FINAL

RACCOON CREEK WATERSHED TMDL

Allegheny, Beaver, and Washington Counties

For Acid Mine Drainage Affected Segments

Prepared by:

Pennsylvania Department of Environmental Protection

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Introduction

This report presents the Total Maximum Daily Loads (TMDLs) developed for segments in the Raccoon Creek Watershed (Attachments A). These were done to address the impairments noted on the 1996 Pennsylvania Section 303(d) list of impaired waters, required under the Clean Water Act, and covers two segments on this list and two additional segments from the 2002 list (shown in Table 1). High levels of metals, and in some areas depressed pH, caused these impairments. All impairments resulted from acid drainage from abandoned coalmines. The TMDL addresses the three primary metals associated with acid mine drainage (iron, manganese, aluminum) and pH.

Table 1. 303(d) Sub-List								
State Water Plan (SWP) Subbasin: 20-D Raccoon Creek								
Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	22	4515	33564	Raccoon Creek	WWF	305(b) Report	RE	Metals & Suspended Solids
1998	25.87	4515	33564	Raccoon Creek	WWF	SWMP	AMD	Metals & Suspended Solids
2002	6.07	4515	33564	Raccoon Creek	WWF	SWMP	AMD	Metals & Suspended Solids
1996	Not on 1996 303(d) list							
1998	Not on 1998 303(d) list							
2002	21.32	990102-1125-TVP	33564	Raccoon Creek	WWF	SWMP	AMD	Metals & pH
1996	5	4533	33846	Burgetts Fork	WWF	305(b) Report	RE	Metals& Suspended Solids
1998	9.88	4533	33846	Burgetts Fork	WWF	SWMP	AMD	Metals & Suspended Solids
2002	2.95	4533	33846	Burgetts Fork	WWF	SWMP	AMD	Metals & Suspended Solids
1996	Not on 1996 303(d) list							
1998	Not on 1998 303(d) list							
2002	6.94	990102-1115-TVP	33846	Burgetts Fork	WWF	SWMP	AMD	Metals & pH

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

Resource Extraction=RE
Warm Water Fishes = WWF
Surface Water Monitoring Program = SWMP
Abandoned Mine Drainage = AMD

See Attachment D, *Excerpts Justifying Changes Between the 1996, 1998, and 2002 Section 303(d) Lists.*

The use designations for the stream segments in this TMDL can be found in PA Title 25 Chapter 93.

Directions to the Raccoon Creek Watershed

The Raccoon Creek Watershed is located in southwestern Pennsylvania, occupying western Allegheny, southern Beaver, and northern Washington Counties. The watershed area is found on United States Geological Survey Maps covering portions of the Midland, Beaver, Aliquippa, Hookstown, Burgettstown, Clinton, Avella, and Midway 7.5-Minute Quadrangles. The Raccoon Creek Watershed is approximately 184 square miles in area. Raccoon Creek is approximately 46 miles in length and its headwaters originate in the town of Hickory, PA. The watershed consists of mostly rural areas with small villages, agricultural land, wood lots, and previously strip-mined land. Raccoon Creek flows north and discharges to the Ohio River near Joshephtown, PA in Beaver County. Burgettstown, PA is located at the confluence of Burgetts Fork and Raccoon Creek. Raccoon Creek State Park is located in the west central portion of the watershed. Raccoon Creek can be accessed by traveling from Pittsburgh west on Route 22, which crosses over Raccoon Creek near the Bavington exit. Burgetts Fork can be accessed by traveling on Route 18 south from Burgettstown. Burgetts Fork runs parallel to Route 18 for its entire length.

Geology

The watershed area is located entirely within the Pittsburgh Low Plateau Section-Prototypical Area of the Appalachian Plateaus Province. The Prototypical Area of the Pittsburgh Low Plateau Sections is the largest unit of the Appalachian Plateaus Province. The watershed has a general relief pattern of broad, dissected upland underlain by horizontal sedimentary rocks. The surface is broad, rounded ridges and intervening valleys. The watershed is located within two different portions of the stratigraphic sequence. The southern portion is located sporadically in the Pennsylvanian-Permian Transition and the Permian System. The northern and predominate portion of the watershed is located within the Pennsylvanian System.

Segments addressed in this TMDL

There are nine active mining permits in the watershed. Table 2 below contains the nine active permits in the watershed with a description of the status of the permit. Discharges from the mining operations that are active are considered to be point sources. All remaining discharges in the watershed are from abandoned mines and are considered to be nonpoint sources. Each segment on the Section 303(d) list will be addressed as a separate TMDL. These TMDLs will be expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Table 2. Active Mining Permits in the Raccoon Creek Watershed

Permit No.	Operation and Company Name	Operation Status
SMP 63831601	Champion Preparation Plant, Champion Processing Inc.	Mining complete, permit area meets Stage II Bond Release requirements. Permitted treatment facilities no longer in use.
SMP 63940102 NPDES PA0200891	Game Lands SE, Mulligan Mining, Inc.	Mining complete, site backfilled and revegetated. Permitted treatment facilities no longer in use.
SMP 63000101 NPDES PA0202819	Gamelands NW, Mulligan Mining, Inc.	There are three sedimentation ponds permitted to discharge; however, ponds have never discharged.
GFCC 63-02-02	Dobrowalski, Robinson Coal Co.	GFCC site. No NPDES permitted discharges.
SMP 63743212	Champion Coal Silt, Washington Energy Processing, Inc.	No NPDES permit. Plant does not discharge.
SMP 63733701	Champion Refuse Disposal Area, Champion Processing, Inc.	No NPDES permit. Discharges only when plant operated. WLA calculated.
SMP 63920701 NPDES PA0214451	PennBalt Refuse Site, PennBalt, Inc.	Active Mine, WLA calculated.
SMP 63020102 NPDES PA0250309	Duran Mine, Mulligan Mining, Inc.	Active Mine, WLA calculated.
SMP 63823020 NPDES PA0616621	Roman Mine, Goodall Mining Company	Three sedimentation ponds permitted to discharge. No recorded flows.

For the permits that have completed mining and have backfilled and revegetated the sites (see Table 2), no waste load allocations are calculated. This is because the permitted facilities are no longer in use; therefore, they do not require a waste load allocation. For the sites that do not hold NPDES permits (see Table 2), no waste load allocation is necessary due to the lack of a discharge. The permits that have sedimentation ponds with no recorded discharges (see Table 2) are not being assigned waste load allocations. These ponds are used to contain stormwater runoff. It has been determined that effects from sedimentation ponds are negligible because their potential discharges are based on infrequent and temporary events and the ponds should rarely discharge if reclamation and revegetation is concurrent. In addition, sedimentation ponds are designed in accordance with PA Code Title 25 Chapter 87.108 (h) to at minimum contain runoff from a 10-year 24-hour precipitation event.

The Champion Refuse Disposal Area (SMP63733701) is located in the Little Raccoon Run Watershed. Little Raccoon Run has been found to be attaining its uses and is not impaired from AMD. The Champion Refuse site has one treatment pond (POND06) that is permitted to discharge. This pond only discharges when the plant is operated and water is pumped to the plant for treatment. Discharges from this plant may occur once or twice a month in the late summer or fall and for a week in the early spring or during a long rain or snowmelt event. When the plant does discharge it is estimated to be around 1000 gpm, however, there are no recorded flow measurements. Water quality data at an instream monitoring point (SP-B) located downstream of the Champion Refuse discharge shows low average concentrations of iron (0.30 mg/L), manganese (0.14 mg/L), and aluminum (0.23 mg/L). Criteria are not exceeded on any sampling event. A waste load allocation is calculated for the POND06 discharge based on permit limits and the estimated flow.

The Mulligan Mining, Inc. Duran Mine (SMP63020102) is also located in the Little Raccoon Run Watershed. The permit contains two treatment ponds and three sedimentation ponds. Only the treatment ponds are assigned waste load allocations because of the negligible effects of sedimentation ponds as previously explained.   The permit was issued in July 2003 so no data is available to calculate a WLA; therefore, the WLA is calculated as described in the *Method to Quantify Treatment Pond Pollutant Load* section of the report. The Duran site has two polluting discharges, D-1 and D-2, that pre-date Mulligan Mining's operations. The permits are therefore issued under DEP's subchapter F regulations, which provide that the permittee's effluent limits are based on baseline pollution conditions rather than standard coal mining BAT standards. The subchapter F discharges on these sites have been treated as nonpoint source for the purpose of doing the TMDL. Mulligan Mining, Inc will be daylighting a number of abandoned deep mine voids which is expected to improve water quality of the pre-existing discharges.

The reduction necessary to meet applicable water quality standards from preexisting conditions (including discharges from areas coextensive with areas permitted under the remining program Subchapter F or G) are expressed in the LA portion of the TMDL. The WLAs express the basis for applicable effluent limitations on point sources. Except for any expressed assumptions, any WLA allocated to a remining permittee does not require the permittee to necessarily implement the reductions from preexisting conditions set forth in the LA. Additional requirements for the permittee to address the preexisting conditions are set forth in the applicable NPDES/mining permit. Table 3 contains the baseline pollutant summary for the two abandoned discharges located on the Duran site. The map in attachment A shows the location of these two discharges. The individual discharges are not assigned load allocations, however; discharge affects on the stream are taken into account at the closest downstream sampling point and it is noted that the discharges are a contributing pollutant source to the segment.

Table 3. Duran Site Pre-existing Discharge Baseline Summary

Discharge	Parameter	Effluent Limits (lbs/day)
D-1	Fe	1.3
	Mn	1.1
	Al	8.7
	Acidity	80.3
D-2	Fe	2.3
	Mn	1.8
	Al	10.8
	Acidity	142.0

The PennBalt Refuse Site (SMP 63920701, NPDES PA0214451) is an active mine with three sedimentation ponds, of which two discharge, 001 and 003. The discharge flows are estimated to be about 1 gpm for 001 and 3 gpm for 003. These two discharges are assigned waste load allocations.

Clean Water Act Requirements

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

Additionally, the federal Clean Water Act and the Environmental Protection Agency’s (EPA) implementing regulations (40 CFR Part 130) require:

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

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

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

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

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

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

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

These TMDLs were developed in partial fulfillment of the 1997 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

Section 303(d) Listing Process

Prior to developing TMDLs for specific waterbodies, there must be sufficient data available to assess which streams are impaired and should be on the Section 303(d) list. With guidance from the EPA, the states have developed methods for assessing the waters within their respective jurisdictions.

The primary method adopted by the Pennsylvania Department of Environmental Protection (DEP) for evaluating waters changed between the publication of the 1996 and 1998 Section 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[2] reporting process. DEP is now using the Statewide Surface Waters Assessment Protocol (SSWAP), a modification of the EPA's 1989 Rapid Bioassessment Protocol II (RBP-II), as the primary mechanism to assess Pennsylvania's waters. The SSWAP provides a more consistent approach to assessing Pennsylvania's streams.

The assessment method requires selecting representative stream segments based on factors such as surrounding land uses, stream characteristics, surface geology, and point source discharge locations. The biologist selects as many sites as necessary to establish an accurate assessment for a stream segment; the length of the assessed stream segment can vary between sites. All the biological surveys included kick-screen sampling of benthic macroinvertebrates and habitat evaluations. Benthic macroinvertebrates are identified to the family level in the field.

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on habitat scores and a series of narrative biological statements used to evaluate the benthic macroinvertebrate community. If the stream is determined to be impaired, the source and cause of the impairment is documented. An impaired stream must be listed on the state's Section 303(d) list with the source and cause. A TMDL must be developed for the stream segment and each pollutant. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

Basic Steps for Determining a TMDL

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

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);

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

2. Calculating TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

Although the Raccoon Creek Watershed spans over three counties, the majority of the mining has occurred in Washington County. Coal mining in the watershed began in the late eighteenth century. The earliest coalmine known to exist in Washington County is dated 1781. After this date, other outcrop mines were opened near Coal Center and Canonsburg. Due to the relative ease of access and the quality of the coal, Washington County soon had numerous small mines operating. These mines operated for home heating and the powering of small, localized industrial activity. After 1820, the need for coal was increased for home heating purposes. By 1840, the early Pittsburgh industrial complex became another consumer of the region's abundant coal resources. Soon, railroads and locks and dams were constructed, which facilitated the transportation of coal to the Pittsburgh market and further spurred increased mining/production of Washington County coal (circa 1880 Washington County delivered 700,000 tons of coal to market). From 1880 to 1923 there were annual increases in the amount of coal produced, and by 1923 the highest amount of coal produced was recorded (24.5 million tons). Decreases in coal production occurred after 1923 until the 1960's when large steel companies created a certain amount of industry stability. Large steel companies owned seven of the nine major mines at this time and 14.1 million tons of coal were produced in 1966 in Washington County. Only one year later (1967), however, coal production in the Raccoon Creek Watershed was estimated to be less than 100,000 tons.[3]

Despite the fact that coal production has decreased from 1923 to the present, Washington County ranks number two among Pennsylvania counties in coal production. Besides the current active mining operations, the watershed contains a large amount of coal refuse from abandoned and/or historic mining/waste sites. These areas are the source of many water quality/environmental problems in the watershed.

The Raccoon Creek Watershed is known to have at least 175 to 200 AMD discharges. Of these discharges, seven have been identified as primary AMD discharges (see Attachment A). The primary AMD discharge sites in the Raccoon Creek watershed are L2, P6, P7, E1, JB1, JB2, and H3. Remediation of these seven sites would have significant impact on the water quality of the watershed.

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[3] U.S. Department of the Interior. 1968. Sources of Coal Mine Drainage Pollution, Raccoon Creek Watershed, Pennsylvania, (Work Document No. 28), Planning and Evaluation Section, Wheeling, WV.

AMD Methodology

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

The statistical analysis described below can be applied to situations where all of the pollutant loading is from non-point sources as well as those where there are both point and non-point sources. The following defines what are considered point sources and non-point sources for the purposes of our evaluation; point sources are defined as permitted discharges or a discharge that has a responsible party, non-point sources are then any pollution sources that are not point sources. For situations where all of the impact is due to 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[4] 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)

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

Mean = average observed concentration

Standard Deviation = standard deviation of observed data

The overall percent reduction required is the 99th percentile value of the probability distribution generated by the 5,000 iterations, so that the allowable long-term average (LTA) concentration is:

LTA = Mean * (1 – PR99) where (2)

LTA = allowable LTA source concentration in mg/l

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

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

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

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

For pH TMDLs, acidity is compared to alkalinity as described in Attachment B. Each sample point used in the analysis of pH by this method must have measurements for total alkalinity and 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 from AMD 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.

