FINAL

NORTH FORK BEECH CREEK WATERSHED TMDL
Centre County

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 North Fork Beech 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 one segment on this list (shown in Table 1). This segment was included on the 1996 list for metals and other inorganic impairments. In 1998 the segment was resurveyed, assigned a new segment id, and pH added as cause of impairment to the 2002 PA Section 303(d) list. An Unnamed Tributary to North Fork Beech Creek was also added with a separate segment id to the 2002 list for metals and pH 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: 09-C Bald Eagle Creek

Year	Miles	Segment ID	DEP Stream Code	Stream Name	Designated Use	Data Source	Source	EPA 305(b) Cause Code
1996	5.9	7116	22781	North Fork Beech Creek	CWF	305(b) Report	RE	Metals & Other Inorganics
1998	5.96	7116	22781	North Fork Beech Creek	CWF	SWMP	AMD	Metals & Other Inorganics
2002	15.3	New survey; new id. 980609-1400-MAF	22796, 22791 & 22781	Cherry Run, Little Sandy Run, & North Fork Beech Creek	CWF	SWAP	AMD	Metals, Other Inorganics & pH
1996	Not on 1996 303(d) list							
1998	Not on 1998 303(d) list							
2002	0.4	980901-1300-MAF	22789	Unt. North Fork Beech Creek	CWF	SWAP	AMD	Metals & pH

Resource Extraction=RE
Cold Water Fishes = CWF
Surface Water Monitoring Program = SWMP
Surface Water Assessment Program = SWAP
Abandoned Mine Drainage = AMD

[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.*

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.

There is one segment (980605-1300-MAF) in the North Fork Beech Creek Watershed that was listed in 2002 for nutrient impairments from onsite wastewater. A TMDL to address this segment is not included in this report, but will be addressed at a later date.

Directions to the North Fork Beech Creek Watershed

The North Fork of Beech Creek Watershed is located in North Central Pennsylvania, occupying a northwestern portion of Centre County in Burnside and Snow Shoe Townships. The watershed area is found on United States Geological Survey maps covering portions of the Snow Shoe, Snow Shoe SE and Karthaus 7.5-Minute Quadrangles. The area within the watershed consists of 21 square miles. Land uses within the watershed include abandoned mine lands, forestlands, and rural residential properties with small communities scattered throughout the area.

The village of Clarence is located near the headwaters of the North Fork of Beech Creek. Clarence can be easily reached by traveling on Interstate 80 to the Snow Shoe exit. The Snow Shoe exit lies 25 miles east of Clearfield and 10 miles west of Bellefonte. Once at the Snow Shoe exit one can travel approximately one mile north on SR144 to Snow Shoe Borough. Clarence can be reached by traveling through Snow Shoe via Clarence Road. The North Fork of Beech Creek passes beneath Clarence Road as you enter Clarence.

Hydrology and Geology

The North Fork of Beech Creek exists until the confluence with the South Fork of Beech Creek. The two join to form the main stem of Beech Creek. Named tributaries to North Fork include Cherry Run and Little Sandy Run. The streams drain the area from west to east. North Fork Beech Creek flows from an elevation of 1500 feet above sea level near its headwaters to an elevation 1220 feet above sea level at its confluence with the South Fork.

The North Fork Beech Creek Watershed lies within the Appalachian Plateau Physiographic Province. The watershed area is comprised of Pennsylvanian and Mississipian aged rocks, which are divided into the Pottsville and Allegheny Groups Pennsylvanian period and Mauch Chunck Formation and Burgoon Sandstone of the Mississpian period. The majority of the watershed is located regionally on the southeast limb of the Snow Shoe Syncline with the watershed headwaters lying across the axial plane on the northwest limb of the syncline. The syncline crosses the watershed just north of the Cherry Run and North Fork of Beech Creek confluence.

Younger Pennsylvanian aged rocks of the Pottsville and Allegheny Groups are exposed on the hilltops north of North Fork and the older Mississippian rocks of the Mauch Chunk Formation and Burgoon Sandstone are exposed in the valleys of the watershed and south of North Fork on the hilltops. Strata in the watershed are oriented in a SW to NE trend and dip to the northwest with the exception of the headwaters strata which dip to the southeast. The majority of the coal in the watershed area is found to the north of the North Fork of Beech Creek. Coal is also present south of the North Fork of Beech Creek on the hilltops near the headwaters. The coal is deposited in seven seams: the Mercer, Brookville, Clarion, Lower Kittanning, Middle Kittanning, Upper Kittanning and Lower Freeport.

Segments addressed in this TMDL

There is one Government Financed Construction Contract (GFCC) mining operation in the watershed, GFCC number 14-04-01, CMT Energy Inc. Poorman Side site; however, alternate Erosion and Sedimentation (E&S) controls, such as hay bales, are utilized resulting in no NPDES discharge points. All of the discharges in the watershed are from abandoned mines and are treated as non-point sources. Each segment on the Section 303(d) list is addressed as a separate TMDL. These TMDLs are expressed as long-term, average loadings. Due to the nature and complexity of mining effects on the watershed, expressing the TMDL as a long-term average gives a better representation of the data used for the calculations. See Attachment C for TMDL calculations.

Clean Water Act Requirements

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

Additionally, the federal Clean Water Act and the 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.

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

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

Basic Steps for Determining a TMDL

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

1. Collection and summarization of pre-existing data (watershed characterization, inventory contaminant sources, determination of pollutant loads, etc.);
2. Calculating the TMDL for the waterbody using EPA approved methods and computer models;
3. Allocating pollutant loads to various sources;
4. Determining critical and seasonal conditions;
5. Public review and comment and comment period on draft TMDL;
6. Submittal of final TMDL; and
7. EPA approval of the TMDL.

Watershed History

Coal was first discovered in 1819 by a hunting party in an out-cropping close to a spring on land in the Snow Shoe region. Coal mining was minimal in the early years. All the coal was being used locally up until 1859. In 1859 the Bellefonte and Snow Shoe Railroad was completed enabling the coals of the watershed to be moved to markets in other areas of the east coast. Mining villages sprung up around the mining within the watershed. Early mining involved digging shafts into the coal and mining it. Deep mining later gave way to strip mining of the coal. The deep mining and strip mining of the past have left deep mine entries, refuse piles, subsidence and pooling areas, altered landscapes which were not reclaimed, and the exposure of acid bearing overburden to air and water. These sources have led to the pollution and degradation of the watershed. Recent mining includes the following:

The Betz Strip Mine Operation (MDP 4773SM1) was issued to R. S Carlin Inc. on February 1, 1973. The total affected area was not to exceed 378 acres. The coal seams mined were the Lower Kittanning (16 acres) and Clarion (286 acres) coals. In October of 1984 the site was repermitted as described below as SMP14733009.

The Mine #22 Operation (SMP 14733009, NPDES PA0128341) was issued to R. S. Carlin, Inc. on October 29, 1984. The total permit area was 646 acres with 305 acres affected. The coal seams mined were the Lower Kittanning (102 acres), Clarion 3 (255 acres), Clarion 2 (255 acres), and Clarion 1 (255 acres) coals. Coal removal and backfilling were completed by the fall of 1997 and the site is currently eligible for Stage II Bond Release.

The Robinson Operation (SMP 14840103, NPDES PA0610372) was issued to Chews Contracting Company, Inc. on August 1, 1984. The total permit area was 74 acres with 41 acres affected. The coal seam mined was the Clarion (41 acres). Backfilling and reclaiming was completed in September of 1995. This site is located near the village of Fountain on the southern side of the North Fork of Beech Creek.

The North Fork Operation (SMP 14820102, NPDES PA0609811) was issued to Johnson and Morgan on October 4, 1984. The total permit area was 392 acres with 235 acres affected. The coal seams mined were the Lower Kittanning (235 acres), Middle Kittanning (135 acres) and Upper Kittanning (51 acres) coals. Mining was completed in June of 1992. The site is located on the hilltop northwest of the village of Snow Shoe.

