# Redstone Creek
# TMDL
## Fayette County, Pennsylvania

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**TMDL**
**Redstone Creek Watershed**
**Fayette County, Pennsylvania**

## Introduction

These Total Maximum Daily Load (TMDL) calculations have been prepared for segments in the Redstone Creek Watershed (Attachment A) which include segments on named and unnamed tributaries to Redstone Creek. These TMDLs were completed to address the impairments noted on the 1996 Pennsylvania 303(d) and Integrated Water Quality Report lists, required under the Clean Water Act, and cover the listed segments shown in Table 1 below. Metals, pH and suspended solids in discharge water from abandoned coalmines cause the majority of the impairment. The TMDLs address the three primary metals associated with abandoned mine drainage (iron, manganese, aluminum), and pH. Suspended solids and siltation in runoff water from abandoned mines, agriculture, roads, and derelict land use are the primary causes of the rest of the impairment in the Redstone Creek Watershed. The TMDLs in attachments I-M address siltation, suspended solids and sedimentation for the entire Redstone Creek Watershed. Future TMDLs will address the issues of organic enrichment and low dissolved oxygen as they were listed in 2004 and after the 1996 listings.

| **Table 1. 303(d) and Integrated Water Quality Report Listed Segments** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| State Water Plan (SWP) Subbasin: 19C | | | | | | | | |
| HUC: 05020005-Lower Monongahela | | | | | | | | |
| **Listed** | **Miles** | **Assessment Id** | **Stream Id** | **Stream Name** | **Designated Use** | **Segments** | **Source** | **Cause Code** |
| 2004 | 0.2 | 4271 | **39931** | **Redstone Creek** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 1996 | 1.24 | 4346 | **39931** | **Redstone Creek** | WWF | 6 | Abandoned Mine Drainage | Metals |
| 1996 | | | **39931** | **Redstone Creek** | WWF | | Abandoned Mine Drainage | Suspended Solids |
| 2004 | 0.32 | 4783 | **39931** | **Redstone Creek** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2006 | 21.8 | 13187 | **39931** | **Redstone Creek** | WWF | | Abandoned Mine Drainage | Metals |
| 2004 | 0.44 | 4965 | **39938** | **Redstone Creek Unt** | WWF | 1 | Road Runoff | Siltation |
| 2006 | 0.52 | 13187 | **40017** | **Redstone Creek Unt** | WWF | 5 | Abandoned Mine Drainage | Metals |
| 2004 | 1.04 | 4347 | **40108** | **Redstone Creek Unt** | WWF | 2 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40108** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | | | **40108** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | Suspended Solids |
| 2004 | 0.78 | 4347 | **40122** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40122** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | Suspended Solids |
| 2004 | | | **40122** | **Redstone Creek Unt** | WWF | | Road Runoff | Siltation |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2004 | 0.38 | 4347 | **40123** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40123** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | | | **40123** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | Suspended Solids |
| 2004 | 2.51 | 4351 | **40124** | **Redstone Creek Unt** | WWF | 6 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40124** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | 0.6 | 4351 | **40125** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40125** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | 0.37 | 4351 | **40126** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40126** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | 0.69 | 4351 | **40127** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40127** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | 0.43 | 4351 | **40128** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40128** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | 0.51 | 4351 | **40129** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40129** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | 0.56 | 4351 | **40130** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40130** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2006 | 1.79 | 13152 | **40135** | **Redstone Creek Unt** | WWF | 3 | Abandoned Mine Drainage | Metals |
| 2006 | 0.69 | 13152 | **40136** | **Redstone Creek Unt** | WWF | 3 | Abandoned Mine Drainage | Metals |
| 2006 | 0.59 | 13152 | **40137** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | 0.74 | 4347 | **63976** | **Redstone Creek Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | 0.74 | | **63976** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | 0.74 | | **63976** | **Redstone Creek Unt** | WWF | | Abandoned Mine Drainage | Suspended Solids |
| 2004 | | | **63976** | **Redstone Creek Unt** | WWF | | Road Runoff | Siltation |
| 2004 | 3.1 | 4345 | **40132** | **Bennington Spring Run** | WWF | 2 | Abandoned Mine Drainage | pH |
| 2004 | 3.1 | 4345 | **40132** | **Bennington Spring Run** | WWF | 2 | Removal of Vegetation | Siltation |
| 2004 | 3.1 | 4345 | **40132** | **Bennington Spring Run** | WWF | 2 | Road Runoff | Siltation |
| 2004 | 0.22 | 4345 | **40133** | **Bennington Spring Run Unt** | WWF | 1 | Abandoned Mine Drainage | pH |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2004 | 0.22 | 4345 | **40133** | **Bennington Spring Run Unt** | WWF | 2 | Abandoned Mine Drainage | Siltation |
| 2004 | 4.22 | 4707 | **40109** | **Coal Lick Run** | WWF | 11 | Erosion from Derelict Land | Siltation |
| 2004 | 1.05 | 4707 | **40110** | **Coal Lick Run Unt** | WWF | 1 | Erosion from Derelict Land | Siltation |
| 2004 | 1.5 | 4707 | **40111** | **Coal Lick Run Unt** | WWF | 4 | Erosion from Derelict Land | Siltation |
| 2004 | 1.6 | 4707 | **40113** | **Coal Lick Run Unt** | WWF | 3 | Erosion from Derelict Land | Siltation |
| 2004 | 1.6 | 4707 | **40113** | **Coal Lick Run Unt** | WWF | 3 | Road Runoff | Siltation |
| 2004 | 1.17 | 4707 | **40114** | **Coal Lick Run Unt** | WWF | 3 | Erosion from Derelict Land | Siltation |
| 2004 | 0.42 | 4707 | **40115** | **Coal Lick Run Unt** | WWF | 1 | Erosion from Derelict Land | Siltation |
| 2004 | 0.35 | 4707 | **40116** | **Coal Lick Run Unt** | WWF | 2 | Erosion from Derelict Land | Siltation |
| 2004 | 0.7 | 4707 | **40117** | **Coal Lick Run Unt** | WWF | 1 | Erosion from Derelict Land | Siltation |
| 2004 | 0.84 | 4707 | **40118** | **Coal Lick Run Unt** | WWF | 3 | Erosion from Derelict Land | Siltation |
| 2004 | 0.54 | 4707 | **40119** | **Coal Lick Run Unt** | WWF | 2 | Erosion from Derelict Land | Siltation |
| 2004 | 0.57 | 4707 | **40120** | **Coal Lick Run Unt** | WWF | 3 | Erosion from Derelict Land | Siltation |
| 2004 | 0.52 | 4707 | **40121** | **Coal Lick Run Unt** | WWF | 1 | Erosion from Derelict Land | Siltation |
| 2004 | 0.13 | 4707 | **63977** | **Coal Lick Run Unt** | WWF | 1 | Erosion from Derelict Land | Siltation |
| 2004 | 3.89 | 4338 | **40086** | **Cove Run** | WWF | 6 | Abandoned Mine Drainage | Metals |
| 2004 | 1.02 | 4338 | **40087** | **Cove Run Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | 0.38 | 4338 | **40088** | **Cove Run Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40088** | **Cove Run Unt** | WWF | | Road Runoff | Siltation |
| 2004 | 1.21 | 4338 | **40089** | **Cove Run Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40089** | **Cove Run Unt** | WWF | | Road Runoff | Siltation |
| 2004 | 1.12 | 4338 | **40100** | **Cove Run Unt** | WWF | 2 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40100** | **Cove Run Unt** | WWF | | Road Runoff | Siltation |
| 2004 | 0.92 | 4338 | **40101** | **Cove Run Unt** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40101** | **Cove Run Unt** | WWF | | Road Runoff | Siltation |
| 2004 | 3.64 | 4284 | **39969** | **Crabapple Run** | WWF | 8 | Abandoned Mine Drainage | pH |
| 2004 | | | **39969** | **Crabapple Run** | WWF | | Agriculture | Siltation |
| 2004 | 0.52 | 4284 | **39970** | **Crabapple Run Unt** | WWF | 1 | Abandoned Mine Drainage | pH |
| 2004 | | | **39970** | **Crabapple Run Unt** | WWF | | Agriculture | Siltation |
| 2004 | 1.11 | 4284 | **39971** | **Crabapple Run Unt** | WWF | 4 | Abandoned Mine Drainage | pH |
| 2004 | | | **39971** | **Crabapple Run Unt** | WWF | | Agriculture | Siltation |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2004 | 0.52 | 4284 | **39972** | **Crabapple Run Unt** | WWF | 1 | Abandoned Mine Drainage | pH |
| 2004 | | | **39972** | **Crabapple Run Unt** | WWF | | Agriculture | Siltation |
| 2004 | 0.72 | 4284 | **39973** | **Crabapple Run Unt** | WWF | 1 | Abandoned Mine Drainage | pH |
| 2004 | | | **39973** | **Crabapple Run Unt** | WWF | | Agriculture | Siltation |
| 2006 | 0.32 | 13230 | **39974** | **Crabapple Run Unt** | WWF | 1 | Road Runoff | Siltation |
| 2004 | 0.82 | 4284 | **39975** | **Crabapple Run Unt** | WWF | 1 | Abandoned Mine Drainage | pH |
| 2004 | | | **39975** | **Crabapple Run Unt** | WWF | | Agriculture | Siltation |
| 2004 | 0.36 | 4284 | **39976** | **Crabapple Run Unt** | WWF | 3 | Abandoned Mine Drainage | pH |
| 2004 | | | **39976** | **Crabapple Run Unt** | WWF | | Agriculture | Siltation |
| 2004 | 0.41 | 4348 | **40131** | **Lick Run** | WWF | 1 | Abandoned Mine Drainage | Metals |
| 2004 | | | **40131** | **Lick Run** | WWF | | Abandoned Mine Drainage | pH |
| 2004 | | | **40131** | **Lick Run** | WWF | | Road Runoff | Siltation |
| 2004 | 0.3 | 4323 | **40058** | **Rankin Run** | WWF | 1 | Abandoned Mine Drainage | Metals |

Pennsylvania's 1996, 1998, and 2002 Section 303(d) lists and the 2004 and 2006 Integrated Water Quality Report were approved by the Environmental Protection Agency (EPA). The 1996 Section 303(d) list provides the basis for measuring progress under the 1997 lawsuit settlement of American Littoral Society and Public Interest Group of Pennsylvania v. EPA.
The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.
**WWF** = Warm Water Fisheries
**Unt** = Unnamed Tributary
**See Attachment E**, *Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists and the 2004 and 2006 Integrated Water Quality Report.*
**See Attachment N for additional listings to 2006,** *Pennsylvania Integrated Water Quality Monitoring and Assessment Report Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL*

## Directions to the Redstone Creek Watershed

Redstone Creek Watershed is located in western Pennsylvania's Fayette County which is about 45 miles southeast of Pittsburgh, PA. Take PA State Route 51 south from Pittsburgh, PA to Uniontown, PA. Redstone Creek begins in the Chestnut Ridge Mountain near Fort Necessity and flows westerly as do many of the creeks and streams in the area. Redstone Creek flows toward the northwest as it passes through Uniontown, Phillips, Smock, and Grindstone before entering the Monongahela River near Brownsville. The watershed is generally bordered southerly by Interstate 40 and lies within the following townships: Brownsville, Jefferson, Franklin, Dunbar, North Union, South Union, Redstone and Menallen.

## Segments addressed in this TMDL

The Redstone Creek Watershed is affected by pollution from abandoned mine drainage (AMD). The AMD has caused high levels of metals and suspended solids in Bute Run, Rankin Run, Unnamed Tributary 40124 and segments in Redstone Creek all of which are within the Redstone Creek Watershed. Table 1 and Attachments A and N give an explanation and locations of the AMD allocation points.

There are currently two mining permits issued in the Redstone Creek Watershed which will be treated as point sources and assigned waste load allocations. All of the other discharges in the watershed are from abandoned mines and will be treated as non-point sources and fall under the load allocation for the stream segment they contribute to. The distinction between non-point and point sources in this case is determined on the basis of whether or not there is a responsible party for the discharge. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

**Clean Water Act Requirements**

Section 303(d) of the 1972 Clean Water Act requires states, territories, and authorized tribes to establish water quality standards. The water quality standards identify the uses for each waterbody and the scientific criteria needed to support that use. Uses can include designations for drinking water supply, contact recreation (swimming), and aquatic life support. Minimum goals set by the Clean Water Act require that all waters be "fishable" and "swimmable."

Additionally, the federal Clean Water Act and the U.S. Environmental Protection Agency's (USEPA) implementing regulations (40 CFR 130) require:

- States to develop lists of impaired waters for which current pollution controls are not stringent enough to meet water quality standards (the list is used to determine which streams need TMDLs);

- States to establish priority rankings for waters on the lists based on severity of pollution and the designated use of the waterbody; states must also identify those waters for which TMDLs will be developed and a schedule for development;

- States to submit the list of waters to USEPA every four years (April 1 of the even numbered years);

- States to develop TMDLs, specifying a pollutant budget that meets state water quality standards and allocate pollutant loads among pollution sources in a watershed, e.g., point and nonpoint sources; and

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

Despite these requirements, states, territories, authorized tribes, and USEPA have not developed many TMDLs since 1972. Beginning in 1986, organizations in many states filed lawsuits against the USEPA for failing to meet the TMDL requirements contained in the federal Clean Water Act and its implementing regulations. While USEPA has entered into consent agreements with the plaintiffs in several states, many lawsuits still are pending across the country.

In the cases that have been settled to date, the consent agreements require USEPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.).

**303(d) List and Integrated Water Quality Report 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 and/or the Integrated Water Quality Report. With guidance from the USEPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (Pa. DEP) for evaluating waters changed between the publication of the 1996 and 1998 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 305(b) reporting process. Pa. DEP is now using the Unassessed Waters Protocol (UWP), a modification of the USEPA Rapid Bioassessment Protocol II (RPB-II), as the primary mechanism to assess Pennsylvania's waters. The UWP provides a more consistent approach to assessing Pennsylvania's streams.