Method to Quantify Treatment Pond Pollutant Load

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

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

Discharge from treatment ponds on a mine site is intermittent and often varies as a result of precipitation events. Measured flow rates are almost never available. If accurate flow data are available, it is used along with the Best Available Technology (BAT) limits to quantify the WLA for one or more of the following: aluminum, iron, and manganese. The following formula is used:

Flow (MGD) X BAT limit (mg/l) X 8.34 = lbs/day

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

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

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

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

Total Average Flow = Direct Pit Precipitation + Spoil Runoff

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

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

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

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

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

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

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

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

While most mining operations are permitted and allowed to have a standard, 1500' x 300' pit, most are well below that size and have a corresponding decreased flow and load. Where pit dimensions are greater than the standard size or multiple pits are present, the calculations to define the potential pollution load can be adjusted accordingly. Hence, the above calculated

Waste Load Allocation is very generous and likely high compared to actual conditions that are generally encountered. A large margin of safety is included in the WLA calculations.

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

TMDL Endpoints

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

Because most of the pollution sources in the watershed are nonpoint sources, the larges part of the TMDL is expressed as Load Allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 4. Applicable Water Quality Criteria

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

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

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

A TMDL equation consists of a waste load allocation (WLA), load allocation (LA), and a margin of safety (MOS). The waste load allocation is the portion of the load assigned to point sources. The load allocation is the portion of the load assigned to non-point sources. The margin of safety is applied to account for uncertainties in the computational process. The margin of safety may be expressed implicitly (documenting conservative processes in the computations) or explicitly (setting aside a portion of the allowable load). The TMDL allocations in this report are based on available data. Other allocation schemes could also meet the TMDL.

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 5 for each segment are based on the assumption that all upstream allocations are achieved and take into account all upstream reductions. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. As changes occur in the watershed, the TMDLs may be re-evaluated to reflect current conditions. An implicit MOS based on conservative assumptions in the analysis is included in the TMDL calculations.

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

Each permitted discharge in a segment is assigned a waste load allocation and the total waste load allocation for each segment is included in this table. There are currently three permits in the watershed with treatment discharges. The difference between the TMDL and the WLA at each point is the load allocation (LA) at the point. The LA at each point includes all loads entering the segment, including those from upstream allocation points. The percent reduction is calculated to show the amount of load that needs to be reduced within a segment in order for water quality standards to be met at the point.

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

Table 5. TMDL Component Summary for the Raccoon 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 %
SL3	*Burgetts Fork, upstream of Unnamed Tributary 33859*						
	Fe	97.2	11.7	0.0	11.7	85.5	88
	Mn	32.1	16.7	0.0	16.7	15.4	48
	Al	23.7	23.7	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
SL4	*Mouth of Unnamed Tributary 33852 to Burgetts Fork*						
	Fe	196.3	2.0	0.0	2.0	194.3	99
	Mn	10.8	2.7	0.0	2.7	8.1	75
	Al	2.4	2.4	NA	NA	0.0	0
	Acidity	88.4	76.1	0.0	76.1	12.3	14
SL5	*Mouth of Unnamed Tributary 33851 to Burgetts Fork*						
	Fe	19.3	2.9	0.0	2.9	16.4	85
	Mn	16.7	3.8	0.0	3.8	12.9	77
	Al	30.4	1.2	0.0	1.2	29.2	96
	Acidity	138.2	30.4	0.0	30.4	107.8	78
MP49	*Mouth of Unnamed Tributary 33847*						
	Fe	1.4	1.4	NA	NA	0.0	0
	Mn	4.2	0.8	0.0	0.8	3.4	82
	Al	1.6	0.3	0.0	0.3	1.3	82
	Acidity	2.8	2.8	NA	NA	0.0	0
SL6	*Burgetts Fork, downstream of Unnamed Tributary 33847*						
	Fe	27.3	27.3	NA	NA	0.0	0
	Mn	169.8	13.6	0.0	13.6	113.7	89
	Al	60.0	13.8	0.0	13.8	13.3	49
	Acidity	0.0	0.0	NA	NA	0.0	0
SL1	*Raccoon Creek, downstream of Tributary 33892*						
	Fe	33.0	33.0	NA	NA	0.0	0
	Mn	7.9	7.9	NA	NA	0.0	0
	Al	39.5	29.7	0.0	29.7	9.8	25
	Acidity	0.0	0.0	NA	NA	0.0	0
SL8	*Mouth of Unnamed Tributary 33884 to Raccoon Creek*						
	Fe	19.1	3.4	0.0	3.4	15.7	82
	Mn	17.1	4.8	0.0	4.8	12.3	72
	Al	84.1	1.7	0.0	1.7	82.4	98
	Acidity	526.3	10.5	0.0	10.5	515.8	98
SL7	*Raccoon Creek, downstream of Tributary 33845*						
	Fe	542.2	97.6	0.2	97.4	403.0	81
	Mn	228.7	68.6	0.2	68.4	0.0	0
	Al	223.0	33.5	0.2	33.3	50.9	60
	Acidity	0.0	0.0	NA	NA	0.0	0
MP38	*Tributary 33844 to Raccoon Creek*						
	Fe	0.7	0.7	NA	NA	0.0	0
	Mn	2.0	0.5	0.0	0.5	1.5	76
	Al	0.4	0.4	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
R1	*Raccoon Creek, downstream of Unnamed Tributary 33839*						
	Fe	705.4	42.3	0.0	42.3	218.5	84
	Mn	219.1	87.6	0.0	87.6	0.0	0
	Al	349.7	35.0	0.0	35.0	125.1	78
	Acidity	0.0	0.0	NA	NA	0.0	0
SL9	*Mouth of Little Raccoon Run*						
	Fe	24.7	24.7	19.4	5.3	0.0	0
	Mn	21.5	21.5	13.4	8.1	0.0	0
	Al	38.8	38.8	6.2	32.6	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
SL10	*Raccoon Creek, upstream of Potato Garden Run*						
	Fe	419.6	75.5	0.0	75.5	0.0	0
	Mn	140.4	123.6	0.0	123.6	0.0	0
	Al	189.5	189.5	NA	NA	0.0	0
	Acidity	0.0	0.0	NA	NA	0.0	0
167	*Mouth of Potato Garden Run*						
	Fe	9.1	9.1	NA	NA	0.0	0
	Mn	27.1	8.9	0.0	8.9	18.2	67
	Al	0.5	0.5	NA	NA	0.0	0
	Acidity	266.2	266.2	NA	NA	0.0	0
WQN903	*Mouth of Raccoon Creek*						
	Fe	899.6	197.9	NA	197.9	320.6	62
	Mn	156.1	156.1	NA	NA	0.0	0
	Al	635.0	88.9	0.0	88.9	392.5	82
	Acidity	NA	NA	NA	NA	0.0	0

NA meets WQS. No TMDL necessary.

In the instance that the allowable load is equal to the measured load (e.g. iron MP49, Table 5), the simulation determined that water quality standards are being met instream and therefore no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point.

Following is an example of how the allocations, presented in Table 5, for a stream segment are calculated. For this example, iron allocations for R1, SL7 and MP38 are shown. As demonstrated in the example, all upstream contributing loads are accounted for at each point. Attachment C contains the TMDLs by segment analysis for each allocation point in a detailed discussion. These analyses follow the example. Attachment A contains a map of the sampling point locations for reference.

R1	Load (lbs/day)
Existing Load	705.4
Difference in Existing Loads	162.5
Load tracked from upstream	98.3
Total load tracked	260.8
Allowable Load	42.3
Load Reduction	218.5
% Reduction required	84

260.8 = 162.5 + 0.7 + 97.6

162.5 = 705.4 - 0.7 - 542.2

0.7

MP38	Load (lbs/day)
Existing Load	0.7
Allowable Load	0.7
Load Reduction	0.0
% Reduction	0

97.6

SL7	Load (lbs/day)
Existing Load	542.2
Allowable Load	97.6
Load Reduction	403.0
% Reduction	81

Waste load allocations are assigned to the permitted discharges for the following; Pennbalt Inc. Pennbalt 1 Mine SMP 63920701 (NPDES PA0214451), Champion Processing Inc. Champion Coal Refuse Disposal/Prep Site SMP 63733701 (no NPDES), and the Mulligan Mining Inc. Duran Mine SMP 63020102 (NPDES PA0250309).

For the Pennbalt and Champion sites, the waste load allocations are calculated by multiplying the average flow from the discharge by the permit limits. There are three sedimentation ponds on the Pennbalt site, of which two discharge (001 and 003). The average estimated flows from these ponds are 1 gpm for 001 and 3 gpm for 003. Aluminum is not included in the permit; however a waste load allocation is calculated to allow for the discharge of aluminum. The standard BAT limit of 2.0 mg/L is used for these calculations. The WLAs for 001 and 003 are being evaluated at sample point SL7.

The Champion Refuse site has one treatment pond (POND06) that is permitted to discharge. This pond only discharges when the plant is operated and water is pumped to the plant for treatment. Discharges from this plant may occur once or twice a month in the late summer or fall and for a week in the early spring or during a long rain or snowmelt event. When the plant does discharge it is estimated to be around 1000 gpm, however, there are no recorded flow measurements. The waste load allocation is calculated for the POND06 discharge based on permit limits and the estimated flow. The permit limits are stricter than the standard BAT limits.

Waste load allocations are assigned to the two treatment ponds located (004 and 005) on the Duran site using the method as described in *The Method to Quantify Treatment Pond Pollutant Load* section of the report. For 004 the pit dimensions are 110’ x 500’ and for 005 the dimensions are 110’ x 350’. Aluminum is not included in the permit; however a waste load allocation is calculated to allow for the discharge of aluminum. The standard BAT limit of 2.0 mg/L is used for these calculations.

The WLAs for POND06, 004, and 005 are being evaluated at sample point SL9.

No required reductions of permit limits are required at this time. All necessary reductions are assigned to non-point sources.

Table 6 below contains the WLAs for the Raccoon Creek Watershed permitted discharges.

Table 6. Waste Load Allocation of Permitted Discharge

Parameter	Allowable Average Monthly Conc. (mg/L)	Measured Average Flow (MGD)	WLA (lbs/day)
Pennbalt Inc. SMP 63920701, NPDES PA0214451			
001			
Fe	3.0	0.00144	0.04
Mn	2.0	0.00144	0.02
Al	2.0	0.00144	0.02

Parameter	Allowable Average Monthly Conc. (mg/L)	Measured Average Flow (MGD)	WLA (lbs/day)
003			
Fe	3.0	0.00432	0.1
Mn	2.0	0.00432	0.07
Al	2.0	0.00432	0.07
Champion Processing Inc. SMP 63733701			
POND06			
Fe	1.6	1.44	19.2
Mn	1.1	1.44	13.2
Al	0.5	1.44	6.0
Mulligan Mining Inc.SMP630230102, NPDES PA0250309			
004			
Fe	3.0	0.0056	0.14
Mn	2.0	0.0056	0.09
Al	2.0	0.0056	0.09
005			
Fe	3.0	0.00391	0.10
Mn	2.0	0.00391	0.07
Al	2.0	0.00391	0.07

Recommendations

Skelly and Loy, Inc. completed the *Raccoon Creek Watershed AMD Survey and Preliminary Restoration Plan EPA Section 104(b)(3) Document* for the Raccoon Creek Watershed Association (RCWA) in December 2000. As previously stated, seven primary AMD discharges have been identified in the Raccoon Creek Watershed. The remediation of these sites will greatly improve the water quality of the watershed. Many local area organizations including RCWA, Independent Marsh Foundation (IMF), Washington County Conservation District (WCCD), and DEP are working together in order to remediate these discharges. The following are the different projects that have been completed or initiated for each of the seven primary AMD discharges.

Langeloth Borehole (L2)

The Langeloth Borehole project was completed in 2000 and consists of an aerobic wetland/pond system, which provides detention, aeration, and storage for iron sludge. This system, designed by the Natural Resources Conservation Service (NRCS) of the United States Department of Agriculture (USDA), removes over 50 tons of iron per year from Burgetts Fork. The project was funded through DEP and EPA Section 319 grant and was built and is maintained by RCWA and WCCD.

Figure 1. Photographs of the recently completed Langeloth Borehole Passive Treatment site.

Hamilton Discharge (H3)

The Hamilton passive treatment system, designed by DEP-BAMR, will remove about seven tons of iron per year from Potato Garden Run, a tributary to Raccoon Creek. The project was funded by the Pennsylvania Turnpike Commission and the Office of Surface Mining (OSM) and is being built by RCWA, IMF, WCCD, and Allegheny County Conservation District (ACCD). The system will be maintained by WCCD and RCWA.

East Plum Run (P6) and West Plum Run (P7)

A Round 4 Growing Greener Grant has been secured by WCCD and CONSOL for the development of engineering designs to treat the Plum Run discharges. Plum Run releases approximately 65 tons of iron per year to Burgetts Fork.

Erie Mine (E1)

A Round 4 Growing Greener Grant has been secured by WCCD and CONSOL for the development of engineering designs to treat the Erie Mine discharge. Over 18 tons per year of iron is introduced to the watershed through this discharge.

Joffre Borehole (JB1)

JB1 is the largest AMD discharge in the watershed. It discharges over 120 tons per year of iron and 13 tons per year of aluminum into the watershed. Round 4 Growing Greener funding has been secured for the engineering designs to treat the JB1 discharge. Stream Restoration Inc. has submitted a Round 5 Growing Greener application for the construction of a passive treatment system to treat the JB1 discharge. The proposed system will consist of a series of retention (settling) ponds and wetlands.

Joffre Borehole (JB2)

A Round 1 Growing Greener Grant was awarded to WCCD. Construction is slated to began in the fall of 2003. This abandoned mine drainage seep, located near Burgettstown in Washington County, dumps over 13 tons of iron and 2 tons of aluminum yearly into the headwaters of Raccoon Creek. The Independence Marsh Foundation is accepting the donation of this property for the purpose of building a Vertical Flow Reactor (VFR), a wetland system that will remove iron and acidity. Sponsors for the project are WCCD, IMF, and RCWA. DEP, EPA Section 319, and OSM provided funding for the project. The system was designed by DEP-BAMR and will be maintained by WCCD, IMF, and RCWA.

Cenco Seep

An additional Round 4 Growing Greener Grant was awarded to the WCCD for the construction of a Vertical Flow Reactor on the Cenco Seep discharge (non primary AMD discharge). The system, designed by CONSOL, will remove 5 lbs/day of aluminum and iron to St. Patrick's Run. Sponsors of the project are WCCD and RCWA with funding provided by DEP and OSM.

