WICONISCO CREEK WATERSHED TMDL
Dauphin and Schuylkill Counties

Prepared for:

Pennsylvania Department of Environmental Protection

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INTRODUCTION

Location

The Wiconisco Creek Watershed is approximately 116 square miles in area. The headwaters of Wiconisco Creek are located inside the northwestern border of Schuylkill County, a few miles east-northeast of Muir, Pennsylvania. The watershed is located on the U.S. Geological Survey (USGS) 7.5 minute quadrangles of Pine Grove, Tower City, Lykens, Elizabethville, and Millersburg, Pa. The stream flows east-southeast from western Schuylkill County into northern Dauphin County, where it joins Rattling Creek, Bear Creek, and Little Wiconisco Creek. The mouth of Wiconisco Creek is located at the Susquehanna River in Millersburg, Pa. The Boroughs of Millersburg, Elizabethville, Berrysburg, and Villages of Pleasant Hills, Reservoir Heights, Cloverly Acres are located in the western portion of the watershed. The Boroughs of Lykens, Gratz, Wiconisco and Villages of Loyalton, Big Run, Dayton are located in the midsection of the watershed. The Boroughs of Williamstown, Tower City, and Villages of Sheridan, Reinerton, Orwin, Muir are located in the eastern portion of the watershed. State Route 209 travels parallel to the creek through the entire watershed, and State Routes 225 and 325 bisect portions of the mainstem of Wiconisco Creek. Numerous township roads provide access to Wiconisco Creek and its tributaries (Attachment A).

Segments Addressed in this TMDL

The Wiconisco Creek Watershed is affected by pollution from acid mine drainage (AMD), on-site wastewater, and grazing-related agriculture. The AMD has caused high levels of metals and low pH in the mainstem of Wiconisco Creek (Figure 1) above Loyalton, Pa. Strip mining and deep mining of anthracite coal in the eastern portion of the watershed account for most of the AMD inputs. Bear Creek, Big Lick Tunnel, Porter Tunnel, and Keffer's Tunnel have significant flows to the mainstem reducing water quality. The Susquehanna River Basin Commission (SRBC) developed a TMDL for the Bear Creek Watershed in 2001. Bear Creek (Figure 2) enters Wiconisco Creek in the town of Lykens, Pa. Eight of the 10 major AMD problem areas in the watershed are listed in the Operation Scarlift Report (Sanders and Thomas, 1973) and identified as draining directly into Wiconisco Creek. Excess sediment and nutrients, from various sources, are also a problem in the Little Wiconisco Creek Subwatershed. Based on the 303(d) (Table 1) listings for Wiconisco Creek Watershed, there are also several unnamed tributaries contributing excessive sediment and nutrient loads directly to the Wiconisco Creek mainstem. The stream designations for Wiconisco Creek, defined by Pa. Title 25 Chapter 96, can be found in Table 2.

Figure 1. Wiconisco Creek

Figure 2. The Confluence of Bear and Wiconisco Creek

Table 1. 303(d) Listed Streams Addressed by the TMDL

Segment ID	Year Listed	Stream Name	Stream Code	Source	Cause	Miles
2164	1996	Wiconisco Creek	16895	Abandoned Mine Drainage	Metals, Suspended Solids, pH	6.42
2164	1998	Wiconisco Creek	16895	Abandoned Mine Drainage	Metals, Suspended Solids	6.42
970515-1252-JLR	2002	Wiconisco Creek	16895	Abandoned Mine Drainage	Metals, pH, Siltation	12.6
970512-1446-JLR	2002	Little Wiconisco Creek	16898	Agriculture	Nutrients, Siltation	9.3
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16903	Agriculture	Nutrients, Siltation	2.0
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16905	Agriculture	Nutrients, Siltation	0.2
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16906	Agriculture	Nutrients, Siltation	0.4
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16907	Agriculture	Nutrients, Siltation	0.4
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16908	Agriculture	Nutrients, Siltation	0.4
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16909	Agriculture	Nutrients, Siltation	2.0
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16911	Agriculture	Nutrients, Siltation	0.5
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16912	Agriculture	Nutrients, Siltation	0.4
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16913	Agriculture	Nutrients, Siltation	1.5
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16915	Agriculture	Nutrients, Siltation	0.6
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16916	Agriculture	Nutrients, Siltation	0.5
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16918	Agriculture	Nutrients, Siltation	0.9
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16919	Agriculture	Nutrients, Siltation	0.5
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16920	Agriculture	Nutrients, Siltation	1.2
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16921	Agriculture	Nutrients, Siltation	0.6
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16922	Agriculture	Nutrients, Siltation	0.53
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16923	Agriculture	Nutrients, Siltation	1.05
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16924	Agriculture	Nutrients, Siltation	0.99
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16925	Agriculture	Nutrients, Siltation	0.54
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16926	Agriculture	Nutrients, Siltation	0.8
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16928	Agriculture	Nutrients, Siltation	0.4
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16929	Agriculture	Nutrients, Siltation	0.5
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16930	Agriculture	Nutrients, Siltation	1.2
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16931	Agriculture	Nutrients, Siltation	2.0

Segment ID	Year Listed	Stream Name	Stream Code	Source	Cause	Miles
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16932	Agriculture	Nutrients, Siltation	0.4
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16933	Agriculture	Nutrients, Siltation	1.0
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16934	Agriculture	Nutrients, Siltation	0.2
970512-1446-JLR	2002	UNT Little Wiconisco Creek	16935	Agriculture	Nutrients, Siltation	1.1
970512-1215-JLR	2002	UNT Wiconisco Creek	16938	Crop Related Ag	Siltation	2.3
970512-1215-JLR	2002	UNT Wiconisco Creek	16939	Crop Related Ag	Siltation	0.6
970512-1215-JLR	2002	UNT Wiconisco Creek	16941	Crop Related Ag	Siltation	0.5
970512-1215-JLR	2002	UNT Wiconisco Creek	16942	Crop Related Ag	Siltation	0.8
970512-1215-JLR	2002	UNT Wiconisco Creek	16945	Crop Related Ag	Siltation	0.6
970513-0836-JLR	2002	UNT Wiconisco Creek	16951	Unknown	Unknown	0.7
970513-0836-JLR	2002	UNT Wiconisco Creek	16952	Unknown	Unknown	1.6
970515-1155-JLR	2002	UNT Wiconisco Creek	17052	Removal of Vegetation, Small Residential Runoff	Nutrients/Siltation	1.5
970515-1155-JLR	2002	UNT Wiconisco Creek	17053	Removal of Vegetation, Small Residential Runoff	Siltation/Nutrients	0.1
971217-1150-JLR	2002	UNT Wiconisco Creek	17058	Grazing Related Ag	Siltation	2.5
971217-1150-JLR	2002	UNT Wiconisco Creek	17060	Grazing Related Ag	Siltation	0.1
971217-1150-JLR	2002	UNT Wiconisco Creek	17061	Grazing Related A	Siltation	0.4
971217-1150-JLR	2002	UNT Wiconisco Creek	17062	Grazing Related A	Nutrients	0.1

See Attachment B, Excerpts Justifying Changes Between the 1996, 1998, 2002, and draft 2004 Section 303(d) lists.

Table 2. Stream Designation

Stream Name/Number of Segments	Zone	County	Water Uses Protected	Exceptions To Specific Criteria
2-Wiconisco Creek	Mainstem	Dauphin	WWF	None
3-Unnamed Tributaries to Wiconisco Creek	Basins, Source to US 209 Bridge at Loyalton	Schuylkill-Dauphin	CWF	None
3-Bear Creek	Basin	Dauphin	CWF	None
3-Rattling Creek	Basin, source to Confluence of East and West Branches	Dauphin	EV	None
3-Rattling Creek	Basin, confluence of East and West Branches to Mouth	Dauphin	HQ-CWF	None
3-Unnamed Tributaries to Wiconisco Creek	Basins, US 209 Bridge at Loyalton to Mouth	Dauphin	WWF	None
3-Little Wiconisco Creek	Basin	Dauphin	WWF	None

There are active mining operations in the watershed; however, none of the operations produce a discharge. Some permits are remining operations that are not contributing to point source pollution because they have not created any new discharges and have not caused pre-existing discharges to worsen. All of the discharges in the watershed are from abandoned mines and will be treated as nonpoint sources. The distinction between point and nonpoint sources in this case is determined on the basis of whether or not there is a responsible party for the discharge. Where there is no responsible party, the discharge is considered to be a nonpoint source. Each pollutant on the 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 better representation of the data used for calculations. A map showing the impaired waters of the Wiconisco Creek Watershed is shown in Figure 3.