The Morgan Operation (SMP 14960101, NPDES PA0220388) was issued to River Hill Coal Company, Inc. on May 12, 1997. The total permit area was 48.5 acres with 46.3 acres affected. The coal seams mined were the Lower Freeport (1.9 acres), Upper Kittanning Rider (12.8 acres) and Upper Kittanning (15.3 acres) coals. Mining was completed in May of 2003. The mine site is located on the hilltop above the headwaters unnamed tributary to the North Fork of Beech Creek.

The C & K (SMP 14880101, NPDES PA0116220) was issued to PAC Coal Company on September 8, 1988. The total permit area was 43.2 acres with 27.4 total acres affected. The coal seams mined were the Mercer #1 and Mercer #2 (17.7 acres) coals. Coal removal was completed in December of 1991 and backfilling was completed in March of 1992. This site is located south of the North Fork of Beech Creek.

The CMT Energy Inc., Government Financed Construction Contract (GFCC 14-04-01) was issued in the fall of 2003 and is expected to be active for 3 years. 7.1 total acres are to be affected with reclamation of 2.5 acres. With this GFCC, 22,000 tons of coal refuse will be removed. The permit area will use hay bales as a barrier while excavating refuse, which results in no NPDES discharges.

AMD Methodology

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

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

Allowable loads are determined for each point of interest using Monte Carlo simulation. Monte Carlo simulation is an analytical method meant to imitate real-life systems, especially when other analyses are too mathematically complex or too difficult to reproduce. Monte Carlo simulation calculates multiple scenarios of a model by repeatedly sampling values from the probability distribution of the uncertain variables and using those values to populate a larger data set. Allocations were applied uniformly for the watershed area specified for each allocation point. For each source and pollutant, it was assumed that the observed data were log-normally distributed. Each pollutant source was evaluated separately using @Risk[3] by performing 5,000 iterations to determine the required percent reduction so that the water quality criteria, as defined in the *Pennsylvania Code. Title 25 Environmental Protection, Department of Environmental Protection, Chapter 93, Water Quality Standards,* will be met instream at least 99 percent of the time. For each iteration, the required percent reduction is:

PR = maximum {0, (1-Cc/Cd)} where (1)

PR = required percent reduction for the current iteration

Cc = criterion in mg/l

Cd = randomly generated pollutant source concentration in mg/l based on the observed data

Cd = RiskLognorm(Mean, Standard Deviation) where (1a)

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)

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

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.

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 TMDLs' component makeup will be Load Allocations (LAs). All allocations will be specified as long-term average daily concentrations. These long-term average concentrations are expected to meet water-quality criteria 99% of the time as required in PA Title 25 Chapter 96.3(c). The following table shows the applicable water-quality criteria for the selected parameters.

Table 2. Applicable Water Quality Criteria

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
Sulfates	250	Total Recoverable

*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.

Other Inorganics

The cause of other inorganic impairment as listed on the 1996 Section 303(d) list is sulfates. Due to Title 25 Chapter 96.3(d), which requires the water quality criterion be met at the point of potable water withdrawal, a TMDL to address sulfates is not necessary. The average sulfate concentration at the mouth of North Fork Beech Creek is 122 mg/L, which is below the criterion of 250 mg/L. The nearest potable water withdrawal to North Fork Beech Creek occurs approximately 95 miles downstream of the mouth at the PA American White Deer (PWSID #4490023) on the West Branch of the Susquehanna River. Because of distance, assimilation capacity, and the criterion is not exceeded at the mouth of North Fork Beech Creek, a TMDL to address sulfates is not necessary. Sulfate data for the mouth of North Fork is included in Attachment E.

TMDL Elements (WLA, LA, MOS)

$$TMDL = WLA + LA + MOS$$

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

Allocation Summary

These TMDLs will focus remediation efforts on the identified numerical reduction targets for each watershed. The reduction schemes in Table 3 for each segment are based on the assumption that all upstream allocations are 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 no NPDES permitted discharges in the watershed and therefore all waste load allocations are equal to zero. 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.

In the instance that the allowable load is equal to the existing load (e.g. manganese point NFUT04, Table 3), the simulation determined that water quality standards are being met instream 99% of the time and no TMDL is necessary for the parameter at that point. Although no TMDL is necessary, the loading at the point is considered at the next downstream point.

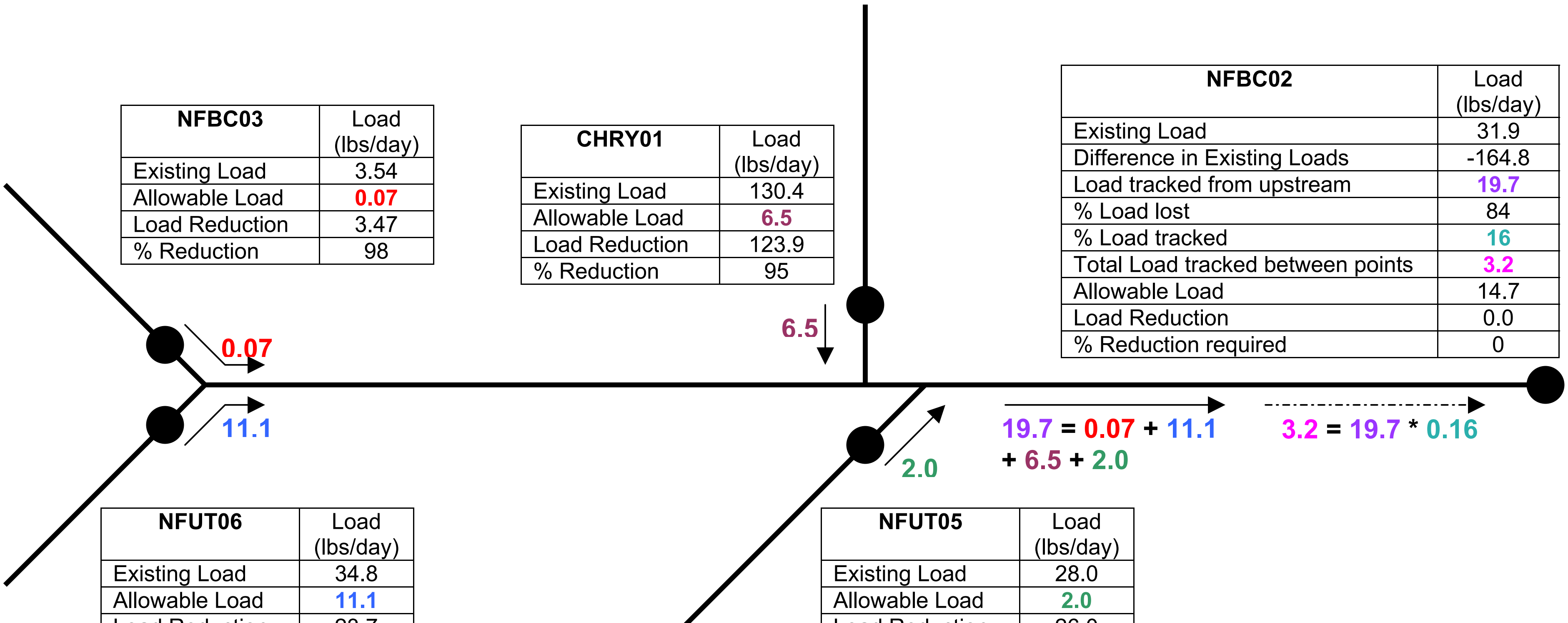
Table 3. TMDL Component Summary for the North Fork Beech Creek Watershed