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

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

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

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

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

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

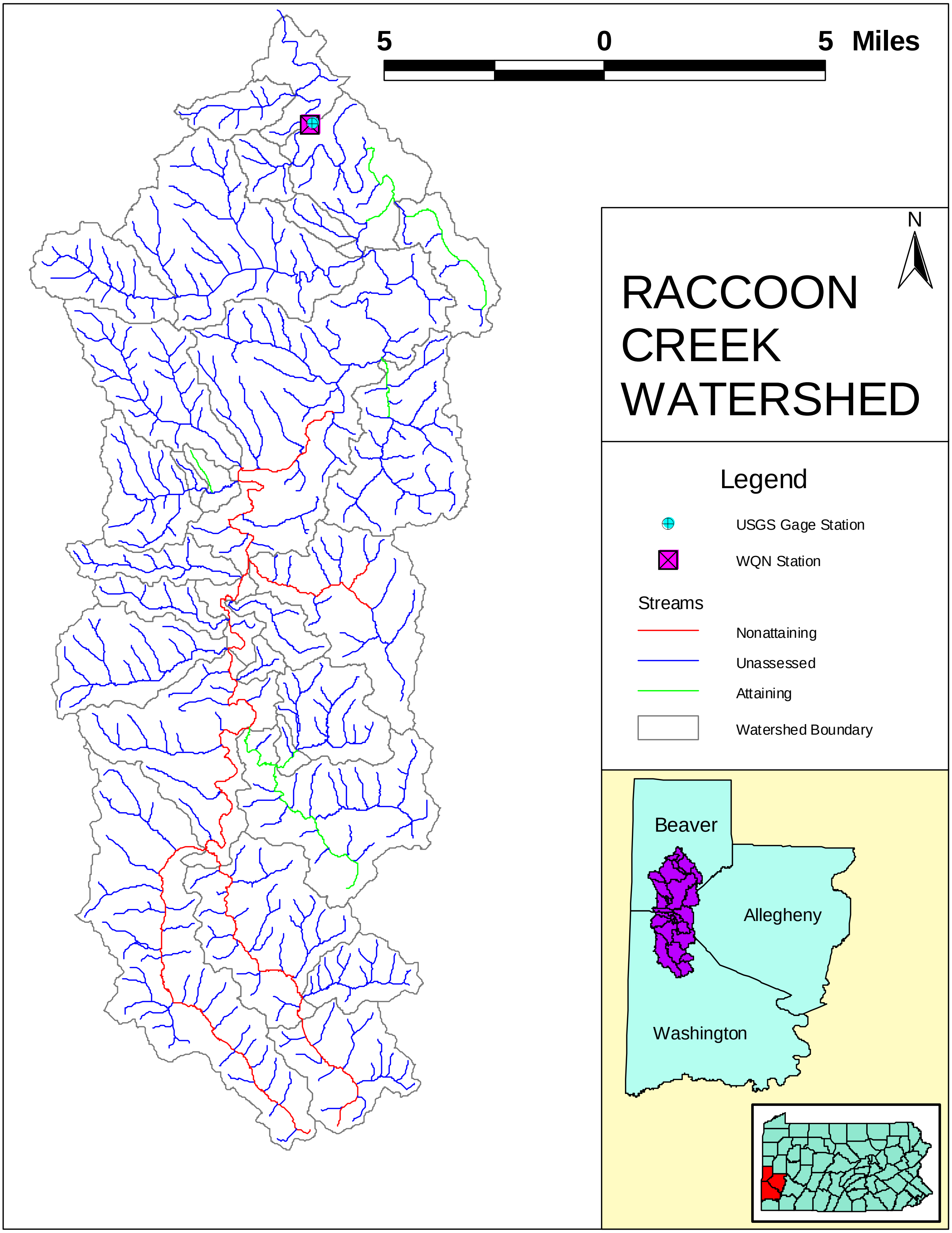
Reclaim PA is DEP’s initiative designed to maximize reclamation of the state’s quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of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

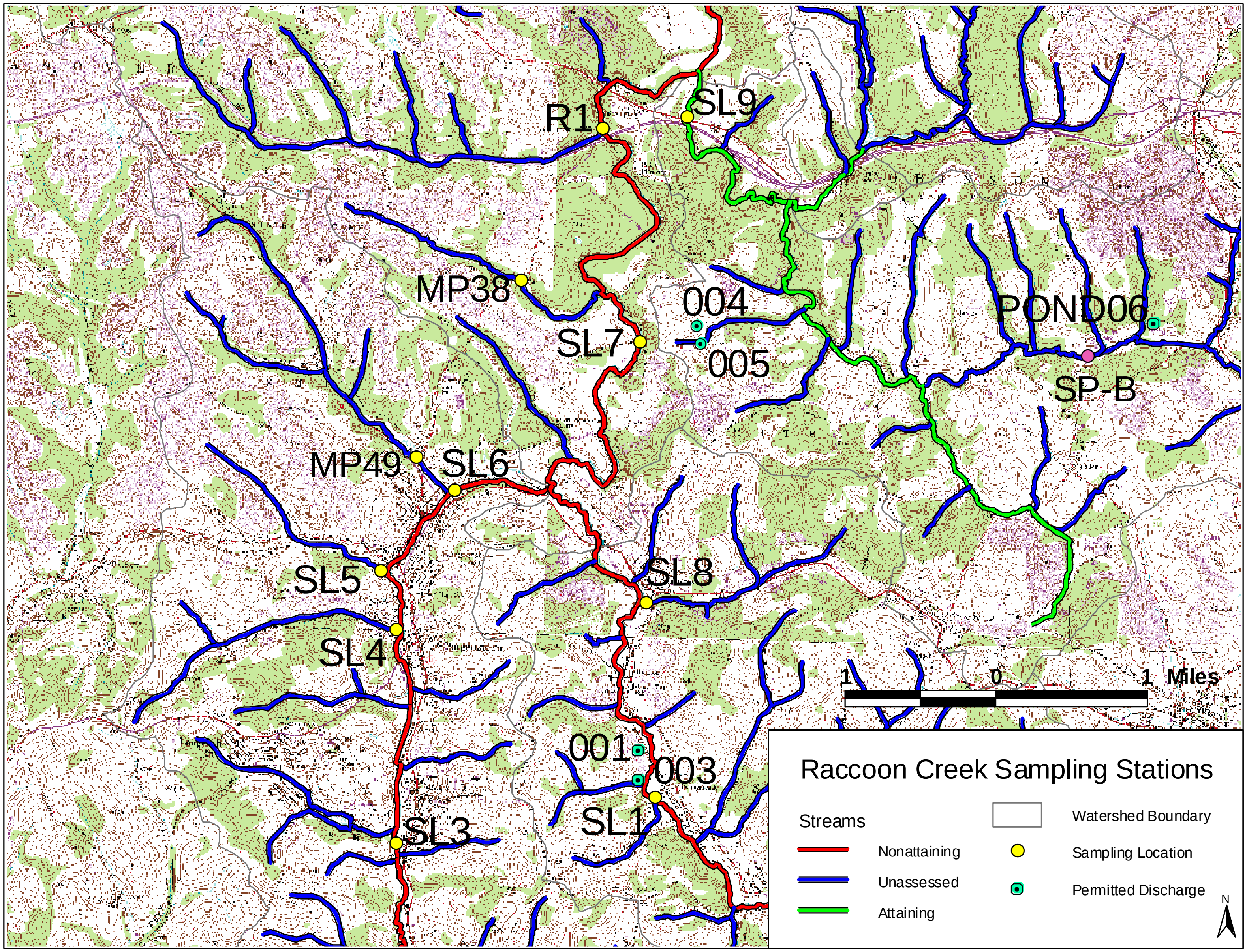
Public Participation

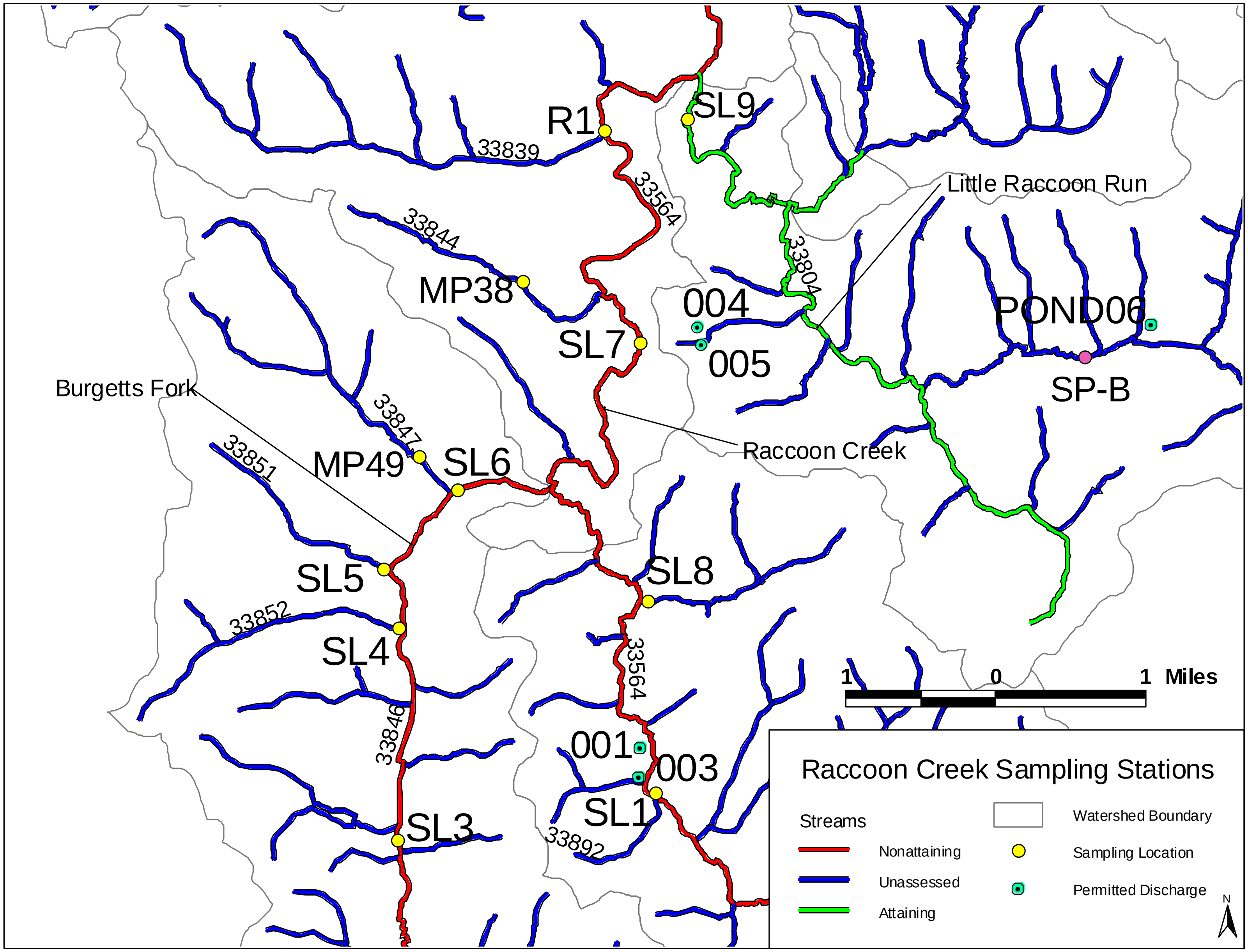
Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on December 4, 2004 and the *Beaver County Times/Allegheny Times* on January 18, 2005 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from December 4, 2004 to February 2, 2005. A public meeting was held on January 25, 2005 at the Raccoon Creek State Park Office to discuss the proposed TMDL.

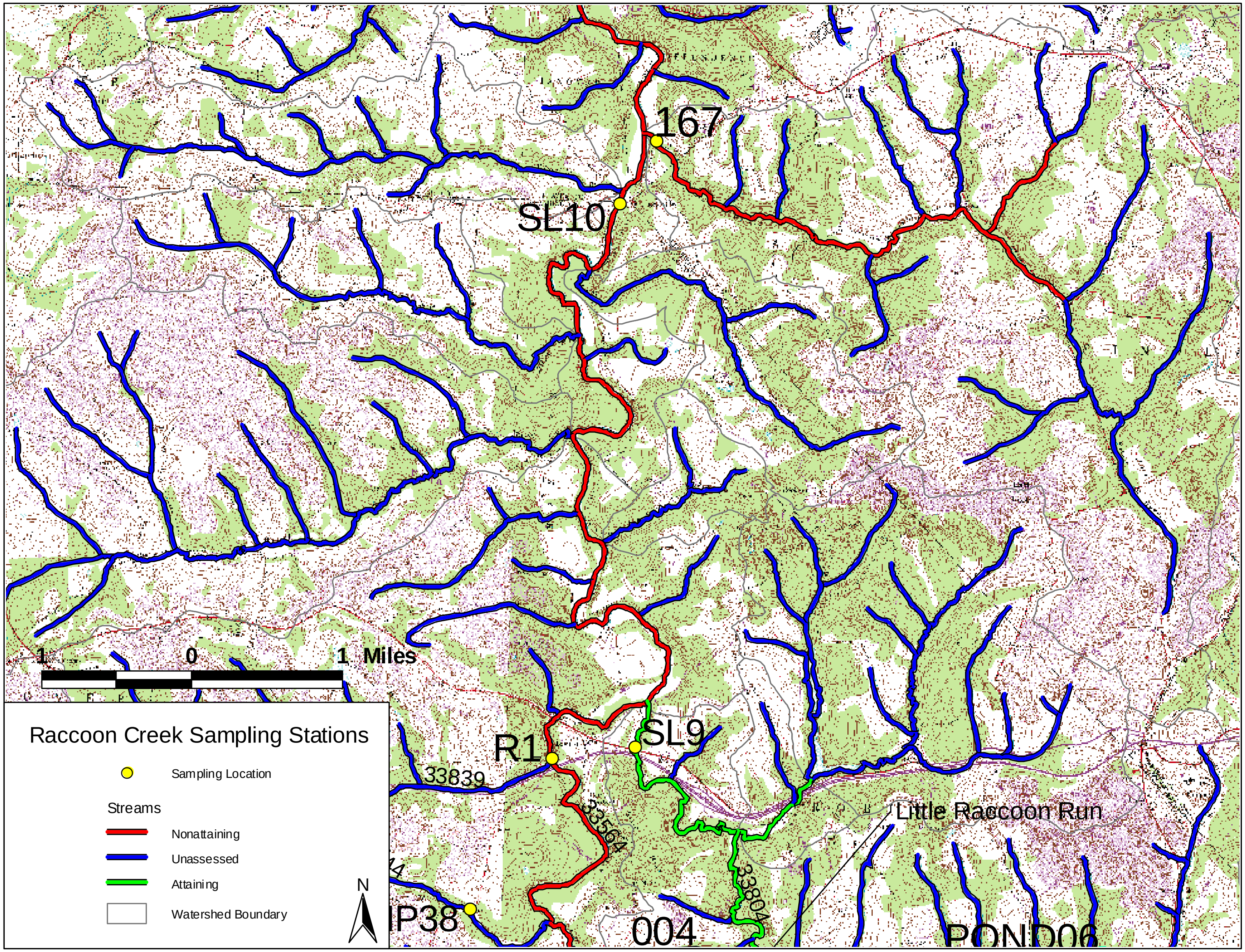
Attachment A

Raccoon Creek Watershed Maps


5
0
5 Miles
N
RACCOON CREEK WATERSHED
Legend
USGS Gage Station
WQN Station
Streams
Nonattaining
Unassessed
Attaining
Watershed Boundary
Beaver
Allegheny
Washington