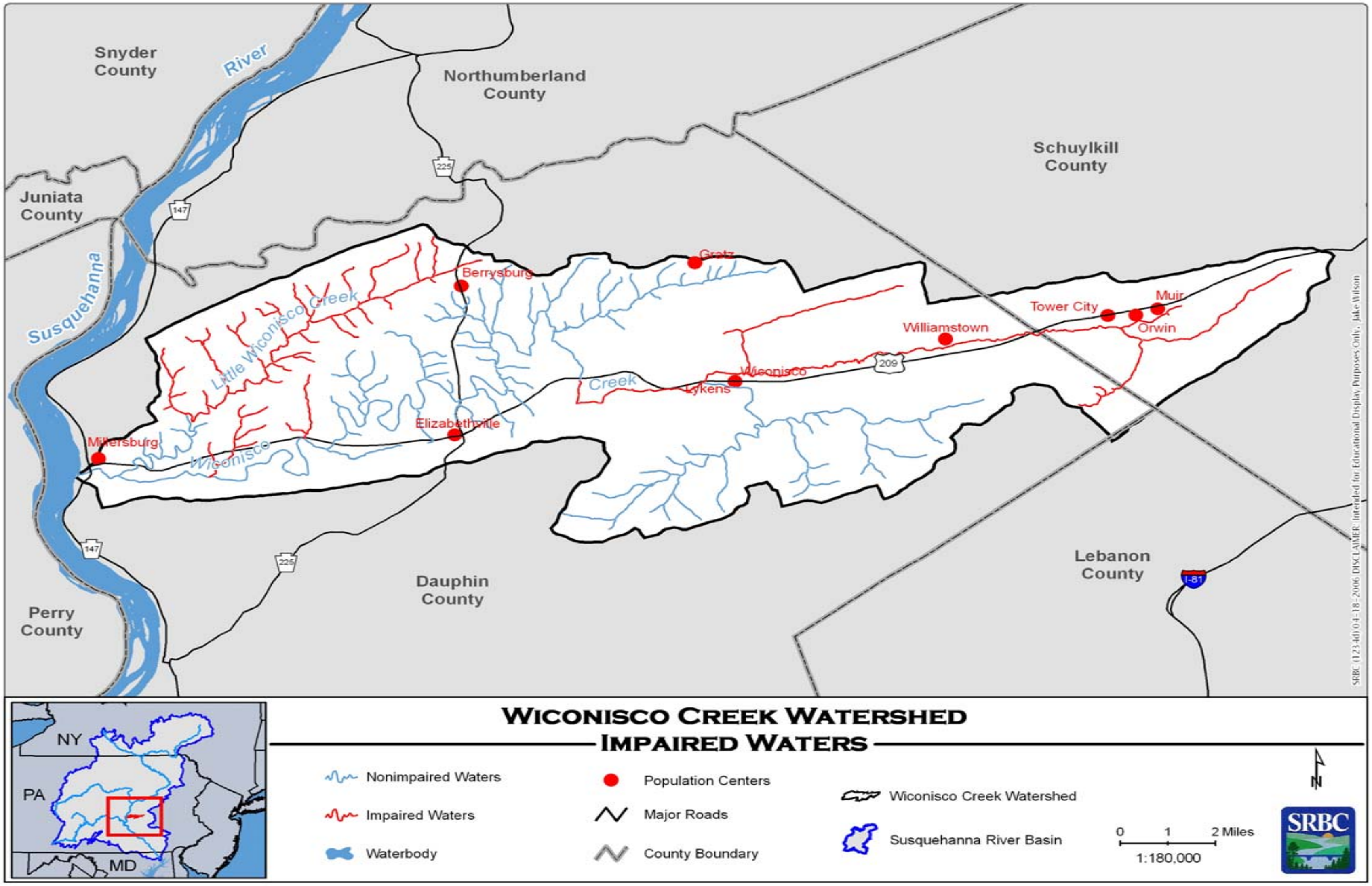

Figure 3. *Map Showing the Impaired Waters in the Wiconisco Creek Watershed*

CLEAN WATER ACT REQUIREMENTS

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

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

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

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

- States to submit the list of waters to USEPA every 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

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

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

In the cases that have been settled to date, the consent agreements require USEPA to backstop TMDL development, track TMDL development, review state monitoring programs, and fund studies on issues of concern (e.g., AMD, implementation of nonpoint source Best Management Practices (BMPs), etc.). These TMDLs were developed in partial fulfillment of the 1996 lawsuit settlement of *American Littoral Society and Public Interest Group of Pennsylvania v. EPA.*

SECTION 303(D) LISTING PROCESS

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

The primary method adopted by the Pennsylvania Department of Environmental Protection (PADEP) for evaluating waters changed between the publication of the 1996 and 1998 303(d) lists. Prior to 1998, data used to list streams were in a variety of formats, collected under differing protocols. Information also was gathered through the Section 305(b)[1] reporting process. PADEP is now using the Unassessed Waters Protocol (UWP), a modification of the USEPA Rapid Bioassessment Protocol II (RPB-II), as the primary mechanism to assess Pennsylvania's waters. The UWP provides a more consistent approach to assessing Pennsylvania's streams.

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

After the survey is completed, the biologist determines the status of the stream segment. The decision is based on the performance of the segment using a series of biological metrics. If the stream is determined to be impaired, the source and cause of the impairment are documented. An impaired stream must be listed on the state's 303(d) list with the documented source and cause. A TMDL must be developed for the stream segment. A TMDL is for only one pollutant. If a stream segment is impaired by two pollutants, two TMDLs must be developed for that stream segment. In order for the process to be more effective, adjoining stream segments with the same source and cause listing are addressed collectively, and on a watershed basis.

BASIC STEPS FOR DETERMINING A TMDL

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

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

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

2. Calculate TMDL for the waterbody using USEPA approved methods and computer models;
3. Allocate pollutant loads to various sources;
4. Determine critical and seasonal conditions;
5. Submit draft report for public review and comments; and
6. Obtain USEPA approval of the TMDL.

This document will present the information used to develop the Wiconisco Creek Watershed TMDL.

WATERSHED BACKGROUND

The Wiconisco Creek Watershed lies in the Appalachian Ridge and Valley Physiographic Province. It is characterized by folding, faulting, and steeply dipping anticlinal and synclinal geology. The maximum elevation of approximately 1,785 feet is found at the top of Big Lick Mountain, north of Williamstown, and the minimum elevation of approximately 360 feet is at the mouth of Wiconisco Creek. This watershed receives approximately 44 inches of precipitation per year (Commonwealth of Pennsylvania, 2002).

Wiconisco Creek flows east to west, from its headwaters (Figure 4) just east of Muir to its confluence with the Susquehanna River in Millersburg, Pa. Major tributaries of Wiconisco Creek include Little Wiconisco Creek, Rattling Creek and Bear Creek. Smaller tributaries include several unnamed water bodies located throughout the watershed.

Figure 4. Wiconisco Creek near Muir

The watershed is primarily forested (58.5 percent), with approximately 5.6 percent developed lands (Figure 5). Agriculture, mainly croplands and hay fields, accounts for 35.3 percent of the land use. Coal surface mining and deep mines have impacted approximately 2.6 percent of the watershed. Waterbodies and wetlands account for the rest of the area.

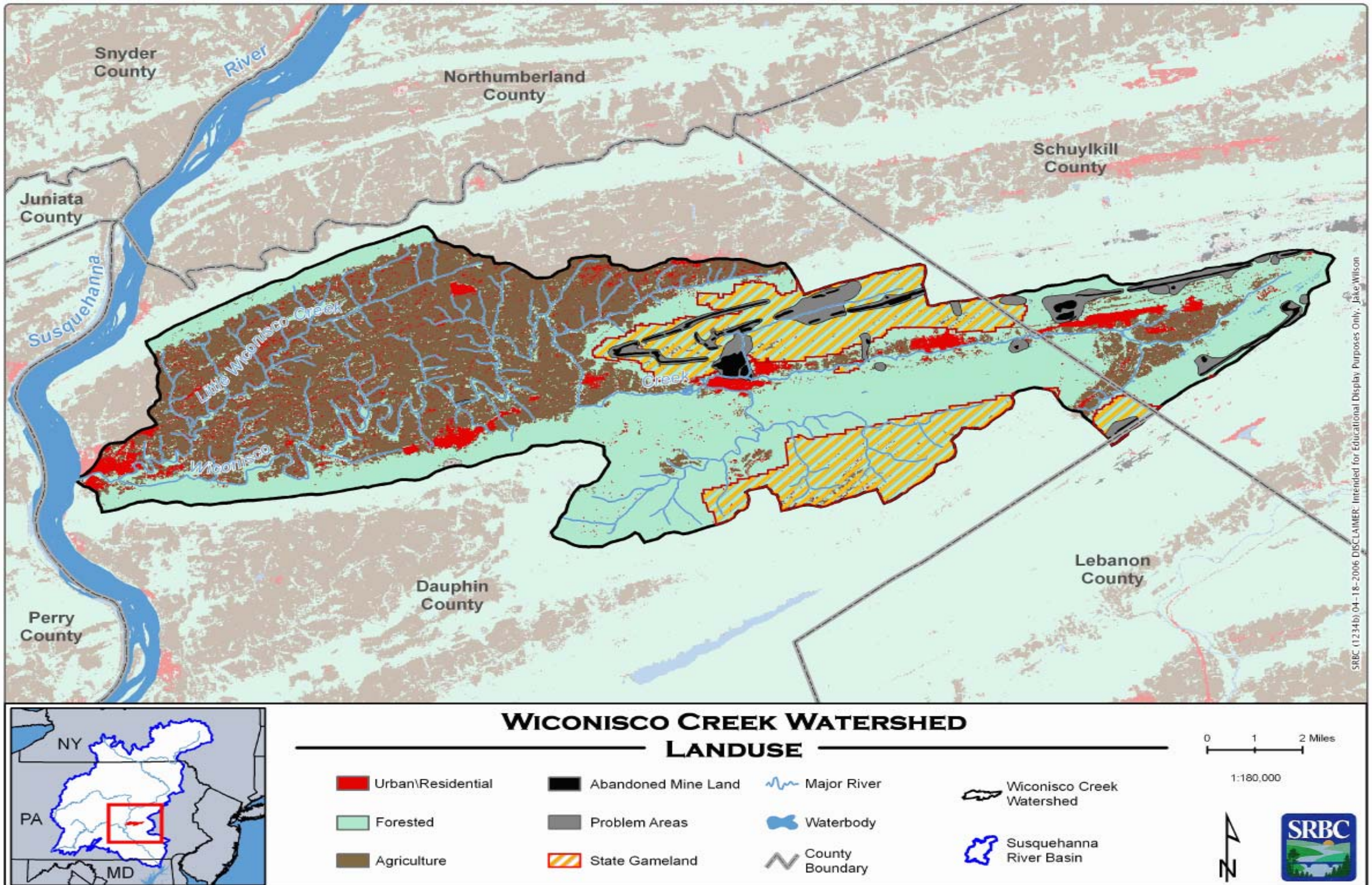

Figure 5. Wiconisco Creek Watershed Land Use

The surficial geology of the Wiconisco Creek Watershed is 100 percent sedimentary (Figure 6). The primary geologic formation in the watershed is the Mauch Chunk, comprised predominantly of shale. The other geologic formations include sandstones of the Duncannon Member of the Catskill Formation, Pottsville Formation, Llewellyn Formation, Pocono Formation, and the Spechty Kopf Formation (Commonwealth of Pennsylvania, 2002).