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 are documented. An impaired stream must be listed on the state's 303(d) list and/or the Integrated Water Quality Report with the documented source and cause. A TMDL must be developed for the stream segment. A TMDL is for only one pollutant. If a stream segment is impaired by two pollutants, two TMDLs must be developed for that stream segment. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

**Basic Steps for Determining a TMDL**

Although all watersheds must be handled on a case-by-case basis when developing TMDLs, there are basic processes or steps that apply to all cases. They include:

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculate TMDL for the waterbody using USEPA approved methods and computer models;
3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;

5. Submit draft report for public review and comments; and
6. USEPA approval of the TMDL.

**Watershed History**

The use of coal in the Redstone Creek watershed began as early as 1760 but was not used commercially in any large degree until the late 1850's when one of the first railroads from Connellsville to Pittsburgh was completed. The commercial use of coal continued its commercial expansion during the Civil War when the demand for pig iron increased substantially and was fueled largely by coal and coke from the Connellsville area. The increase in coal and coke continued to be high throughout the remainder of the 19$^{th}$ century into the early to mid 20$^{th}$ century as large quantities of coal was used to produce manufactured gas that provided lights for many of the northeast corridor cities.

Redstone Creek is part of the Monongahela River Basin in Fayette County and drains a 109 square mile area of central and western Fayette County, Pennsylvania. The headwaters of Redstone Creek begin in Forbes State Forest very near to the crest of Chestnut Ridge and flows northwest 28 miles to the confluence with the Monongahela River at Brownsville. Surface elevations at the headwaters begin near 2,300 msl near the crest of Chestnut Ridge and decrease down to near 750msl where Redstone Creek enters the Monongahela River. The general topography is comprised of alternating hills and valley's and includes a combination of urban and rural residential areas as well as some agricultural areas. Uniontown is the largest population center within the watershed.

The general geology is comprised of alternating anticline and synclinal structures including the Uniontown Syncline which is the most prominent geologic structure within the watershed and responsible for several deep mine discharges including the Phillips discharge and other deep mine discharges that discharge into Rankin Run and Bute Run. Numerous coal seams have been mined within the3 watershed to include the Waynesburg, Sewickley, Redstone, Pittsburgh, Upper Freeport, Lower Kittanning, and Brookville-Clarion. By far, the Pittsburgh Coal seam has been the most productive of all as over 90% of the tonnage mined to date has been from this one coal seam.

The most significant mining impacts are noted at REDS 7, 7A and 7B. REDS 7A and 7B are downstream sampling locations on Bute Run and Rankin Run and indicate AMD parameters (mostly high iron) from large deep mine discharges that enter these streams. REDS 7 is the main stem of Redstone Creek at Waltersburg and is the first sampling location downstream of the main deep mine discharges referenced above. Although the flows are considerable at this point, the entire main stem of Redstone Creek from Phillips (and other) to REDS 7 (and further downstream) has high instream iron concentrations and indicates considerable iron deposition. Although there has been considerable surface mining throughout the history of mining in this watershed, the main problem is, by far, the deep mine discharges.

**AMD Methodology**

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

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

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[1] 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:

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

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

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

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

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

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

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 a true reflection of acidity. This method assures that Pennsylvania’s standard for pH is met when the acid concentration reduction is met.

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

## TMDL Endpoints

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

Because of the nature of the pollution sources in the watershed, the TMDLs component makeup will be load allocations that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pennsylvania Title 25 Chapter 96.3(c) specifies that a minimum 99 percent level of protection is required. All metals criteria evaluated in this TMDL are specified as total recoverable. Pennsylvania does have dissolved criteria for iron; however, the data used for this analysis report iron as total recoverable. Table 2 shows the water quality criteria for the selected parameters.

**Table 2. Applicable Water Quality Criteria**

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

*The pH values shown will be used when applicable. In the case of freestone streams with little or no buffering capacity, the TMDL endpoint for pH will be the natural background water quality. 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 nonpoint sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load).

## Impairment due to suspended solids/siltation

The suspended solids, or siltation, impairment noted in Redstone Creek and its tributaries is due to runoff from historic mining, active mining operations, development and croplands located throughout the watershed. An existing sediment load was computed using the Generalized Watershed Loading Function (GWLF) model. This model is being used by the Department to address sedimentation/siltation/suspended solids problems in other watersheds throughout the Commonwealth.

The "Reference Watershed Approach" is used to determine the sediment load reduction needed for this watershed. The Reference Watershed Approach compares two watersheds, one attaining its designated uses and one that is impaired based on biological assessments. Both watersheds must have similar land use/cover distributions. Other features such as base geologic formation should be matched to the extent possible; however, most variations can be adjusted in the model. The objective of the process is to reduce the loading rate of pollutants in the impaired stream segment to a level equivalent to, or slightly lower than, the loading rate in the non-impaired, reference segment. This load reduction will result in conditions favorable to the return of a healthy biological community to the impaired stream segments.

In general, three factors are considered when selecting a suitable reference watershed. The first factor is to use a watershed that the Department has assessed and determined to be attaining water quality standards. The second factor is to find a watershed that closely resembles the impaired watershed in physical properties such as land cover/land use, physiographic province, and geology. Finally, the size of the reference watershed should be within 20-30% of the impaired watershed area. The search for a reference watershed that would satisfy the above characteristics was done by means of a desktop screening using several GIS coverages, including the Multi-Resolution Land Characteristics (MRLC), Landsat-derived land cover/use grid, the Pennsylvania's 305(b) assessed streams database, and geologic rock types.

South Fork Tenmile Creek Watershed was selected for use as the reference watershed. The watershed is located in State Water Plan subbasin 19G; the protected use is aquatic life. Couth Fork Tenmile Creek Basin is designated as Warm Water Fishes (WWF) and High Quality Warm Water Fishes (HQ-WWF) under §93.9v in Title 25 of the Pa. Code (Commonwealth of Pennsylvania, 2007). Based on the Department's 305(b) report database, South Fork Tenmile Creek Watershed is currently attaining its designated uses. The attainment of designated uses is based on sampling done by the Department, using the Statewide Surface Water Assessment protocol. A map of the South Fork Tenmile Creek Watershed is located in Attachment I.

Drainage area, location, land use and other physical characteristics such as geology and rock types of the Redstone Creek Watershed were compared to the South Fork Tenmile Creek Watershed. An analysis of the available characteristics revealed that while land cover/use distributions are not an exact match, the watersheds are similar.

A suspended solids/siltation TMDL for the Redstone Creek Watershed was developed using the ArcView Generalized Watershed Loading Function (AVGWLF) model as described in Attachment J. The AVGWLF model was used to establish existing loading conditions for the Redstone Creek Watershed and the South Fork Tenmile Creek Reference Watershed. All modeling outputs have been included in Attachment K.

The sediment reduction goal for the TMDL is based on setting the watershed-loading rate of the impaired Redstone Creek equal to the watershed-loading rate in the un-impaired South Fork Tenmile Creek Watershed. The load reduction for suspended solids in Redstone Creek was assigned to the land use categories coal mines/quarry and croplands.

The TMDL for sediment results in a 64% reduction in loading from croplands, 32% from coal mines and 32% from transitional lands. A more detailed explanation of sediment calculations is contained in Attachment H. The individual components of the TMDL are summarized in Table 3 and the load allocation summary is given in Table 4.

**Table 3. TMDL, WLA, MOS, LA, LNR, and ALA for Redstone Creek Watershed**

| Component | Sediment (lbs/yr.) |
|---|---|
| TMDL (Total Maximum Daily Load) | 29,153,632 |
| WLA (Waste Load Allocation) | 14,383 |
| MOS (Margin of Safety) | 2,915,363 |
| LA (Load Allocation) | 26,223,885 |
| LNR (Loads Not Reduced) | 15,971,200 |
| ALA (Adjusted Load Allocation) | 10,252,685 |

**Table 4. Sediment Load Allocations & Reductions for the Redstone Creek Watershed**

| Pollutant Source | Acres | Unit Area Loading Rate (lbs/ac/yr) | | Pollutant Loading (lbs/yr) | | Percent Reduction |
|---|---|---|---|---|---|---|
| | | Current | Allowable | Current | Allowable | |
| CROPLAND | 10224 | 1891.36 | 680.75 | 19,377,000 | 6,974,321 | 64% |
| COAL MINES | 210 | 16959.05 | 11536.28 | 3,561,400 | 2,422,619 | 32% |
| TRANSITIONAL | 892 | 1410.31 | 959.36 | 1,258,000 | 855,746 | 32% |
| TOTAL | | | | 24,196,400 | 10,252,685 | 58% |

**Allocation Summary**

This TMDL will focus remediation efforts on the identified numerical reduction targets for each watershed. As changes occur in the watershed, the TMDL may be re-evaluated to reflect current conditions. Table 5 presents the estimated reductions identified for all points in the watershed. Attachment C gives detailed TMDLs by segment analysis for each allocation point.

**Table 5. Summary Table – Redstone Creek Watershed**

| *Station* | *Parameter* | *Existing Load (lbs/day)* | *TMDL Allowable Load (lbs/day)* | *WLA (lbs/day)* | *LA (lbs/day)* | *Load Reduction (lbs/day)* | *Percent Reduction %* |
|---|---|---|---|---|---|---|---|
| REDS16 | Unnamed Tributary (UNT) 40135 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | 0.70 | NA | NA | NA | NA | NA |
| | Mn | 0.23 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS15 | Redstone Creek Headwaters, Stream Code 39931 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | 7.04 | NA | NA | NA | NA | NA |
| | Mn | 1.16 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS14 | Lick Run 40131 | | | | | | |

| Station | Parameter | Existing Load (lbs/day) | TMDL Allowable Load (lbs/day) | WLA (lbs/day) | LA (lbs/day) | Load Reduction (lbs/day) | Percent Reduction % |
|---|---|---|---|---|---|---|---|
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | ND | NA | NA | NA | NA | NA |
| | Mn | 3.91 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS13 | Redstone Creek 39931 | | | | | | |
| | Al | 38.47 | 35.78 | - | 35.78 | 2.69 | 7 |
| | Fe | 55.94 | NA | NA | NA | NA | NA |
| | Mn | 27.85 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS12 | UNT 40124 | | | | | | |
| | Al | 5.75 | 3.28 | - | 3.28 | 2.47 | 43 |
| | Fe | 22.37 | 8.50 | - | 8.50 | 13.87 | 62 |
| | Mn | 14.00 | 3.08 | - | 3.08 | 10.92 | 78 |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS11 | Redstone Creek 39931 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | 34.54 | NA | NA | NA | NA | NA |
| | Mn | 10.32 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS10 | Redstone Creek 39931 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | ND | NA | NA | NA | NA | NA |
| | Mn | 1.47 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS09 | Cove Run 40086 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | ND | NA | NA | NA | NA | NA |
| | Mn | 1.38 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS08 | Redstone Creek 39931 | | | | | | |
| | Al | 131.82 | 89.64 | - | 89.64 | 42.18 | 32 |
| | Fe | 226.69 | 113.35 | - | 113.35 | 113.35 | 50 |
| | Mn | 34.19 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS07B | Rankin Run 40058 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | 81.02 | 5.67 | - | 5.67 | 75.35 | 93 |
| | Mn | 5.89 | 4.77 | - | 4.77 | 1.12 | 19 |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS07A | Bute Run 40045 | | | | | | |
| | Al | 10.76 | 3.34 | - | 3.34 | 7.43 | 69 |
| | Fe | 232.22 | 9.29 | - | 9.29 | 222.93 | 96 |
| | Mn | 21.01 | 6.93 | - | 6.93 | 14.08 | 67 |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS07 | Redstone Creek 39931 | | | | | | |
| | Al | ND | NA | 1.12 | NA | NA | NA |
| | Fe | 954.42 | 209.97 | 4.52 | 205.45 | 332.82* | 61* |
| | Mn | 117.72 | NA | 3.00 | NA | NA | NA |
| | Acidity | ND | NA | 0.00 | NA | NA | NA |

| Station | Parameter | Existing Load (lbs/day) | TMDL Allowable Load (lbs/day) | WLA (lbs/day) | LA (lbs/day) | Load Reduction (lbs/day) | Percent Reduction % |
|---|---|---|---|---|---|---|---|
| REDS06 | Redstone Creek 39931 | | | | | | |
| | Al | ND | NA | 0.56 | 1.03 | NA | NA |
| | Fe | 299.39 | 74.85 | 2.26 | 72.59 | 0.00* | 0* |
| | Mn | 40.88 | NA | 1.50 | NA | NA | NA |
| | Acidity | ND | NA | NA | 8.32 | NA | NA |
| REDS05 | Crabapple Run 39969 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | ND | NA | NA | NA | NA | NA |
| | Mn | ND | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS04 | Redstone Creek 39931 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | 246.97 | 66.68 | - | 66.68 | 0.00* | 0* |
| | Mn | 29.31 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS03 | Redstone Creek 39931 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | ND | NA | NA | NA | NA | NA |
| | Mn | ND | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS02 | UNT 39937 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | 0.14 | NA | NA | NA | NA | NA |
| | Mn | ND | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |
| REDS01 | Redstone Creek Mouth 39931 | | | | | | |
| | Al | ND | NA | NA | NA | NA | NA |
| | Fe | 182.79 | 104.19 | - | 104.19 | 78.40 | 43 |
| | Mn | 21.52 | NA | NA | NA | NA | NA |
| | Acidity | ND | NA | NA | NA | NA | NA |

*Takes into account load reductions from upstream sources.

## Recommendations

Partnership with and support for the Greater Redstone Clearwater Initiative (GRCI) is recommended as they have completed stream assessments in the Redstone Creek Watershed and drafted AMD treatment system designs to address the AMD discharges in the watershed. Some of the work of the GRCI includes the following:

- In 2000 the GRCI received a $66,203 Growing Greener Grant for the "Water Quality And Riparian Health Watershed Assessment For The Greater Redstone Watershed" project. A significant portion of the project focused on the AMD discharges and the abandoned mine lands within the watershed. The AMD sources were identified and sampled. The final report recommended that remediation efforts be focused on two priority areas, the Phillips Discharge and the Rankin Run Discharges.

- In 2002 the GRCI received a $139,034 Growing Greener Grant for the "Phillips Mine Discharge Remediation Project". The project evaluated the treatment system alternatives, determined the various permitting requirements and prepared the detailed engineering designs for the selected treatment system.

- In 2002 the GRCI also received a $27,314 Growing Greener Grant for the "Rankin Run AMD Design Project". The project conducted monitoring (chemistry and flows) of the Rankin Run Discharges, developed detailed mapping of the area, conducted wetlands delineation of the area and developed a conceptual treatment system design.

- The GRCI has also received grants for stream bank stabilization, watershed education and cleanup projects within the watershed.

In addition to the above recommendation, re-mining of abandoned deep mines through the Department of Environmental Protection's Subchapter F program would help to alleviate AMD. Since net alkaline deep mine discharges comprise the majority of the mining related pollution, it is also recommended that work be continued with local watershed groups to develop passive treatment systems to achieve the reductions recommended in this TMDL document.