R1
SL9
MP38
004
SL7
005
POND06
SP-B
MP49
SL6
SL5
SL8
SL4
001
003
SL1
SL3
1 0 1 Miles
Raccoon Creek Sampling Stations
Streams
Nonattaining
Unassessed
Attaining
Watershed Boundary
Sampling Location
Permitted Discharge
N


R1
SL9
33839
33564
Little Raccoon Run
33844
33804
MP38
004
POND06
SL7
005
SP-B
Burgetts Fork
33847
Raccoon Creek
33851
MP49
SL6
SL5
SL8
33852
SL4
33564
1 0 1 Miles
33846
001
003
SL1
SL3
33892
Raccoon Creek Sampling Stations
Streams
Nonattaining
Unassessed
Attaining
Watershed Boundary
Sampling Location
Permitted Discharge
N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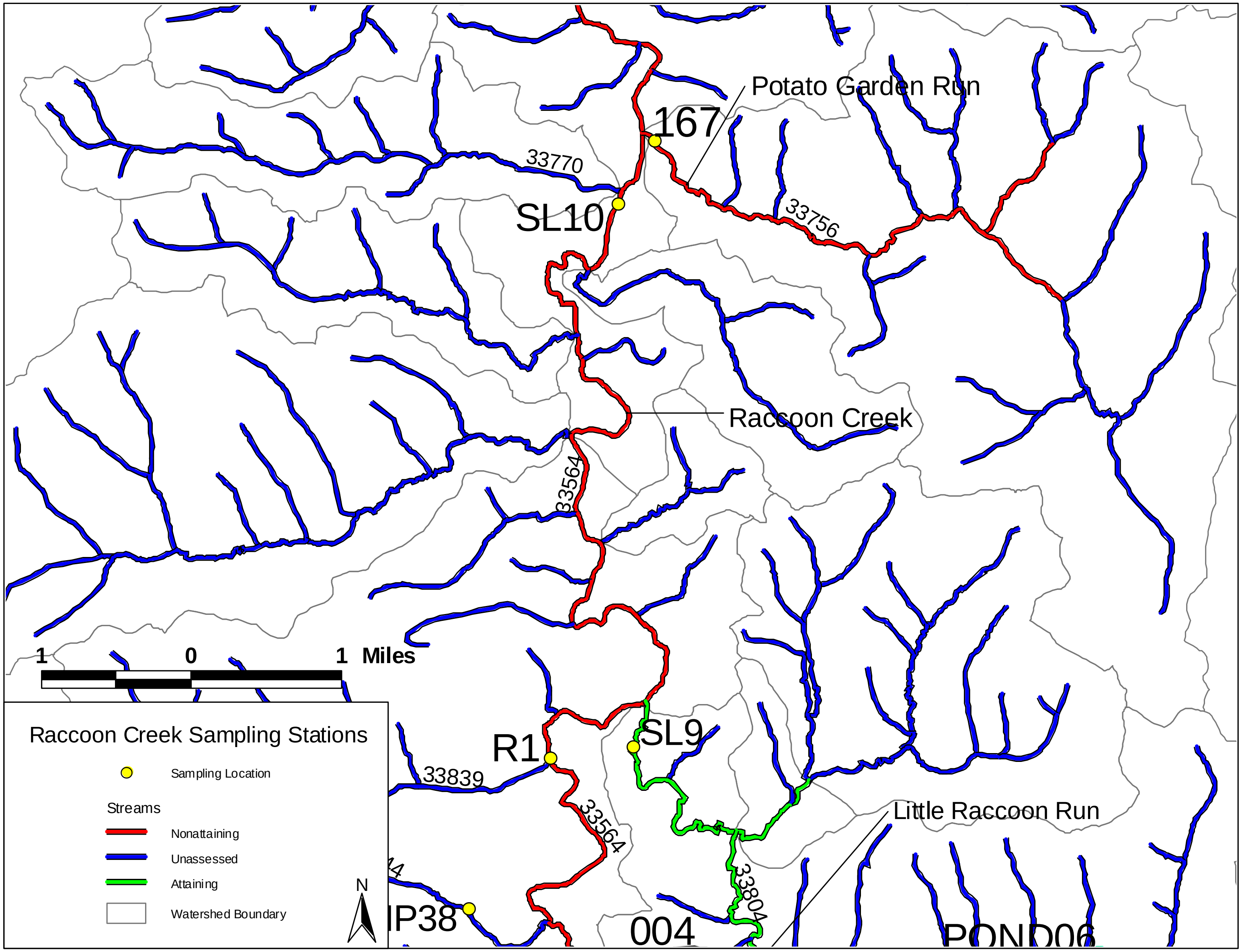
SL10
SL9
R1
33839
33564
33804
IP38
004
POND06
Little Raccoon Run
1
0
1 Miles
Raccoon Creek Sampling Stations
Sampling Location
Streams
Nonattaining
Unassessed
Attaining
Watershed Boundary
N



Potato Garden Run
167
33770
SL10
33756
Raccoon Creek
33564
1
0
1 Miles
Raccoon Creek Sampling Stations
Sampling Location
Streams
Nonattaining
Unassessed
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R1
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Little Raccoon Run
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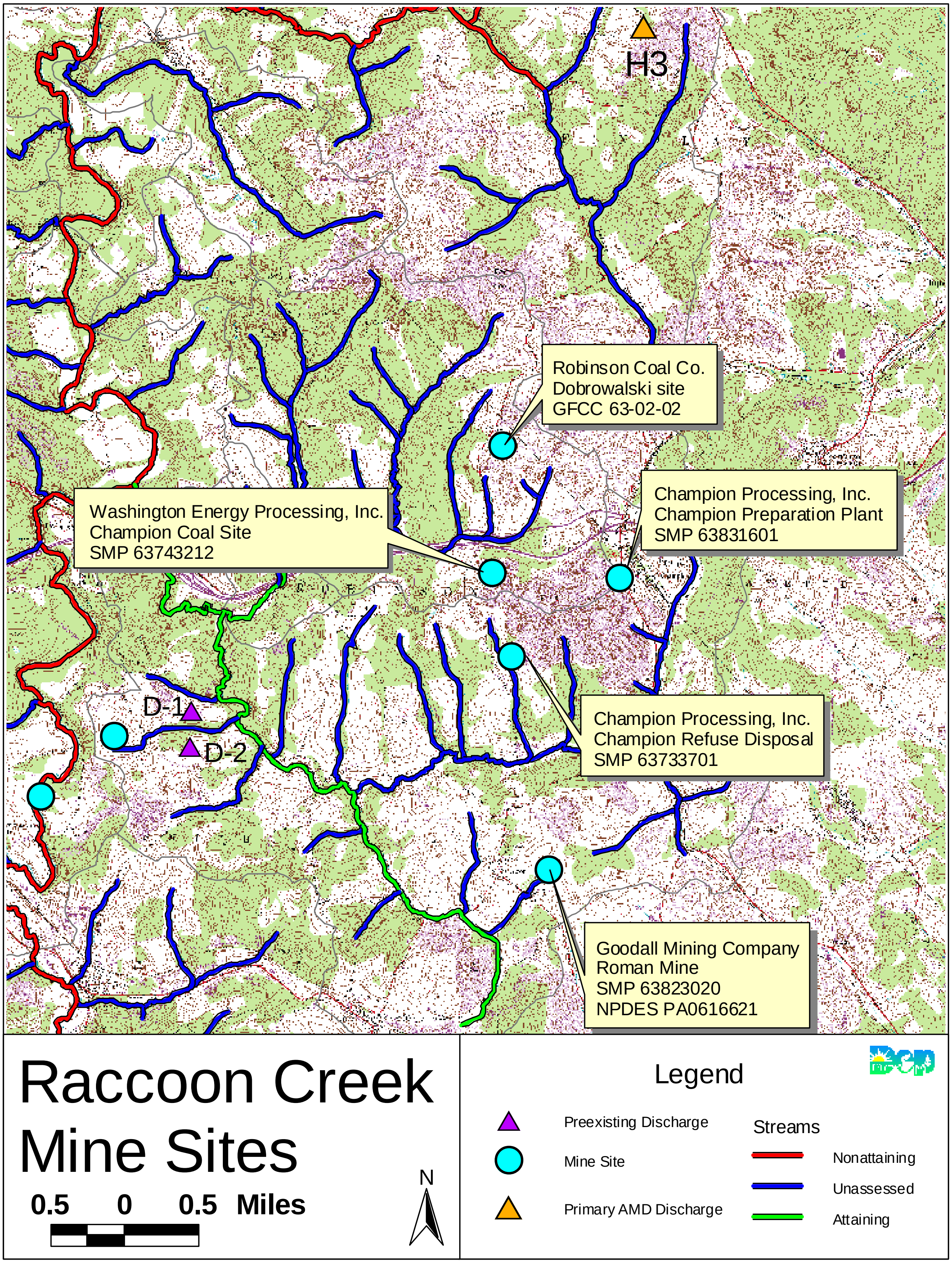
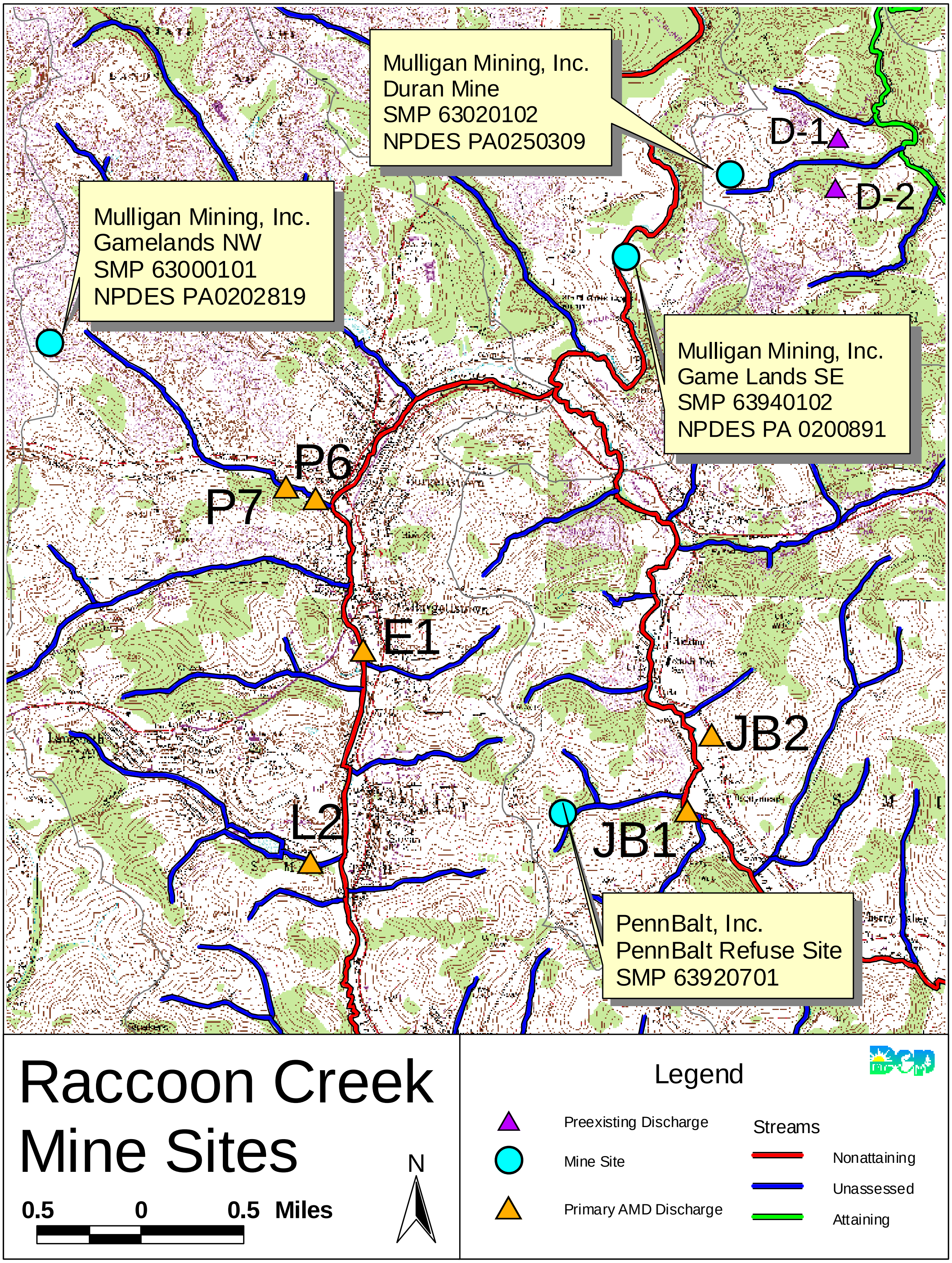
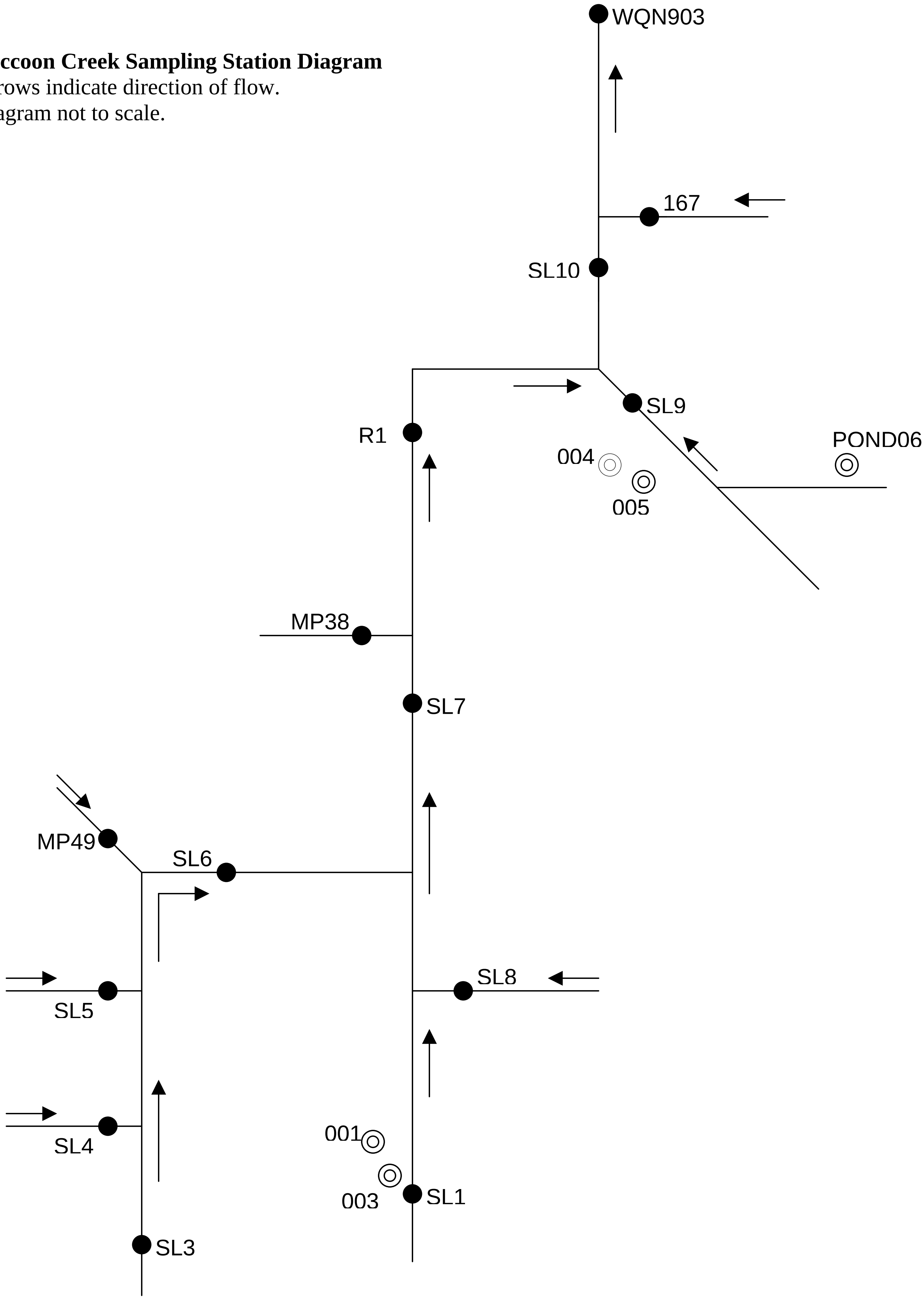
IP38
004
POND06


