50%					
28					5602353		19059200	71%					

Attachment H
AVGWLF OUTPUT

AVGWLF Transport File and Model Output for Stump Creek

Edit Transport File

Rural LU	Area (ha)	CN	K	LS	C	P
HAY/PAST	1066	75	0.297	2.403	0.03	0.45
CROPLAND	1692	82	0.295	2.507	0.42	0.45
FOREST	3718	73	0.298	1.758	0.002	0.45
QUARRY	71	89	0.292	0.77	0.8	0.1
COAL_MINES	5	87	0.27	1.513	0.8	0.1
Bare Land	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
UNPAVED_RD	8	87	0.297	1.265	0.8	1
TRANSITION	269	87	0.295	2.275	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
LO_INT_DEV	327	83	0.298	1.929	0.08	0.2
HI_INT_DEV	13	93	0.3	0.113	0.08	0.2

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
APR	0.68	13	0	0.26	0	0
MAY	0.85	14	1	0.26	0	0
JUN	0.95	15	1	0.26	0	0
JUL	1.01	15	1	0.26	0	0
AUG	1.04	14	1	0.26	0	0
SEP	1.06	12	1	0.08	0	0
OCT	0.91	11	0	0.08	0	0
NOV	0.82	10	0	0.08	0	0
DEC	0.77	9	0	0.08	0	0
JAN	0.59	9	0	0.08	0	0
FEB	0.63	10	0	0.08	0	0
MAR	0.66	12	0	0.08	0	0

Antecedent Moisture Condition

Day 1	Day 2	Day 3	Day 4	Day 5
0	0	0	0	0

Init Unsat Stor (cm)	10	Initial InitSnow (cm)	0
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.126
Recess Coef (1/dia)	0.1	Sediment A Factor	5.8849E-04
Seepage Coef (1/dia:)	0	Unsat Avail Wat (cm)	13.0315
Tile Drain Density	0	Tile Drain Ratio	0.5

e: [New Volume]

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Gary
GWLFRuns
Stump
clipthemes

transedit0.dat

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Average Loads by Source in English Units

GWLF Total Loads for Stump_Run_1

Period of analysis: 21 years, from Apr 1975 to Mar 1996

Source	Area (Acres)	Runoff (in)	Tons: Erosion	Tons: Sediment	Total Loads (Pounds): Dis N	Total N	Dis P	Total P
HAY/PAST	2634.1	2.7	2197.4	276.9	4562.8	6224.0	203.1	334.9
CROPLAND	4181.0	4.8	50599.0	6375.5	12848.9	51101.8	596.4	3631.2
FOREST	9187.4	2.3	375.1	47.3	900.2	1183.8	28.4	50.9
QUARRY	175.4	8.8	273.4	34.4	4.2	210.9	0.7	17.1
COAL_MINES	12.4	7.3	35.0	4.4	0.2	26.7	0.0	2.1
UNPAVED_RD	19.8	7.3	514.6	64.8	95.4	484.4	6.6	37.4
TRANSITION	664.7	7.3	24724.4	3115.3	3208.0	21899.7	221.2	1704.1
LO_INT_DEV	808.0	5.2	643.5	55.2	0.0	202.8	0.0	27.1
HI_INT_DEV	32.1	13.3	1.5	0.1	0.0	0.3	0.0	0.0
Tile Drainage				0.0		0.0		0.0
Stream Bank				1757.8		175.8		77.3
Groundwater					71896.8	71896.8	1445.4	1445.4
Point Sources					0.0	0.0	0.0	0.0
Septic Systems					125.9	125.9	45.1	45.1
Totals	17715.0	3.30	79363.8	11731.7	93642.6	153532.9	2546.9	7372.6