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
NFBC03	*North Fork Beech Creek upstream of Unnamed Tributary 22797*						
	Al	0.29	0.05	0.0	0.05	0.24	83
	Fe	3.54	0.07	0.0	0.07	3.47	98
	Mn	1.23	0.05	0.0	0.05	1.18	96
	Acidity	16.2	0.0	0.0	0.0	16.2	100
NFUT06	*Mouth of Unnamed Tributary 22797*						
	Al	78.2	5.5	0.0	5.5	72.7	93
	Fe	34.8	11.1	0.0	11.1	23.7	68
	Mn	58.8	7.6	0.0	7.6	51.2	87
	Acidity	1,152.7	0.0	0.0	0.0	1,152.7	100
CHRY01	*Mouth of Cherry Run*						
	Al	31.4	4.1	0.0	4.1	27.3	87
	Fe	130.4	6.5	0.0	6.5	123.9	95
	Mn	50.6	4.0	0.0	4.0	46.6	92
	Acidity	803.3	0.0	0.0	0.0	803.3	100
NFUT05	*Mouth of Unnamed Tributary 22795*						
	Al	27.7	1.1	0.0	1.1	26.6	96
	Fe	28.0	2.0	0.0	2.0	26.0	93
	Mn	34.3	1.4	0.0	1.4	32.9	96
	Acidity	470.0	0.0	0.0	0.0	470.0	100
NFBC02	*North Fork Beech Creek upstream of Little Sandy Run and Unnamed Tributary 22786*						
	Al	16.3	7.2	0.0	7.2	0.0	0
	Fe	31.9	14.7	0.0	14.7	0.0	0
	Mn	20.4	12.8	0.0	12.8	0.0	0
	Acidity	588.3	0.0	0.0	0.0	0.0	0
LSND01	*Mouth of Little Sandy Run*						
	Al	117.3	10.6	0.0	10.6	106.7	91
	Fe	162.1	27.6	0.0	27.6	134.5	83
	Mn	137.5	13.7	0.0	13.7	123.8	90
	Acidity	1,926.4	0.0	0.0	0.0	1,926.4	100
NFUT04	*Mouth of Unnamed Tributary 22786*						
	Al	14.7	2.2	0.0	2.2	12.5	85
	Fe	4.4	2.7	0.0	2.7	1.7	39
	Mn	7.4	7.4	NA	NA	0.0	0
	Acidity	70.7	70.7	NA	NA	0.0	0
PNCK01	*Mouth of Pancake Run*						
	Al	3.0	0.7	0.0	0.7	2.3	78
	Fe	0.1	0.1	NA	NA	0.0	0
	Mn	0.9	0.9	NA	NA	0.0	0
	Acidity	29.8	0.0	0.0	0.0	29.8	100

Station	Parameter	Existing Load (lbs/day)	TMDL Allowable Load (lbs/day)	WLA (lbs/day)	LA (lbs/day)	Load Reduction (lbs/day)	Percent Reduction %
NFUT03	*Mouth of Unnamed Tributary 22784*						
	Al	6.8	0.2	0.0	0.2	6.6	97
	Fe	0.5	0.4	0.0	0.4	0.1	27
	Mn	3.3	0.3	0.0	0.3	3.0	92
	Acidity	60.8	0.0	0.0	0.0	60.8	100
NFUT02	*Mouth of Unnamed Tributary 22783*						
	Al	0.9	0.2	0.0	0.2	0.7	81
	Fe	0.1	0.1	NA	NA	0.0	0
	Mn	0.5	0.2	0.0	0.2	0.3	57
	Acidity	8.4	0.0	0.0	0.0	8.4	100
NFUT01	*Mouth of Unnamed Tributary 22782*						
	Al	0.03	0.03	NA	NA	0.0	0
	Fe	0.05	0.05	NA	NA	0.0	0
	Mn	0.01	0.01	NA	NA	0.0	0
	Acidity	1.2	0.1	0.0	0.1	1.1	88
NFBC01	*Mouth of North Fork Beech Creek*						
	Al	226.3	54.3	0.0	54.3	28.1	34
	Fe	121.8	76.7	0.0	76.7	0.0	0
	Mn	236.8	54.5	0.0	54.5	36.7	40
	Acidity	2,914.0	0.0	0.0	0.0	299.3	100

NA, meets WQS. No TMDL necessary.

Following is an example of how the allocations, presented in Table 3 are calculated. For this example, iron allocations for points NFBC03, NFUT06, CHRY01, NFUT05, and NFBC02 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.



NFBC03	Load (lbs/day)
Existing Load	3.54
Allowable Load	**0.07**
Load Reduction	3.47
% Reduction	98

CHRY01	Load (lbs/day)
Existing Load	130.4
Allowable Load	**6.5**
Load Reduction	123.9
% Reduction	95

NFBC02	Load (lbs/day)
Existing Load	31.9
Difference in Existing Loads	-164.8
Load tracked from upstream	**19.7**
% Load lost	84
% Load tracked	**16**
Total Load tracked between points	**3.2**
Allowable Load	14.7
Load Reduction	0.0
% Reduction required	0

NFUT06	Load (lbs/day)
Existing Load	34.8
Allowable Load	**11.1**
Load Reduction	23.7
% Reduction	68

NFUT05	Load (lbs/day)
Existing Load	28.0
Allowable Load	**2.0**
Load Reduction	26.0
% Reduction	93

Recommendations

Currently there is a watershed assessment underway for the Beech Creek Watershed, which includes the North Fork. All of the tributaries and sources of acid mine drainage will be evaluated and prioritized based on their severity and flow. The Beech Creek Watershed Association is an active watershed group focusing its efforts in and around the Beech Creek Watershed. The group will use the watershed assessment to focus its attention on the top priorities for the watershed. Once the problem areas have been prioritized the group can then apply for funding to begin the process of cleaning up the watershed.

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 1960's, Pennsylvania has been a national leader in establishing laws and regulations to ensure reclamation and plugging occur after active operation is completed.