H3
Robinson Coal Co.
Dobrowalski site
GFCC 63-02-02
Washington Energy Processing, Inc.
Champion Coal Site
SMP 63743212
Champion Processing, Inc.
Champion Preparation Plant
SMP 63831601
D-1
D-2
Champion Processing, Inc.
Champion Refuse Disposal
SMP 63733701
Goodall Mining Company
Roman Mine
SMP 63823020
NPDES PA0616621
Raccoon Creek
Mine Sites
0.5 0 0.5 Miles
N
Legend
Preexisting Discharge
Mine Site
Primary AMD Discharge
Streams
Nonattaining
Unassessed
Attaining



Mulligan Mining, Inc.
Duran Mine
SMP 63020102
NPDES PA0250309
D-1
D-2
Mulligan Mining, Inc.
Gamelands NW
SMP 63000101
NPDES PA0202819
Mulligan Mining, Inc.
Game Lands SE
SMP 63940102
NPDES PA 0200891
P6
P7
E1
JB2
L2
JB1
PennBalt, Inc.
PennBalt Refuse Site
SMP 63920701
Raccoon Creek
Mine Sites
0.5 0 0.5 Miles
N
Legend
Preexisting Discharge
Mine Site
Primary AMD Discharge
Streams
Nonattaining
Unassessed
Attaining

Raccoon Creek Sampling Station Diagram
Arrows indicate direction of flow.
Diagram not to scale.



Attachment B

Method for Addressing Section 303(d) Listings for pH

Method for Addressing Section 303(d) Listings for pH

There has been a great deal of research conducted on the relationship between alkalinity, acidity, and pH. Research published by the Department of Environmental Protection demonstrates that by plotting net alkalinity (alkalinity-acidity) vs. pH for 794 mine sample points, the resulting pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the EPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

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

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

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

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

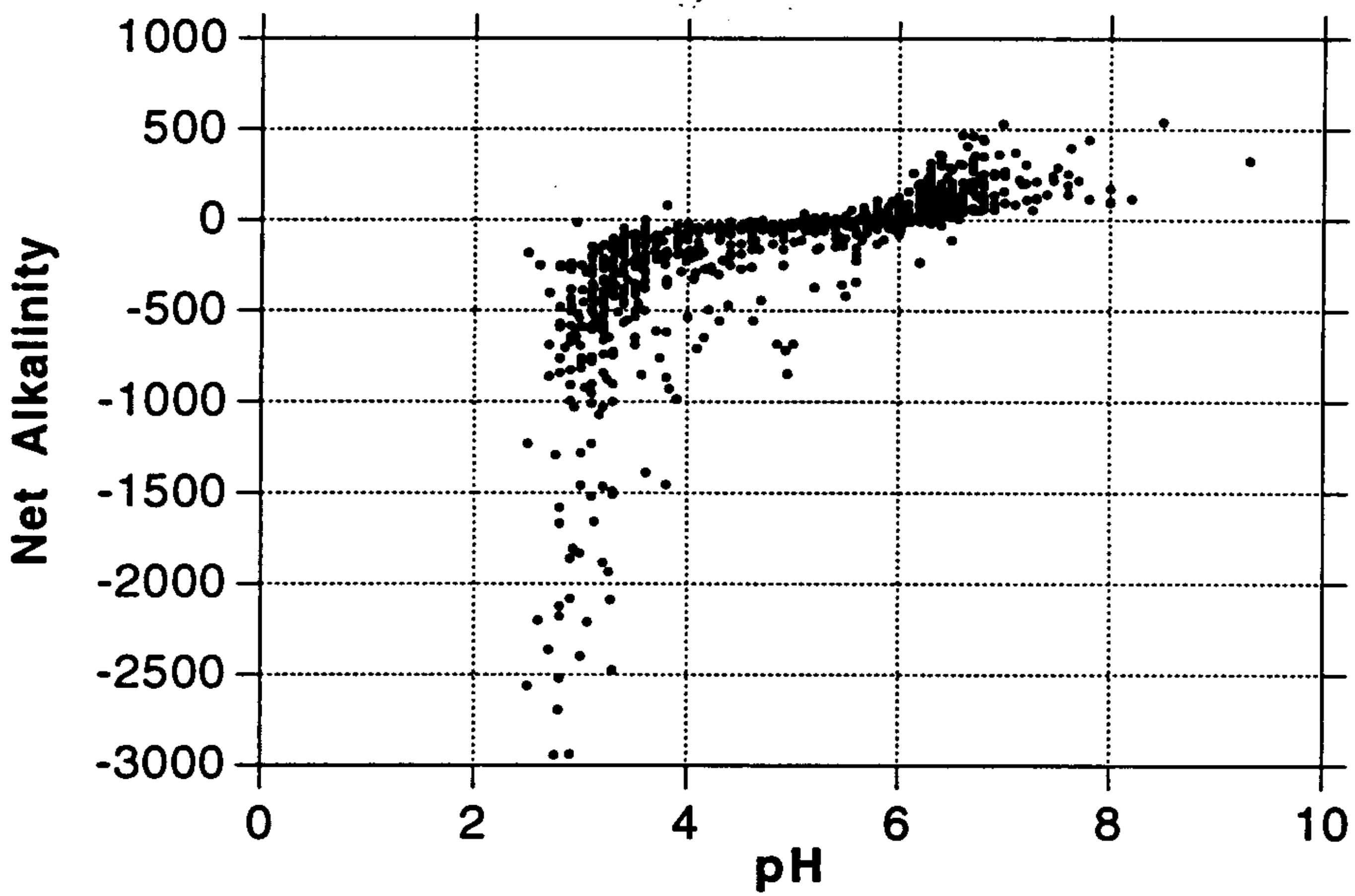


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C

TMDLs By Segment

Raccoon Creek and Burgetts Fork

The TMDL for Burgetts Fork consists of load allocations of three tributaries and two sampling sites along the stream. The TMDL for Raccoon Creek consists of waste load allocations to five permitted discharges and load allocations of eight tributaries, including Burgetts Fork, Little Raccoon Run, and Potato Garden Run, and five sampling sites along the stream. Following is an explanation of the TMDL for each allocation point.

Burgetts Fork is one of the principal headwater tributaries to Raccoon Creek. Four of the primary AMD discharges, the Langeloth Borehole, Erie Mine, and East and West Plum Run, are located in the Burgetts Fork Watershed.

Burgetts Fork and Raccoon Creek are both listed as impaired on the PA Section 303(d) list by high metals, suspended solids, and depressed pH from AMD. The elevated suspended solids are due to metals precipitation, and therefore by removing the metals loading to the stream, the suspended solids will also be removed. For pH, the objective is to reduce acid loading to the stream that will in turn raise the pH to the acceptable range. The result of this analysis is an acid loading reduction that equates to meeting standards for pH (see TMDL Endpoint section in the report, Table 4). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at each sample point for aluminum, iron, manganese, and acidity. The analysis is designed to produce an average value that, when met, will be protective of the water-quality criterion for that parameter 99% of the time. An analysis was performed using Monte Carlo simulation to determine the necessary long-term average concentration needed to attain water-quality criteria 99% of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and standard deviation of the data set, 5000 iterations of sampling were completed, and compared against the water-quality criterion for that parameter. For each sampling event a percent reduction was calculated, if necessary, to meet water-quality criteria. A second simulation that multiplied the percent reduction times the sampled value was run to insure that criteria were met 99% of the time. The mean value from this data set represents the long-term average concentration that needs to be met to achieve water-quality standards.

TMDL Calculations - Sample Point SL3, Burgetts Fork upstream of Unnamed Tributary 33859 near Slovan

The TMDL for Burgetts Fork consists of a load allocation to all of the area above sampling point SL3 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point SL3. In-stream flow measurements were not available for sample point SL3. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL3 is 9.37 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles.

This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point SL3 equals the flow of 8.40 cfs (5.43 MGD) at sample point SL3.

This segment was included on the 1996 Section 303(d) list for metals and suspended solids impairments. Sample data at point SL3 shows pH ranging between 6.9 and 7.9; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured aluminum load is equal to the allowable aluminum load. Because the WQS is met, a TMDL for aluminum is not necessary. Although a TMDL is not necessary the loading is considered at the next downstream point, SL6.

Table C1. TMDL Calculations at Point SL3				
Flow = 5.43 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	2.15	97.2	0.26	11.7
Mn	0.71	32.1	0.37	16.7
Al	0.52	23.7	0.52	23.7
Acidity	0.00	0.0	0.00	0.0
Alkalinity	181.17	8,202.6		

Table C2. Calculation of Load Reduction Necessary at Point SL3				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	97.2	32.1	23.7	0.0
Allowable Load	11.7	16.7	23.7	0.0
Load Reduction	85.5	15.4	0.0	0.0
Total % Reduction	88	48	0	0

TMDL Calculations - Sampling Point SL4, mouth of Unnamed Tributary 33852

The TMDL for sampling point SL4 consists of a load allocation to all of the area above the sampling point shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point SL4. In-stream flow measurements were not available for sample point SL4. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL4 is 1.00 square mile. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles. This gives a flow yield of 0.896 cfs/sq. mi. Multiplying the flow yield for the known point times the watershed area above point SL4 equals the flow of 0.896 cfs (0.58 MGD) at sample point SL4.

There is currently no entry for this segment on the PA Section 303(d) list. Sample data at point SL4 shows pH ranging between 6.1 and 6.5; pH will be addressed as part of this TMDL because of the mining impacts.

Water quality analysis determined that the measured aluminum load is equal to the allowable aluminum load. Because the WQS is met, a TMDL for aluminum is not necessary. Although a TMDL is not necessary the loading is considered at the next downstream point, SL6.

Table C3. TMDL Calculations at Point SL4				
Flow = 0.58 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	40.69	196.3	0.41	2.0
Mn	2.25	10.8	0.56	2.7
Al	0.51	2.4	0.51	2.4
Acidity	18.33	88.4	15.77	76.1
Alkalinity	108.17	521.8		

Table C4. Calculation of Load Reduction Necessary at Point SL4				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	196.3	10.8	2.4	88.4
Allowable Load	2.0	2.7	2.4	76.1
Load Reduction	194.3	8.1	0.0	12.3
Total % Reduction	99	75	0	14

TMDL Calculations - Sampling Point SL5, mouth of Unnamed Tributary 33851

The TMDL for sampling point SL5 consists of a load allocation of the area upstream of the sample point shown in Attachment A. The load allocation for this tributary was computed using water-quality sample data collected at point SL5. In-stream flow measurements were not available for sample point SL5. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL5 is 1.32 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles. This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point SL5 equals the flow of 1.18 cfs (0.76 MGD) at sample point SL5.

There is currently no entry for this segment on the PA Section 303(d) list. Sample data at point SL5 shows pH ranging between 4.5 and 6.8; pH is addressed as part of this TMDL because of the mining impacts.

Table C5. TMDL Calculations at Point SL5				
Flow = 0.76 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	3.04	19.3	0.46	2.9
Mn	2.62	16.7	0.60	3.8
Al	4.78	30.4	0.19	1.2
Acidity	21.73	138.2	4.78	30.4
Alkalinity	30.32	192.8		

Table C6. Calculation of Load Reduction Necessary at Point SL5				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	19.3	16.7	30.4	138.2
Allowable Load	2.9	3.8	1.2	30.4
Load Reduction	16.4	12.9	29.2	107.8
Total % Reduction	85	77	96	78

TMDL Calculations - Sample Point MP49, near mouth of Unnamed Tributary 33847

The TMDL for sample point MP49 consists of a load allocation to all of the area above the sample point shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point MP49. The average flow, measured at the sampling point MP49 (0.39 MGD), is used for these computations

There is currently no entry for this segment on the PA Section 303(d) list. Sample data at point MP49 shows pH ranging between 5.8 and 7.6; pH is addressed as part of this TMDL because of the mining impacts.