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

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

The Bureau of Abandoned Mine Reclamation (BAMR) is Pennsylvania's primary bureau in dealing with abandoned mine reclamation (AMR) issues. BAMR has established a comprehensive plan for AMR throughout the Commonwealth. The plan prioritizes and guides reclamation efforts throughout the state and makes the most of available funds. For more information please visit (www.dep.state.pa.us/dep/deputate/minres/bamr/complan1.htm).

In developing and implementing a comprehensive plan for abandoned mine reclamation, the resources (both human and financial) of the participants must be coordinated to insure cost-effective results. The following set of principles is intended to guide this decision making process:

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

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

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

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

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

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

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

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

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

In addition to the abandoned mine reclamation program, regulatory programs also are assisting in the reclamation and restoration of Pennsylvania's land and water. PADEP has been effective in implementing the NPDES program for mining operations throughout the Commonwealth. This reclamation was done through the use of remining permits that have the potential for reclaiming abandoned mine lands, at no cost to the Commonwealth or the federal government. Long-term treatment agreements were initialized for facilities/operators that need to assure treatment of post-mining discharges or discharges they degraded which will provide for long-term treatment of discharges. According to OSM, "PADEP is conducting a program where active mining sites are, with very few exceptions, in compliance with the approved regulatory program".

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

- Project XL - The Pennsylvania Department of Environmental Protection (“PADEP”) has proposed this XL Project to explore a new approach to encourage the remining and reclamation of abandoned coal mine sites. The approach would be based on compliance with in-stream pollutant concentration limits and implementation of best management practices (“BMPs”), instead of National Pollutant Discharge Elimination System (“NPDES”) numeric effluent limitations measured at individual discharge points. This XL project would provide for a test of this approach in up to eight watersheds with significant abandoned mine drainage (“AMD”) pollution. The project will collect data to compare in-stream pollutant concentrations versus the loading from individual discharge points and provide for the evaluation of the performance of BMPs and this alternate strategy in PADEP’s efforts to address AMD.
- Awards of grants for 1) proposals with economic development or industrial application as their primary goal and which rely on recycled mine water and/or a site that has been made suitable for the location of a facility through the elimination of existing Priority 1 or 2 hazards, and 2) new and innovative mine drainage treatment technologies that will provide waters of higher purity that may be needed by a particular industry at costs below conventional treatment costs as in common use today or reduce the costs of water treatment below those of conventional lime treatment plants. Eight contracts totaling $4.075 M were awarded in 2006 under this program.
- Projects using water from mine pools in an innovative fashion, such as the Shannopin Deep Mine Pool (in southwestern Pennsylvania), the Barnes & Tucker Deep Mine Pool (the Susquehanna River Basin Commission into the Upper West Branch Susquehanna River), and the Wadesville Deep Mine Pool (Excelon Generation in Schuylkill County).

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

**Public Participation**

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on December 6, 2008 and the draft on December 8, 2008to foster public comment on the allowable loads calculated. A public meeting was held on December 12, 2008 beginning at 10AM at the Southwest Regional Office in Uniontown, PA to discuss the proposed TMDL.

**Future TMDL Modifications**

In the future, the Department may adjust the load and/or wasteload allocations in this TMDL to account for new information or circumstances that are developed or discovered during the implementation of the TMDL when a review of the new information or circumstances indicate that such adjustments are appropriate. Adjustment between the load and wasteload allocation will only be made following an opportunity for public participation. A wasteload allocation adjustment will be made consistent and simultaneous with associated permit(s) revision(s)/reissuances (i.e., permits for revision/reissuance in association with a TMDL revision will be made available for public comment concurrent with the related TMDLs availability for public comment). New information generated during TMDL implementation may include, among other things, monitoring data, BMP effectiveness information, and land use information. All changes in the TMDL will be tallied and once the total changes exceed 1% of the total original TMDL allowable load, the TMDL will be revised. The adjusted TMDL, including its LAs and WLAs, will be set at a level necessary to implement the applicable WQS and any adjustment increasing a WLA will be supported by reasonable assurance demonstration that load allocations will be met. The Department will notify EPA of any adjustments to the TMDL within 30 days of its adoption and will maintain current tracking mechanisms that contain accurate loading information for TMDL waters.

**Changes in TMDLs That May Require EPA Approval**

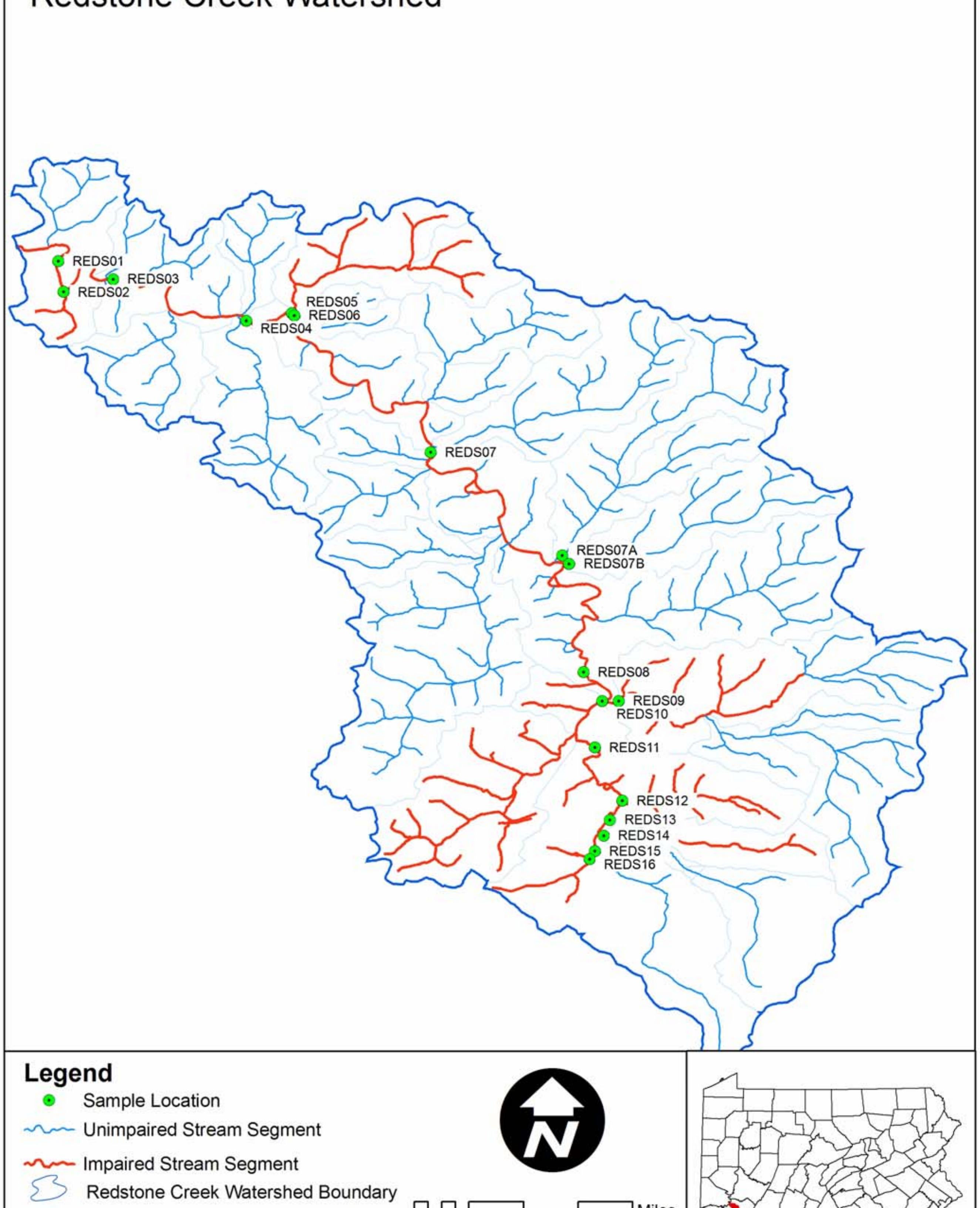
- Increase in total load capacity.
- Transfer of load between point (WLA) and nonpoint (LA) sources.
- Modification of the margin of safety (MOS).
- Change in water quality standards (WQS).
- Non-attainment of WQS with implementation of the TMDL.
- Allocations in trading programs.

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

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

# *Attachment A*

## Redstone Creek Watershed Map



Redstone Creek Watershed
REDS01
REDS02
REDS03
REDS04
REDS05
REDS06
REDS07
REDS07A
REDS07B
REDS08
REDS09
REDS10
REDS11
REDS12
REDS13
REDS14
REDS15
REDS16
Legend
Sample Location
Unimpaired Stream Segment
Impaired Stream Segment
Redstone Creek Watershed Boundary

# *Attachment B*

## Method for Addressing 303(d) List and/or Integrated Water Quality Report Listings for pH

## Method for Addressing 303(d) List and/or Integrated Water Quality Report Listings for pH

Potenz hydrogen (pH) is a measurement of hydrogen ion concentration presented as a negative logarithm. As such, pH measurements are not conducive to standard statistics. Additionally, pH does not measure latent acidity and 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 that would result from the treatment of abandoned mine drainage.

Research published by the Pa. Department of Environmental Protection demonstrates that by plotting net alkalinity (alkalinity minus acidity) vs. pH for 794 mine sample points, the pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the USEPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93. Thus, it is required that the acid load in streams with pH impairments shall be reduced so that net alkalinity is greater than zero 99% of the time.

Based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the 303(d) List and/or Integrated Water Quality Report due to pH. Net alkalinity will be used to evaluate pH in TMDL calculations. 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 measured in units of milligrams per liter (mg/l) $CaCO_3$ by titration. The same statistical procedure that has been described for use in the evaluation of the metals that have numeric water quality criteria 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 of six to 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 also assures that Pennsylvania's standard for pH is attained when the acid concentration reduction is attained.

There are, however, several documented cases of free stone streams in Pennsylvania having a natural background pH below six. If the natural pH of a stream on the 303(d) List and/or Integrated Water Quality Report 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. It is required that the acid load in all other streams shall be reduced so that net alkalinity is greater than zero 99% of the 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.*

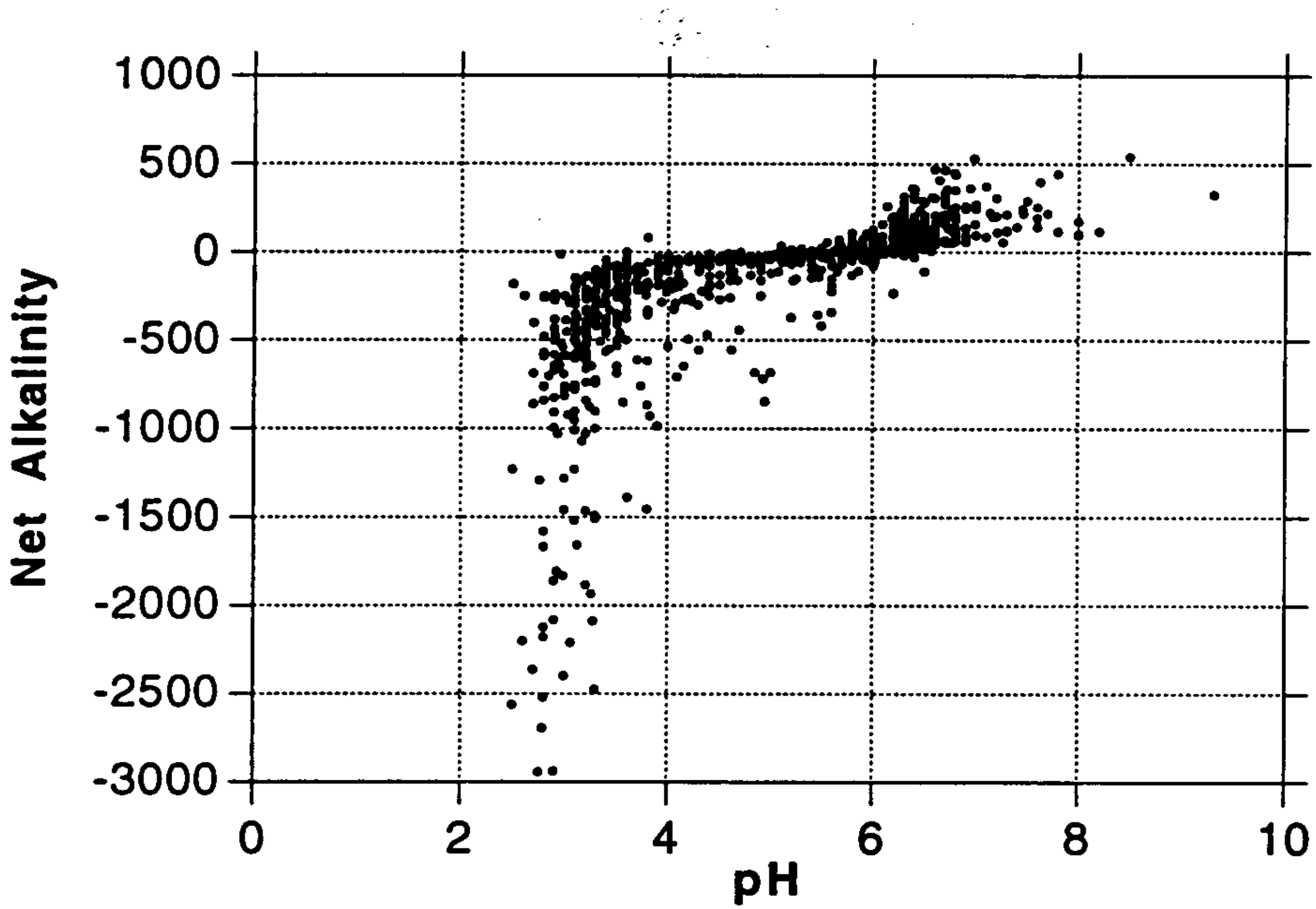
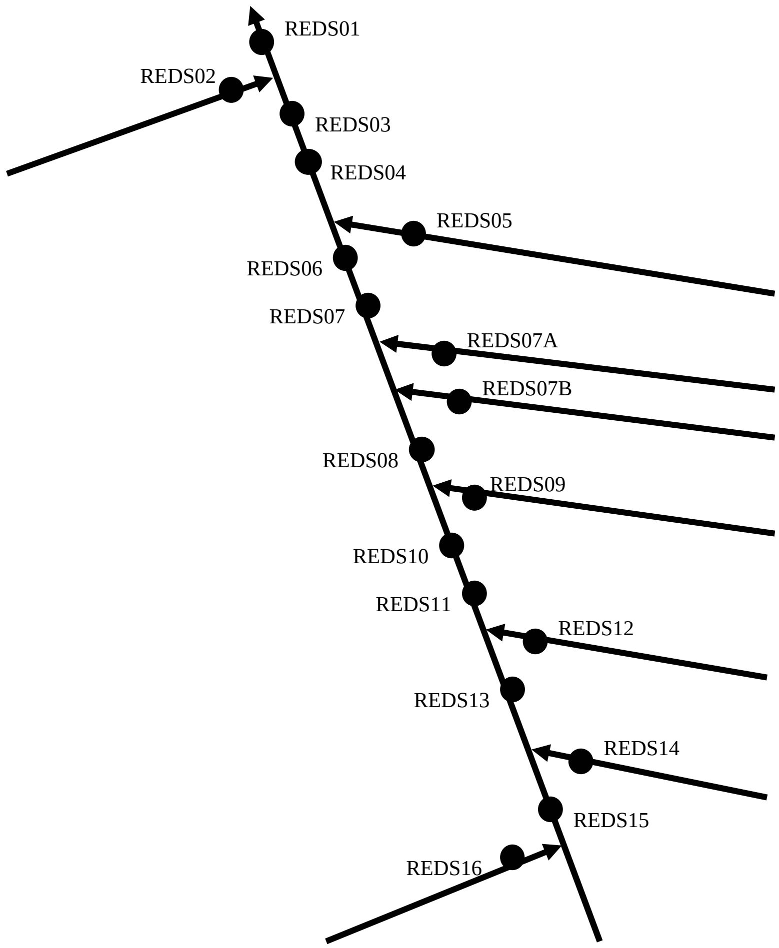



**Figure 1**. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

# ***Attachment C***

## **TMDLs By Segment**

**Redstone Creek Watershed Sampling Stations Diagram**
Arrows represent direction of flow
Diagram not to scale




**Redstone Creek Watershed**

The TMDL for the Redstone Creek Watershed consists of load allocations for eighteen sampling stations along Redstone Creek and its tributaries.