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

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

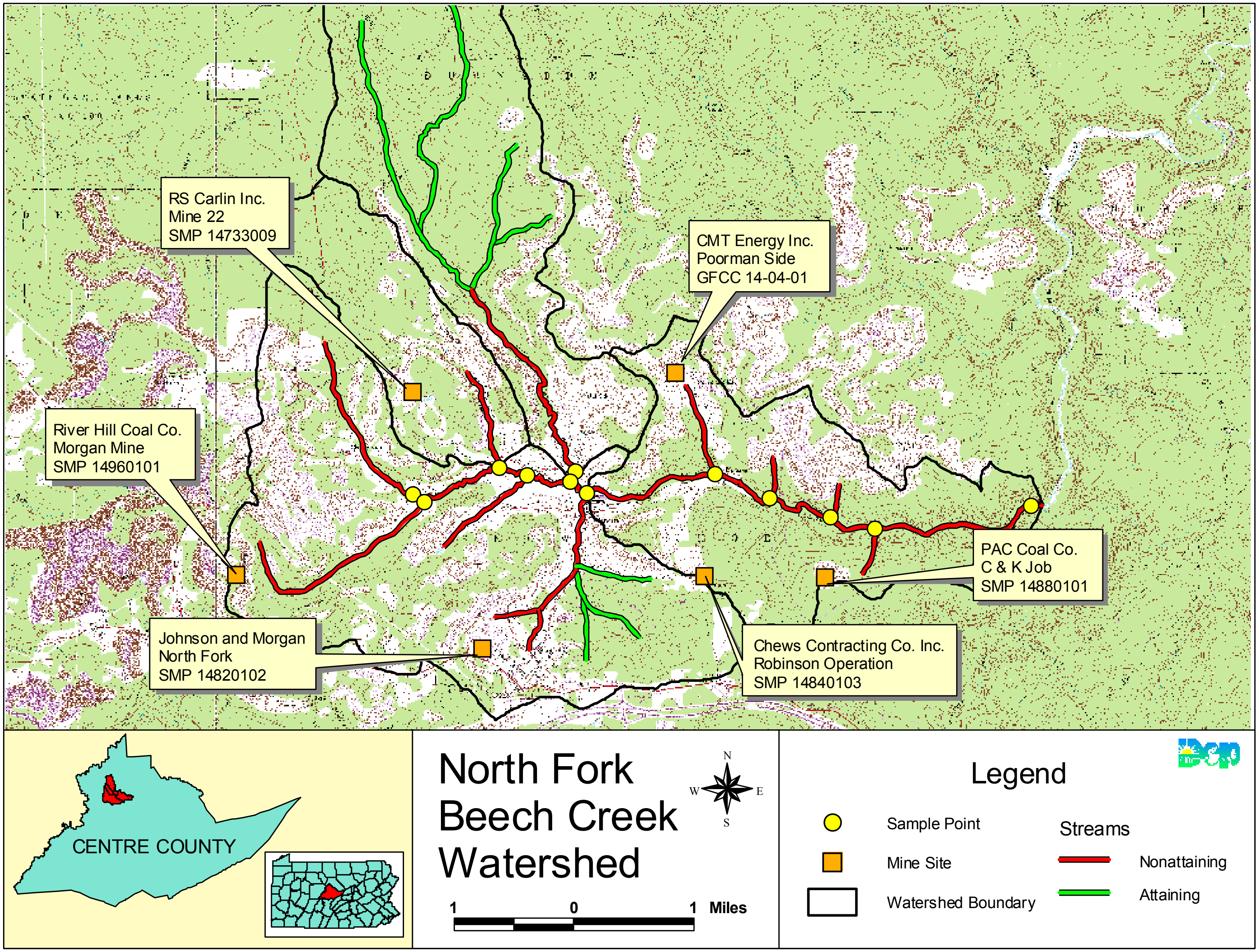
Reclaim PA is DEP's initiative designed to maximize reclamation of the state's quarter million acres of abandoned mineral extraction lands. Abandoned mineral extraction lands in Pennsylvania constituted a significant public liability – more than 250,000 acres of abandoned surface mines, 2,400 miles of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

Public Participation

Public notice of the draft TMDL was published in the *Pennsylvania Bulletin* on November 6, 2004 and the *Centre Daily Times* on November 3 and 10, 2004 to foster public comment on the allowable loads calculated. The public comment period on this TMDL was open from November 6, 2004 to January 5, 2005. A public meeting was held on November 15, 2004 at the Beech Creek Municipal Building in Beech Creek, PA to discuss the proposed TMDL.

Attachment A

North Fork Beech Creek Watershed Maps


RS Carlin Inc.
Mine 22
SMP 14733009
CMT Energy Inc.
Poorman Side
GFCC 14-04-01
River Hill Coal Co.
Morgan Mine
SMP 14960101
PAC Coal Co.
C & K Job
SMP 14880101
Johnson and Morgan
North Fork
SMP 14820102
Chews Contracting Co. Inc.
Robinson Operation
SMP 14840103
CENTRE COUNTY
North Fork Beech Creek Watershed
N
W
E
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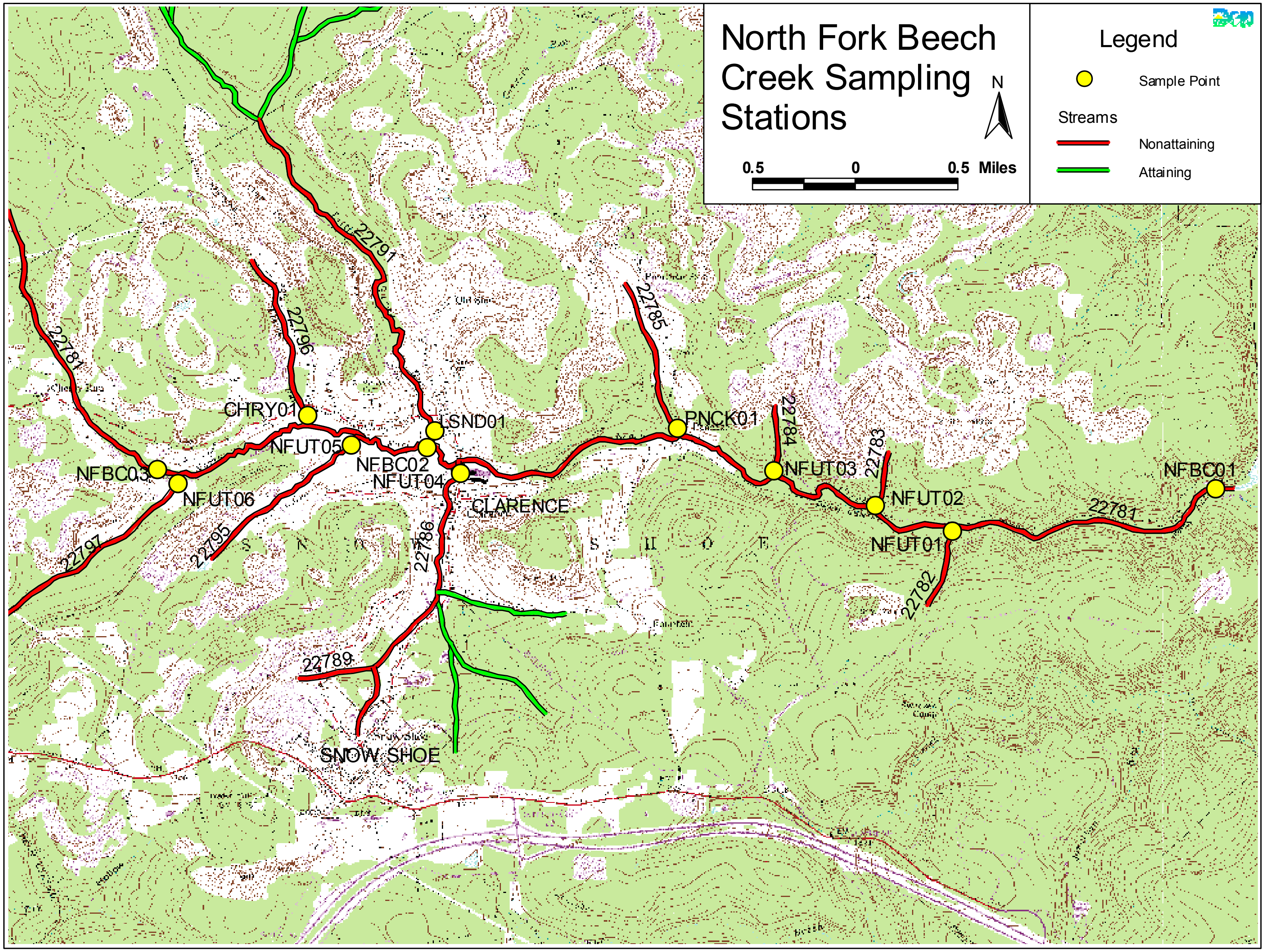
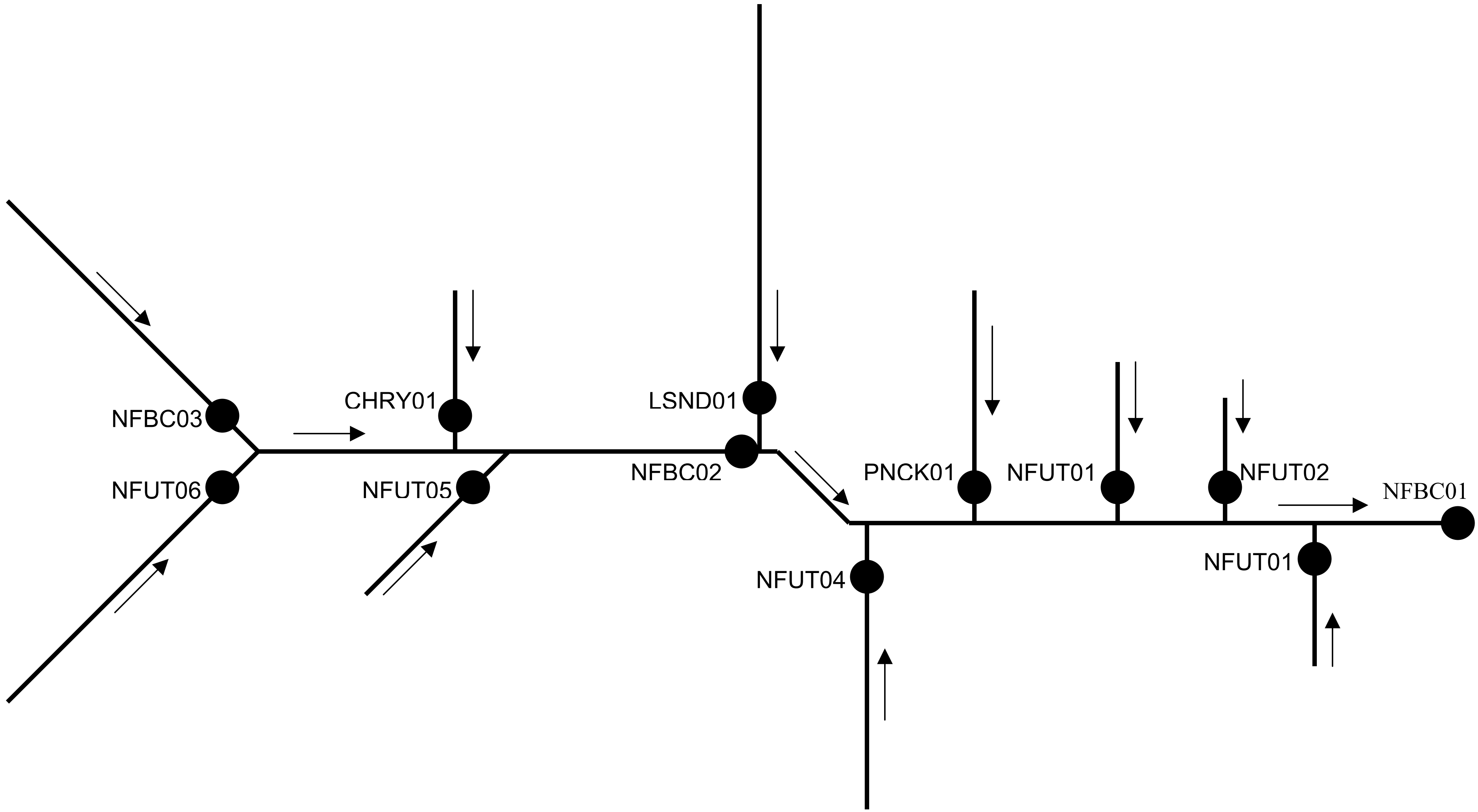
Legend
Sample Point
Mine Site
Watershed Boundary
Streams
Nonattaining
Attaining