Water quality analysis determined that the measured iron load is equal to the allowable iron load. A TMDL for iron at MP49 is not necessary because the WQS is met. Although a TMDL is not necessary, the loading is considered at the next downstream point, SL6.

Table C7. TMDL Calculations at Point MP49				
Flow = 0.39 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.44	1.4	0.44	1.4
Mn	1.31	4.2	0.24	0.8
Al	0.49	1.6	0.088	0.3
Acidity	0.86	2.8	0.86	2.8
Alkalinity	48.57	156.3		

Table C8. Calculation of Load Reduction Necessary at Point MP49				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	1.4	4.2	1.6	2.8
Allowable Load	1.4	0.8	0.3	2.8
Load Reduction	0.0	3.4	1.3	0.0
Total % Reduction	0	82	82	0

TMDL Calculations - Sample Point SL6, downstream of Unnamed Tributary 33847 near mouth of Burgetts Fork

The TMDL for sample point SL6 consists of a load allocation to all of the area between sample point SL6 and sample points SL3, SL4, SL5, and MP49 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point SL6. In-stream flow measurements were not available for sample point SL6. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL6 is 17.91 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles. This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point SL6 equals the flow of 16.04 cfs (10.37 MGD) at sample point SL6.

This segment was added to the PA Section 303(d) list in 2002 for pH and metals impairments. Sample data at point SL6 shows pH ranging between 6.4 and 7.1; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured iron load is equal to the allowable iron load. A TMDL for iron at SL6 is not necessary because the WQS is met. Although a TMDL is not necessary, the loading is considered at the next downstream point, SL7.

Table C9. TMDL Calculations at Point SL6				
Flow = 10.37 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.32	27.3	0.32	27.3
Mn	1.96	169.8	0.16	13.6
Al	0.69	60.0	0.16	13.8
Acidity	0.00	0.0	0.00	0.0
Alkalinity	55.17	4,771.2		

The calculated load reductions for all the loads that enter point SL6 must be accounted for in the calculated reductions at the sample point shown in Table C10. A comparison of measured loads between points SL6, SL5, SL4, SL3 and MP49 shows that there is a loss of iron and acidity loading and an additional manganese and aluminum loading entering the segment. The total segment manganese and aluminum load is the sum of the upstream loads and any additional loading within the segment. For loss of iron and acidity loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C10. Calculation of Load Reduction Necessary at Point SL6				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	27.3	169.8	60.0	0.0
Difference in Existing Load between SL3, SL4, SL5, MP49 & SL6	-287.0	106.0	1.9	-229.4
Load tracked from SL3, SL4, SL5 and MP49	16.0	21.3	25.2	33.2
Percent loss due to instream process	91	-	-	100
Percent of loads tracked through segment	9	-	-	0
Total Load tracked between points SL3, SL4, SL5, MP49 & SL6	1.4	127.2	27.1	0.0
Allowable Load at SL6	27.3	13.6	13.8	0.0
Load Reduction at SL6	0.0	113.7	13.3	0.0
% Reduction required at SL6	0	89	49	0

TMDL Calculations - Sample Point SL1, Raccoon Creek downstream of Unnamed Tributary 33892 near Bonnymeade

The TMDL for Raccoon Creek consists of a load allocation to all of the area above sampling point SL1 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point SL1. In-stream flow measurements were not available for sample point SL1. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL1 is 15.04 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles. This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point SL1 equals the flow of 13.48 cfs (8.71 MGD) at sample point SL1.

This segment was included on the 1996 Section 303(d) list for metals and suspended solids impairments. Sample data at point SL1 shows pH ranging between 7.3 and 8.3; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured iron and manganese loads are equal to the allowable iron and manganese loads. Because WQS are met, TMDLs for iron and manganese are not necessary. Although TMDLs are not necessary the loading is considered at the next downstream point, SL7.

Table C11. TMDL Calculations at Point SL1				
Flow = 8.71 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.45	33.0	0.45	33.0
Mn	0.11	7.9	0.11	7.9
Al	0.54	39.5	0.41	29.7
Acidity	0.00	0.0	0.00	0.0
Alkalinity	178.67	12,981.7		

Table C12. Calculation of Load Reduction Necessary at Point SL1				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	33.0	7.9	39.5	0.0
Allowable Load	33.0	7.9	29.7	0.0
Load Reduction	0.0	0.0	9.8	0.0
Total % Reduction	0	0	25	0

Waste Load Allocations– Discharges 001 and 003, PennBalt, INC.

The PennBalt, INC. SMP 63920701 has three permitted sedimentation ponds, outfalls 001, 003, and 005, of these ponds only outfalls 001 and 003 discharge. The waste load allocations for discharges 001 and 003 are determined from average flow and the monthly average permit limits. The average estimated flows from these ponds are 1 gpm for 001 and 3 gpm for 003. Aluminum is not included in the permit; however a waste load allocation is calculated to allow for the discharge of aluminum. The standard BAT limit of 2.0 mg/L is used for these calculations. The following table shows the waste load allocations for each discharge. The WLAs for 001 and 003 are being evaluated at sample point SL7.

Table C13. Waste Load Allocations at Discharges 001 and 003			
Parameter	**Monthly Avg. Allowable Conc. (mg/L)**	**Average Flow (MGD)**	**Allowable Load (lbs/day)**
Discharge 001			
Fe	3.0	0.00144	0.04
Mn	2.0	0.00144	0.02
Al	2.0	0.00144	0.02
Discharge 003			
Fe	3.0	0.00432	0.1
Mn	2.0	0.00432	0.07
Al	2.0	0.00432	0.07

TMDL Calculations - Sample Point SL8, Mouth of Unnamed Tributary 33884 near Joffre

The TMDL for sample point SL8 consists of a load allocation to all of the area above sampling point SL8 (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point SL8. In-stream flow measurements were not available for sample point SL8. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL8 is 1.43 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles. This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point SL8 equals the flow of 1.23 cfs (0.83 MGD) at sample point SL8.

There is currently no entry for this segment on the PA Section 303(d). Sample data at point SL8 shows pH ranging between 3.5 and 6.1; pH is addressed as part of this TMDL because of the mining impacts.

Table C14. TMDL Calculations at Point SL8

Flow = 0.83 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	2.77	19.1	0.50	3.4
Mn	2.49	17.1	0.70	4.8
Al	12.21	84.1	0.24	1.7
Acidity	76.38	526.3	1.53	10.5
Alkalinity	7.33	50.5		

Table C15. Calculation of Load Reduction Necessary at Point SL8

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	19.1	17.1	84.1	526.3
Allowable Load	3.4	4.8	1.7	10.5
Load Reduction	15.7	12.3	82.4	515.8
Total % Reduction	82	72	98	98

TMDL Calculations - Sample Point SL7, Raccoon Creek

The TMDL for sample point SL7 consists of waste load allocations to discharges 001 and 003 and a load allocation to all of the area between sample point SL7 and sample points SL6, SL8 and SL1 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point SL7. In-stream flow measurements were not available for sample point SL7. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL7 is 38.82 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles. This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point SL7 equals the flow of 34.79 cfs (22.48 MGD) at sample point SL7.

This segment was added to the PA Section 303(d) list in 2002 for pH and metals impairments. Sample data at point SL7 shows pH ranging between 6.6 and 7.5; pH is not addressed as part of this TMDL.

Table C16. TMDL Calculations at Point SL7				
Flow = 22.48 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	2.89	542.2	0.52	97.6
Mn	1.22	228.7	0.37	68.6
Al	1.19	223.0	0.18	33.5
Acidity	0.00	0.0	0.00	0.0
Alkalinity	109.00	20,438.9		

The calculated load reductions for all the loads that enter point SL7 must be accounted for in the calculated reductions at the sample point shown in Table C17. A comparison of measured loads between points SL1, SL8, SL6 and SL7 shows that there is a loss of acidity loading and an additional iron, manganese, and aluminum loading entering the segment. The total segment iron, manganese, and aluminum load is the sum of the upstream loads and any additional loading within the segment. For loss of acidity loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Because the WLAs from the Pennbalt site are relatively small, the values are rounded up to the nearest tenth for the evaluation.

Table C17. Calculation of Load Reduction Necessary at Point SL7				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	542.2	228.7	223.0	0.0
Difference in Existing Load between SL7, SL6, SL8 & SL1	462.9	33.9	39.3	-526.3
Load tracked from SL6, SL1 & SL8	37.8	26.3	45.1	10.5
Percent loss due to instream process	-	-	-	100
Percent of loads tracked through segment	-	-	-	0
Total Load tracked between points SL7, SL6, SL8 & SL1	500.6	60.2	84.4	0.0
Allowable Load at SL7	97.6	68.6	33.5	0.0
WLA (001 & 003)	0.2	0.2	0.2	-
LA	97.4	68.4	33.3	-
Load Reduction at SL7	403.0	0.0	50.9	0.0
% Reduction required at SL7	81	0	60	0

TMDL Calculations - Sample Point MP38, near mouth of Unnamed Tributary 33844

The TMDL for MP38 consists of a load allocation to all of the area above sampling point MP38 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point MP38. The average flow, measured at the sampling point MP38 (0.21 MGD), is used for these computations

There is currently no entry for this segment on the PA Section 303(d) list. Sample data at point MP38 shows pH ranging between 6.1 and 7.0; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured iron and aluminum loads are equal to the allowable iron and aluminum loads. Because WQS are met, TMDLs for iron and aluminum are not necessary. Although TMDLs are not necessary, the loads are considered at the next downstream point, R1.

Table C18. TMDL Calculations at Point MP38

Flow = 0.21 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.41	0.7	0.41	0.7
Mn	1.14	2.0	0.27	0.5
Al	0.22	0.4	0.22	0.4
Acidity	0.00	0.0	0.00	0.0
Alkalinity	109.43	192.1		

Table C19. Calculation of Load Reduction Necessary at Point MP38

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	0.7	2.0	0.4	0.0
Allowable Load	0.7	0.5	0.4	0.0
Load Reduction	0.0	1.5	0.0	0.0
Total % Reduction	0	76	0	0

TMDL Calculations - Sample Point R1, Raccoon Creek downstream of Unnamed Tributary 33839

The TMDL for sample point R1 consists of a load allocation to all of the area between sample point R1 and sample points SL7 and MP38 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point R1. In-stream flow measurements were not available for sample point R1. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point R1 is 44.22 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles.

This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point R1 equals the flow of 39.62 cfs (25.61 MGD) at sample point R1.

This segment was included on the 1996 PA Section 303(d) list for pH and metals impairments. Sample data at point R1 shows pH ranging between 6.4 and 8.0; pH is not addressed as part of this TMDL.

Table C20. TMDL Calculations at Point R1				
Flow = 25.61 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	3.30	705.4	0.20	42.3
Mn	1.03	219.1	0.41	87.6
Al	1.64	349.7	0.16	35.0
Acidity	0.00	0.0	0.00	0.0
Alkalinity	94.35	20,150.2		

The calculated load reductions for all the loads that enter point R1 must be accounted for in the calculated reductions at the sample point shown in Table C21. A comparison of measured loads between points R1, MP38, and SL7 shows that there is a loss of manganese loading and an additional iron and aluminum loading entering the segment. The total segment iron and aluminum load is the sum of the upstream loads and any additional loading within the segment. For loss of manganese loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C21. Calculation of Load Reduction Necessary at Point R1				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	705.4	219.1	349.7	0.0
Difference in Existing Load between R1, MP38 & SL7	162.5	-11.6	126.3	0.0
Load tracked from MP38 & SL7	98.3	60.7	33.8	0.0
Percent loss due to instream process	-	5	-	-
Percent of loads tracked through segment	-	95	-	-
Total Load tracked between points R1, MP38 & SL7	260.8	57.6	160.1	0.0
Allowable Load at R1	42.3	87.6	35.0	0.0
Load Reduction at R1	218.5	0.0	125.1	0.0
% Reduction required at R1	84	0	78	0

Waste Load Allocations – Discharges 004 and 005, Mulligan Mining, Inc. and POND06, Champion Processing, Inc.

The Champion Refuse Disposal Area (SMP63733701) is located in the Little Raccoon Run Watershed. The Champion Refuse site has one treatment pond (POND06) that is permitted to discharge. This pond only discharges when the plant is operated and water is pumped to the plant for treatment. Discharges from this plant may occur once or twice a month in the late summer or fall and for a week in the early spring or during a long rain or snowmelt event. When the plant does discharge it is estimated to be around 1000 gpm, however, there are no recorded flow measurements. A waste load allocation is calculated for the POND06 discharge based on permit limits and the estimated flow.

The Mulligan Mining, Inc. Duran Mine (SMP63020102) is also located in the Little Raccoon Run Watershed. The permit contains two treatment ponds. The treatment ponds are assigned waste load allocations. Aluminum is not included in the permit; however a waste load allocation is calculated to allow for the discharge of aluminum. The standard BAT limit of 2.0 mg/L is used for these calculations. The WLA is calculated as described in the *Method to Quantify Treatment Pond Pollutant Load* section of the report.

The WLAs for 004, 005, and POND06 are being evaluated at sample point SL7.

Table C22. Waste Load Allocations at Discharges 004, 005, and POND06

Parameter	Monthly Avg. Allowable Conc. (mg/L)	Average Flow (MGD)	Allowable Load (lbs/day)
Discharge 004			
Fe	3.0	0.0056	0.14
Mn	2.0	0.0056	0.09
Al	2.0	0.0056	0.09
Discharge 005			
Fe	3.0	0.00391	0.10
Mn	2.0	0.00391	0.07
Al	2.0	0.00391	0.07
POND06			
Fe	1.6	1.44	19.2
Mn	1.1	1.44	13.2
Al	0.5	1.44	6.0

TMDL Calculations – SL9, Mouth of Little Raccoon Run

The TMDL for Little Raccoon Run consists of waste load allocations to discharges 004, 005, and POND06 and a load allocation to all of the area above sampling point SL9 (Attachment A). The load allocation for this stream segment was computed using water-quality sample data collected at point SL9. In-stream flow measurements were not available for sample point SL9. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL9 is 16.06 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles. This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point SL9 equals the flow of 14.39 cfs (9.30 MGD) at sample point SL9.