The Redstone Creek Watershed is listed for metals, pH and suspended solids from AMD as being the cause of the degradation to the stream. The Redstone Creek Watershed is also listed for sedimentation, siltation and suspended solids which are addressed in attachments I-M. The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at the points below for aluminum, iron, manganese and acidity by using a Monte Carlo simulation analysis. This analysis is designed to produce a long-term average concentration that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean (average) 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 ensure 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.

**REDS16 Unnamed Tributary (UNT) 40135**

Biological assessments demonstrate that the segment from REDS16 to the source is attaining its designated uses. Because its uses are being attained, no TMDL is necessary.

**REDS15 Redstone Creek 39931**

No reductions are necessary for the segment from REDS15 to REDS14 because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**REDS14 Lick Run 40131**

No reductions are necessary for Lick Run because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**REDS13 Redstone Creek 39931**

The TMDL for this sample point consists of a load allocation to the segment upstream to the source. The load allocation for this segment was computed using water-quality sample data collected at point REDS13. The average flow, measured at REDS13 (10144.00 MGD), is used for these computations.

**Table C1. Load Allocations for Point REDS13**

| | Measured Sample Data | | Allowable | |
|---|---|---|---|---|
| Parameter | Conc. (mg/l) | Load (lbs/day) | Conc. (mg/l) | Load (lbs/day) |
| Al | 0.32 | 38.47 | 0.29 | 35.78 |
| Fe | 0.46 | 55.94 | NA | NA |
| Mn | 0.23 | 27.85 | NA | NA |
| Acid | ND | ND | NA | NA |
| Alk | 81.96 | 9984.81 | | |

The calculated load reductions for all the loads that enter point REDS13 must be accounted for in the calculated reductions at sample point REDS13 shown in Table C2.

| Table C2. Calculation of Load Reduction at Point REDS13 | |
|---|---|
| | Al (lbs/day) |
| Existing Load | 38.47 |
| Difference in Existing Load between REDS15, REDS14 & REDS13 | 21.24 |
| Load tracked from REDS15 & REDS14 | 17.23 |
| Total Load tracked from REDS15 & REDS14 | 38.47 |
| Allowable Load at REDS13 | 35.78 |
| Load Reduction at REDS13 | 2.69 |
| % Reduction required at REDS13 | 7 |

**REDS12 UNT 40124**

The TMDL for this sample point on UNT 40124 consists of a load allocation to the segment upstream to the source. The load allocation for this segment of UNT 40124 was computed using water-quality sample data collected at point REDS12. The average flow, measured at REDS12 (1312.80 MGD), is used for these computations.

| Table C3. Load Allocations at Point REDS12 | | | | |
|---|---|---|---|---|
| | **Measured Sample Data** | | **Allowable** | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | Conc. (mg/l) | Load (lbs/day) |
| Al | 0.37 | 5.75 | 0.21 | 3.28 |
| Fe | 1.42 | 22.37 | 0.54 | 8.50 |
| Mn | 0.89 | 14.00 | 0.20 | 3.08 |
| Acid | ND | ND | NA | NA |
| Alk | 104.28 | 1644.10 | | |

| Table C4. Calculation of Load Reductions Necessary at Point REDS12 | | | |
|---|---|---|---|
| | Al (lb/day) | Fe (lbs/day) | Mn (lbs/day) |
| Existing Load | 5.75 | 22.37 | 14.00 |
| Allowable Load = TMDL | 3.28 | 8.50 | 3.08 |
| Load Reduction | 2.47 | 13.87 | 10.92 |
| % Reduction Segment | 43 | 62 | 78 |

**REDS11 Redstone Creek**

No reductions are necessary for the segment from REDS11 to REDS12 and REDS13 because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**REDS10 Redstone Creek**

No reductions are necessary for the segment from REDS10 to REDS11 because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**REDS09 Cove Run**

No reductions are necessary for this segment because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**REDS08 Redstone Creek**

The TMDL for this segment of Redstone Creek consists of a load allocation to the area between sample points REDS08, REDS09 and REDS10. The load allocation for this segment was computed using water-quality sample data collected at point REDS08. The average flow, measured at REDS08 (31777.80 MGD), is used for these computations.

**Table C5. Load Allocations for Point REDS08**

| | Measured Sample Data | | Allowable | |
|---|---|---|---|---|
| Parameter | Conc. (mg/l) | Load (lbs/day) | Conc. (mg/l) | Load (lbs/day) |
| Al | 0.35 | 131.82 | 0.23 | 89.64 |
| Fe | 0.59 | 226.69 | 0.30 | 113.35 |
| Mn | 0.09 | 34.19 | NA | NA |
| Acid | ND | ND | NA | NA |
| Alk | 115.20 | 43964.77 | | |

The calculated load reductions for all the loads that enter point REDS08 must be accounted for in the calculated reductions at sample point REDS08 shown in Table C6.

**Table C6. Calculation of Load Reduction at Point REDS08**

| | Al | Fe |
|---|---|---|
| Existing Load | 131.82 | 226.69 |
| Difference in Existing Load between REDS9, REDS10 & REDS11 | 118.87 | 218.92 |
| Load tracked from REDS10 & REDS09 | 12.95 | 7.77 |
| Total Load tracked from REDS10 & REDS09 | 131.82 | 226.69 |
| Allowable Load at REDS08 | 89.64 | 113.35 |
| Load Reduction at REDS08 | 42.18 | 113.35 |
| % Reduction required at REDS08 | 32 | 50 |

**REDS07B Rankin Run**

The TMDL for this sample point consists of a load allocation to the segment upstream to the source. The load allocation for this segment was computed using water-quality sample data collected at point REDS07B. The average flow, measured at REDS07B (472.61 MGD), is used for these computations.

| Table C7. Load Allocations for Point REDS07B | | | | |
|---|---|---|---|---|
| | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | Conc. (mg/l) | Load (lbs/day) |
| Al | ND | ND | NA | NA |
| Fe | 14.27 | 81.02 | 1.00 | 5.67 |
| Mn | 1.04 | 5.89 | 0.84 | 4.77 |
| Acid | ND | ND | NA | NA |
| Alk | 46.99 | 266.70 | | |

| Table C8. Calculation of Load Reduction at Point REDS07B | | |
|---|---|---|
| | Fe | Mn |
| Existing Load | 81.02 | 5.89 |
| Allowable Load=TMDL | 5.67 | 4.77 |
| Load Reduction | 75.35 | 1.12 |
| Total % Reduction | 93 | 19 |

**REDS07A Bute Run**

The TMDL for this sample point consists of a load allocation to the segment upstream to the source. The load allocation for this segment was computed using water-quality sample data collected at point REDS07A. The average flow, measured at REDS07A (1826.96 MGD), is used for these computations.

| Table C9. Load Allocations for Point REDS07A | | | | |
|---|---|---|---|---|
| | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | Conc. (mg/l) | Load (lbs/day) |
| Al | 0.49 | 10.76 | 0.15 | 3.34 |
| Fe | 10.58 | 232.22 | 0.42 | 9.29 |
| Mn | 0.96 | 21.01 | 0.32 | 6.93 |
| Acid | ND | ND | NA | NA |
| Alk | 28.89 | 633.82 | | |

| Table C10. Calculation of Load Reduction at Point REDS07A | | | |
|---|---|---|---|
| | Al | Fe | Mn |
| Existing Load | 10.76 | 232.22 | 21.01 |
| Allowable Load=TMDL | 3.34 | 9.29 | 6.93 |
| Load Reduction | 7.43 | 222.93 | 14.08 |
| Total % Reduction | 69 | 96 | 67 |

**Waste Load Allocation – Toby Brothers Iron & Metal Facility**

The Toby Brothers Iron & Metal Facility (NPDES PA0218618) is a metallurgic plant. Outfalls 001 and 002 are storm water runoff discharges to Craig Branch of Bute Run. Effluent limits for iron and manganese exist for this permit; however, they are non-numeric (listed as monitor and report). In addition, the permit has never reported a discharge. Therefore, a numeric wasteload allocation is not included in this TMDL.

**REDS07 Redstone Creek**

The TMDL for this segment of Redstone Creek consists of a load allocation to the area between sample points REDS07, REDS07B and REDS07A. The load allocation for this segment was computed using water-quality sample data collected at point REDS07. The average flow, measured at REDS07 (21715.80 MGD), is used for these computations.

| Table C11. Load Allocations for Point REDS07 | | | | |
|---|---|---|---|---|
| | Measured Sample Data | | Allowable | |
| Parameter | Conc. (mg/l) | Load (lbs/day) | Conc. (mg/l) | Load (lbs/day) |
| Al | ND | ND | NA | NA |
| Fe | 3.66 | 954.42 | 0.81 | 209.97 |
| Mn | 0.45 | 117.72 | NA | NA |
| Acid | ND | ND | NA | NA |
| Alk | 140.88 | 36741.23 | | |

The calculated load reductions for all the loads that enter point REDS07 must be accounted for in the calculated reductions at sample point REDS07 shown in Table C12.

| Table C12. Calculation of Load Reduction at Point REDS07 | |
|---|---|
| | Fe |
| Existing Load | 954.42 |
| Difference in Existing Load between REDS08, REDS07B, REDS07A & REDS07 | 414.49 |
| Load tracked from REDS08, REDS07B & REDS07A | 128.31 |
| Total Load tracked from REDS08, REDS07B & REDS07A | 542.79 |
| Allowable Load at REDS07 | 209.97 |
| Load Reduction at REDS07 | 332.82 |
| % Reduction required at REDS07 | 61 |

**Waste Load Allocation – Stash Mining Co. (SMP26070104, NPDES # PA0251135)**

Stash Mining Co. has four mine drainage treatment facilities requiring treatment. The following table shows the waste load allocation for the discharges that flow into UNT 40005 upstream of REDS07.

| Table C13. Waste load allocations for the Stash Mining Co. mining operations | | | |
|---|---|---|---|
| Parameter | Monthly Avg. Allowable Conc. (mg/L) | Average Flow | Allowable Load |
| | | (MGD) | (lbs/day) |
| Al | 0.75 | 0.18 | 1.12 |
| Fe | 3.0 | 0.18 | 4.52 |
| Mn | 2.0 | 0.18 | 3.00 |

**REDS06 Redstone Creek**

No reductions are necessary for the segment from REDS06 to REDS07 because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**Waste Load Allocation – Stash Mining Co. (SMP26070104, NPDES # PA0251135)**

Stash Mining Co. has two mine drainage treatment facilities requiring treatment. The following table shows the waste load allocation for the discharges that flow into Redstone Creek upstream of REDS06.

| Table C14. Waste load allocations for the Stash Mining Co. mining operations | | | |
|---|---|---|---|
| Parameter | Monthly Avg. Allowable Conc. (mg/L) | Average Flow | Allowable Load |
| | | (MGD) | (lbs/day) |
| Al | 0.75 | 0.09 | 0.56 |
| Fe | 3.0 | 0.09 | 2.26 |
| Mn | 2.0 | 0.09 | 1.50 |

**REDS05 Crabapple Run**

No reductions are necessary for this segment because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**REDS04 Redstone Creek**

No reductions are necessary for the segment from REDS04 to REDS05 and REDS06 because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**REDS03 Redstone Creek**

No reductions are necessary for the segment from REDS03 to REDS04 because water quality standards are being attained. Because water quality standards are being attained, no TMDL is necessary.

**REDS02 UNT 39937**

Biological assessments demonstrate that the segment from REDS02 to the source is attaining its designated uses. Because its uses are being attained, no TMDL is necessary.

**REDS01 Redstone Creek**

The TMDL for this segment of Redstone Creek consists of a load allocation to the area between sample points REDS01, REDS02 and REDS03. The load allocation for this segment was computed using water-quality sample data collected at point REDS01. The average flow, measured at REDS01 (29180.20 MGD), is used for these computations.

**Table C15. Load Allocations for Point REDS01**

| | Measured Sample Data | | Allowable | |
|---|---|---|---|---|
| Parameter | Conc. (mg/l) | Load (lbs/day) | Conc. (mg/l) | Load (lbs/day) |
| Al | ND | ND | NA | NA |
| Fe | 0.52 | 182.79 | 0.30 | 104.19 |
| Mn | 0.06 | 21.52 | NA | NA |
| Acid | ND | ND | NA | NA |
| Alk | 193.76 | 67901.74 | | |

The calculated load reductions for all the loads that enter point REDS01 must be accounted for in the calculated reductions at sample point REDS01 shown in Table C16.