North Fork Beech Creek Sampling Stations
N
0.5
0
0.5 Miles
Legend
Sample Point
Streams
Nonattaining
Attaining
CHRY01
LSND01
PNCK01
NFBC03
NFUT05
NFBC02
NFUT04
NFUT06
NFUT03
NFUT02
NFUT01
NFBC01
CLARENCE
SNOW SHOE
22791
22796
22781
22785
22784
22783
22786
22795
22797
22782
22789

North Fork Beech Creek Sampling Station Diagram
Arrows represent 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.*

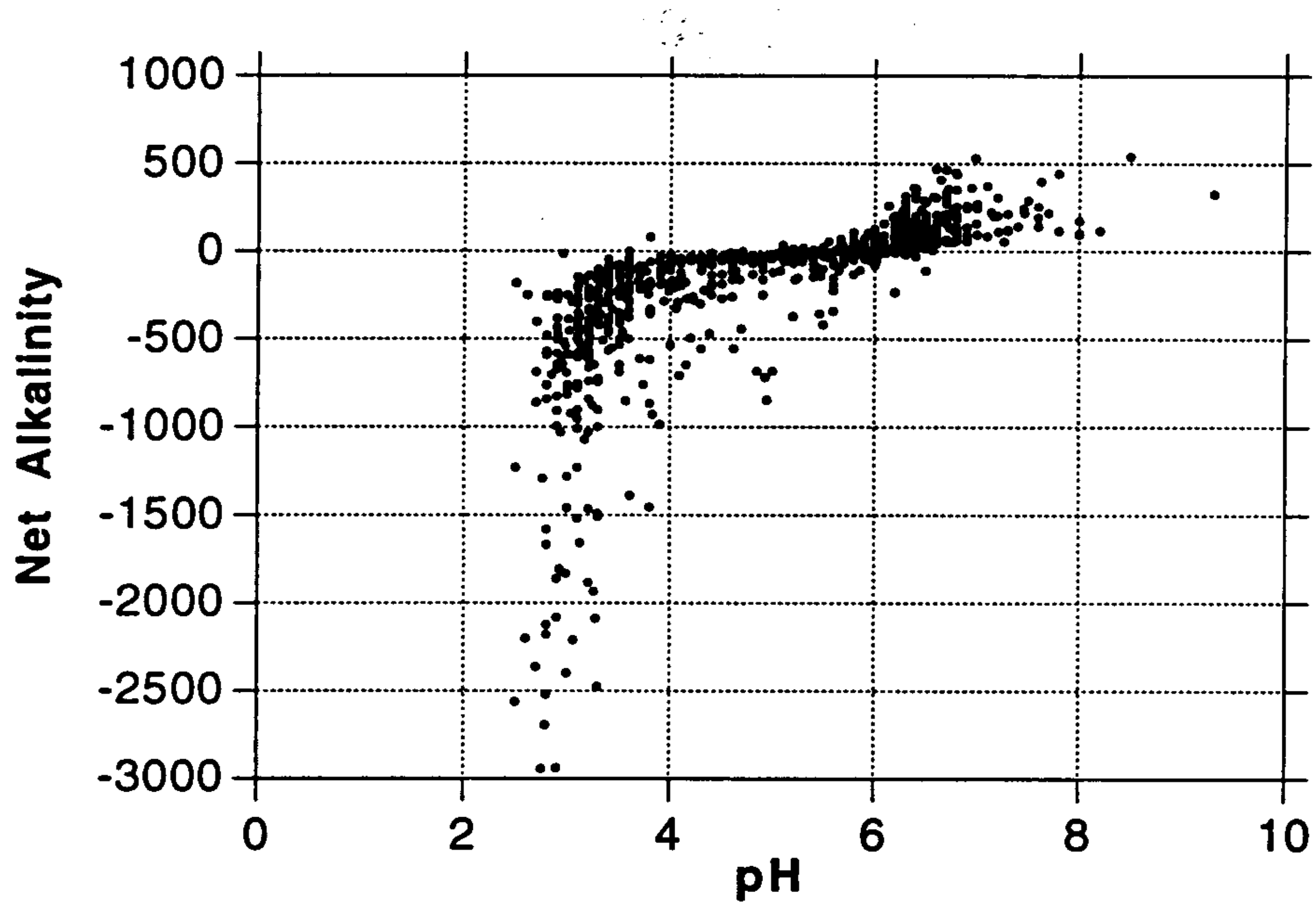


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Attachment C
TMDLs By Segment

North Fork Beech Creek

The TMDL for the North Fork Beech Creek consists of load allocations of nine tributaries and three sampling sites along the stream. Because there are no permitted discharges in the watershed, no WLAs are assigned.

North Fork Beech Creek is listed as impaired on the PA Section 303(d) list by both high metals and low pH from AMD as being the cause of the degradation to the stream. 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 3). The method and rationale for addressing pH is contained in Attachment B.