The soils in Wiconisco Creek watershed include the Dekalb-Lehew, Calvin-Leck Kill and Klinesville Associations (Figure 7). These soils are moderately deep to very deep. They range from poorly drained to well drained; the permeability of the soils likewise varies from slow to rapid. Most of the areas in the Wiconisco Creek Watershed are moderately permeable and well drained. All of the soils in the watershed are formed from acidic bedrock. The soils are therefore strongly acidic without much buffering capacity. The K-factor, a value given to determine soil erodability, ranges from 0.17 to 0.24 in the watershed (Commonwealth of Pennsylvania, 2002).

Anthracite coal has historically been the most economically important geologic resource in northeast Dauphin and Schuylkill Counties. Most of the mineable coal seams are located on Short Mountain, Bear Valley, Big Lick Mountain and portions of Broad Mountain. According to the Scarlift Report for the watershed, the Llewellyn, Pottsville, and Pocono Formations contain several mineable coal seams.

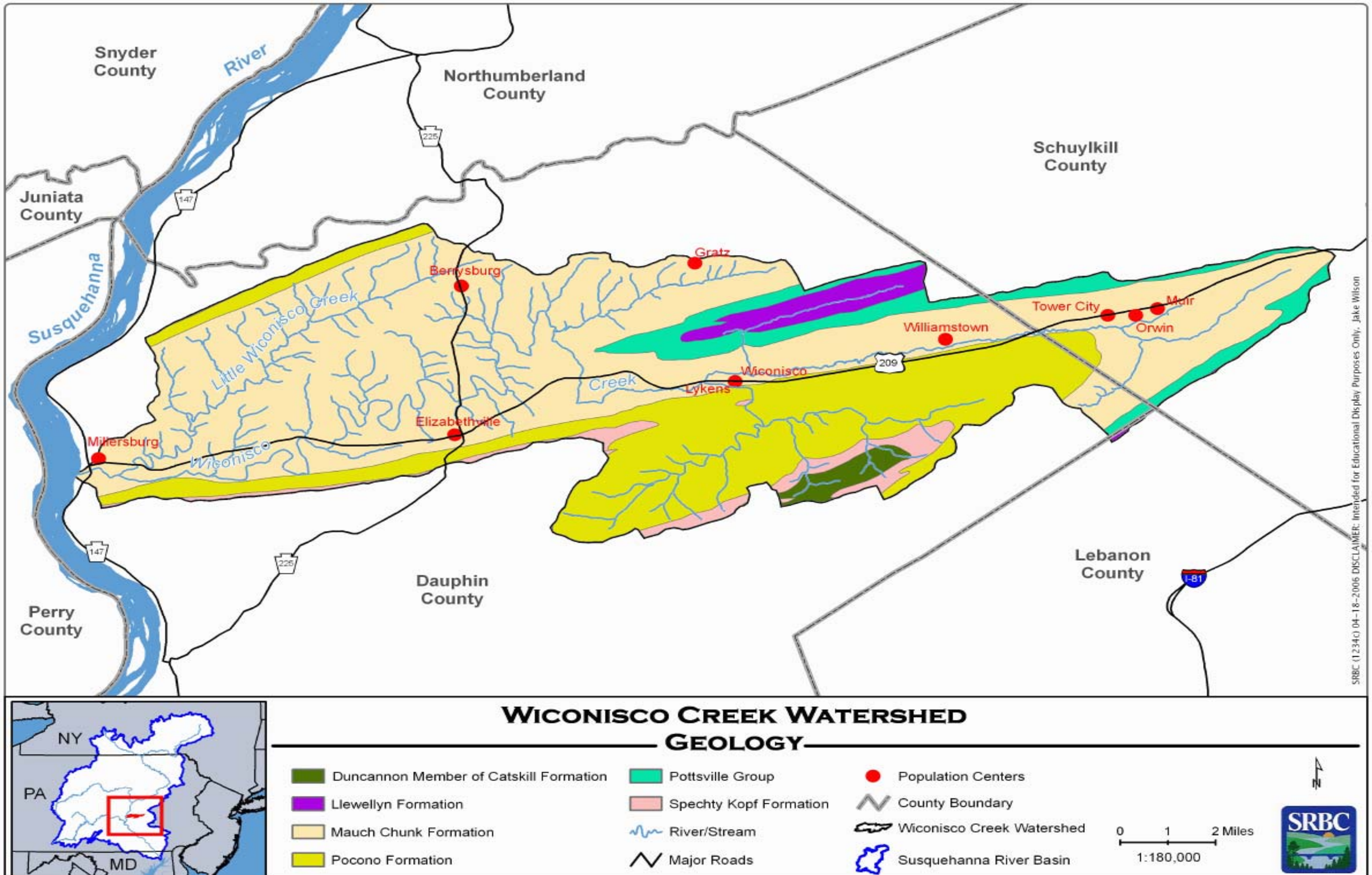

Figure 6. Wiconisco Creek Watershed Geology

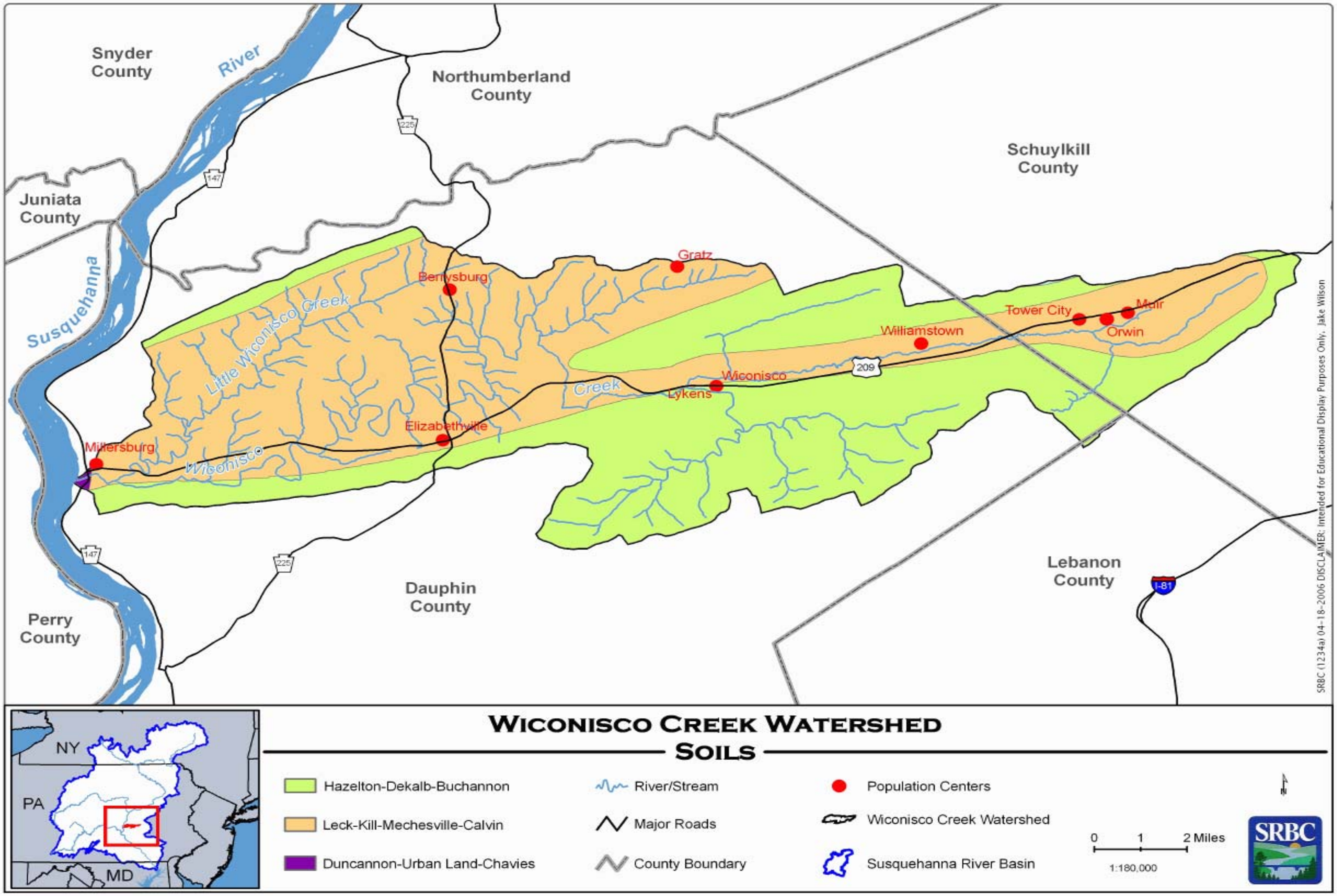

Figure 7. Wiconisco Creek Watershed Soils

Extraction of the anthracite coal in the watershed has been from surface mining and deep mining. Strip and drift mining (Figure 8) of coal seams that are horizontal in orientation can be found in the eastern portions of the anthracite region in the watershed; this often resulted in fairly level underground tunnels running for miles as coal was mined along a particular seam. Deep mining or mining of near vertical coal seams can be found in the western portion of the anthracite region in the watershed. Most of the mining occurred before 1930, decades before any state or federal mining acts were passed.