Little Raccoon Run has been founded to be attaining its uses. Water quality analysis determined that TMDLs are not necessary at point SL9. Sample data at point SL9 shows pH ranging between 6.8 and 7.6; pH is not addressed as part of this TMDL. Although TMDLs are not necessary, WLAs are assigned to the permitted discharges on Little Raccoon Run. In addition affects from the preexisting discharges, D-1 and D-2, are included in the LA portion at SL9.

Table C23. TMDL Calculations at Point SL9

Flow = 9.30 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.32	24.7	0.32	24.7
Mn	0.28	21.5	0.28	21.5
Al	0.50	38.8	0.50	38.8
Acidity	0.00	0.0	0.00	0.0
Alkalinity	76.67	5,946.3		

Table C24. Calculation of Load Reduction Necessary at Point SL9

	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	24.7	21.5	38.8	0.0
Allowable Load	24.7	21.5	38.8	0.0
WLA (004, 005 & POND06)	19.4	13.4	6.2	0.0
LA	5.3	8.1	32.6	0.0
Load Reduction	0.0	0.0	0.0	0.0
% Reduction Required	0	0	0	0.0

TMDL Calculations - Sample Point SL10, Raccoon Creek upstream of Potato Garden Run

The TMDL for sample point SL10 consists of a load allocation to all of the area between sample point SL10 and sample points R1 and SL9 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point SL10. In-stream flow measurements were not available for sample point SL1. Flow for this point was estimated using the unit-area hydrology from a known point (USGS Station ID 05030101) on Raccoon Creek.

The watershed area above sample point SL10 is 76.12 square miles. The known flow point on Raccoon Creek had an average flow of 159.50 cfs, and a watershed area of 178 square miles. This gives a flow yield of 0.896 cfs/sq.mi. Multiplying the flow yield for the known point times the watershed area above point SL10 equals the flow of 68.21 cfs (44.08 MGD) at sample point SL10.

This segment was included on the PA 1996 Section 303(d) list for pH and metals impairments. Sample data at point SL10 shows pH ranging between 5.1 and 8.2; pH is not addressed as part of this TMDL.

Table C25. TMDL Calculations at Point SL10				
Flow = 44.08 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.14	419.6	0.21	75.5
Mn	0.38	140.4	0.34	123.6
Al	0.52	189.5	0.52	189.5
Acidity	0.00	0.0	0.00	0.0
Alkalinity	103.27	37,969.4		

The calculated load reductions for all the loads that enter point SL10 must be accounted for in the calculated reductions at the sample point shown in Table C26. A comparison of measured loads between points SL9, R1 and SL10 shows that there is a loss of metals loading within the segment. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment.

Table C26. Calculation of Load Reduction Necessary at Point SL10				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	419.6	140.4	189.5	0.0
Difference in Existing Load between SL10, SL9 & R1	-310.5	-100.1	-198.9	0.0
Load tracked from SL9 & R1	67.1	79.1	73.7	0.0
Percent loss due to instream process	43	42	51	-
Percent of loads tracked through segment	57	58	49	-
Total Load tracked between points SL10, SL9 & R1	38.5	46.2	36.0	0.0
Allowable Load at SL10	75.5	123.6	189.5	0.0
Load Reduction at SL10	0.0	0.0	0.0	0.0
% Reduction required at SL10	0	0	0	0

TMDL Calculations - Sample Point 167, mouth of Potato Garden Run

The TMDL for sample point 167, from the approved Potato Garden Run TMDL, consists of a load allocation to all of the area above sampling point 167 (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point 167. The average flow, measured at the sampling point 167 (3.11 MGD), is used for these computations

This segment was included on the 1996 PA Section 303(d) list for metals. In 1999 the segment was resurveyed and pH was added as a cause of impairment. Sample data at point MP167 shows pH ranging between 7.5 and 7.8; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured iron and aluminum loads are equal to the allowable iron and aluminum loads. Because WQS are met, TMDLs for iron and aluminum are not necessary. Although TMDLs are not necessary, the loads are considered at the next downstream point, WQN903.

Table C27. TMDL Calculations at Point 167				
Flow = 3.11 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	0.35	9.1	0.35	9.1
Mn	1.04	27.1	0.34	8.9
Al	0.02	0.5	0.02	0.5
Acidity	10.25	266.2	10.25	266.2
Alkalinity	75.62	1,963.7		

Table C28. Calculation of Load Reduction Necessary at Point 167				
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)	Acidity (lbs/day)
Existing Load	9.1	27.1	0.5	266.2
Allowable Load	9.1	8.9	0.5	266.2
Load Reduction	0.0	18.2	0.0	0.0
Total % Reduction	0	67	0	0

TMDL Calculations - Sample Point WQN903, near mouth of Raccoon Creek

The TMDL for sample point WQN 903 consists of a load allocation to all of the area between sample point WQN 903 and sample points SL10 and 167 shown in Attachment A. The load allocation for this stream segment was computed using water-quality sample data collected at point WQN 903. The location of the USGS Gage Station 05030101 and the WQN 903 station are the same so the average flow (103.10 MGD) measured at the gage station is used in these computations.

This segment was included on the PA 1996 Section 303(d) list for pH and metals impairments. Sample data at point WQN 903 shows pH ranging between 6.8 and 8.7; pH is not addressed as part of this TMDL.

Water quality analysis determined that the measured manganese load is equal to the allowable manganese load. Because the WQS is met, a TMDL for manganese is not necessary.

Table C29. TMDL Calculations at Point WQN903				
Flow = 103.10 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Fe	1.05	899.6	0.23	197.9
Mn	0.18	156.1	0.18	156.1
Al	0.74	635.0	0.10	88.9

The calculated load reductions for all the loads that enter point WQN903 must be accounted for in the calculated reductions at the sample point shown in Table C30. A comparison of measured loads between points SL10, 167 and WQN903 shows that there is a loss of manganese loading and an increase in iron and aluminum loading within the segment. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream loads to determine the amount of load that is tracked through the segment. The total segment iron and aluminum load is the sum of the upstream loads plus any additional loading entering the segment.

Table C30. Calculation of Load Reduction Necessary at Point WQN903			
	Fe (lbs/day)	Mn (lbs/day)	Al (lbs/day)
Existing Load	899.6	156.1	635.0
Difference in Existing Load between WQN903	470.9	-11.4	444.9
Load tracked from SL10 & 167	47.6	55.1	36.5
Percent loss due to instream process	-	7	-
Percent of loads tracked through segment	-	93	-
Total Load tracked between points WQN903, SL10 & 167	518.5	51.4	481.4
Allowable Load at WQN903	197.9	156.1	88.9
Load Reduction at WQN903	320.6	0.0	392.5
% Reduction required at WQN903	62	0	82

Margin of Safety

For this study the margin of safety is applied implicitly. A MOS is implicit because the allowable concentrations and loadings were simulated using Monte Carlo techniques and employing the @Risk software. Other margins of safety used for this TMDL analysis include the following:

- Effluent variability plays a major role in determining the average value that will meet water-quality criteria over the long-term. The value that provides this variability in our analysis is the standard deviation of the dataset. The simulation results are based on this variability and the existing stream conditions (an uncontrolled system). The general assumption can be made that a controlled system (one that is controlling and stabilizing the pollution load) would be less variable than an uncontrolled system. This implicitly builds in a margin of safety.
- An additional MOS is provided because the calculations were done with a daily Fe average instead of the 30-day average
- The method used to calculate a flow for a WLA using the area of the pit and ungraded portions is conservative and an implicit margin of safety.

Seasonal Variation

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

Critical Conditions

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

Attachment D

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

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

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

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

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

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

Attachment E

Water Quality Data Used In TMDL Calculations

Station	Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/l	mg/l	mg/l	mg/l
MP38	2/27/2001	250	6.2	90	0	0.4	1.97	0.23
Latitude:	5/23/2001	100	6.2	82	0	0.64	2.34	0.43
40 24' 32"	9/24/2001	188	6.2	134	0	0.53	0.39	0.34
	11/19/2001	65		98	0	0.23	0.49	0.06
Longitude:	1/29/2002	100	7	102	0	0.38	1.18	0.17
80 22' 43"	6/17/2002	275	6.6	92	0	0.41	1.46	0.15
	9/15/2002	45	6.1	168	0	0.28	0.18	0.14
	Average	146.14286	6.38333	109.42857	0.00000	0.41000	1.14429	0.21714
	St Dev	91.48302	0.34881	30.69667	0.00000	0.14000	0.83060	0.12776
MP49	2/27/2001		6.2	10	6	0.76	3.45	2.72
Latitude:	5/23/2001	500	6.8	38	0	0.39	2.11	0.16
40 23' 30"	9/24/2001	312	5.8	74	0	0.66	0.53	0.34
	11/19/2001	128	7.6	36	0	0.25	0.73	0.04
Longitude:	1/29/2002			50	0	0.66	1.27	0.05
80 23' 28"	6/17/2002	250	6.5	52	0	0.24	0.56	0.07
	9/15/2002	150	6	80	0	0.12	0.49	0.04
	Average	268.00000	6.48333	48.57143	0.85714	0.44000	1.30571	0.48857
	St Dev	149.67298	0.65243	23.82476	2.26779	0.25173	1.11061	0.98989
167	6/30/2000	2170	7.77	71	8	0.22	0.62	0.02
Latitude:	10/1/2000	1171	7.56	74	6	0.06	0.55	0.02
N40°29.003'	1/13/2001	1510	7.51	91	22	0.50	1.80	0.02
Longitude:	4/1/2001	3798	7.62	67	5	0.62	1.2	0.02
W80°21.466'	Average	2162.25000	7.61500	75.62246	10.25000	0.35000	1.04250	0.02000
Potato Garden Run	St Dev	1166.72544	0.11269	10.66838	7.93200	0.25586	0.58300	0.00000

Station	Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/l	mg/l	mg/l	mg/l
SL10	10/18/1999		7.4	92	0	0.3	0.198	0.5
	11/15/1999		7.1	94	0	0.3	0.266	0.5
Latitude:	12/1/1999		7.2	102	0	0.3	0.599	0.5
40 28’ 38”	1/10/2000		7.6	106	0	0.674	0.466	0.5
Longitude:	2/16/2000		7.3	88	0	1.73	0.384	0.671
80 21’ 43”	3/7/2000		7.8	110	0	6.26	0.517	0.5
	4/20/2000		7.5	112	0	1.09	0.475	0.5
Raccoon Creek upstream of	5/15/2000		5.1	102	0	0.3	0.123	0.5
Potato Garden Run	6/27/2000		7.6	134	0	0.8	0.232	0.5
	7/24/2000		8.2	112	0	0.3	0.13	0.5
	8/28/2000		7.3	84	0	0.499	0.812	0.5
	Average		7.28182	103.27273	0.00000	1.14118	0.38200	0.51555
	St Dev		0.78590	14.03632	0.00000	1.75604	0.21594	0.05156
SL9	8/18/1999		6.8	68	0	0.3	0.164	0.5
	10/18/1999		7.1	74	0	0.3	0.164	0.5
Latitude:	11/15/1999		6.8	72	0	0.3	0.475	0.5
40 25’ 31”	12/1/1999		6.9	78	0	0.3	0.358	0.5
Longitude:	1/10/2000		7.3	74	0	0.3	0.386	0.5
80 21’ 31”	2/16/2000		6.9	58	0	0.527	0.435	0.5
	3/7/2000		7.5	80	0	0.3	0.46	0.5
Mouth of Little Raccoon Run	4/20/2000		7.2	74	0	0.3	0.4	0.5
	5/15/2000		7.6	88	0	0.3	0.068	0.5
	6/27/2000		7.1	88	0	0.3	0.105	0.5
	7/24/2000		6.9	88	0	0.3	0.107	0.5
	8/28/2000		6.9	78	0	0.3	0.211	0.5
	Average		7.08333	76.66667	0.00000	0.31892	0.27775	0.50000
	St Dev		0.26912	8.87625	0.00000	0.06553	0.15471	0.00000

Station	Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/l	mg/l	mg/l	mg/l
SL8	8/9/1999		4.5	8.8	72	1.04	2.45	11.5
	10/18/1999		4.7	10	26	1.38	2.52	5.55
Latitude:	11/15/1999		4.9	12.4	24	1.56	2.74	5
40 22’ 42”	12/1/1999		6.1	20	4.2	2.52	2.51	4.75
Longitude:	1/10/2000		5.6	13.6	9.2	1.96	2.34	6.94
80 21’ 42”	2/16/2000		5.5	13.8	15.2	2.12	1.82	7.41
	3/7/2000		3.9	0	114	3.2	2.68	17.7
Mouth of Unnamed	4/20/2000		4.2	6	122	3.35	2.32	15
Trib 33884	5/15/2000		3.6	0	142	4.98	2.5	17.4
	6/27/2000		4.1	3.4	92	2.02	1.99	11.7
	7/24/2000		3.9	0	92	2.61	2.45	14.2
	8/28/2000		3.5	0	204	6.53	3.5	29.4
	Average		4.54167	7.33333	76.38333	2.77250	2.48500	12.21250
	St Dev		0.83824	6.80125	62.77257	1.58577	0.41267	7.18512
SL7	9/9/1999		6.6	56	0	1.2	2.41	0.5
	10/18/1999		7	88	0	0.557	1.92	0.5
Latitude:	11/15/1999		6.6	98	0	0.672	1.73	0.5
40 24’ 12”	12/1/1999		6.9	116	0	2.33	1.27	0.5
Longitude:	1/10/2000		7.5	132	0	2.62	0.695	0.5
80 21’ 48”	2/16/2000		7.2	118	0	3.11	0.438	1.11
	3/7/2000		7.4	128	0	4.06	0.81	1.37
Burgetts Fork downstream	4/20/2000		7.1	136	0	3.56	0.697	1.34
of Unnamed Trib 33847	5/15/2000		7.3	96	0	4.31	1.3	1.64
	6/27/2000		7.4	150	0	4.12	0.59	1.46
	7/24/2000		7	110	0	2.3	0.995	0.772
	8/28/2000		6.7	80	0	5.86	1.78	4.08
	Average		7.05833	109.00000	0.00000	2.89158	1.21958	1.18933