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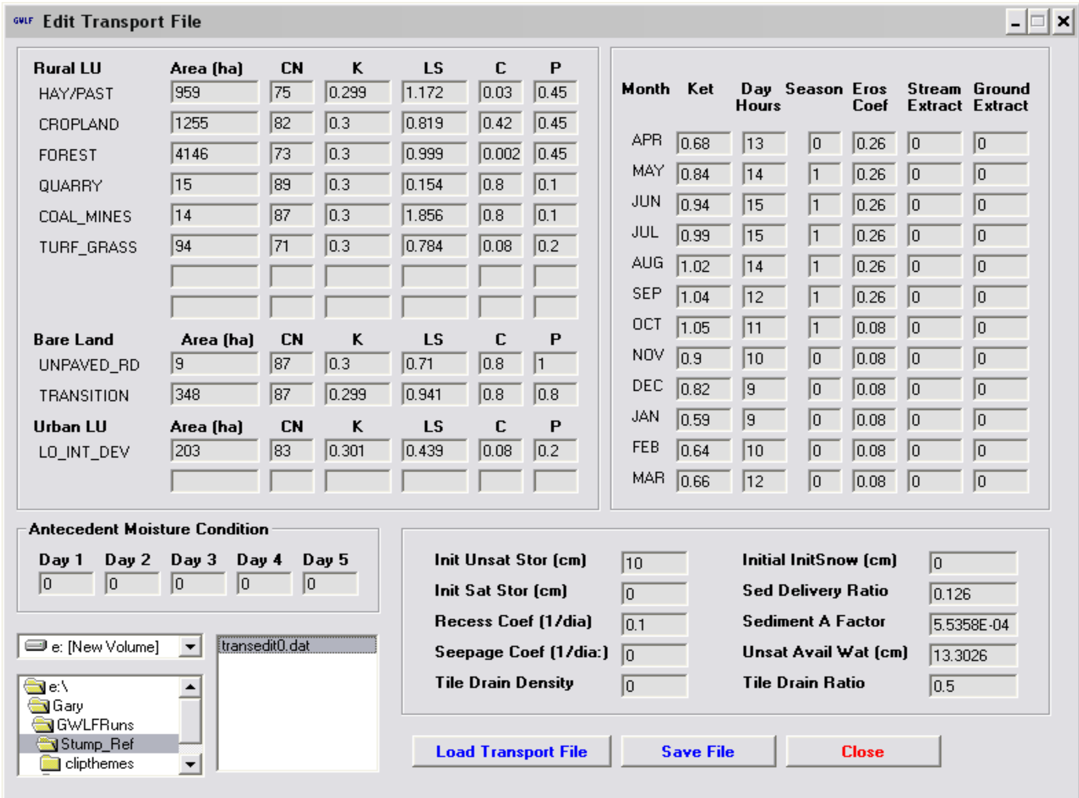
AVGWLF Transport File and Model Output for Beaverdam Run



Edit Transport File

Rural LU	Area (ha)	CN	K	LS	C	P
HAY/PAST	959	75	0.299	1.172	0.03	0.45
CROPLAND	1255	82	0.3	0.819	0.42	0.45
FOREST	4146	73	0.3	0.999	0.002	0.45
QUARRY	15	89	0.3	0.154	0.8	0.1
COAL_MINES	14	87	0.3	1.856	0.8	0.1
TURF_GRASS	94	71	0.3	0.784	0.08	0.2

Bare Land	Area (ha)	CN	K	LS	C	P
UNPAVED_RD	9	87	0.3	0.71	0.8	1
TRANSITION	348	87	0.299	0.941	0.8	0.8

Urban LU	Area (ha)	CN	K	LS	C	P
LO_INT_DEV	203	83	0.301	0.439	0.08	0.2

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
APR	0.68	13	0	0.26	0	0
MAY	0.84	14	1	0.26	0	0
JUN	0.94	15	1	0.26	0	0
JUL	0.99	15	1	0.26	0	0
AUG	1.02	14	1	0.26	0	0
SEP	1.04	12	1	0.26	0	0
OCT	1.05	11	1	0.08	0	0
NOV	0.9	10	0	0.08	0	0
DEC	0.82	9	0	0.08	0	0
JAN	0.59	9	0	0.08	0	0
FEB	0.64	10	0	0.08	0	0
MAR	0.66	12	0	0.08	0	0

Antecedent Moisture Condition

Day 1	Day 2	Day 3	Day 4	Day 5
0	0	0	0	0

Init Unsat Stor (cm)	10	Initial InitSnow (cm)	0
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.126
Recess Coef (1/dia)	0.1	Sediment A Factor	5.5358E-04
Seepage Coef (1/dia:)	0	Unsat Avail Wat (cm)	13.3026
Tile Drain Density	0	Tile Drain Ratio	0.5