Figure 8. Typical Anthracite Drift Operation

Mining activity commonly occurred below the water table, resulting in tunnel collapsing, development of mine pools, and indefinite discharging. Big Lick Tunnel (Figure 9), Bear Creek Discharges (Figure 10), Porter Tunnel, and Keffer's Tunnel are responsible for much of the water quality impairment in the AMD segment of the watershed. Kalmia and Keim Tunnels, located on Broad Mountain, do not contribute significant flow into the watershed. Tower City Tunnels #1 and #2 also do not contribute significant flow. The Tower City Tunnels are located on the south side of Porter Mountain. These discharges are the result of abandoned mine drainage with no responsible party for cleanup (Sanders and Thomas, 1973).

Several companies have mined large areas of the watershed from the late 1800s to the present (Attachment C). Table 3 lists the six active mining permits in the watershed. None of these permits have been associated with problem discharges.

Figure 9. Big Lick Tunnel

Figure 10. AMD Discharge to Bear Creek

Table 3. Mining Permits in the Wiconisco Creek Watershed

Permit No.	NPDES No.	Effective Dates	Company Name	Status
22850201R2	none	1986- 2001	Meadowbrook Coal Company	Active
22030201	none	1985-2005	Meadowbrook Coal Company	Active
33851602AR2004	none	1998-2003	Meadowbrook Coal Company	Active
22851601T	none	1985-2000	The Harriman Coal Company	Active
54850204CB	none		Jeddo-Highland Coal Company	Active
22851304R2	none		S & M Coal Company	Active

The Pottsville District Mining Office anticipates new coal mining permits in the Wiconisco Creek Watershed within the next few years. These permits will be limited to the upper coal seams, which are alkaline in nature. If any of these new permitted mines produce a problem discharge, the TMDL for Wiconisco Creek will have to be reevaluated.

Little Wiconisco Creek (Figure 11) also contributes to impairment in the Wiconisco Creek Watershed. Excessive nutrients (phosphorus and nitrogen) have been a major contributor to impairment. Also, sedimentation has played a large role in degrading the Little Wiconisco Creek. Lack of manure detention systems, excessive fertilizing, and uncontrolled grazing are just a couple of examples that can lead to degradation of the creek.

Figure 11. Little Wiconisco Creek

There have been numerous grant applications and studies on the Wiconisco Creek Watershed in the past. For example:

- Starting March 22, 2005, the Dauphin County Conservation District (DCCD) and Wiconisco Creek Restoration Association (WCRA) have implemented a comprehensive remediation strategy for the Bear Creek Subwatershed, located within the Wiconisco Creek Watershed. DCCD and WCRA began treatment system design in April 2005, and completed the Bear Creek Remediation Plan in June 2005. DCCD and WCRA also completed the land acquisition in August 2005 and site construction was completed in November 2005 (http://www.dauphincd.org).
- Through a Growing Greener Grant from PADEP, an eighteen month study of the Wiconisco Creek Watershed, particularly the AMD portions of the creek, was completed by DCCD. DCCD employed Skelly and Loy Inc., to create the Comprehensive Mine Drainage Mitigation Report to determine what measures can be taken to remediate AMD sections of the watershed (http://www.dauphincd.org).
- 2003 – WCRA completed a stream side cleanup for the majority of the watershed. WCRA filled 3 industrial size dumpsters with trash that did not include tires within the creek.
- DCCD, WCRA, and Pennsylvania Department of Conservation and Natural Resources have experimented with the application of limestone sand dosing in the West Branch of Rattling Creek. Rattling Creek is not listed on the 303(d) list, but due to acid rain deposition, the watershed has experienced some backward trends in water quality. DCCD has recorded improved measures mainly in pH in this subwatershed (http://www.dauphincd.org).
- Through PADEP funding, DCCD, WCRA and Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) completed the Wiconisco Creek Conservation Plan in 1998. This plan included water quality, social-economic measures, and other geographical parameters. The plan was implemented to jump start funding and heighten awareness of the Wiconisco Creek Watershed (http://www.dauphincd.org).
- 1998 – WCRA planted 1,000 trees along Wiconisco Creek south of Tower City, Pennsylvania.

TMDLS TO ADDRESS AMD IMPAIRMENT

TMDL ENDPOINTS

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

Because of the nature of the pollution sources in the watershed, the TMDL's components/makeup will be load allocations that are specified above a point in the stream segment. All allocations will be specified as long-term average daily concentrations. These long-term average daily concentrations are expected to meet water quality criteria 99 percent of the time. Pa. Title 25 Chapter 96.3(c) specifies that the water quality standards must be met 99 percent of the time. The iron TMDLs are expressed as total recoverable as the iron data used for this analysis were reported as total recoverable. Table 4 shows the 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 0.3	30-Day Average Total Recoverable Dissolved
Manganese (Mn)	1.00	Total Recoverable
pH *	6.0-9.0	N/A

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

TMDL ALLOCATIONS SUMMARY

Methodology for dealing with metal and pH impairments is discussed in Attachment C. Information for the TMDL analysis using the methodology described above is contained in the TMDLs by segment section in Attachment D.

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

Table 5. Summary Table–Wiconisco Creek Watershed

Station	Parameter	Measured Sample Data		Allowable		Reduction Identified
		Conc. (mg/l)	Load (lb/day)	LTA Conc. (mg/l)	Load (lb/day)	Percent
WICO 7.0	Fe	1.53	66.22	0.64	27.78	58*
	Mn	0.94	40.46	0.52	22.35	45*
	Al	1.02	44.09	0.22	9.70	78*
	Acidity	42.85	1,852.28	6.43	277.84	85*
	Alkalinity	1.02	44.09			
WICO 6.0	Fe	0.41	58.92	0.41	58.92	0*
	Mn	0.35	50.29	0.35	50.29	0*
	Al	0.24	24.57	0.12	16.55	0*
	Acidity	48.30	6,940.75	3.38	485.85	90*
	Alkalinity	9.80	1,408.27			
WICO 5.0	Fe	0.00	0.00	0.00	0.00	0*
	Mn	0.30	59.73	0.30	59.73	0*
	Al	0.00	0.00	0.00	0.00	0*
	Acidity	30.80	6,132.64	6.16	1,226.53	0*
	Alkalinity	10.60	2,110.58			
WICO 4.0	Fe	0.81	238.61	0.28	83.51	35*
	Mn	0.32	94.27	0.32	94.27	0*
	Al	0.14	41.24	0.09	25.57	62*
	Acidity	27.47	8,092.07	7.69	2,265.78	0*
	Alkalinity	22.45	6,613.29			
B3	Fe	2.60	144.80	0.10	5.60	0
	Mn	1.55	86.40	0.43	24.00	45
	Al	0.51	28.40	0.19	10.60	63
	Acidity	6.94	386.60	0.27	15.00	0
	Alkalinity	70.17	3,909.30			
WICO 3.0	Fe	1.70	753.73	0.71	316.57	15*
	Mn	0.46	203.95	0.46	203.95	0*
	Al	0.00	0.00	0.00	0.00	0*
	Acidity	28.55	12,658.21	4.85	2,151.90	49*
	Alkalinity	24.80	10,995.57			
WICO 2.0	Fe	1.26	575.47	0.53	242.06	0*
	Mn	0.31	141.58	0.31	141.58	0*
	Al	0.00	0.00	0.00	0.00	0*
	Acidity	35.33	16,135.98	5.30	2,420.63	30*
	Alkalinity	23.15	10,573.11			
WICO 1.0	Fe	0.43	275.15	0.35	223.96	0*
	Mn	0.16	102.38	0.16	102.38	0*
	Al	0.00	0.00	0.00	0.00	0*
	Acidity	22.05	14,109.68	2.21	1,414.17	33*
	Alkalinity	13.57	8,683.37			

*The percent reduction for WICO 1.0 – WICO 7.0 are found in Attachment

TMDLS TO ADDRESS NUTRIENT & SEDIMENT IMPAIRMENTS

SUMMARY OF LITTLE WICONISCO AND UNTS TO WICONISCO CREEK TMDL

1. The impaired stream segments addressed by this total maximum daily load (TMDL) are located in northern Dauphin County. Little Wiconisco drains approximately 17.48 square miles of Wiconisco Creek watershed, as part of State Water Plan subbasin 06C. The aquatic life existing use for Little Wiconisco Creek, is warm water fisheries under §93.9f in Title 25 of the Pa. Code (Commonwealth of Pennsylvania, 2001).