**Table C16. Calculation of Load Reduction at Point REDS01**

| | Al |
|---|---|
| Existing Load | 182.79 |
| Difference in Existing Load between REDS03, REDS02 & REDS01 | 152.39 |
| Load tracked from REDS03 & REDS02 | 30.40 |
| Total Load tracked from REDS03 & REDS02 | 182.79 |
| Allowable Load at REDS01 | 104.19 |
| Load Reduction at REDS01 | 78.60 |
| % Reduction required at REDS01 | 43 |

**Margin of Safety (MOS)**

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:

A MOS is added when 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 represent 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*

## Method for Calculating Loads from Mine Drainage Treatment Facilities from Surface Mines

## 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.

Total Measured Load = Allowed Load + 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

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 0.75 mg/l x 0.01202 = 0.3 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 abandoned 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 Abandoned mine drainage 1987-1996: A Post Mortem Study, March 1999). As a result of efforts to insure that abandoned 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 may be greater than the current level of mining activity, an additional WLA amount may be included in the allowed load to allow for future mining.

# *Attachment E*

## Excerpts Justifying Changes between the 1996, 1998, and 2002 Section 303(d) Lists and the 2004 and 2006 Integrated Water Quality Reports

The following are excerpts from the Pennsylvania DEP Section 303(d) narratives that justify changes in listings between the 1996, 1998, and 2002 303(d) Lists and the 2004 and 2006 Integrated Water Quality Report. The Section 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

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In the 1996 Section 303(d) narrative, strategies were outlined for changes to the listing process. Suggestions included, but were not limited to, a migration to a Global Information System (GIS), improved monitoring and assessment, and greater public input.

The migration to a GIS was implemented prior to the development of the 1998 Section 303(d) list. As a result of additional sampling and the migration to the GIS some of the information appearing on the 1996 list differed from the 1998 list. Most common changes included:

1. mileage differences due to recalculation of segment length by the GIS;
2. slight changes in source(s)/cause(s) due to new EPA codes;
3. changes to source(s)/cause(s), and/or miles due to revised assessments;
4. corrections of misnamed streams or streams placed in inappropriate SWP subbasins; and
5. unnamed tributaries no longer identified as such and placed under the named watershed listing.

Prior to 1998, segment lengths were computed using a map wheel and calculator. The segment lengths listed on the 1998 Section 303(d) list were calculated automatically by the GIS (ArcInfo) using a constant projection and map units (meters) for each watershed. Segment lengths originally calculated by using a map wheel and those calculated by the GIS did not always match closely. This was the case even when physical identifiers (e.g., tributary confluence and road crossings) matching the original segment descriptions were used to define segments on digital quad maps. This occurred to some extent with all segments, but was most noticeable in segments with the greatest potential for human errors using a map wheel for calculating the original segment lengths (e.g., long stream segments or entire basins).

## Migration to National Hydrography Data (NHD)

New to the 2006 report is use of the 1/24,000 National Hydrography Data (NHD) streams GIS layer. Up until 2006 the Department relied upon its own internally developed stream layer. Subsequently, the United States Geologic Survey (USGS) developed 1/24,000 NHD streams layer for the Commonwealth based upon national geodatabase standards. In 2005, DEP contracted with USGS to add missing streams and correct any errors in the NHD. A GIS contractor transferred the old DEP stream assessment information to the improved NHD and the old DEP streams layer was archived. Overall, this marked an improvement in the quality of the streams layer and made the stream assessment data compatible with national standards but it necessitated a change in the Integrated Listing format. The NHD is not attributed with the old DEP five digit stream codes so segments can no longer be listed by stream code but rather only by stream name or a fixed combination of NHD fields known as reachcode and ComID. The NHD is aggregated by Hydrologic Unit Code (HUC) watersheds so HUCs rather than the old State Water Plan (SWP) watersheds are now used to group streams together. A more basic change was the shift in data management philosophy from one of “dynamic segmentation” to “fixed segments”. The dynamic segmentation records were proving too difficult to mange from an historical tracking perspective. The fixed segment methods will remedy that problem. The stream assessment data management has gone through many changes over the years as system requirements and software changed. It is hoped that with the shift to the NHD and OIT’s (Office of Information Technology) fulltime staff to manage and maintain SLIMS the systems and formats will now remain stable over many Integrated Listing cycles.

# *Attachment F*

## Water Quality Data Used In TMDL Calculations

| Monitoring Point: | REDS16 | | | UNT 40135 | | |
|---|---|---|---|---|---|---|
| Date Collected | Alk MG/L | Al MG/L | Flow GPM | Acid MG/L | Fe MG/L | Mn MG/L |
| 8/23/2007 | 197.6 | 0.25 | 578 | -168.8 | 0.15 | 0.072 |
| 9/13/2007 | 228.2 | 0.25 | 144 | -159.6 | 0.396 | 0.101 |
| 10/9/2007 | 227.8 | 0.25 | 35 | -196.8 | 0.15 | 0.051 |
| Average | 217.87 | 0.25 | 252.33 | -175.07 | 0.23 | 0.07 |
| StDev | 17.55 | 0.00 | 287.25 | 19.38 | 0.14 | 0.03 |

| Monitoring Point: | REDS15 | | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| Date Collected | Alk MG/L | Al MG/L | Flow GPM | Acid MG/L | Fe MG/L | Mn MG/L |
| 8/23/2007 | 33 | 0.25 | 4675 | -14.8 | 0.15 | 0.025 |
| 9/13/2007 | 44.4 | 0.25 | 217 | -23.8 | 0.15 | 0.025 |
| 10/9/2007 | 54 | 0.25 | 16 | -30.8 | 0.15 | 0.058 |
| 11/15/2007 | 49 | 0.25 | 6295 | -27.4 | 0.363 | 0.025 |
| 4/7/2008 | 20.8 | 0.25 | 4025 | -7.6 | 0.15 | 0.025 |
| Average | 40.24 | 0.25 | 3045.60 | -20.88 | 0.19 | 0.03 |
| StDev | 13.36 | 0.00 | 2799.65 | 9.52 | 0.10 | 0.01 |

| Monitoring Point: | REDS14 | | | Lick Run | | |
|---|---|---|---|---|---|---|
| Date Collected | Alk MG/L | Al MG/L | Flow GPM | Acid MG/L | Fe MG/L | Mn MG/L |
| 8/23/2007 | 40 | 0.25 | 7693 | -23.4 | 0.15 | 0.025 |
| 9/13/2007 | 102 | 0.25 | 333 | -34.4 | 0.15 | 0.058 |
| 10/9/2007 | 136.4 | 0.25 | 51 | -68.8 | 0.15 | 0.28 |
| Average | 92.80 | 0.25 | 2692.33 | -42.20 | 0.15 | 0.12 |
| StDev | 48.85 | 0.00 | 4333.00 | 23.68 | 0.00 | 0.14 |

| Monitoring Point: | REDS13 | | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| Date Collected | Alk MG/L | Al MG/L | Flow GPM | Acid MG/L | Fe MG/L | Mn MG/L |
| 8/23/2007 | 52 | 0.25 | 15514 | -14 | 0.434 | 0.17 |
| 9/13/2007 | 101.6 | 0.25 | 766 | -27 | 0.353 | 0.39 |
| 10/9/2007 | 158.4 | 0.25 | 122 | -99.8 | 0.725 | 0.318 |
| 11/15/2007 | 66.4 | 0.579 | 22587 | -40.6 | 0.634 | 0.107 |
| 4/7/2008 | 31.4 | 0.25 | 11731 | -17 | 0.15 | 0.158 |
| Average | 81.96 | 0.32 | 10144.00 | -39.68 | 0.46 | 0.23 |
| StDev | 49.81 | 0.15 | 9676.92 | 35.18 | 0.23 | 0.12 |

| Monitoring Point: | | REDS12 | | UNT 40124 | | |
|---|---|---|---|---|---|---|
| Date | Alk | Al | Flow | Acid | Fe | Mn |
| Collected | MG/L | MG/L | GPM | MG/L | MG/L | MG/L |
| 8/23/2007 | 109.4 | 0.25 | 816 | -27 | 0.983 | 0.325 |
| 9/13/2007 | 140.6 | 0.25 | 70 | -68.6 | 2.46 | 1.54 |
| 10/9/2007 | 125.2 | 0.25 | 22 | -48 | 1.01 | 2.15 |
| 11/15/2007 | 81.2 | 0.825 | 4879 | -61.4 | 1.88 | 0.161 |
| 4/7/2008 | 65 | 0.25 | 777 | -38.8 | 0.762 | 0.263 |
| Average | 104.28 | 0.37 | 1312.80 | -48.76 | 1.42 | 0.89 |
| StDev | 31.06 | 0.26 | 2028.69 | 16.78 | 0.72 | 0.90 |

| Monitoring Point: | | REDS11 | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| Date | Alk | Al | Flow | Acid | Fe | Mn |
| Collected | MG/L | MG/L | GPM | MG/L | MG/L | MG/L |
| 8/23/2007 | 68.4 | 0.25 | 28180 | -37 | 0.584 | 0.18 |
| 9/13/2007 | 120.6 | 0.25 | 1009 | -78.2 | 0.15 | 0.025 |
| 10/9/2007 | 169.6 | 0.25 | 96 | -113.4 | 0.15 | 0.059 |
| Average | 119.53 | 0.25 | 9761.67 | -76.20 | 0.29 | 0.09 |
| StDev | 50.61 | 0.00 | 15957.28 | 38.24 | 0.25 | 0.08 |

| Monitoring Point: | | REDS10 | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| Date | Alk | Al | Flow | Acid | Fe | Mn |
| Collected | MG/L | MG/L | GPM | MG/L | MG/L | MG/L |
| 8/29/2007 | 167.2 | 0.25 | 3816 | -124.8 | 0.15 | 0.061 |
| 9/13/2007 | 179.4 | 0.25 | 2352 | -130.4 | 0.15 | 0.025 |
| 10/3/2007 | 222.2 | 0.25 | 1466 | -169 | 0.15 | 0.058 |
| Average | 189.60 | 0.25 | 2544.67 | -141.40 | 0.15 | 0.05 |
| StDev | 28.88 | 0.00 | 1186.79 | 24.07 | 0.00 | 0.02 |

| Monitoring Point: | | REDS09 | | Cove Run | | |
|---|---|---|---|---|---|---|
| Date | Alk | Al | Flow | Acid | Fe | Mn |
| Collected | MG/L | MG/L | GPM | MG/L | MG/L | MG/L |
| 8/29/2007 | 131.6 | 0.25 | 3493 | -75.2 | 0.15 | 0.061 |
| 9/13/2007 | 144 | 0.25 | 1308 | -99.2 | 0.15 | 0.056 |
| 10/3/2007 | 173.2 | 0.25 | 504 | -105.8 | 0.15 | 0.078 |
| Average | 149.60 | 0.25 | 1768.33 | -93.40 | 0.15 | 0.07 |
| StDev | 21.36 | 0.00 | 1546.76 | 16.10 | 0.00 | 0.01 |

| Monitoring Point: | | REDS08 | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| **Date Collected** | **Alk MG/L** | **Al MG/L** | **Flow GPM** | **Acid MG/L** | **Fe MG/L** | **Mn MG/L** |
| 8/29/2007 | 148.4 | 0.25 | 11568 | -98.2 | 0.302 | 0.025 |
| 9/13/2007 | 123.4 | 0.25 | 6841 | -83.2 | 0.15 | 0.025 |
| 10/3/2007 | 137.4 | 0.25 | 4857 | -91 | 0.15 | 0.025 |
| 11/15/2007 | 85.4 | 0.727 | 108793 | -66.6 | 1.59 | 0.208 |
| 4/7/2008 | 81.4 | 0.25 | 26830 | -58.6 | 0.778 | 0.165 |
| Average | 115.20 | 0.35 | 31777.80 | -79.52 | 0.59 | 0.09 |
| StDev | 30.38 | 0.21 | 43905.67 | 16.57 | 0.61 | 0.09 |

| Monitoring Point: | | REDS07B | | Rankin Run | | |
|---|---|---|---|---|---|---|
| **Date Collected** | **Alk MG/L** | **Al MG/L** | **Flow GPM** | **Acid MG/L** | **Fe MG/L** | **Mn MG/L** |
| 11/14/2007 | 198.6 | 0.25 | 1347 | -161.6 | 17 | 1.03 |
| 5/28/2008 | 220 | 0.25 | 2087 | -179.4 | 12.596 | 0.932 |
| 6/25/2008 | 210.4 | 0.25 | 1017 | -192.8 | 12.285 | 1.102 |
| 7/10/2008 | 302 | 0.25 | 1179 | * | 15.215 | 1.087 |
| Average | 232.75 | 0.25 | 1407.50 | -177.93 | 14.27 | 1.04 |
| StDev | 46.99 | 0.00 | 472.61 | 15.65 | 2.24 | 0.08 |

| Monitoring Point: | | REDS07A | | Bute Run | | |
|---|---|---|---|---|---|---|
| **Date Collected** | **Alk MG/L** | **Al MG/L** | **Flow GPM** | **Acid MG/L** | **Fe MG/L** | **Mn MG/L** |
| 11/14/2007 | 115.2 | 0.25 | 591 | -81.2 | 0.15 | 0.087 |
| 5/28/2008 | 155.6 | 1.212 | 2125 | -119.6 | 13.406 | 1.147 |
| 6/25/2008 | 169.2 | 0.25 | 2237 | -155.6 | 15.123 | 1.343 |
| 7/10/2008 | 181.8 | 0.25 | 4982 | * | 13.656 | 1.253 |
| Average | 155.45 | 0.49 | 2483.75 | -118.80 | 10.58 | 0.96 |
| StDev | 28.89 | 0.48 | 1826.96 | 37.21 | 7.00 | 0.59 |

| Monitoring Point: | | REDS07 | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| **Date Collected** | **Alk MG/L** | **Al MG/L** | **Flow GPM** | **Acid MG/L** | **Fe MG/L** | **Mn MG/L** |
| 8/29/2007 | 152.4 | 0.25 | 18833 | -87.6 | 2.82 | 0.341 |
| 9/13/2007 | 145.8 | 0.25 | 17287 | -89.6 | 2.81 | 0.459 |
| 10/3/2007 | 160.4 | 0.25 | 8800 | -101.2 | 3.13 | 0.635 |
| 11/14/2007 | 131 | 0.25 | 19307 | -93.2 | 4.43 | 0.403 |
| 4/8/2008 | 114.8 | 0.25 | 44352 | -104.4 | 5.108 | 0.419 |
| Average | 140.88 | 0.25 | 21715.80 | -95.20 | 3.66 | 0.45 |
| StDev | 18.14 | 0.00 | 13350.49 | 7.31 | 1.05 | 0.11 |