e: [New Volume]
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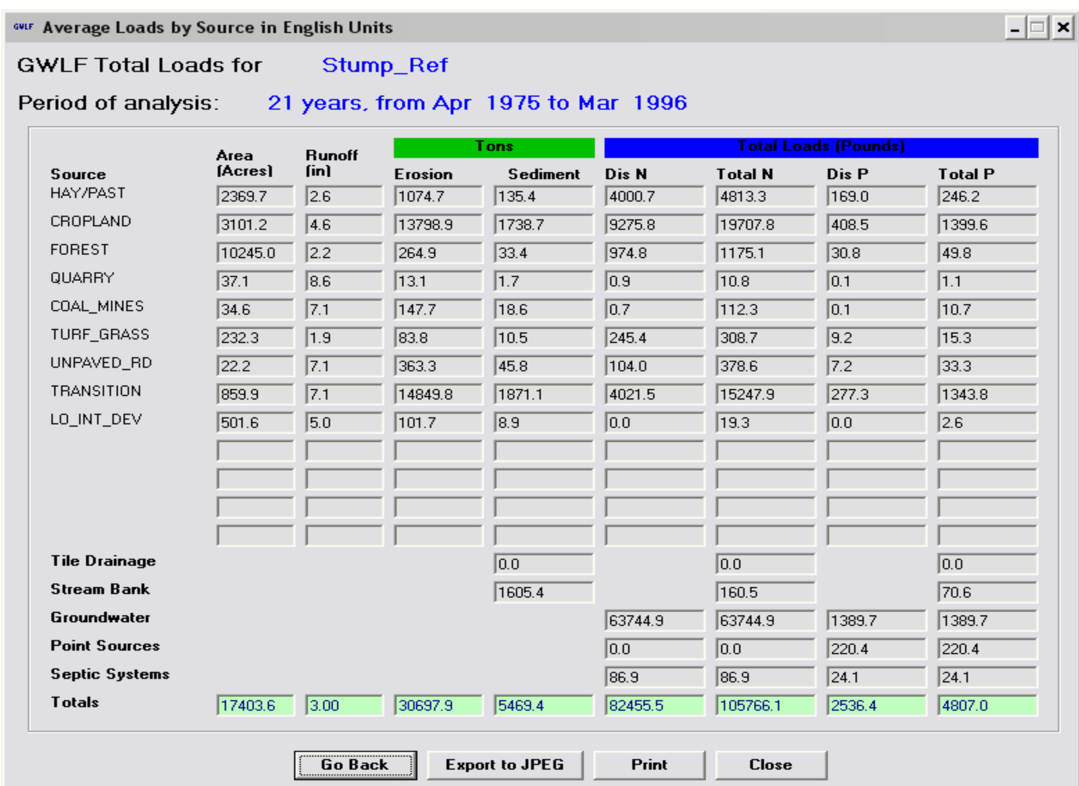
GWLFRuns
Stump_Ref
clipthemes
transedit0.dat

Load Transport File | Save File | Close



Average Loads by Source in English Units

GWLF Total Loads for Stump_Ref

Period of analysis: 21 years, from Apr 1975 to Mar 1996

Source	Area (Acres)	Runoff (in)	Tons: Erosion	Tons: Sediment	Total Loads (Pounds): Dis N	Total N	Dis P	Total P
HAY/PAST	2369.7	2.6	1074.7	135.4	4000.7	4813.3	169.0	246.2
CROPLAND	3101.2	4.6	13798.9	1738.7	9275.8	19707.8	408.5	1399.6
FOREST	10245.0	2.2	264.9	33.4	974.8	1175.1	30.8	49.8
QUARRY	37.1	8.6	13.1	1.7	0.9	10.8	0.1	1.1
COAL_MINES	34.6	7.1	147.7	18.6	0.7	112.3	0.1	10.7
TURF_GRASS	232.3	1.9	83.8	10.5	245.4	308.7	9.2	15.3
UNPAVED_RD	22.2	7.1	363.3	45.8	104.0	378.6	7.2	33.3
TRANSITION	859.9	7.1	14849.8	1871.1	4021.5	15247.9	277.3	1343.8
LO_INT_DEV	501.6	5.0	101.7	8.9	0.0	19.3	0.0	2.6
Tile Drainage				0.0		0.0		0.0
Stream Bank				1605.4		160.5		70.6
Groundwater					63744.9	63744.9	1389.7	1389.7
Point Sources					0.0	0.0	220.4	220.4
Septic Systems					86.9	86.9	24.1	24.1
Totals	17403.6	3.00	30697.9	5469.4	82455.5	105766.1	2536.4	4807.0

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Attachment I

Excerpts Justifying Changes Between the 1996, 1998, 2002 and 2004 Section 303(d) Lists

The following are excerpts from the Pennsylvania DEP 303(d) narratives that justify changes in listings between the 1996, 1998, 2002 and 2004 lists. The 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

In the 1996 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 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 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).