2. The Little Wiconisco Creek TMDL was developed to address use impairments caused by nutrients and sediment. Pennsylvania's 2002 303(d) list identified 32.11 miles of Little Wiconisco Creek (with its UNTs) as impaired by nutrients and siltation emanating from agricultural activities in the basin. In order to ensure attainment and maintenance of water quality standards in the Little Wiconisco Creek, mean annual loadings of total phosphorus and sediment will need to be limited to 4,434.00 pounds per year (lbs/yr) and 6,846,428.55 lbs/yr, respectively.

   The major components of the Little Wiconisco Creek TMDL are summarized below:

Components	Total Phosphorus (lbs/yr)	Sediment (lbs/yr)
TMDL (Total Maximum Daily Load)	4,434.00	6,846,428.55
MOS (Margin of Safety)	443.40	684,642.85
LA (Load Allocation)	3,990.60	6,161,785.70

3. Mean annual total phosphorus and sediment loadings are estimated to be 7,196.15 lbs/yr and 7,290,450.59 lbs/yr, respectively. To meet the TMDL, the phosphorus and sediment loadings will require a 39 percent and 6 percent reduction, respectively.

4. There are no point sources to address in this TMDL.

5. The adjusted load allocation (ALA) is the actual portion of the LA distributed among nonpoint sources receiving reductions, or sources that are considered controllable. Controllable sources receiving allocations are hay/pasture, cropland, developed lands, and streambanks. The phosphorus and sediment TMDL includes a nonpoint source ALA of 2,927.26 lbs/yr and 5,862,001.90 lbs/yr, respectively. Phosphorus and sediment loadings from all other sources, such as forested areas, were maintained at their existing levels. Allocations of phosphorus and sediment to controllable nonpoint sources, or the ALA, for the Little Wiconisco TMDL are summarized below:

Adjusted Load Allocations for Sources of Phosphorus and Sediment

Pollutant	Current Loading (lbs/yr)	Adjusted Load Allocation (lbs/yr)	% Reduction
Phosphorus	7,196.15	2,927.26	59
Sediment	7,290,450.59	5,862,001.90	20

6. Ten percent of the Little Wiconisco Creek phosphorus and sediment TMDL was set aside as a MOS. The MOS is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. The MOS for the phosphorus and sediment TMDL was set at 443.40 lbs/yr and 684,642.85 lbs/yr, respectively.

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

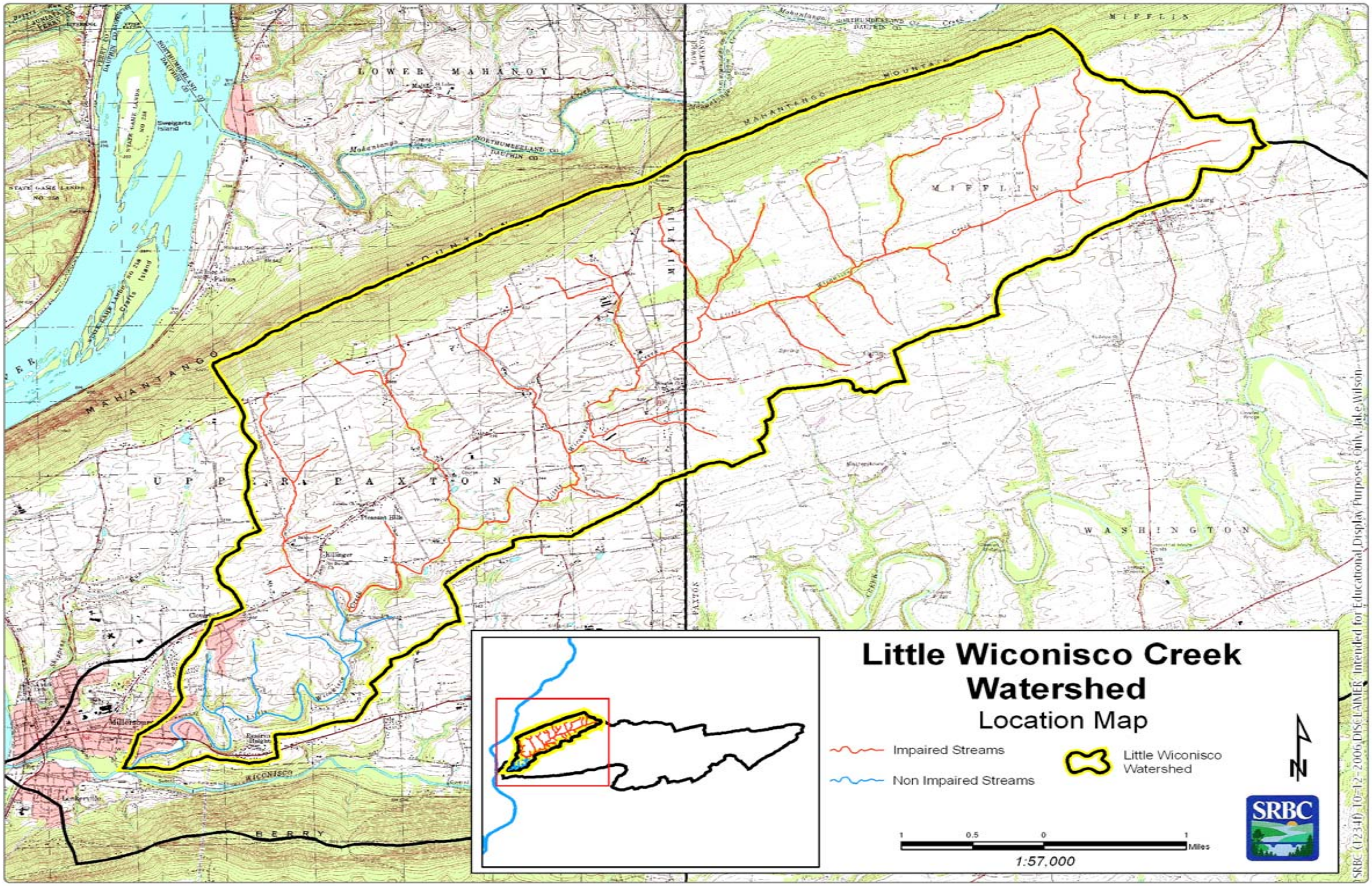

Figure 12. Location Map of Little Wiconisco Creek Watershed

I. Surface Water Quality

Pennsylvania's 1996 303(d) list identified 32.11 miles of Little Wiconisco Creek and its tributaries as impaired by nutrients and siltation/suspended solids emanating from agricultural activities in the basin (Table 1).

II. Approach to TMDL Development

A. Pollutants & Sources

Nutrients and sediment have been identified as the pollutants causing designated use impairments in the Little Wiconisco Creek watershed, with the source listed as agricultural activities, both crop and grazing related. At present, there are no point source contributions within the area.

As stated in previous sections, the landscape is dominantly agriculture. Pastures and croplands extend right up to the streambanks with little to no riparian buffer zones present. Livestock have unlimited access to streambanks throughout most of the watershed. Based on visual observations, streambank erosion is severe in most reaches of the stream.

B. TMDL Endpoints

In an effort to address the excessive nutrient and sediment found in the Little Wiconisco Creek, TMDLs loading limits were developed for phosphorus and sediment. The phosphorus TMDL is intended to address nutrient impairments from agriculture land uses that were first identified in Pennsylvania's 1996 303(d) list. The decision to use phosphorus load reductions to address nutrient enrichment is based on an understanding of the relationship between nitrogen, phosphorus, and organic enrichment in stream systems. Elevated nutrient loads from human activities (nitrogen and phosphorus in particular) can lead to increased productivity of aquatic plants and other organisms, resulting in the degradation of water quality conditions through the depletion of dissolved oxygen in the water column (Novotny and Olem, 1994; Hem, 1983). In aquatic ecosystems the quantities of trace elements are typically plentiful; however, nitrogen and phosphorus may be in short supply. The nutrient that is in the shortest supply is called the limiting nutrient because its relative quantity affects the rate of production (growth) of aquatic biomass. If the limiting nutrient load to a waterbody can be reduced, the available pool of nutrients that can be utilized by plants and other organisms will be reduced and, in general, the total biomass can subsequently be decreased as well (Novotny and Olem, 1994). In most efforts to control the eutrophication processes in waterbodies, emphasis is placed on the limiting nutrient. However, this is not always the case. For example, if nitrogen is the limiting nutrient, it still may be more efficient to control phosphorus loads if the nitrogen originates from difficult to control sources, such as nitrates in groundwater.

In most freshwater systems, phosphorus is the limiting nutrient for aquatic growth. In some cases, however, the determination of which nutrient is the most limiting is difficult. For this reason, the ratio of the amount of nitrogen to the amount of phosphorus is often used to make this determination (Thomann and Mueller, 1987). If the nitrogen/phosphorus (N/P) ratio is less than 10, nitrogen is limiting. If the N/P ratio is greater than 10, phosphorus is the limiting nutrient. For the Little Wiconisco Creek watershed, the average N/P ratio is approximately 15, which indicates to phosphorus as the limiting nutrient. Controlling the phosphorus loading to the Little Wiconisco Creek watershed will limit plant growth, thereby helping to eliminate use impairments currently being caused by excess nutrients.

C. Reference Watershed Approach

The TMDL developed for the Little Wiconisco Creek watershed addresses phosphorus and sediment. Because neither Pennsylvania nor the USEPA has instream numerical water quality criteria for phosphorus and sediment, a method was developed to implement the applicable narrative criteria. The method for these types of TMDLs is termed the “Reference Watershed Approach.” Meeting the water quality objectives specified for this TMDL will result in the impaired stream segment attaining its designated uses.