| Monitoring Point: | | REDS06 | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| **Date Collected** | **Alk MG/L** | **Al MG/L** | **Flow GPM** | **Acid MG/L** | **Fe MG/L** | **Mn MG/L** |
| 8/29/2007 | 148.4 | 0.25 | 20465 | -92.4 | 0.441 | 0.093 |
| 9/20/2007 | 153.4 | 0.25 | 13538 | -118.2 | 0.445 | 0.111 |
| 10/3/2007 | 151.2 | 0.25 | 9609 | -108.4 | 0.404 | 0.087 |
| 11/14/2007 | 124 | 0.25 | 21629 | -89.6 | 1.04 | 0.131 |
| 4/8/2008 | 112.2 | 0.25 | 46729 | -108 | 3.236 | 0.338 |
| Average | 137.84 | 0.25 | 22394.00 | -103.32 | 1.11 | 0.15 |
| StDev | 18.58 | 0.00 | 14477.43 | 12.01 | 1.22 | 0.11 |

| Monitoring Point: | | REDS05 | | Crabapple Run | | |
|---|---|---|---|---|---|---|
| **Date Collected** | **Alk MG/L** | **Al MG/L** | **Flow GPM** | **Acid MG/L** | **Fe MG/L** | **Mn MG/L** |
| 8/29/2007 | 199.2 | 0.25 | 574 | -156.4 | 0.15 | 0.025 |
| 9/20/2007 | 238.2 | 0.25 | 100 | -206.4 | 0.15 | 0.025 |
| 10/3/2007 | 257.4 | 0.25 | 40 | -234.2 | 0.15 | 0.025 |
| 11/14/2007 | 176.4 | 0.25 | 528 | -167.4 | 0.15 | 0.025 |
| 4/8/2008 | 159.2 | 0.25 | 1562 | -142.6 | 0.15 | 0.025 |
| Average | 206.08 | 0.25 | 560.80 | -181.40 | 0.15 | 0.03 |
| StDev | 41.20 | 0.00 | 609.76 | 37.88 | 0.00 | 0.00 |

| Monitoring Point: | | REDS04 | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| **Date Collected** | **Alk MG/L** | **Al MG/L** | **Flow GPM** | **Acid MG/L** | **Fe MG/L** | **Mn MG/L** |
| 8/29/2007 | 148 | 0.25 | 21160 | -80.8 | 0.667 | 0.084 |
| 9/20/2007 | 151 | 0.25 | 11473 | -117.6 | 0.15 | 0.05 |
| 10/3/2007 | 142.4 | 0.25 | 9878 | -107.2 | 0.15 | 0.025 |
| 11/14/2007 | 125.8 | 0.25 | 23044 | -94 | 0.923 | 0.097 |
| 4/8/2008 | 110.8 | 0.25 | 40381 | -97.6 | 2.963 | 0.32 |
| Average | 135.60 | 0.25 | 21187.20 | -99.44 | 0.97 | 0.12 |
| StDev | 16.94 | 0.00 | 12187.23 | 13.88 | 1.16 | 0.12 |

| Monitoring Point: | | REDS03 | | Redstone Creek | | |
|---|---|---|---|---|---|---|
| **Date Collected** | **Alk MG/L** | **Al MG/L** | **Flow GPM** | **Acid MG/L** | **Fe MG/L** | **Mn MG/L** |
| 8/29/2007 | 149.4 | 0.25 | 27422 | -102 | 0.15 | 0.025 |
| 9/20/2007 | 153.2 | 0.25 | 12595 | -126.4 | 0.15 | 0.025 |
| 10/3/2007 | 158 | 0.25 | 10379 | -126 | 0.15 | 0.025 |
| Average | 153.53 | 0.25 | 16798.67 | -118.13 | 0.15 | 0.03 |
| StDev | 4.31 | 0.00 | 9266.56 | 13.97 | 0.00 | 0.00 |

| Monitoring Point: | REDS02 | | UNT 39937 | | | |
|---|---|---|---|---|---|---|
| Date Collected | Alk MG/L | Al MG/L | Flow GPM | Acid MG/L | Fe MG/L | Mn MG/L |
| 8/29/2007 | 226.6 | 0.25 | 53 | -182 | 0.589 | 0.025 |
| 9/20/2007 | | | 0 | | | |
| 10/3/2007 | | | 0 | | | |
| 11/14/2007 | 255 | 0.25 | 2.1 | -209.8 | 0.15 | 0.025 |
| 4/8/2008 | 222.2 | 0.25 | 135 | -213.4 | 0.15 | 0.025 |
| Average | 234.60 | 0.25 | 38.02 | -201.73 | 0.30 | 0.03 |
| StDev | 17.80 | 0.00 | 58.76 | 17.18 | 0.25 | 0.00 |

| Monitoring Point: | REDS01 | | Redstone Creek | | | |
|---|---|---|---|---|---|---|
| Date Collected | Alk MG/L | Al MG/L | Flow GPM | Acid MG/L | Fe MG/L | Mn MG/L |
| 8/29/2007 | 193 | 0.25 | 27753 | -133.4 | 0.15 | 0.025 |
| 9/20/2007 | 225 | 0.25 | 15001 | -169.4 | 0.15 | 0.025 |
| 10/3/2007 | 242.4 | 0.25 | 11777 | -176.4 | 0.15 | 0.025 |
| 11/14/2007 | 161.4 | 0.25 | 29516 | -118.6 | 0.837 | 0.025 |
| 4/8/2008 | 147 | 0.25 | 61854 | -137.6 | 1.321 | 0.207 |
| Average | 193.76 | 0.25 | 29180.20 | -147.08 | 0.52 | 0.06 |
| StDev | 40.55 | 0.00 | 19834.62 | 24.73 | 0.54 | 0.08 |

# ***Attachment G***

## Comment and Response

No public comments were received for the Redstone Creek Watershed TMDL.

# *Attachment H*

## TMDLs and NPDES Permitting Coordination

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

**Load Tracking Mechanisms**

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

**Options for Permittees in TMDL Watersheds**

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

**Options identified**

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

## Other possible options

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

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

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

# *Attachment I*

## Redstone Creek Sediment Calculations

# Redstone 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 24 years simulated by the model (1975 to 1998). This information was then used to calculate existing unit area loading rates for the Redstone Creek and Upper South Fork Tenmile Creek Watersheds.

| Table A. Existing Loading Values for Redstone Creek (impaired) | | | |
|---|---|---|---|
| Source | Area (ac) | Sediment (lbs) | Unit Area Load (lbs/ac/yr) |
| HAY/PAST | 8,807 | 1,149,000 | 130 |
| CROPLAND | 10,245 | 19,377,000 | 1,891 |
| FOREST | 37,955 | 659,200 | 17 |
| WETLAND | 163 | 200 | 1 |
| COAL_MINES | 210 | 3,561,400 | 16,959 |
| TURF_GRASS | 344 | 31,800 | 93 |
| UNPAVED_RD | 17 | 108,200 | 6,254 |
| TRANSITION | 892 | 1,258,000 | 1,410 |
| LO_INT_DEV | 10,411 | 499,000 | 48 |
| HI_INT_DEV | 314 | 10,200 | 33 |
| Stream Bank | | 13,513,600 | |
| total | 69,357 | 40,167,600 | 579 |

| Table B. Existing Loading Values for Upper South Fork Tenmile Creek(reference) | | | |
|---|---|---|---|
| Source | Area (ac) | Sediment (lbs.) | Unit Area Load (lb/ac/yr) |
| HAY/PAST | 7,801 | 914,400 | 117 |
| CROPLAND | 7,391 | 11,805,800 | 1,597 |
| FOREST | 56,795 | 909,200 | 16 |
| WETLAND | 42 | 200 | 5 |
| COAL_MINES | 59 | 91,000 | 1,535 |
| Unpaved_Rd | 287 | 2,846,400 | 9,932 |
| TRANSITION | 208 | 446,200 | 2,149 |
| LO_INT_DEV | 1,092 | 34,000 | 31 |
| HI_INT_DEV | 10 | 2,600 | 263 |
| Stream Bank | | 13,922,600 | |
| total | 73,684 | 30,972,400 | 420 |

The TMDL target sediment load for Redstone Creek is the product of the unit area sediment-loading rate in the reference watershed (Upper South Fork Tenmile Creek) and the total area of the impaired watershed (Redstone 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 Upper South Fork Tenmile Creek (lbs/acre/yr) | Total Watershed Area in Redstone Creek (acres) | TMDL Total Load (lbs/year) |
| Sediment | 420 | 69,357 | 29,153,632 |

**Targeted TMDL values were used as the basis for load allocations and reductions in the Redstone 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

*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 * 29,153,632

MOS = 2,915,363 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 = 29,153,632 – 2,915,363 – 14,383

LA = 26,223,885 lbs/yr

LA = 6,092.84 lbs/day

*Waste Load Allocation*

A Waste Load Allocation (WLA) has been calculated for 3 discharges included in the Stash Mining Company NPDES permit. The standard pit size was used to calculate the average discharge. The permit limit for TSS is 35. The total waste load calculated for this TMDL is 14,383.4 lbs/yr (39.41 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 Redstone Creek Watershed were applied to COAL_MINES, TRANSITIONAL LAND and CROPLAND sources for sediment. Those land uses/sources for which existing loads were not reduced (HAY/PAST, FOREST, WETLAND, TURF_GRASS, UNPAVED_RD, LO_INT_DEV, HI_INT_DEV and Stream bank) kept their current loading values, Table D. The ALA for sediment is 10,252,685 lbs/yr.

Table D. Load Allocation, Loads Not Reduced and Adjusted Load Allocations for the Redstone Creek Sediment TMDL

| | Sediment (lbs./yr) |
|---|---|
| Load Allocation | 26,223,885 |
| Loads Not Reduced | 15,971,200 |
| Hay/past | 1,149,000 |
| FOREST | 659,200 |
| Wetland | 200 |
| Turf_grass | 31,800 |
| unpaved_rd | 108,200 |
| lo_int_dev | 499,000 |
| hi_int_dev | 10,200 |
| *stream bank* | 13,513,600 |
| Adjusted load allocation | 10,252,685 |

*TMDL*

The sediment TMDL for the Redstone Creek Watershed consists of a Load Allocation, Margin of Safety (MOS) and a Waste Load Allocation (WLA). The individual components of the TMDL are summarized in Table E.

| Table E. TMDL, WLA, MOS, LA, LNR and ALA for Redstone Creek Sediment TMDL | | |
|---|---|---|
| Component | Sediment (lbs/yr) | Sediment (lbs/day) |
| TMDL (Total Maximum Daily Load) | 29,153,632 | 79,873 |
| WLA (Waste Load Allocation) | 14,383 | 39 |
| MOS (Margin of Safety) | 2,915,363 | 7,987 |
| LA (Load Allocation) | 26,223,885 | 71,846 |
| LNR (Loads Not Reduced) | 15,971,200 | 43,757 |
| ALA (Adjusted Load Allocation) | 10,252,685 | 28,090 |

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

| Table F. Sediment Load Allocations & Reductions for the Redstone Creek Watershed | | | | | | |
|---|---|---|---|---|---|---|
| Pollutant Source | Acres | Unit Area Loading Rate (lbs/ac/yr) | | Pollutant Loading (lbs/yr) | | Percent Reduction |
| | | Current | Allowable | Current | Allowable | |
| CROPLAND | 10224 | 1891.36 | 680.75 | 19,377,000 | 6,974,321 | 64% |
| COAL MINES | 210 | 16959.05 | 11536.28 | 3,561,400 | 2,422,619 | 32% |
| TRANSITIONAL | 892 | 1410.31 | 959.36 | 1,258,000 | 855,746 | 32% |
| TOTAL | | | | 24,196,400 | 10,252,685 | 58% |

*Consideration of Critical Conditions*

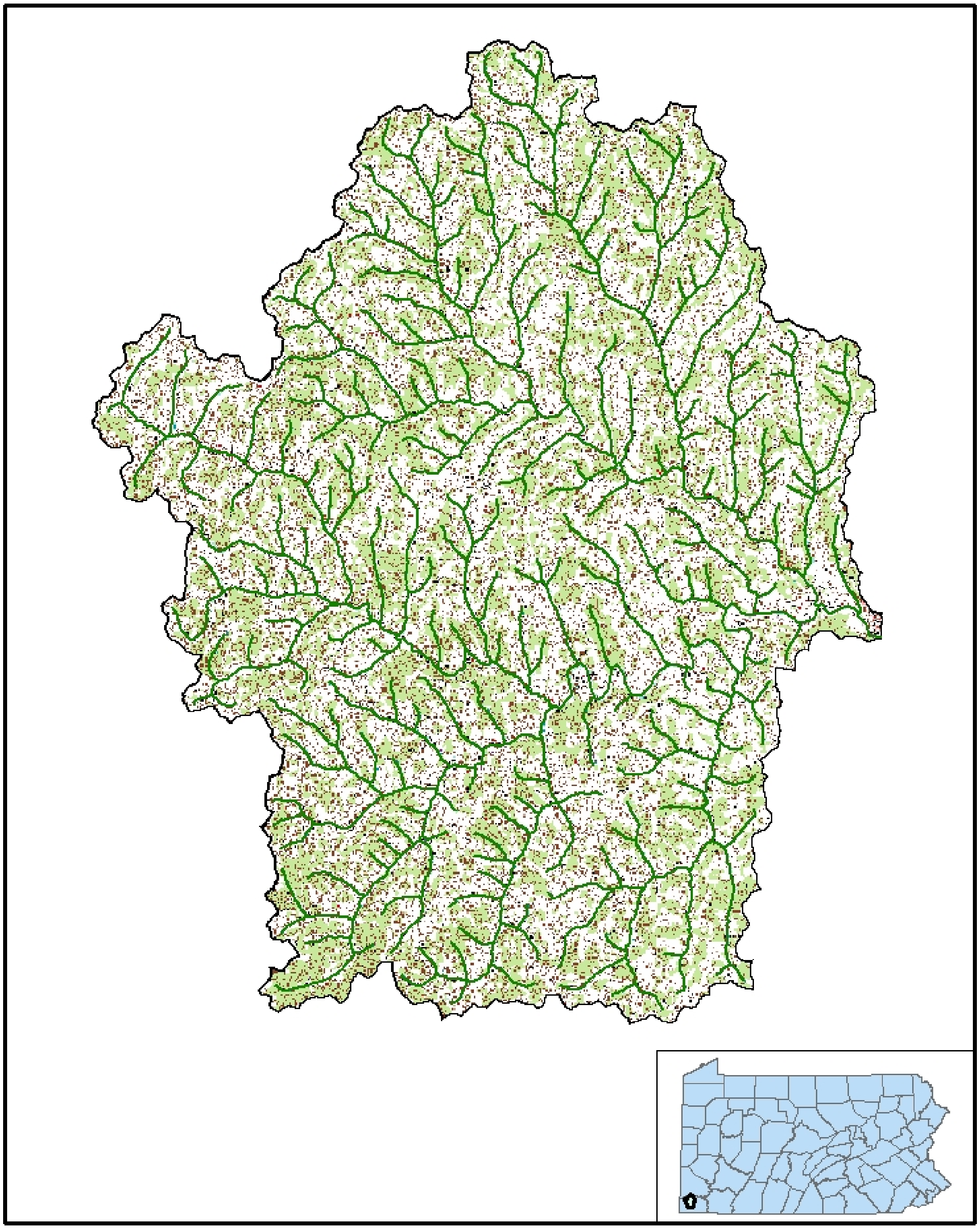
The AVGWLF model is a continuous simulation model, which uses daily time steps for weather data and water balance calculations. Monthly calculations are made for sediment loads based on the daily water balance accumulated to monthly values. Therefore, all flow conditions are taken into account for loading 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 J***

## **Map of Reference Watershed Upper South Fork Tenmile Creek**



Upper South Fork Tenmile Creek

# *Attachment K*

## AVGWLF Model Overview & GIS-Based Derivation of Input Data

TMDLs for the Redstone 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 Watershed Management.