An allowable long-term average in-stream concentration was determined at each point for iron, manganese, aluminum, 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 NFBC03, North Fork Beech Creek upstream of Unnamed Tributary 22797

The TMDL for sample point NFBC03 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point NFBC03. The average flow of 0.012 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point NFBC03 shows pH ranging between 2.77 and 3.28, pH is addressed in this TMDL.

Table C1. TMDL Calculations at Point NFBC03				
Flow = 0.012 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	2.78	0.29	0.47	0.05
Fe	34.00	3.54	0.68	0.07
Mn	11.82	1.2	0.47	0.05
Acidity	155.96	16.2	0.00	0.0
Alkalinity	0.00	0.0		

Table C2. Calculation of Load Reduction Necessary at Point NFBC03				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	0.29	3.54	1.23	16.2
Allowable Load	0.05	0.07	0.05	0.0
Load Reduction	0.24	3.47	1.18	16.2
% Reduction Segment	83	98	96	100

TMDL Calculations - Sample Point NFUT06, Mouth of Unnamed Tributary 22797

The TMDL for sample point NFUT06 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point NFUT06. The average flow of 2.56 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point NFUT06 shows pH ranging between 3.40 and 4.29, pH is addressed in this TMDL.

Table C3. TMDL Calculations at Point NFUT06				
Flow = 2.56 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	3.66	78.2	0.26	5.5
Fe	1.63	34.8	0.52	11.1
Mn	2.75	58.8	0.36	7.6
Acidity	53.96	1,152.7	0.00	0.0
Alkalinity	0.00	0.0		

Table C4. Calculation of Load Reduction Necessary at Point NFUT06				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	78.2	34.8	58.8	1,152.7
Allowable Load	5.5	11.1	7.6	0.0
Load Reduction	72.7	23.7	51.2	1,152.7
% Reduction Segment	93	68	87	100

TMDL Calculations - Sample Point CHRY01, Mouth of Cherry Run

The TMDL for sample point CHRY01 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point CHRY01. The average flow of 1.32 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point CHRY01 shows pH ranging between 3.13 and 3.66, pH is addressed in this TMDL.

Table C5. TMDL Calculations at Point CHRY01				
Flow = 1.32 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	2.85	31.4	0.37	4.1
Fe	11.82	130.4	0.59	6.5
Mn	4.58	50.6	0.37	4.0
Acidity	72.79	803.3	0.00	0.0
Alkalinity	0.00	0.0		

Table C6. Calculation of Load Reduction Necessary at Point CHRY01				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	31.4	130.4	50.6	803.3
Allowable Load	4.1	6.5	4.0	0.0
Load Reduction	27.3	123.9	46.6	803.3
% Reduction Segment	87	95	92	100

TMDL Calculations - Sample Point NFUT05, Mouth of Unnamed Tributary 22795

The TMDL for sample point NFUT05 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point NFUT05. The average flow of 0.60 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point NFUT05 shows pH ranging between 3.13 and 3.39, pH is addressed in this TMDL.

Table C7. TMDL Calculations at Point NFUT05				
Flow = 0.60 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	5.51	27.7	0.22	1.1
Fe	5.57	28.0	0.39	2.0
Mn	6.82	34.3	0.27	1.4
Acidity	93.44	470.0	0.00	0.0
Alkalinity	0.00	0.0		

Table C8. Calculation of Load Reduction Necessary at Point NFUT05				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	27.7	28.0	34.3	470.0
Allowable Load	1.1	2.0	1.4	0.0
Load Reduction	26.6	26.0	32.9	470.0
% Reduction Segment	96	93	96	100

TMDL Calculation - Sampling Point NFBC02, North Fork Beech Creek upstream of Little Sandy Run

The TMDL for sampling point NFBC02 consists of a load allocation of the area between sample points NFBC03, NFUT06, CHRY01, NFUT05 and NFBC02. The load allocation for this stream segment was computed using water-quality sample data collected at point NFBC02. The average flow of 3.42 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point NFBC02 shows pH ranging between 3.93 and 4.69, pH is addressed in this TMDL.

Table C9. TMDL Calculations at Point NFBC02				
Flow = 3.42 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.57	16.3	0.25	7.2
Fe	1.12	31.9	0.51	14.7
Mn	0.71	20.4	0.45	12.8
Acidity	20.61	588.3	0.00	0.0
Alkalinity	0.11	3.1		

The calculated load reductions for all the loads that enter point NFBC02 must be accounted for in the calculated reductions at sample point NFBC02 shown in Table C10. A comparison of measured loads between points NFBC03, NFUT06, CHRY01, NFUT05 and NFBC02 shows that there is a loss of loading for all parameters. For loss of loading, the percent of load lost within the segment is calculated and applied to the upstream-allocated loads to determine the amount of load that is tracked through the segment.

Table C10. Calculation of Load Reduction Necessary at Point NFBC02				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	16.3	31.9	20.4	588.3
Difference in Existing Load between points	-121.4	-164.8	-124.5	-1,853.9
Load tracked from upstream	10.7	19.7	13.1	0.0
% Load lost	88	84	86	76
% Load tracked	12	16	14	24
Total Load tracked between points	1.3	3.2	1.8	0.0
Allowable Load at NFBC02	7.2	14.7	12.8	0.0
Load Reduction at NFBC02	0.0	0.0	0.0	0.0
% Reduction required at NFBC02	0	0	0	0

TMDL Calculations - Sample Point LSND01, Mouth of Little Sandy Run

The TMDL for sample point LSND01 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point LSND01. The average flow of 3.62 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point LSND01 shows pH ranging between 3.21 and 3.81, pH is addressed in this TMDL.

Table C11. TMDL Calculations at Point LSND01				
Flow = 3.62 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	3.88	117.3	0.35	10.6
Fe	5.37	162.1	0.91	27.6
Mn	4.55	137.5	0.46	13.7
Acidity	63.77	1,926.4	0.00	0.0
Alkalinity	0.00	0.0		

Table C12. Calculation of Load Reduction Necessary at Point LSND01				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	117.3	162.1	137.5	1,926.4
Allowable Load	10.6	27.6	13.7	0.0
Load Reduction	106.7	134.5	123.8	1,926.4
% Reduction Segment	91	83	90	100

TMDL Calculations - Sample Point NFUT04, mouth of Unnamed Tributary 22786

The TMDL for sample point NFUT04 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this tributary was computed using water-quality sample data collected at point NFUT04. The average flow of 1.25 MGD, measured at the point, is used for these computations.

This segment was included on the 2002 PA Section 303(d) list for metals and pH impairments from AMD. Sample data at point NFUT04 shows pH ranging between 6.44 and 7.87; 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. Although a TMDL is not necessary, the measured load is considered at the next downstream point, NFBC01.

Table C13. TMDL Calculations at Point NFUT04				
Flow = 1.25 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	1.41	14.7	0.21	2.2
Fe	0.42	4.4	0.26	2.7
Mn	0.71	7.4	0.71	7.4
Acidity	6.78	70.7	6.78	70.7
Alkalinity	26.94	281.0		

Table C14. Calculation of Load Reduction Necessary at Point NFUT04				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	14.7	4.4	7.4	70.7
Allowable Load	2.2	2.7	7.4	70.7
Load Reduction	12.5	1.7	0.0	0.0
% Reduction Segment	85	39	0	0

TMDL Calculations - Sample Point PNCK01, Mouth of Pancake Run

The TMDL for sample point PNCK01 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point PNCK01. The average flow of 0.17 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point PNCK01 shows pH ranging between 4.03 and 4.42 pH is addressed in 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 loads from PNCK01 are considered at the next downstream point, NFBC01.