Attachment J
Water Quality Data Used In TMDL Calculations

SC03	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/27/2004	7.4	38.4	-5.80	<300.00	<50.00	<500.00	
8/30/2004	7.7	75.2	-41.80	<300.00	<50.00	<500.00	
11/10/2004	7.5	56.2	-37.20	<300.00	<50.00	<500.00	
3/23/2005	7.2	33.0	-6.00	300.00	76.00	<500.00	
AVERAGE	7.5	50.7	-22.7	300.0	76.0	#DIV/0!	**397.19**
ST DEV	0.208167	19.10567	19.48983	#DIV/0!	#DIV/0!	#DIV/0!	
SC04	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/27/2004	7.0	21.8	4.60	<300.00	90.00	<500.00	
8/30/2004	7.3	48.2	-27.80	<300.00	<50.00	<500.00	
11/10/2004	7.1	39.4	-27.00	<300.00	<50.00	<500.00	
3/23/2005	7.0	25.2	5.00	410.00	172.00	<500.00	
AVERAGE	7.1	33.7	-11.3	410.0	131.0	#DIV/0!	**139.59**
ST DEV	0.141421	12.3368	18.59426	#DIV/0!	57.98276	#DIV/0!	
SC05	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/27/2004	7.5	48.0	-5.60	423.00	67.00	<500.00	
8/30/2004	7.9	90.8	-65.00	<300.00	55.00	<500.00	
11/10/2004	7.7	82.0	-61.00	<300.00	<50.00	<500.00	
3/23/2005	7.4	44.4	-7.80	<300.00	228.00	<500.00	
AVERAGE	7.6	66.3	-34.9	423.0	116.7	#DIV/0!	**403.33**
ST DEV	0.221736	23.53182	32.5582	#DIV/0!	96.604	#DIV/0!	
SC02	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/27/2004	6.8	17.4	19.60	<300.00	276.00	<500.00	
8/30/2004	6.9	25.2	12.60	<300.00	310.00	<500.00	
11/10/2004	6.7	21.4	23.00	301.00	389.00	<500.00	
3/22/2005	6.8	16.6	17.00	<300.00	295.00	<500.00	
AVERAGE	6.8	20.2	18.1	301.0	317.5	#DIV/0!	**378.62**
ST DEV	0.08165	3.967787	4.385962	#DIV/0!	49.65548	#DIV/0!	
SC01A	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/27/2004	7	27.8	22.40	483.00	414.00	<500.00	
8/30/2004	7.3	48.6	-18.60	<300.00	185.00	<500.00	
11/16/2004	7.0	40.6	3.20	521.00	397.00	<500.00	

3/17/2005	6.9	32.2	9.60	394.00	656.00	<500.00	
AVERAGE	7.1	37.3	4.2	466.0	413.0	#DIV/0!	**3343.79**
ST DEV	0.173205	9.216652	17.13894	65.18435	192.6049	#DIV/0!	
SC13	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Initial**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/8/2003	6.8	29.4	0	0.597	0.158	<.5	***21423***
6/19/2003	7.3	53.6	0	1.25	0.239	<.5	***6462***
10/7/2003	7	52.6	0	0.696	0.244	<.5	***4779***
4/27/2004	7.1	34.4	24.2	0.752	0.167	<.5	***23827***
8/12/2004	7.5	67	-36	0.954	0.205	<.5	***3073***
10/26/2004	7.2	65	-21.8	0.796	0.344	<.5	***2636***
		50.33333	-5.6	0.840833	0.226167	#DIV/0!	***10366.67***
		15.49692	20.82652	0.232619	0.067768	#DIV/0!	***9621.354***
SR1	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/8/2003	6.2	45.6	24.8	13.9	0.499	1.77	
6/19/2003	6.4	63.8	10.4	15.3	0.579	1.44	
10/7/2003	6.4	60	21	21.2	0.718	1.71	
4/27/2004	6.6	42.8	35	9.02	0.334	0.995	
8/12/2004	6.5	64	8.2	15.4	0.551	1.12	
10/26/2004	6.2	45.2	35.4	<.3	<.05	<.5	
	6.383333	53.56667	22.46667	14.964	0.5362	1.407	**3192.91**
	0.160208	10.04344	11.67128	4.348963	0.139078	0.3452463	
SC11	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/3/2003	6.3	38.6	16.6	8.2	0.433	1.14	
6/19/2003	6.6	55.4	0	7.28	0.381	0.668	
10/7/2003	6.7	54.2	0	10.1	0.469	0.75	
4/27/2004	6	37.2	30.2	4.18	0.236	0.586	
8/12/2004	6.7	61.2	-8	8.81	0.396	0.623	
10/26/2004	6.5	47	9.6	12.2	0.556	1.27	
	6.466667	48.93333	8.066667	8.461667	0.411833	0.8395	**13677.46**
	0.273252	9.676914	13.80821	2.70474	0.106413	0.2912688	
BRD2	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Initial**