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

D. Selection of the Reference Watershed

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

The East Branch of Stony Fork was selected as the reference watershed for developing the Little Wiconisco Creek TMDL. East Branch Stony Fork is located southwest of the town of Wellsboro, in Tioga County, Pa. (Figure 13). The watershed is located in State Water Plan subbasin 9A, and protected uses include aquatic life and recreation. The tributary is currently has no designation under §93.9z in Title 25 of the Pa. Code (Commonwealth of Pennsylvania, 2001). Based on PADEP assessments, East Branch Stony Fork is currently attaining its designated uses. The attainment of designated uses is based on

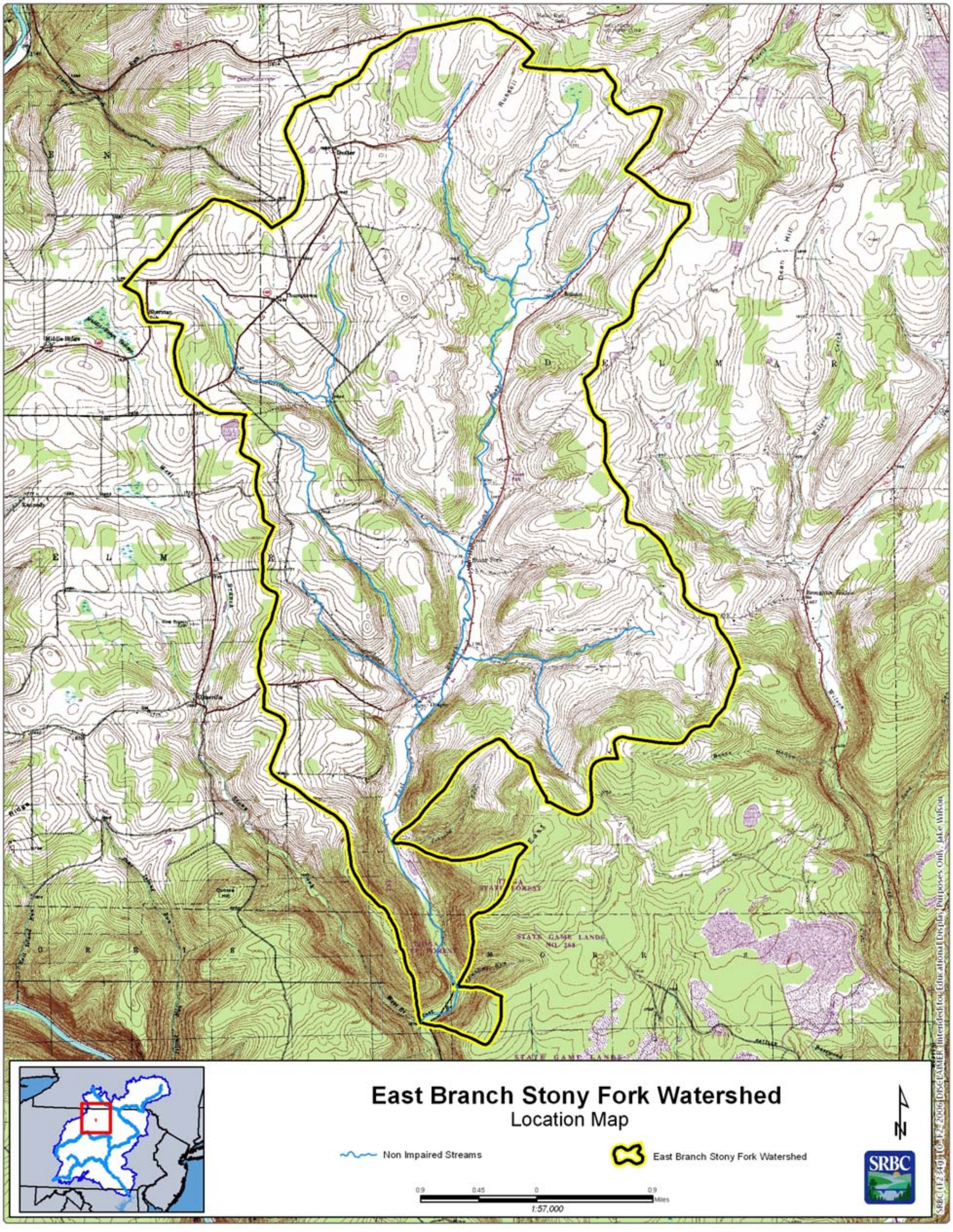

Figure 13.   Location Map of the Reference Watershed, East Branch Stony Fork

sampling done by the PADEP in 1997, as part of its State Surface Water Assessment Program.

Drainage area, location, and other physical characteristics of the Little Wiconisco Creek were compared to the East Branch of Stony Fork reference stream (Table 6). Agriculture is the dominant land use category in both East Branch Stony Fork (57 percent) and the Little Wiconisco Creek (71 percent). The geology, soils, and precipitation in both are also similar (Table 6).

Table 6. Comparison Between Little Wiconisco Creek and East Branch Stony Fork

Attribute	Watershed	
	Little Wiconisco	**East Branch Stony Fork**
Physiographic Province	Ridge and Valley (100%)	Appalachian Plateaus (100%)
Area (mi^2)	17.48	19.28
Land Use	Agriculture (70.56%) Development (1.65%) Forested (22.51%)	Agriculture (56.98%) Development (0.013%) Forested (39.52%)
Geology	Interbedded Sedimentary (95%) Sandstone (5%)	Interbedded Sedimentary (95%) Sandstone (5%)
Soils	Leck Kill (90%) Hazelton (10%)	Volusia-Mardin-Lordstown (55%) Wellsboro-Oquaga-Morris (30%) Oquaga-Lordstown-Wurtsboro (15%)
Dominant HSG	Leck Kill A (0%) B (43%) C (50%) D (7%) Hazelton A (2%) B (45%) C (53%) D (0%)	Volusia-Mardin-Lordstown A (0%) B (0%) C (100%) D (0%) Wellsboro-Oquaga-Morris A (0%) B (0%) C (95%) D (5%) Oquaga-Lordstown-Wurtsboro A (0%) B (0%) C (100%) D (0%)
K Factor	Leck Kill (0.32) Hazelton (0.18)	Volusia-Mardin-Lordstown (0.23) Wellsboro-Oquaga-Morris (0.25) Oquaga-Lordstown-Wurtsboro (0.22)
20-Yr. Ave. Rainfall (in)	39.31	36.22
20-Yr. Ave. Runoff (in)	3.29	1.89

III. Watershed Assessment and Modeling

TMDLs for the Little Wiconisco Creek watershed were developed using the ArcView Generalized Watershed Loading Function model (AVGWLF) as described in Appendix H. The AVGWLF model was used to establish existing loading conditions for the Little Wiconisco Creek watershed and the reference East Branch Stony Fork watershed. All modeling inputs have been attached to this TMDL as Appendices I and J. SRBC staff compared aerial photography and 2001 state landuse coverages for the Little Wiconisco Creek and East Branch Stony Fork watersheds. SRBC determined that the landuse of Little Wiconisco Creek matched the aerial photography of the watershed. While reviewing East Branch Stony Fork, SRBC found that the watershed had a 3.07% transitional land listed. Upon further review and comparison with aerial photographs of the region, SRBC determined that 90% of the transitional areas were grass areas. SRBC elected to change the transitional landuse from 3.07% to 0.25%, to calculate a more accurate measure of loadings in the East Branch Stony Fork watershed. This changed the sediment and phosphorous loadings for East Branch Stony Fork from 1,553.25 and 3,460,921.20 to new loadings of 123.99 and 276,292.40.

The AVGWLF model produced information on watershed size, land use, and phosphorus loading. The phosphorus and sediment loads represent an annual average over a 19-year period (1976 to 1994) for Little Wiconisco Creek and a 12-year period (1985 to 1996) for East Branch Stony Fork. This information was then used to calculate existing unit area loading rates for the Little Wiconisco Creek and East Branch Stony Fork reference watersheds. Phosphorus and sediment loading information for both the impaired watershed and the reference watershed are shown in Tables 7 and 8, respectively.