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 Arc View (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 (Arc View 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 L*

## 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 Redstone Creek

Microsoft Excel - 9-17EMPR.xls

P28

| | 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 | | | | | 10252685 | 10252685 | | | | | |
| 3 | | 29153632 | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | |
| 6 | | | Annual Average | | | | | % reduction | | | | Allowable | |
| 7 | Step 3: | | Load | Load Sum | Check | Initial Adjust | Recheck | allocation | Load Reduct | Initial LA | Acres | Loading Rate | % Reduction |
| 8 | | CROPLAND | 19377000.0 | 24196400.0 | bad | 10252685 | ADJUST | 0.68 | 3278365 | 6974321 | 10245 | 680.75 | 64.0% |
| 9 | | | | | | | 4819400 | | | | | | |
| 10 | | COAL MINES | 3561400.0 | | good | 3561400 | | 0.24 | 1138781 | 2422619 | 210 | 11536.28 | 32.0% |
| 11 | | | | | | | | | | | | | |
| 12 | | Transitional | 1258000.0 | | good | 1258000 | | 0.08 | 402254 | 855746 | 892 | 959.36 | 32.0% |
| 13 | | | | | | | | | | | | | |
| 14 | | | | | | 15072085 | | 1.00 | | 10252685 | | | |
| 15 | | | | | | | | | | | | | |
| 16 | | All Ag. Loading Rat | 903.56 | | | | | | | | | | |
| 17 | Step 4: | | | | | | | | | | | | |
| 18 | | | | Allowable (Target) | | Current | | | | | | | |
| 19 | | | Acres | loading rate | Final LA | Loading Rates | Current Load | % Red. | | | | | |
| 20 | Step 5: | CROPLAND | 10245 | 680.75 | 6974321 | 1891.36 | 19377000 | 64% | | | | | |
| 21 | | | | | | | | | | | | | |
| 22 | | COAL MINES | 210 | 11536.28 | 2422619 | 16959.05 | 3561400 | 32% | | | | | |
| 23 | | | | | | | | | | | | | |
| 24 | | transitional | 892 | 959.36 | 855746 | 1410.31 | 1258000 | 32% | | | | | |
| 25 | | | | | | | | | | | | | |
| 26 | | | | | 10252685 | | 24196400 | 58% | | | | | |
| 27 | | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | | |
| 29 | | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | | |

lbs. / empr

Ready NUM

# *Attachment M*

## AVGWLF OUTPUT

## AVGWLF Transport File and Model Output for Redstone Creek

GWLF Total Loads for file: redstone9-17(5)-1

Period of analysis: 24 years from 1975 to 1998

| Source | Area (Acres) | Runoff (in) | Tons: Erosion | Tons: Sediment | Total Loads (Pounds): Dis N | Total N | Dis P | Total P |
|---|---|---|---|---|---|---|---|---|
| Hay/Past | 8806.8 | 1.4 | 6838.8 | 574.5 | 7559.8 | 11006.5 | 703.4 | 992.9 |
| Cropland | 10245.0 | 2.8 | 115339.0 | 9688.5 | 17048.8 | 75179.7 | 1576.6 | 6459.6 |
| Forest | 37955.3 | 1.2 | 3923.3 | 329.6 | 1934.0 | 3911.4 | 61.1 | 227.2 |
| Wetland | 163.1 | 4.6 | 1.0 | 0.1 | 32.3 | 32.8 | 1.0 | 1.1 |
| Coal_Mines | 210.0 | 4.6 | 21199.1 | 1780.7 | 2.6 | 10687.0 | 0.4 | 897.9 |
| Turf_Grass | 343.5 | 1.0 | 189.2 | 15.9 | 190.3 | 285.6 | 6.3 | 14.4 |
| Unpaved_Rd | 17.3 | 4.6 | 644.6 | 54.1 | 52.3 | 377.2 | 3.6 | 30.9 |
| Transition | 892.0 | 4.6 | 7488.4 | 629.0 | 2696.9 | 6471.0 | 186.0 | 503.0 |
| Lo_Int_Dev | 10410.5 | 3.1 | 2969.7 | 249.5 | 0.0 | 4219.1 | 0.0 | 562.6 |
| Hi_Int_Dev | 313.8 | 9.4 | 60.5 | 5.1 | 0.0 | 2130.3 | 0.0 | 236.2 |
| Farm Animals | | | | | | 0.0 | | 0.0 |
| Tile Drainage | | | | 0.0 | | 0.0 | | 0.0 |
| Stream Bank | | | | 6756.8 | | 675.7 | | 297.3 |
| Groundwater | | | | | 235930.7 | 235930.7 | 4291.8 | 4291.8 |
| Point Sources | | | | | 102726.5 | 102726.5 | 1285.2 | 1285.2 |
| Septic Systems | | | | | 3866.0 | 3866.0 | 569.2 | 569.2 |
| Totals | 69357.4 | 1.80 | 158653.6 | 20083.7 | 372040.1 | 457499.4 | 8684.5 | 16369.1 |

Go Back | Pathogen Loads | Export to JPEG | Print | Close

| Rural LU | Area (ha) | CN | K | LS | C | P |
|---|---|---|---|---|---|---|
| Hay/Past | 3564 | 75 | 0.32 | 2.107 | 0.03 | 0.45 |
| Cropland | 4146 | 82 | 0.324 | 2.155 | 0.42 | 0.45 |
| Forest | 15360 | 73 | 0.303 | 3.845 | 0.002 | 0.52 |
| Wetland | 66 | 87 | 0.325 | 0.22 | 0.01 | 0.1 |
| Coal_Mines | 85 | 87 | 0.245 | 7.545 | 0.8 | 0.8 |
| Turf_Grass | 139 | 71 | 0.316 | 1.277 | 0.08 | 0.2 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| **Bare Land** | **Area (ha)** | **CN** | **K** | **LS** | **C** | **P** |
| Unpaved_Rd | 7 | 87 | 0.312 | 1.75 | 0.8 | 1 |
| Transition | 361 | 87 | 0.323 | 0.476 | 0.8 | 0.8 |
| **Urban LU** | **Area (ha)** | **CN** | **K** | **LS** | **C** | **P** |
| Lo_Int_Dev | 4213 | 83 | 0.323 | 0.647 | 0.08 | 0.2 |
| Hi_Int_Dev | 127 | 93 | 0.32 | 0.441 | 0.08 | 0.2 |

| Month | Ket | Day Hours | Season | Eros Coef | Stream Extract | Ground Extract |
|---|---|---|---|---|---|---|
| Jan | 0.63 | 9.4 | 0 | 0.08 | 0 | 0 |
| Feb | 0.68 | 10.4 | 0 | 0.08 | 0 | 0 |
| Mar | 0.71 | 11.8 | 0 | 0.08 | 0 | 0 |
| Apr | 0.72 | 13.2 | 0 | 0.26 | 0 | 0 |
| May | 0.87 | 14.3 | 1 | 0.26 | 0 | 0 |
| Jun | 0.96 | 14.9 | 1 | 0.26 | 0 | 0 |
| Jul | 1.01 | 14.6 | 1 | 0.26 | 0 | 0 |
| Aug | 1.04 | 13.6 | 1 | 0.26 | 0 | 0 |
| Sep | 1.05 | 12.2 | 1 | 0.08 | 0 | 0 |
| Oct | 0.92 | 10.8 | 0 | 0.08 | 0 | 0 |
| Nov | 0.85 | 9.7 | 0 | 0.08 | 0 | 0 |
| Dec | 0.81 | 9.1 | 0 | 0.08 | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| Init Unsat Stor (cm) | 10 | Initial Snow (cm) | 0 | Recess Coefficient | 0.1 |
| Init Sat Stor (cm) | 0 | Sed Delivery Ratio | 0.084 | Seepage Coefficient | 0 |
| Unsat Avail Wat (cm) | 14.4037 | Tile Drain Ratio | 0.5 | Sediment A Factor | 3.3250E-04 |
| | | Tile Drain Density | 0 | | |

Load File | Save File | Export to JPEG | Close

## AVGWLF Transport File and Model Output for Upper South Fork Tenmile Creek

GWLF Total Loads for file: redstonereference9-18(2)-1

Period of analysis: 24 years from 1975 to 1998

| Source | Area (Acres) | Runoff (in) | Tons | | Total Loads (Pounds) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Erosion | Sediment | Dis N | Total N | Dis P | Total P |
| Hay/Past | 7801.1 | 1.4 | 5575.1 | 457.2 | 6620.7 | 9363.7 | 640.4 | 978.7 |
| Cropland | 7390.9 | 2.7 | 71986.8 | 5902.9 | 12047.9 | 47465.4 | 1179.2 | 5547.4 |
| Forest | 56794.6 | 1.2 | 5543.6 | 454.6 | 2875.9 | 5603.3 | 90.8 | 427.2 |
| Wetland | 42.0 | 4.5 | 1.6 | 0.1 | 8.1 | 8.9 | 0.3 | 0.4 |
| Coal_Mines | 59.3 | 4.5 | 555.1 | 45.5 | 0.7 | 273.8 | 0.1 | 33.8 |
| Unpaved_Rd | 286.6 | 4.5 | 17356.5 | 1423.2 | 846.2 | 9385.6 | 58.4 | 1111.5 |
| Transition | 207.6 | 4.5 | 2720.6 | 223.1 | 612.8 | 1951.3 | 42.3 | 207.3 |
| Lo_Int_Dev | 1092.2 | 3.0 | 207.5 | 17.0 | 0.0 | 424.8 | 0.0 | 56.6 |
| Hi_Int_Dev | 9.9 | 9.1 | 15.8 | 1.3 | 0.0 | 63.6 | 0.0 | 7.1 |
| **Farm Animals** | | | | | | 0.0 | | 0.0 |
| **Tile Drainage** | | | | 0.0 | | 0.0 | | 0.0 |
| **Stream Bank** | | | | 6961.3 | | 696.1 | | 306.3 |
| **Groundwater** | | | | | 250637.0 | 250637.0 | 4218.6 | 4218.6 |
| **Point Sources** | | | | | 0.0 | 0.0 | 0.0 | 0.0 |
| **Septic Systems** | | | | | 1703.4 | 1703.4 | 302.4 | 302.4 |
| **Totals** | 73684.2 | 1.40 | 103962.7 | 15486.2 | 275352.7 | 327577.0 | 6532.3 | 13197.2 |

Go Back | Pathogen Loads | Export to JPEG | Print | Close

| Rural LU | Area (ha) | CN | K | LS | C | P |
|---|---|---|---|---|---|---|
| Hay/Past | 3157 | 75 | 0.368 | 1.779 | 0.03 | 0.45 |
| Cropland | 2991 | 82 | 0.369 | 3.627 | 0.3 | 0.3 |
| Forest | 22984 | 73 | 0.37 | 3.137 | 0.002 | 0.52 |
| Wetland | 17 | 87 | 0.376 | 1.27 | 0.01 | 0.1 |
| Coal_Mines | 24 | 87 | 0.384 | 0.471 | 0.8 | 0.8 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| | 0 | 0 | 0 | 0 | 0 | 0 |
| **Bare Land** | **Area (ha)** | **CN** | **K** | **LS** | **C** | **P** |
| Unpaved_Rd | 116 | 87 | 0.369 | 7.505 | 0.52 | 0.52 |
| Transition | 84 | 87 | 0.366 | 0.692 | 0.8 | 0.8 |
| **Urban LU** | **Area (ha)** | **CN** | **K** | **LS** | **C** | **P** |
| Lo_Int_Dev | 442 | 83 | 0.353 | 0.416 | 0.08 | 0.2 |
| Hi_Int_Dev | 4 | 93 | 0.32 | 3.872 | 0.08 | 0.2 |

| Month | Ket | Day Hours | Season | Eros Coef | Stream Extract | Ground Extract |
|---|---|---|---|---|---|---|
| Jan | 0.61 | 9.4 | 0 | 0.08 | 0 | 0 |
| Feb | 0.66 | 10.4 | 0 | 0.08 | 0 | 0 |
| Mar | 0.69 | 11.8 | 0 | 0.08 | 0 | 0 |
| Apr | 0.7 | 13.2 | 0 | 0.26 | 0 | 0 |
| May | 0.87 | 14.3 | 1 | 0.26 | 0 | 0 |
| Jun | 0.97 | 14.9 | 1 | 0.26 | 0 | 0 |
| Jul | 1.02 | 14.6 | 1 | 0.26 | 0 | 0 |
| Aug | 1.05 | 13.6 | 1 | 0.26 | 0 | 0 |
| Sep | 1.07 | 12.2 | 1 | 0.08 | 0 | 0 |
| Oct | 0.93 | 10.8 | 0 | 0.08 | 0 | 0 |
| Nov | 0.84 | 9.7 | 0 | 0.08 | 0 | 0 |
| Dec | 0.79 | 9.1 | 0 | 0.08 | 0 | 0 |

| | | | | | |
|---|---|---|---|---|---|
| **Init Unsat Stor (cm)** | 10 | **Initial Snow (cm)** | 0 | **Recess Coefficient** | 0.1 |
| **Init Sat Stor (cm)** | 0 | **Sed Delivery Ratio** | 0.082 | **Seepage Coefficient** | 0 |
| **Unsat Avail Wat (cm)** | 19.8029 | **Tile Drain Ratio** | 0.5 | **Sediment A Factor** | 3.2160E-04 |
| | | **Tile Drain Density** | 0 | | |