Date	Lab	mg/l	mg/l	ug/l	ug/l	ug/l	Flow
4/9/2003	6.8	236.2	0	7.47	0.36	<.5	534
6/19/2003	6.8	231.4	0	7.93	0.345	<.5	421
10/7/2003	7.1	241.4	0	6.97	0.369	<.5	243
4/27/2004	7.2	132.8	-96.6	3.72	0.221	<.5	878
8/12/2004	6.9	237	-119.8	6.47	0.324	<.5	202
	6.96	215.76	-43.28	6.512	0.3238	#DIV/0!	455.6
	0.181659	46.51159	59.82852	1.653427	0.059939	#DIV/0!	271.6971
BRD1	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Initial**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/9/2003	6.8	180.4	0	7.7	0.396	<.5	273
6/19/2003	6.8	181.2	0	7.56	0.368	<.5	236
10/7/2003	6.9	184.6	0	7.69	0.41	<.5	205
4/27/2004	6.9	185.4	-97.8	7.84	0.395	<.5	272
8/4/2004	6.8	180.8	-119	6.9	0.347	<.5	136
10/26/2004							
	6.84	182.48	-43.36	7.538	0.3832	#DIV/0!	224.4
	0.054772	2.334952	59.84436	0.370162	0.025312	#DIV/0!	56.90606
BR1	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/9/2003	7.1	56.6	0	1.02	0.062	<.5	
6/19/2003	7.3	87.6	0	1.25	0.1	<.5	
10/7/2003	7.5	115	0	0.878	0.145	<.5	
4/27/2004	7.2	45	2.8	0.989	0.053	<.5	
8/4/2004	7.4	93.2	0	1.02	0.098	<.5	
10/26/2004	7.7	130.2	64.4	1.03	0.135	<.5	
	7.366667	87.93333	11.2	1.031167	0.098833	#DIV/0!	**1004.00**
	0.216025	32.77796	26.08662	0.121142	0.037145	#DIV/0!	
PRD1	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Initial**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/9/2003	6.3	74.8	0	5.86	0.765	1.97	1004
6/18/2003	6.1	114.2	0	10.6	0.735	0.681	722
10/2/2003	6.2	100	0	5.02	0.726	1.07	939
4/26/2004	6.1	73.4	-14.2	4.02	0.757	1.06	1037
8/4/2004	6.5	112.2	-66.4	6.98	0.611	<.5	663
10/26/2004	6.6	108.2	1	5.08	0.712	0.572	693

	6.3	97.13333	-13.2667	6.26	0.717667	1.0706	843.00
	0.209762	18.49872	26.66673	2.34357	0.055798	0.5498689	168.7092
PR1	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/9/2003	6.3	43.8	3.8	2.69	0.337	0.932	
6/18/2003	6.6	79.2	0	4.29	0.387	<.5	
10/2/2003	6.4	79.4	0	4.23	0.503	0.902	
4/27/2004	6.6	44	18.4	1.82	0.257	0.617	
8/4/2004	6.7	80.2	-43.6	4.89	0.355	<.5	
10/26/2004	6.5	97.2	6	4.23	0.636	0.627	
	6.516667	70.63333	-2.56667	3.691667	0.4125	0.7695	**1752.32**
	0.147196	21.80327	21.21525	1.173037	0.135631	0.1708069	
SC08	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
6/18/2003	6.9	54.8	0	5.01	0.389	0.522	
10/2/2003	7	54.6	0	4.55	0.452	<.5	
4/27/2004	6.8	37.8	28.2	2.82	0.23	<.5	
8/4/2004	6.9	62.8	-21	3.38	0.365	<.5	
10/26/2004	6.9	61	-11.6	4.78	0.583	<.5	
	6.9	54.2	-0.88	4.108	0.4038	0.522	**19523.90**
	0.070711	9.870157	18.48599	0.955181	0.128809	#DIV/0!	
SC07	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/3/2003	6.6	38.8	0	4.81	0.398	0.642	
6/18/2003	6.2	53.8	0	5.2	0.387	0.616	
10/1/2003	7.1	51.8	0	2.92	0.354	<.5	
4/27/2004	6.8	36.8	31.6	2.54	0.21	0.516	
8/4/2004	6.9	60.4	40.4	2.37	0.332	<.5	
10/26/2004	7	59.6	-9.6	3.29	0.573	<.5	
	6.766667	50.2	10.4	3.521667	0.375667	0.5913333	**20159.91**
	0.326599	10.17291	20.36625	1.198523	0.117804	0.0665232	
UNT11	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**