Table 7. Existing Phosphorus and Sediment Loads for Little Wiconisco Creek

Pollutant Source	Acreage	Phosphorus		Sediment	
		Mean Annual Loading (lbs/yr)	Unit Area Loading (lbs/ac/yr)	Mean Annual Loading (lbs/yr)	Unit Area Loading (lbs/ac/yr)
HAY/PAST	2,935.60	566.27	0.19	165,227.40	56.28
CROPLAND	5,011.30	4,403.42	0.88	3,758,885.20	750.08
CONIF_FOR	44.50	0.20	0.00	92.80	2.09
MIXED_FOR	397.80	2.30	0.01	1,466.60	3.69
DECID_FOR	1,944.70	254.43	0.13	298,224.40	153.35
UNPAVED_RO	17.30	74.63	4.31	83,399.20	4,820.76
TRANSITION	551.00	1,025.52	1.86	1,038,855.40	1,885.40
LO_INT_DEV	177.90	0.35	0.00	10,206.20	57.37
HI_INT_DEV	4.90	0.00	0.00	161.20	32.90
Streambank		42.55		1,933,932.19	
Groundwater		806.41			
Point Source		0.00			
Septic Systems		20.07			
TOTAL	11,085.00	7,196.15	0.65	7,290,450.59	657.69

Table 8. Existing Phosphorus and Sediment Loads for East Branch Stony Fork

Pollutant Source	Acreage	Phosphorus		Sediment	
		Mean Annual Loading (lbs/yr)	Unit Area Loading (lbs/ac/yr)	Mean Annual Loading (lbs/yr)	Unit Area Loading (lbs/ac/yr)
HAY/PAST	3,575.10	556.30	0.16	497,140.80	139.06
CROPLAND	3,672.00	3,264.67	0.89	6,114,864.40	1,665.27
CONIF_FOR	835.20	15.29	0.02	32,300.40	38.67
MIXED_FOR	210.00	1.26	0.01	2,069.40	9.85
DECID_FOR	3,825.20	74.77	0.02	159,049.00	41.58
UNPAVED_RO	64.20	96.16	1.50	194,595.40	41.58
TRANSITION	30.10	123.99	4.12	276,292.40	9,179.15
LO_INT_DEV	17.30	0.01	0.00	3,875.60	224.02
Streambank		6.00		272,903.80	
Groundwater		692.81			
Point Source		0.00			
Septic Systems		38.31			
Total	12,229.10	4,869.57	0.40	7,553,091.20	617.63

IV. TMDLs

Targeted TMDL values for the Little Wiconisco Creek watershed were established based on current loading rates for phosphorus and sediment in the East Branch Stony Fork reference watershed. Biological assessments have determined that East Branch Stony Fork is currently attaining its designated uses. Reducing the loading rate of phosphorus and sediment in the Little Wiconisco Creek watershed to levels equivalent to those in the reference watershed will provide conditions favorable for the reversal of current use impairments.

A. Background Pollutant Conditions

There are two separate considerations of background pollutants within the context of this TMDL. First, there is the inherent assumption of the reference watershed approach that because of the similarities between the reference and impaired watershed, the background pollutant contributions will be similar. Therefore, the background pollutant contributions will be considered when determining the loads for the impaired watershed that are consistent with the loads from the reference watershed. Second, the AVGWLF model implicitly considers background pollutant contributions through the soil and the groundwater component of the model process.

B. Targeted TMDLs

Targeted TMDL values for phosphorus and sediment were determined by multiplying the total area of Little Wiconisco Creek watershed (11,085.00 acres) by the appropriate unit area loading rate for the East Branch Stony Fork reference watershed (Table 9). The existing mean annual loading of phosphorus to Little Wiconisco Creek (7,196.15 lbs/yr) will need to be reduced by 49 percent to meet the targeted TMDL of 4,434.00 lbs/yr. The existing mean annual loading of sediment to Little Wiconisco Creek (7,290,450.59 lbs/yr) will need to be reduced by 16 percent to meet the targeted TMDL of 6,846,428.55 lbs/yr.

Table 9. Targeted TMDL for the Little Wiconisco Creek Watershed

Pollutant	Area (ac)	Unit Area Loading Rate East Branch Stony Fork Reference Watershed (lbs/ac/yr)	Targeted TMDL for Little Wiconisco Creek (lbs/yr)
Phosphorus	11,085.00	0.40	4,434.00
Sediment	11,085.00	617.63	6,846,428.55

C. Margin of Safety (MOS)

The MOS is that portion of the pollutant loading that is reserved to account for any uncertainty in the data and computational methodology used for the analysis. For this analysis, the MOS is explicit. Ten percent of the targeted TMDL for phosphorus and sediment was reserved as the MOS. Using 10 percent of the TMDL load is based on professional judgment and will provide an additional level of protection to the designated uses of Little Wiconisco Creek. The MOS used for the phosphorus and sediment TMDL was 443.40 lbs/yr and 684,642.85 lbs/yr, respectively.

MOS (phosphorus) = 4,434.00 lbs/yr (TMDL) x 0.1 = 443.40 lbs/yr

MOS (sediment) = 6,846,428.55 lbs/yr (TMDL) x 0.1 = 684,642.85 lbs/yr

D. Adjusted Load Allocation (ALA)

The ALA is the actual portion of the LA distributed among those nonpoint sources receiving reductions. It is computed by subtracting those nonpoint source loads that are not being considered for reductions (loads not reduced or LNR) from the LA. Phosphorus and sediment reductions were made to the hay/pasture, cropland, developed areas (sum of LO_INT_DEV, HI_INT_DEV and septic systems), and streambanks. Those land uses/sources for which existing loads were not reduced (CONIF_FOR, MIXED_FOR, DECID_FOR, and groundwater) were carried through at their existing loading values (Table 10). The ALA for phosphorus and sediment were 2,927.26 lbs/yr and 5,862,001.90 lbs/yr, respectively.

Table 10. Load Allocations, Loads Not Reduced, and Adjusted Load Allocations for Little Wiconisco Creek

	Phosphorus (lbs/yr)	Sediment (lbs/yr)
Load Allocation	3,990.60	6,161,785.70
Loads Not Reduced	1,063.34	299,783.80
CONIF_FOR	0.20	92.80
MIXED_FOR	2.30	1,466.60
DECID_FOR	254.43	298,224.40
Groundwater	806.41	--
Adjusted Load Allocation	2,927.26	5,862,001.90

E. TMDLs

The phosphorus and sediment TMDLs established for the Little Wiconisco Creek watershed consist of a LA, and a MOS. No TMDL was established for nitrogen because the stream is phosphorus limited. The individual components of the TMDL are summarized in Table 11.

Table 11. TMDL, MOS, LA, LNR, and ALA for Little Wiconisco Creek

Component	Phosphorus (lbs/yr)	Sediment (lbs/yr)
TMDL (Total Maximum Daily Load)	4,434.00	6,846,428.55
MOS (Margin of Safety)	443.40	684,642.85
LA (Load Allocation)	3,990.60	6,161,785.70
LNR (Loads Not Reduced)	1,063.34	299,783.80
ALA (Adjusted Load Allocation)	2,927.26	5,862,001.90

V. Calculation of Phosphorus and Sediment Load Reductions

ALAs established in the previous section represent the annual total phosphorus and sediment loads that are available for allocation between contributing sources in the Little Wiconisco Creek watershed. The ALAs for phosphorus and sediment were allocated between agriculture, developed areas, and streambanks. LA and reduction procedures were applied to the entire Little Wiconisco Creek watershed using the Equal Marginal Percent Reduction (EMPR) allocation method (Appendix K). The LA and EMPR procedures were performed using MS Excel and results are presented in Appendix L.

In order to meet the phosphorus TMDL, the load currently emanating from controllable sources must be reduced to 2,927.26 lbs/yr. This can be achieved through reductions in current phosphorus loadings of 48 percent from cropland, and 21 percent from hay/pasture, developed areas, and streambanks (Table 12). The loadings from septic systems were included in the allocation to developed areas.

To meet the sediment TMDL, the current loading from controllable sources will require a reduction to 5,862,001.90 lbs/yr. This is achievable through sediment load reductions of 16 percent for cropland, hay/pasture, developed lands, and streambanks (Table 12).

Table 12. Phosphorus and Sediment Load Allocations & Reductions for Little Wiconisco Creek

Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		% Reduction
		Current	Allowable	Current	Allowable (LA)	
Phosphorus						
Hay/Pasture	2,935.60	0.19	0.15	566.27	445.73	21
Cropland	5,011.30	0.88	0.46	4,403.42	2,304.15	48
Developed	182.80	1.00	0.79	182.80	143.89	21
Streambanks	0.00			5,195.04	2,927.26	44
Sediment						
Hay/Pasture	2,935.60	56.28	47.20	165,227.40	138,550.92	16
Cropland	5,011.30	750.08	628.98	3,758,885.20	3,152,001.50	16
Developed	182.80	6,195.96	5,195.61	1,132,622.00	949,756.66	16
Streambanks	0.00			6,990,666.79	5,862,001.90	16

VI. Consideration of Critical Conditions

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

VII. Consideration of Seasonal Variations

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

VIII. Additional TMDLs For Wiconisco Creek Watershed

Within the Wiconisco Creek Watershed there are four UNTs to Wiconisco Creek that are impaired and need to be addressed. Starting at the mouth and moving upstream, the first impaired UNT is UNT 16938. UNT 16938 is located just east of Reservoir Heights and is located on Figure 14. The second impaired UNT to Wiconisco Creek is 16951, which is located east of UNT 16938 and just upstream on the town of Rife (Figure 14). The third impaired UNT to Wiconisco Creek is UNT 17052, which flows from the towns of Muir to Tower City (Figure 15). UNT 17058 is the last UNT to impair the watershed (Figure 15). UNT 17058 flows between Peter's and Stony Mountains and enter Wiconisco Creek south of Orwin.

These UNTs listed above are too small in area to model accurately using AVGWLF. SRBC used the unit area loading rates and pollutant loadings of sediment and phosphorus from Little Wiconisco Creek (current rates) calculations to determine existing loads. SRBC used reference loading rates from East Branch Stony Fork Reference Watershed (allowable rates) to determine needed reductions. By calculating these loads, SRBC determined that UNTs 17052, 17058, 16951, and 16938 required a 38% reduction for phosphorous and a 6% percent reduction for sediment (Table 13).