Table C15. TMDL Calculations at Point PNCK01

Flow = 0.17 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	2.10	3.0	0.46	0.7
Fe	0.09	0.1	0.09	0.1
Mn	0.62	0.9	0.62	0.9
Acidity	20.73	29.8	0.00	0.0
Alkalinity	0.00	0.0		

Table C16. Calculation of Load Reduction Necessary at Point PNCK01

	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	3.0	0.1	0.9	29.8
Allowable Load	0.7	0.1	0.9	0.0
Load Reduction	2.3	0.0	0.0	29.8
% Reduction Segment	78	0	0	100

TMDL Calculations - Sample Point NFUT03, Mouth of Unnamed Tributary 22784

The TMDL for sample point NFUT03 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point NFUT03. The average flow of 0.092 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point NFUT03 shows pH ranging between 3.35 and 3.89; pH is addressed in this TMDL.

Table C17. TMDL Calculations at Point NFUT03				
Flow = 0.092 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	8.91	6.8	0.27	0.2
Fe	0.70	0.5	0.51	0.4
Mn	4.31	3.3	0.34	0.3
Acidity	79.52	60.8	0.00	0.0
Alkalinity	0.00	0.0		

Table C18. Calculation of Load Reduction Necessary at Point NFUT03				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	6.8	0.5	3.3	60.8
Allowable Load	0.2	0.4	0.3	0.0
Load Reduction	6.6	0.1	3.0	60.8
% Reduction Segment	97	27	92	100

TMDL Calculations - Sample Point NFUT02, Mouth of Unnamed Tributary 22783

The TMDL for sample point NFUT02 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point NFUT02. The average flow of 0.040 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point NFUT02 shows pH ranging between 3.88 and 4.24; pH is addressed in this TMDL.

Water quality analysis determined that the measured iron load is equal to the allowable iron load. Because the WQS is met, a TMDL for iron is not necessary. Although a TMDL is not necessary, the measured load is considered at the next downstream point, NFBC01.

Table C19. TMDL Calculations at Point NFUT02				
Flow = 0.040 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	2.63	0.9	0.50	0.2
Fe	0.19	0.1	0.19	0.1
Mn	1.63	0.5	0.70	0.2
Acidity	25.03	8.4	0.00	0.0
Alkalinity	0.00	0.0		

Table C20. Calculation of Load Reduction Necessary at Point NFUT02				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	0.9	0.1	0.5	8.4
Allowable Load	0.2	0.1	0.2	0.0
Load Reduction	0.7	0.0	0.3	8.4
% Reduction Segment	81	0	57	100

TMDL Calculations - Sample Point NFUT01, Mouth of Unnamed Tributary 22782

The TMDL for sample point NFUT01 consists of a load allocation to all of the area above the point (Attachment A). The load allocation for this segment was computed using water-quality sample data collected at point NFUT01. The average flow of 0.028 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point NFUT01 shows pH ranging between 5.67 and 6.01; pH is addressed in this TMDL.

Water quality analysis determined that the measured metals loads are equal to the allowable metals loads. Because the WQS are met, TMDLs for metals are not necessary. Although TMDLs are not necessary, the measured loads are considered at the next downstream point, NFBC01.

Table C21. TMDL Calculations at Point NFUT01				
Flow = 0.028 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	0.14	0.03	0.14	0.03
Fe	0.19	0.05	0.19	0.05
Mn	0.04	0.01	0.04	0.01
Acidity	5.03	1.2	0.60	0.1
Alkalinity	2.68	0.6		

Table C22. Calculation of Load Reduction Necessary at Point NFUT01				
	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	0.03	0.05	0.01	1.2
Allowable Load	0.03	0.05	0.01	0.1
Load Reduction	0.0	0.0	0.0	1.10
% Reduction Segment	0	0	0	88

TMDL Calculation – Sampling Point NFBC01, mouth of North Fork Beech Creek

The TMDL for sampling point NFBC01 consists of a load allocation of the area between sample points NFBC02, LSND01, NFUT04, PNCK01, NFUT03, NFUT02, NFUT01 and NFBC01. The load allocation for this stream segment was computed using water-quality sample data collected at point NFBC01. The average flow of 14.28 MGD, measured at the point, is used for these computations.

This segment was included on the 1996 PA Section 303(d) list for metals impairments from AMD. In 1998 a new assessment was completed on the segment and pH was added as a cause of impairment. Sample data at point NFBC01 shows pH ranging between 3.68 and 4.89; pH is addressed in this TMDL.

Table C23. TMDL Calculations at Point NFBC01

Flow = 14.28 MGD	Measured Sample Data		Allowable	
Parameter	Conc. (mg/l)	Load (lbs/day)	LTA Conc. (mg/l)	Load (lbs/day)
Al	1.90	226.3	0.46	54.3
Fe	1.02	121.8	0.64	76.7
Mn	1.99	236.8	0.46	54.5
Acidity	24.46	2,914.0	0.00	0.0
Alkalinity	0.13	15.7		

The calculated load reductions for all the loads that enter point NFBC01 must be accounted for in the calculated reductions at sample point NFBC01 shown in Table C24. A comparison of measured loads between points NFBC02, LSND01, NFUT04, PNCK01, NFUT03, NFUT02, NFUT01 and NFBC01 shows that there is additional aluminum, manganese, and acidity load entering the segment and a loss in iron load. The total segment aluminum, manganese, and acidity load is the sum of the upstream loads and the additional loading entering the segment. For loss of iron 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 C24. Calculation of Load Reduction Necessary at Point NFBC01

	Al (lbs/day)	Fe (lbs/day)	Mn (lbs/day)	Acidity (lbs/day)
Existing Load	226.3	121.8	236.8	2,914.0
Difference in Existing Load between points	67.3	-77.4	66.9	228.4
Load tracked from upstream	15.1	34.1	24.3	70.9
% Load lost	-	39	-	-
% Load tracked	-	61	-	-
Total Load tracked between points	82.4	20.8	91.2	299.3
Allowable Load at NFBC01	54.3	76.7	54.5	0.0
Load Reduction at NFBC01	28.1	0.0	36.7	299.3
% Reduction required at NFBC01	34	0	40	100

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 that the calculations were done with a daily Fe average instead of the 30-day average

Seasonal Variation

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

Critical Conditions

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

Attachment 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 list. 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 (gpm)	pH	Alk (mg/L)	Acidity (mg/L)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)	SO4 (mg/L)
NFBC01	3/18/2000	19833	4.89	1	13	1.35	1.69	1.13	66
Latitude:	4/1/2000	11230	4.17	0	22	1.6	1.1	1.4	117
41.04854	5/3/2000	12379	3.76	0	28	2.5	1.1	1.8	144
Longitude:	5/21/2000	7362	3.68	0	28	1.95	0.875	2.3	144
-77.86968	6/7/2000	7348	3.81	0	23	1.8	1	2.1	138
	7/25/2000	1357	3.94	0	32	2.2	0.37	3.2	
	Average	9918.16667	4.04167	0.13167	24.46440	1.90000	1.02250	1.98833	121.90400
	St Dev	6205.05998	0.44951	0.32252	6.57991	0.41352	0.42558	0.73431	32.95649
NFUT01	3/18/2000	44	5.73	3	2	<0.02	<0.02	<.02	
Latitude:	4/1/2000	41	6.01	3	3	0.13	0.15	0.05	
41.04585	5/3/2000	22	5.67	3	2	0.05	0.03	<.02	
Longitude:	5/21/2000	7.7	5.72	2	5	0.05	0.14	<0.02	
-77.89454	6/7/2000	2	5.85	3	13	0.33	0.45	0.02	
	7/24/2000	0.8							
	Average	19.58333	5.79600	2.68275	5.02525	0.14000	0.19250	0.03500	
	St Dev	19.30745	0.13667	0.16875	4.47661	0.13216	0.18007	0.02121	
NFUT02	3/18/2000	89	4.24	0	27	3.33	0.23	2.02	
	4/1/2000	17	4.17	0	25	2.4	0.14	1.5	
Latitude:	5/3/2000	ND	4.01	0	26	2.8	0.24	1.7	
41.04722	5/21/2000	5.08	3.88	0	24	2	<0.02	1.31	
Longitude:	6/7/2000	0.61	3.97	0	22	2.6	0.15	1.6	
-77.90169	7/24/2000	ND							
	Average	27.92250	4.05400	0.00000	25.02561	2.62600	0.19000	1.62600	
	St Dev	41.30179	0.14775	0.00000	1.77772	0.49232	0.05228	0.26321	