4/9/2003	7.2	157	0	0.52	<.05	<.5	
6/18/2003	6.7	259	0	1.25	0.09	<.5	
10/1/2003	7.3	339.2	0	1.43	0.098	<.5	
4/26/2004	7.1	103.2	-72.8	0.777	0.084	<.5	
8/4/2004	7.4	293.2	-249.4	1.05	0.084	<.5	
10/26/2004	7.7	385	-190.6	1.07	0.122	<.5	
	7.233333	256.1	-85.4667	1.016167	0.0956	#DIV/0!	**104.56**
	0.332666	107.8006	109.5457	0.326607	0.015837	#DIV/0!	
UNT12	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
10/1/2003	7.4	48.2	0	0.358	0.079	<.5	
4/27/2004	7.2	38	-15.4	<.3	<.05	<.5	
8/4/2004	7.5	65	-43.6	<.3	<.05	<.5	
10/26/2004	7.7	86.6	-62.6	<.3	<.05	<.5	
	7.45	59.45	-30.4	0.358	0.079	#DIV/0!	**175.80**
	0.208167	21.24924	28.049	#DIV/0!	#DIV/0!	#DIV/0!	
UNT09	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
6/17/2003	7	88	0	1.85	0.976	<.5	
10/1/2003	7.6	74.2	0	0.608	0.263	<.5	
4/26/2004	7	39.4	19	1.34	0.166	0.816	
8/3/2004	7	73.4	-30.4	2.49	0.714	<.5	
10/26/2004	7.2	80.4	-38.6	1.86	0.67	<.5	
	7.16	71.08	-10	1.6296	0.5578	0.816	**745.00**
	0.260768	18.65401	23.84911	0.701691	0.336264	#DIV/0!	
SC01	**pH***	**Alkalinity^**	**Acidity**	**Iron**	**Manganese**	**Aluminum**	**Calculated**
Date	**Lab**	**mg/l**	**mg/l**	**ug/l**	**ug/l**	**ug/l**	**Flow**
4/3/2003	6.7	39.8	0	2.61	0.34	<.5	
6/17/2003	7.3	58.6	0	1.29	0.251	<.5	
9/30/2003	7.2	55.8	0	1.11	0.294	<.5	
4/22/2004	7.4	52.4	-1.6	1.57	0.32	<.5	
8/3/2004	7.1	63.6	-26	1.16	0.239	<.5	
10/26/2004	7.4	69.6	-27.8	0.635	0.432	<.5	
	7.183333	56.63333	-9.23333	1.395833	0.312667	#DIV/0!	**25365.64**
	0.263944	10.22265	13.71039	0.66812	0.07017	#DIV/0!	

***Zero is used in place of less than detects in TMDL calculations**

SC13 was selected as the sample point whose flow was used in a unit area calculation to determine flow values for all other sample points (except for discharges) in the Stump Creek watershed. With a known flow value and a known area of watershed, flow values of all other sample points in the watershed can be determined if their areas are known as well. This unit area method was used for sake of consistency.

Attachment K

Comment and Response

Comments received from Dominion Transmission, Inc. (DTI)

Comment:
The proposed TMDL does not address DTI's NPDES permit No. PA0101656. The NPDES permit is for a wastewater treatment plant.
DTI requests that the TMDL be amended and the waste load allocation (WLA) for total iron of 0.30 pounds per day be added to allow for the discharge from the wastewater treatment plant.
DTI also requests that the WLA be amended to NA for aluminum and manganese for the segment where the treatment plant discharge is located. This would be consistent with the LA of NA for aluminum and manganese in this segment.

Response:
A waste load allocation (WLA) for Dominion Transmission, Inc. has been added to this TMDL. Since aluminum and manganese are not included in Dominion's wastewater permit, they are not included in the WLA given to them in this TMDL.