Load File | Save File | Export to JPEG | Close

# *Attachment N*

## Pennsylvania Integrated Water Quality Monitoring and Assessment Report Streams, Category 5 Waterbodies, Pollutants Requiring a TMDL

| Stream Name<br>Use Designation (Assessment ID)<br>Source | Cause | Date Listed | TMDL Date |
|---|---|---|---|

## Hydrologic Unit Code: 05020005 - Lower Monongahela

**Bennington Spring Run**
HUC: 05020005

Aquatic Life (4345) - 3.10 miles; 2 Segment(s)*

| Source | Cause | Date Listed | TMDL Date |
|---|---|---|---|
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Removal of Vegetation | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Bennington Spring Run (Unt 40133)**
HUC: 05020005

Aquatic Life (4345) - 0.22 miles; 1 Segment(s)*

| Source | Cause | Date Listed | TMDL Date |
|---|---|---|---|
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Removal of Vegetation | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run**
HUC: 05020005

Aquatic Life (4707) - 4.22 miles; 11 Segment(s)*

| Source | Cause | Date Listed | TMDL Date |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run (Unt 40110)**
HUC: 05020005

Aquatic Life (4707) - 1.05 miles; 1 Segment(s)*

| Source | Cause | Date Listed | TMDL Date |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run (Unt 40111)**
HUC: 05020005

Aquatic Life (4707) - 1.50 miles; 4 Segment(s)*

| Source | Cause | Date Listed | TMDL Date |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run (Unt 40113)**
HUC: 05020005

Aquatic Life (4707) - 1.60 miles; 3 Segment(s)*

| Source | Cause | Date Listed | TMDL Date |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |



*Segments are defined as individual COM IDs.

| Stream Name<br>Use Designation (Assessment ID)<br>Source Report | Pennsylvania Integrated Water Quality Monitoring and Assessment<br>Cause | Date Listed | TMDL Date |
|---|---|---|---|

**Coal Lick Run (Unt 40113)**
HUC: 05020005

Aquatic Life (4707) - 1.60 miles; 3 Segment(s)*

| | | | |
|---|---|---|---|
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run (Unt 40114)**
HUC: 05020005

Aquatic Life (4707) - 1.17 miles; 3 Segment(s)*

| | | | |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run (Unt 40115)**
HUC: 05020005

Aquatic Life (4707) - 0.42 miles; 1 Segment(s)*

| | | | |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run (Unt 40116)**
HUC: 05020005

Aquatic Life (4707) - 0.35 miles; 2 Segment(s)*

| | | | |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run (Unt 40117)**
HUC: 05020005

Aquatic Life (4707) - 0.70 miles; 1 Segment(s)*

| | | | |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |

**Coal Lick Run (Unt 40118)**
HUC: 05020005

Aquatic Life (4707) - 0.84 miles; 3 Segment(s)*

| | | | |
|---|---|---|---|
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |



*Segments are defined as individual COM IDs.

| Stream Name<br>Use Designation (Assessment ID)<br>Source Report | Pennsylvania Integrated Water Quality Monitoring and Assessment<br>Cause | Date Listed | TMDL Date |
|---|---|---|---|
| **Coal Lick Run (Unt 40119)**<br>HUC: 05020005 | | | |
| Aquatic Life (4707) - 0.54 miles; 2 Segment(s)* | | | |
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Coal Lick Run (Unt 40120)**<br>HUC: 05020005 | | | |
| Aquatic Life (4707) - 0.57 miles; 3 Segment(s)* | | | |
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Coal Lick Run (Unt 40121)**<br>HUC: 05020005 | | | |
| Aquatic Life (4707) - 0.52 miles; 1 Segment(s)* | | | |
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Coal Lick Run (Unt 63977)**<br>HUC: 05020005 | | | |
| Aquatic Life (4707) - 0.13 miles; 1 Segment(s)* | | | |
| Erosion from Derelict Land | Siltation | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Cove Run**<br>HUC: 05020005 | | | |
| Aquatic Life (4338) - 3.89 miles; 6 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Cove Run (Unt 40087)**<br>HUC: 05020005 | | | |
| Aquatic Life (4338) - 1.02 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |



*Segments are defined as individual COM IDs.

| Stream Name<br>Use Designation (Assessment ID)<br>Source Report | Pennsylvania Integrated Water Quality Monitoring and Assessment<br>Cause | Date Listed | TMDL Date |
|---|---|---|---|
| **Cove Run (Unt 40088)** | | | |
| HUC: 05020005 | | | |
| Aquatic Life (4338) - 0.38 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Cove Run (Unt 40089)** | | | |
| HUC: 05020005 | | | |
| Aquatic Life (4338) - 1.21 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Cove Run (Unt 40100)** | | | |
| HUC: 05020005 | | | |
| Aquatic Life (4338) - 1.12 miles; 2 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Cove Run (Unt 40101)** | | | |
| HUC: 05020005 | | | |
| Aquatic Life (4338) - 0.92 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Crabapple Run** | | | |
| HUC: 05020005 | | | |
| Aquatic Life (4284) - 3.64 miles; 8 Segment(s)* | | | |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Agriculture | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Agriculture | Siltation | 2004 | 2017 |
| Upstream Impoundment | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Crabapple Run (Unt 39970)** | | | |
| HUC: 05020005 | | | |
| Aquatic Life (4284) - 0.52 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Agriculture | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Agriculture | Siltation | 2004 | 2017 |
| Upstream Impoundment | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Crabapple Run (Unt 39971)** | | | |
| HUC: 05020005 | | | |



*Segments are defined as individual COM IDs.

| Stream Name<br>Use Designation (Assessment ID)<br>Source | Pennsylvania Integrated Water Quality Monitoring and Assessment Report<br>Cause | Date Listed | TMDL Date |
|---|---|---|---|
| **Crabapple Run (Unt 39971)**<br>HUC: 05020005 | | | |
| Aquatic Life (4284) - 1.11 miles; 4 Segment(s)* | | | |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Agriculture | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Agriculture | Siltation | 2004 | 2017 |
| Upstream Impoundment | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Crabapple Run (Unt 39972)**<br>HUC: 05020005 | | | |
| Aquatic Life (4284) - 0.52 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Agriculture | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Agriculture | Siltation | 2004 | 2017 |
| Upstream Impoundment | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Crabapple Run (Unt 39973)**<br>HUC: 05020005 | | | |
| Aquatic Life (4284) - 0.72 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Agriculture | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Agriculture | Siltation | 2004 | 2017 |
| Upstream Impoundment | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Aquatic Life (13230) - 0.58 miles; 1 Segment(s)* | | | |
| Road Runoff | Siltation | 2006 | 2019 |
| **Crabapple Run (Unt 39974)**<br>HUC: 05020005 | | | |
| Aquatic Life (13230) - 0.32 miles; 1 Segment(s)* | | | |
| Road Runoff | Siltation | 2006 | 2019 |
| **Crabapple Run (Unt 39975)**<br>HUC: 05020005 | | | |
| Aquatic Life (4284) - 0.82 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Agriculture | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Agriculture | Siltation | 2004 | 2017 |
| Upstream Impoundment | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Crabapple Run (Unt 39976)**<br>HUC: 05020005 | | | |
| Aquatic Life (4284) - 0.36 miles; 3 Segment(s)* | | | |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Agriculture | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Agriculture | Siltation | 2004 | 2017 |
| Upstream Impoundment | Organic Enrichment/Low D.O. | 2004 | 2017 |



*Segments are defined as individual COM IDs.

| Stream Name<br>Use Designation (Assessment ID)<br>Source Report | Pennsylvania Integrated Water Quality Monitoring and Assessment<br>Cause | Date Listed | TMDL Date |
|---|---|---|---|
| **Lick Run**<br>HUC: 05020005 | | | |
| Aquatic Life (4348) - 0.41 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Rankin Run**<br>HUC: 05020005 | | | |
| Aquatic Life (4323) - 0.30 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| **Redstone Creek**<br>HUC: 05020005 | | | |
| Aquatic Life (4271) - 0.20 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Aquatic Life (4346) - 1.24 miles; 6 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 1996 | 2009 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Abandoned Mine Drainage | Suspended Solids | 1996 | 2009 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Aquatic Life (4783) - 0.32 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Aquatic Life (13187) - 21.84 miles; 41 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2006 | 2019 |
| **Redstone Creek (Unt 39937)**<br>HUC: 05020005 | | | |
| Aquatic Life (4965) - 1.13 miles; 5 Segment(s)* | | | |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Small Residential Runoff | Siltation | 2004 | 2017 |
| **Redstone Creek (Unt 39938)**<br>HUC: 05020005 | | | |
| Aquatic Life (4965) - 0.44 miles; 1 Segment(s)* | | | |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Small Residential Runoff | Siltation | 2004 | 2017 |



*Segments are defined as individual COM IDs.

| Stream Name<br>Use Designation (Assessment ID)<br>Source | Pennsylvania Integrated Water Quality Monitoring and Assessment Report<br>Cause | Date Listed | TMDL Date |
|---|---|---|---|
| **Redstone Creek (Unt 40017)**<br>HUC: 05020005 | | | |
| Aquatic Life (13187) - 0.52 miles; 5 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2006 | 2019 |
| **Redstone Creek (Unt 40108)**<br>HUC: 05020005 | | | |
| Aquatic Life (4347) - 1.04 miles; 2 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Abandoned Mine Drainage | Suspended Solids | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Redstone Creek (Unt 40122)**<br>HUC: 05020005 | | | |
| Aquatic Life (4347) - 0.78 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Abandoned Mine Drainage | Suspended Solids | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Redstone Creek (Unt 40123)**<br>HUC: 05020005 | | | |
| Aquatic Life (4347) - 0.38 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Abandoned Mine Drainage | Suspended Solids | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **Redstone Creek (Unt 40124)**<br>HUC: 05020005 | | | |
| Aquatic Life (4351) - 2.51 miles; 6 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| **Redstone Creek (Unt 40125)**<br>HUC: 05020005 | | | |
| Aquatic Life (4351) - 0.60 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |



*Segments are defined as individual COM IDs.

| Stream Name<br>Use Designation (Assessment ID)<br>Source Report | Pennsylvania Integrated Water Quality Monitoring and Assessment<br>Cause | Date Listed | TMDL Date |
|---|---|---|---|
| **Redstone Creek (Unt 40126)**<br>HUC: 05020005 | | | |
| Aquatic Life (4351) - 0.37 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| **Redstone Creek (Unt 40127)**<br>HUC: 05020005 | | | |
| Aquatic Life (4351) - 0.69 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| **Redstone Creek (Unt 40128)**<br>HUC: 05020005 | | | |
| Aquatic Life (4351) - 0.43 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| **Redstone Creek (Unt 40129)**<br>HUC: 05020005 | | | |
| Aquatic Life (4351) - 0.51 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| **Redstone Creek (Unt 40130)**<br>HUC: 05020005 | | | |
| Aquatic Life (4351) - 0.56 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| **Redstone Creek (Unt 40135)**<br>HUC: 05020005 | | | |
| Aquatic Life (13152) - 1.79 miles; 3 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2006 | 2019 |
| **Redstone Creek (Unt 40136)**<br>HUC: 05020005 | | | |
| Aquatic Life (13152) - 0.69 miles; 3 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2006 | 2019 |
| **Redstone Creek (Unt 40137)**<br>HUC: 05020005 | | | |
| Aquatic Life (13152) - 0.59 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2006 | 2019 |



*Segments are defined as individual COM IDs.

| Stream Name<br>Use Designation (Assessment ID)<br>Source | Pennsylvania Integrated Water Quality Monitoring and Assessment Report<br>Cause | Date Listed | TMDL Date |
|---|---|---|---|
| **Redstone Creek (Unt 63976)**<br>HUC: 05020005 | | | |
| Aquatic Life (4347) - 0.74 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2004 | 2017 |
| Abandoned Mine Drainage | pH | 2004 | 2017 |
| Abandoned Mine Drainage | Suspended Solids | 2004 | 2017 |
| Road Runoff | Siltation | 2004 | 2017 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 2004 | 2017 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 2004 | 2017 |
| **zz Unknown NHD Name: 05020005003114**<br>HUC: 05020005 | | | |
| Aquatic Life (13152) - 0.09 miles; 1 Segment(s)* | | | |
| Abandoned Mine Drainage | Metals | 2006 | 2019 |

## Report Summary

### Watershed Summary

| | Stream Miles | Assessment Units | Segments (COMIDs) |
|---|---|---|---|
| Watershed Characteristics | 237.76 | 15 | 582 |

### Impairment Summary

| Source | Cause | Miles | Assessment Units | Segments (COMIDs) |
|---|---|---|---|---|
| Abandoned Mine Drainage | Metals | 45.12 | 10 | 93 |
| Abandoned Mine Drainage | Suspended Solids | 4.17 | 2 | 11 |
| Abandoned Mine Drainage | pH | 21.25 | 6 | 46 |
| Agriculture | Organic Enrichment/Low D.O. | 7.70 | 1 | 19 |
| Agriculture | Siltation | 7.70 | 1 | 19 |
| Erosion from Derelict Land | Siltation | 13.60 | 1 | 36 |
| Removal of Vegetation | Siltation | 3.31 | 1 | 3 |
| Road Runoff | Siltation | 32.51 | 8 | 71 |
| Small Residential Runoff | Organic Enrichment/Low D.O. | 19.94 | 6 | 55 |
| Small Residential Runoff | Siltation | 1.57 | 1 | 6 |
| Upstream Impoundment | Organic Enrichment/Low D.O. | 7.70 | 1 | 19 |
| Urban Runoff/Storm Sewers | Organic Enrichment/Low D.O. | 29.64 | 5 | 62 |
| | | **72.20** ** | **15** ** | **159** ** |

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

### Use Designation Summary

| | Miles | Assessment Units | Segments (COMIDs) |
|---|---|---|---|
| Aquatic Life | 72.20 | 15 | 159 |



*Segments are defined as individual COM IDs.