STATION	Date	Flow (gpm)	pH	Alk (mg/L)	Acidity (mg/L)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)	SO4 (mg/L)
NFUT03	3/18/2000	90	3.89	0	36	0.44	0.02	0.28	
	4/1/2000	57.8	3.74	0	79	11	0.5	4.1	
Latitude:	5/3/2000	55	3.50	0	92	12	0.74	3.89	
41.04955	5/21/2000	87.11	3.35	0	100	12	1.1	5.4	
Longitude:	6/7/2000	83.9	3.35	0	95	11	0.83	5.5	
-77.91133	7/24/2000	8.1	3.46	0	75	7	1	6.7	
	Average	63.65167	3.54750	0.00000	79.52478	8.90667	0.69833	4.31167	
	St Dev	31.14355	0.22104	0.00000	23.54209	4.54360	0.39265	2.22610	
PNCK01	3/18/2000	246	4.42	0	16	2.2	0.21	0.6	
	4/1/2000	119	4.18	0	21	2.2	0.06	0.6	
Latitude:	5/3/2000	164	4.03	0	26	2.6	0.07	0.62	
41.05249	5/21/2000	69.28	4.05	0	22	1.4	0.02	0.605	
Longitude:	6/7/2000	0.31	4.27	0	20	2.1	<0.02	0.69	
-77.92003	7/24/2000	ND		0					
	Average	119.71800	4.19000	0.00000	20.72709	2.10000	0.09000	0.62300	
	St Dev	93.15420	0.16171	0.00000	3.43754	0.43589	0.08287	0.03834	
NFUT04	3/18/2000	1967	6.58	22	4	2.2	1.40	0.7	
	4/1/2000	1116	6.98	16	8	2	0.28	0.66	
Latitude:	5/3/2000	1127	6.44	8	0	2.7	0.13	0.82	
41.05008	5/21/2000	420	7.22	25	10	0.82	0.08	0.78	
Longitude:	6/7/2000	444	7.87	33	8	0.58	0.07	0.71	
-77.94051	7/24/2000	136	7.75	57	11	0.17	0.57	0.56	
	Average	868.33333	7.14000	26.94428	6.78358	1.41167	0.42167	0.70500	
	St Dev	671.22118	0.59002	16.82055	4.21870	1.02087	0.51472	0.09160	

STATION	Date	Flow (gpm)	pH	Alk (mg/L)	Acidity (mg/L)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)	SO4 (mg/L)
LSND01	3/18/2000	4295	3.81	0	28	2	3.60	2.3	
	4/1/2000	3313	3.61	0	53	4.1	5.5	3.6	
Latitude:	5/3/2000	3655	3.23	0	78	6	6.1	4.9	
41.05186	5/21/2000	2108	3.29	0	64	3.6	4.8	4.3	
Longitude:	6/7/2000	1209	3.41	0	50	2.9	4.9	4.4	
-77.94311	7/24/2000	513	3.21	0	109	4.7	7.3	7.8	
	Average	2515.50000	3.42667	0.00000	63.76729	3.88333	5.36667	4.55000	
	St Dev	1482.16676	0.23880	0.00000	27.49949	1.39917	1.26122	1.82948	
NFBC02	3/18/2000	2254	4.69	1	19	0.06	0.07	<0.02	
	4/1/2000	2947	4.33	0	12	0.98	1.1	0.62	
Latitude:	5/3/2000	4021	3.93	0	14	0.83	0.84	0.52	
41.05158	5/21/2000	2446	4.24	0	15	0.6	1.4	0.65	
Longitude:	6/7/2000	2118	4.62	0	7	0.41	1.4	0.58	
-77.94325	7/24/2000	476	4.01	0	57	0.54	1.9	1.2	
	Average	2377.00000	4.30333	0.10833	20.60749	0.57000	1.11833	0.71400	
	St Dev	1160.03517	0.30982	0.26536	18.09462	0.32348	0.62394	0.27601	
CHRY01	3/18/2000	1487	3.66	0	38	2.2	7.00	2.5	
	4/1/2000	1053	3.46	0	64	2.4	8.6	3.6	
Latitude:	5/3/2000	1191	3.23	0	61	2.9	11	4.1	
41.05319	5/21/2000	814	3.28	0	68	2.4	11	4.2	
Longitude:	6/7/2000	836	3.43	0	53	2.5	10.3	3.8	
-77.95443	7/24/2000	132	3.13	0	152	4.7	23	9.3	
	Average	918.83333	3.36500	0.00000	72.79478	2.85000	11.81667	4.58333	
	St Dev	458.66040	0.19024	0.00000	40.44272	0.93541	5.69646	2.38949	

STATION	Date	Flow (gpm)	pH	Alk (mg/L)	Acidity (mg/L)	Al (mg/l)	Fe (mg/l)	Mn (mg/l)	SO4 (mg/L)
NFUT05	3/18/2000	224	3.39	0	66	0.49	0.40	0.42	
	4/1/2000	525	3.25	0	95	5.8	4.1	5.1	
Latitude:	5/3/2000	633	3.13	0	102	7.9	4.5	6.8	
41.05228	5/21/2000	758	3.26	0	70	2.4	13	4.3	
Longitude:	6/7/2000	277	3.25	0	88	7.15	5.8	9.3	
-77.95005	7/24/2000	96	3.25	0	140	9.3	5.6	15	
	Average	418.83333	3.25500	0.00000	93.43911	5.50667	5.56667	6.82000	
	St Dev	258.63907	0.08240	0.00000	26.70579	3.39771	4.13021	4.96653	
NFUT06	3/18/2000	2879	4.29	0	16	0.16	0.07	0.12	
	4/1/2000	1881	3.90	0	41	3.9	1.2	2.3	
Latitude:	5/3/2000	2789	3.40	0	106	5.3	1.9	3.4	
41.04947	5/21/2000	1541	3.45	0	50	3.8	1.9	2.9	
Longitude:	6/7/2000	1326	3.68	0	38	3.3	2.1	3.2	
-77.96656	7/24/2000	257	3.49	0	73	5.5	2.6	4.6	
	Average	1778.83333	3.70167	0.00000	53.95877	3.66000	1.62833	2.75333	
	St Dev	981.71695	0.34208	0.00000	31.78291	1.92520	0.88612	1.49595	
NFBC03	3/18/2000	16	3.28	0	91	2.9	22.00	8	
	4/1/2000	15.2	3.23	0	112	2.5	25	9.5	
Latitude:	5/3/2000	11.3	2.77	0	120	2	19	8.4	
41.04975	5/21/2000	5.54	2.94	0	208	2.8	48	13	
Longitude:	6/7/2000	0.13	3.04	0	175	2.7	40	12	
-77.96677	7/24/2000	3.8	2.98	0	231	3.8	50	20	
	Average	8.66167	3.04000	0.00000	155.95833	2.78333	34.00000	11.81667	
	St Dev	6.47660	0.18984	0.00000	56.86578	0.59133	13.69671	4.47232	

Attachment F

Comment and Response

Comments/Responses on the North Fork Beech Creek Watershed TMDL

A 60-day public comment period was open on the North Fork Beech Creek Watershed Draft TMDL from November 6, 2004 until January 5, 2005. During this time, no comments were received.