Station	Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/l	mg/l	mg/l	mg/l
	St Dev		0.31467	26.64924	0.00000	1.60027	0.62268	1.01103
SL6	8/9/1999		6.8	70	0	0.3	0.589	0.5
	10/18/1999		7.1	74	0	0.3	0.362	2.83
Latitude:	11/15/1999		6.5	68	0	0.3	0.256	0.5
40 23’ 19”	12/1/1999		6.7	64	0	0.329	0.87	0.5
Longitude:	1/10/2000		6.9	52	0	0.3	0.843	0.5
80 23’ 40”	2/16/2000		6.7	46	0	0.3	1.32	0.5
	3/7/2000		6.8	48	0	0.3	8.47	0.5
	4/20/2000		6.4	30	0	0.3	1.51	0.5
	5/15/2000		6.8	38	0	0.3	1.75	0.5
	6/27/2000		6.8	68	0	0.3	0.582	0.5
	7/24/2000		6.7	72	0	0.3	0.413	0.5
	8/28/2000		6.4	32	0	0.457	6.59	0.5
	Average		6.71667	55.16667	0.00000	0.31550	1.96292	0.69417
	St Dev		0.20375	16.16862	0.00000	0.04533	2.67204	0.67261
SL5	9/9/1999		6.4	28	0	1.4	3.52	0.5
	10/18/1999		6.6	48	0	0.453	2.94	0.5
Latitude:	11/15/1999		6.3	52	0	1.72	2.94	1.04
40 22’ 51”	12/1/1999		6.5	58	0	3.66	2.86	1.76
Longitude:	1/10/2000		6.6	42	0	2.77	2.11	3.58
80 23’ 40”	2/16/2000		6.8	68	0	1.64	1.37	1.63
	3/7/2000		5.2	11.4	16.8	4	2.05	6.11
Mouth of Unnamed	4/20/2000		4.8	11.8	44	7.82	2.29	8.18
Tributary 33851	5/15/2000		4.6	11.2	66	3.39	2.59	8.96
	6/27/2000		4.8	10.8	30	2.93	2.66	6.19
	7/24/2000		4.9	11.6	22	3.13	2.63	5.95
	8/28/2000		4.5	11	82	3.51	3.5	12.9

Station	Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/l	mg/l	mg/l	mg/l
	Average		5.66667	30.31667	21.73333	3.03525	2.62167	4.77500
	St Dev		0.92769	21.91230	28.62641	1.85068	0.61094	3.94507
SL4	9/13/1999		6.2	70	58	60.6	2.86	0.5
	10/18/1999		6.2	60	50	49.2	2.4	0.5
Latitude:	11/15/1999		6.1	62	54	50.7	2.78	0.5
40 22’ 31”	12/1/1999		6.4	72	58	58.8	3.18	0.5
Longitude:	1/10/2000		6.6	134	0	36	2.37	0.5
80 23’ 34”	2/16/2000		6.6	126	0	20.2	1.27	0.581
	3/7/2000		6.5	120	0	33.3	1.86	0.5
Mouth of Unnamed	4/20/2000		6.5	126	0	26.3	1.58	0.5
Trib 33825	5/15/2000		6.4	212	0	49.9	2.69	0.5
	6/27/2000		6.5	126	0	28.2	1.7	0.5
	7/24/2000		6.3	98	0	44.6	2.46	0.5
	8/28/2000		6.4	92	0	30.5	1.79	0.5
	Average		6.39167	108.16667	18.33333	40.69167	2.24500	0.50675
	St Dev		0.16214	42.77177	27.15388	13.35007	0.59297	0.02338
SL3	9/13/1999		7.4	204	0	0.64	1.52	0.5
	10/18/1999		7.7	200	0	0.411	1.07	0.5
Latitude:	11/15/1999		7.1	202	0	0.559	0.778	0.5
40 21’ 17”	12/1/1999		7.3	202	0	0.942	0.5	0.5
Longitude:	1/10/2000		7.5	154	0	1.51	0.502	0.5
80 23’ 32”	2/16/2000		6.9	110	0	1.11	0.316	0.684
	3/7/2000		7.6	180	0	1.56	0.463	0.5
Burgetts Fork Upstream	4/20/2000		7.2	170	0	1.31	0.3	0.607
of Unnamed Trib 33895	5/15/2000		7.9	218	0	1.22	0.502	0.5
	6/27/2000		7.1	172	0	4.57	0.663	0.5
	7/24/2000		7.2	194	0	2.45	0.935	0.5

Station	Date	Flow gpm	Lab pH	Alkalinity mg/L	Acidity mg/l	Iron mg/l	Manganese mg/l	Aluminum mg/l
	8/28/2000		6.9	168	0	9.49	0.955	0.5
	Average		7.31667	181.16667	0.00000	2.14767	0.70867	0.52425
	St Dev		0.31286	29.31284	0.00000	2.56775	0.35906	0.05897
SL1	8/9/1999		7.3	160	0	0.477	0.451	0.5
	10/18/1999		7.7	200	0	0.3	0.09	0.5
Latitude:	11/15/1999		7.4	180	0	0.447	0.103	0.5
40 21’ 35”	12/1/1999		7.4	166	0	0.3	0.083	0.5
Longitude;	1/10/2000		7.9	162	0	0.3	0.078	0.5
80 21’ 37”	2/16/2000		7.5	118	0	1.32	0.084	1.03
	3/7/2000		8.3	168	0	0.3	0.064	0.5
Raccoon Creek downstream	4/2/2000		7.9	188	0	0.3	0.082	0.5
of Unnamed Trib 33892	5/15/2000		8.1	192	0	0.3	0.089	0.5
	6/27/2000		7.8	210	0	0.8	0.076	0.5
	7/24/2000		7.7	200	0	0.3	0.052	0.5
	8/28/2000		7.9	200	0	0.3	0.05	0.5
	Average		7.74167	178.66667	0.00000	0.45367	0.10850	0.54417
	St Dev		0.30289	25.57461	0.00000	0.31042	0.10896	0.15300
R1	5/12/1999		7.3	106	0	3.53	1.13	1.44
	6/14/1999		7	80	0	1.09	1.46	0.553
Latitude:	7/14/1999		7	62	0	ND	1.69	ND
40 14’ 00”	8/10/1999		6.5	56	0	ND	1.87	ND
Longitude:	9/13/1999		6.6	5	0	ND	2.11	ND
80 22’ 07”	10/18/1999		6.9	5	0	ND	1.58	ND
	11/15/99		6.6	90	0	ND	1.53	ND
Raccoon Creek downstream	12/1/1999		7	118	0	1.14	1.14	ND
of Unnamed Trib 33839	1/10/2000		7.5	130	0	2.07	0.687	ND
	2/16/2000		7.3	114	0	3.01	0.463	1.28

Station	Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/l	mg/l	mg/l	mg/l
	3/7/2000		7.5	122	0	3.14	0.775	1.13
	4/20/2000		7.3	132	0	3.1	0.678	1.28
	5/15/2000		7.8	90	0	0.84	1.16	ND
	6/27/2000		7.5	146	0	3.29	0.561	1.1
	7/24/2000		7.9	104	0	ND	0.693	ND
	8/28/2000		6.8	76	0	4.29	1.57	3.21
	9/27/2000		7.2	74	0	ND	1.5	ND
	10/12/2000		6.4	82	0	0.504	1.27	ND
	11/13/2000		7.4	90	0	ND	1.08	ND
	12/4/2000		7.2	106	0	1.62	1.25	ND
	1/30/2001		7.1	120	0	30.2	1.25	7.2
	2/26/2001		7.7	134	0	2.25	0.581	1.27
	3/19/2001		7.7	144	0	2.8	0.485	1.13
	4/25/2001		7.3	124	0	2.93	0.654	1.72
	5/21/2001		7.3	84	0	2.34	1.1	1.07
	6/14/2001		8	122	0	1.67	0.561	0.568
	7/26/2001		7.5	74	0	1.42	0.686	0.542
	8/27/2001		6.6	58	0	0.939	0.831	ND
	10/11/2001		6.6	60	0	ND	1.25	ND
	11/7/2001		7.7	98	0	ND	0.837	ND
	12/3/2001		7.7	128	0	0.661	0.645	ND
	1/29/2002		7.3	130	0	1.83	0.61	ND
	2/11/2002		7.9	134	0	3.19	0.534	0.718
	3/20/2002		7.8	132	0	7.33	0.54	2.52
	4/22/2002		7.7	132	0	2.35	0.529	1.05
	5/28/2002		7.5	116	0	5.35	0.725	2.38
	6/24/2002		6.7	86	0	1.89	0.812	0.948
	7/22/2002		7.1	52	0	0.653	1.05	ND
	8/7/2002		6.6	28	0	0.354	1.87	ND

Station	Date	Flow	Lab pH	Alkalinity	Acidity	Iron	Manganese	Aluminum
		gpm		mg/L	mg/l	mg/l	mg/l	mg/l
	9/16/2002		7.1	30	0	ND	1.28	ND
	Average		7.24000	94.35000	0.00000	3.30279	1.02568	1.63732
	St Dev		0.44307	37.25900	0.00000	5.39471	0.44703	1.51828
WQN 903	10/20/1998		7.5	86		0.139	0.076	0.2
	12/15/1998		7.7	84		0.153	0.061	0.2
	3/3/1999		7.8	70		0.453	0.342	0.246
Latitude:	5/27/1999		7.5	80		0.807	0.184	0.578
40°37'40"	7/12/1999		7.9	76		0.538	0.092	0.387
	9/14/1999		7.5	66		0.99	0.144	0.742
Longitude:	11/15/1999		8.2	84		0.118	0.047	0.2
80°20'16"	2/16/2000		7.6	54		1.97	0.335	1.08
	4/13/2000		7	68		4.34	0.271	3.75
	6/22/2000		7.5	100		2.48	0.197	1.88
	8/1/2000		7.5	84		0.905	0.115	0.656
	12/13/2000		6.8	78		0.333	0.106	0.2
	1/29/2001		7.7	84		0.181	0.338	0.2
	3/15/2001		8.4	80		0.145	0.276	0.2
	5/3/2001		8.7	76		0.205	0.069	0.2
	5/16/2001		7.9	80		0.126	0.042	0.2
	7/11/2001		7.2	84		5	0.645	3.79
	9/17/2001		8.3	80		2.48	0.043	0.2
	11/20/2001		7.9	90		0.119	0.06	0.2
	2/21/2002		7.8	76		0.3	0.2	0.2
	4/9/2002		7.8	78		0.19	0.17	0.2
	Average		7.72381	78.95238		1.04629	0.18157	0.73852
	St Dev		0.44711	9.39402		1.42114	0.14759	1.08809

USGS GAGE STATION		
Beaver County, Pennsylvania		
Hydrologic Unit Code 05030101		
Latitude: 40°37'40", Longitude: 80°20'16"		
Drainage area 178.00 square miles		
Gage datum 719.16 feet above sea level NGVD29		
Date	**Flow (ft^3/s)**	**Flow (gpm)**
Jan-98	403	180878
Feb-98	268	120286
Mar-98	303	135995
Apr-98	395	177288
May-98	304	136444
Jun-98	218	97845
Jul-98	129	57899
Aug-98	36.8	16517
Sep-98	23.8	10682
Oct-98	31.8	14273
Nov-98	30.4	13644
Dec-98	53.1	23833
Jan-99	413	185367
Feb-99	226	101436
Mar-99	275	123428
Apr-99	330	148114
May-99	169	75852
Jun-99	44.2	19838
Jul-99	42	18851
Aug-99	19.1	8573
Sep-99	11.6	5206
Oct-99	16	7181
Nov-99	55.4	24865

Dec-99	95.4	42818
Jan-00	112	50269
Feb-00	292	131058
Mar-00	205	92010
Apr-00	339	152153
May-00	226	101436
Jun-00	187	83931
Jul-00	123	55206
Aug-00	202	90664
Sep-00	47.6	21364
Oct-00	49.2	22082
Nov-00	40	17953
Dec-00	168	75403
Jan-01	130	58348
1-Feb	250	112208
Mar-01	286	128365
Apr-01	348	156193
May-01	114	51167
Jun-01	80.6	36176
Jul-01	39.9	17908
Aug-01	19.4	8707
Sep-01	26.4	11849
Average	159.50444	71590
St Dev	125.00210	56104.69087

Champion Processing, INC.	Date	pH	Alkalinity	Acidity	Fe	Mn	Al
SMP 63733701			mg/L	mg/L	mg/L	mg/L	mg/L
SP-B	2/2/2000	7.29	41.00	16.8	0.09	0.04	0.2
Latitude:	5/4/2000	7.79	70.40	6	0.13	0.06	0.23
40 24' 11"	8/3/2000	7.8	80.80	6.2	0.42	0.15	0.2
	11/8/2000	7.59	75.40	6.2	0.09	0.13	0.2
Longitude:	2/21/2001	7.68	71.20	10	0.13	0.06	0.2
80 18' 26"	5/8/2001	7.75	75.60	4.2	0.38	0.1	0.22
	9/6/2001	7.91	128.60	12	0.14	0.31	0.2
	12/4/2001	7.74	99.40	4	0.19	0.16	0.34
Downstream Point on Trib 33824	3/7/2002	7.74	75.20	3.6	0.05	0.03	0.2
	6/7/2002	7.41	58.40	4	0.4	0.12	0.2
	9/5/2002	7.74	104.00	7.8	1.29	0.34	0.34
	Average	7.68	80.00	7.35	0.30	0.14	0.23
	St Dev	0.18	23.53	4.11	0.35	0.10	0.06

Average Flow at USGS Gage Station = 71,590 gpm

Drainage Area = 178.00 sq. miles

Point	**Drainage Area (m^2)**	**Drainage Area (sq miles)**	**Flow (gpm)**	**Flow (cfs)**	**Flow (mgd)**
SL3	24,278,016.65673	9.37374	3,770.03487	8.3995	5.429
SL4	2,586,900.96714	0.99880	401.70937	0.8950	0.578
SL5	3,410,322.54292	1.31673	529.57517	1.1799	0.763
SL6	46,375,304.84671	17.90551	7,201.43324	16.0445	10.370
SL1	38,960,900.06816	15.04280	6,050.08036	13.4794	8.712
SL8	3,694,372.41587	1.42640	573.68413	1.2781	0.826
SL7	100,547,370.95341	38.82134	15,613.59396	34.7865	22.484
R1	114,519,063.89679	44.21581	17,783.20157	39.6203	25.608
SL9	41,589,217.41110	16.05760	6,458.22111	14.3887	9.300
SL10	197,145,938.42764	76.11805	30,613.99423	68.2069	44.084

Attachment F

Comment and Response

Comments/Responses on the Raccoon Creek Watershed TMDL

A 60-day public comment period was open on the Raccoon Creek Watershed Draft TMDL from December 4, 2004 until February 2, 2005. During this time, no comments were received.