Table 13. Additional TMDLs for Wiconisco Creek Watershed

Pollutant Source	Acres	Unit Area Loading Rate (lbs/ac/yr)		Pollutant Loading (lbs/yr)		% Reduction
		Current	Allowable	Current	Allowable (LA)	
Phosphorus						
UNT 17052	885.06	0.65	0.40	575.29	354.02	38
UNT 17058	2,033.60	0.65	0.40	1,321.84	813.44	38
UNT 16951	870.04	0.65	0.40	565.53	348.02	38
UNT 16938	1,261.42	0.65	0.40	819.92	504.57	38
Sediment						
UNT 17052	885.06	657.69	617.63	582,095.11	546,639.60	6
UNT 17058	2,033.60	657.69	617.63	1,337,478.30	1,256,012.30	6
UNT 16951	870.04	657.69	617.63	572,216.60	537,362.80	6
UNT 16938	1,261.42	657.69	617.63	829,623.31	779,090.83	6

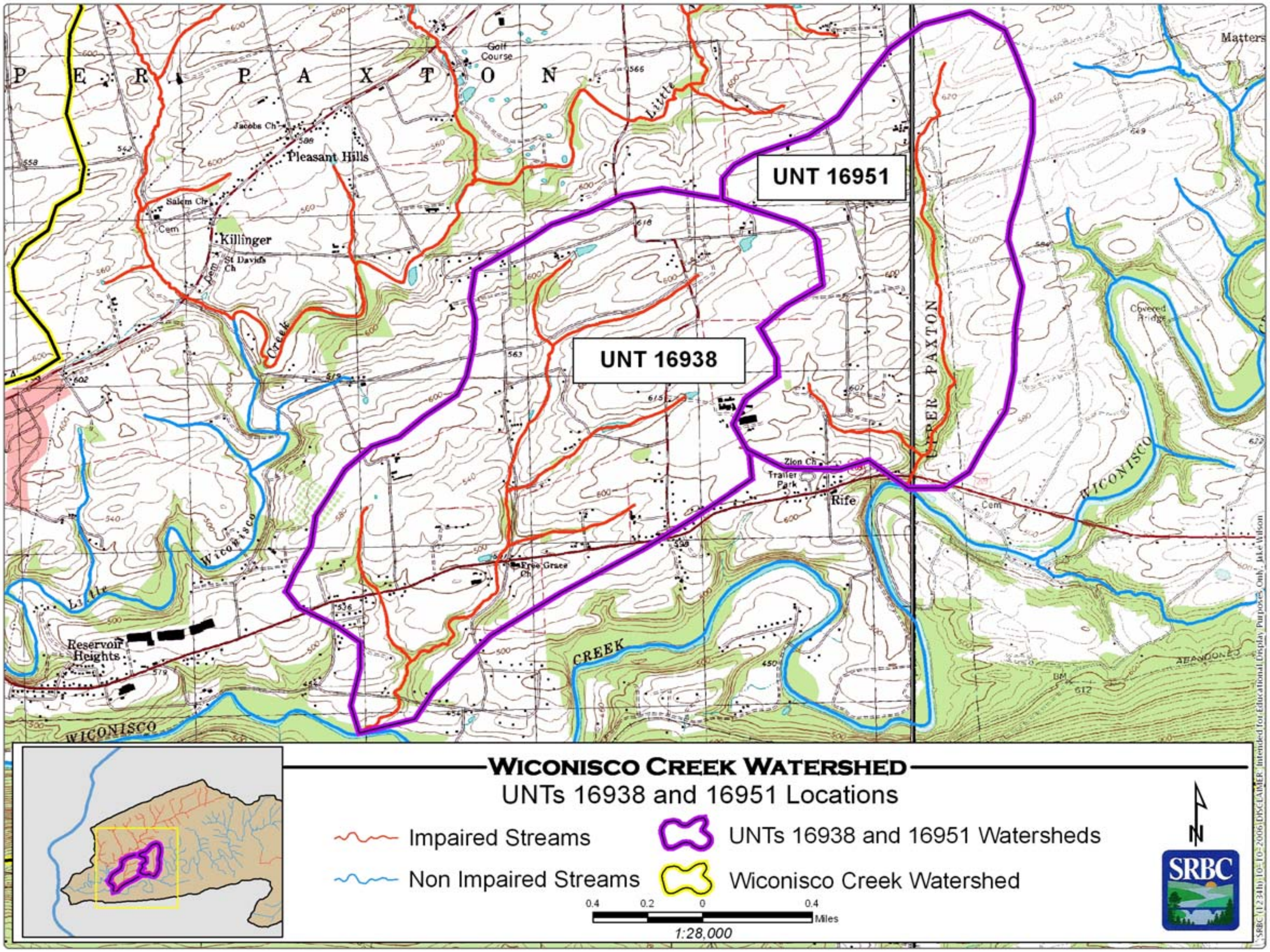

Figure 14. Wiconisco Creek Watershed, UNTs 16938 and 16951 Locations

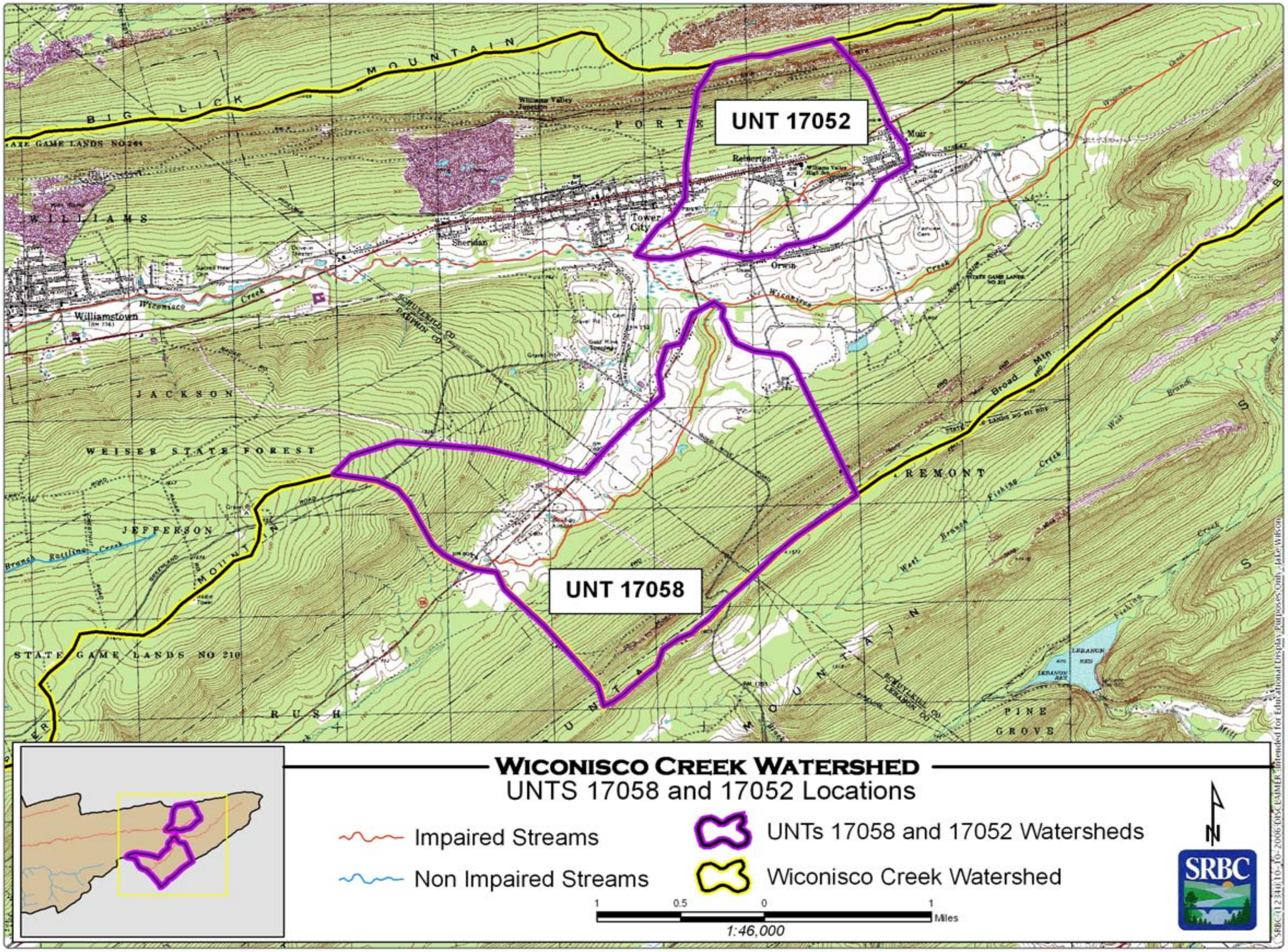

Figure 15. *Wiconisco Creek Watershed, UNTs 17058 and 17052 Locations*

RECOMMENDATIONS FOR IMPLEMENTATION

PADEP's efforts to reclaim abandoned mine lands will be the focal point for water quality improvement in Wiconisco Creek Watershed. However, support from other programs, such as the 319 Nonpoint Source Program, will be needed to improve conditions in those areas affected by agricultural activities

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

The WCRA was formed in 1997. Since that time, WCRA has been very active planning and completing projects to restore the water quality in Wiconisco Creek. WCRA's projects consisted of tree planting in various areas and stream cleanups for the entire watershed. WCRA has partnered with other agencies such as DCCD to help fund the Bear Creek remediation project. Consequently, declining membership has created hurdles for WCRA in completing several other goals.

TMDLs represent an attempt to quantify the pollutant load that may be present in a waterbody and still ensure attainment and maintenance of water quality standards. The Little Wiconisco Creek TMDL identifies the necessary overall load reductions for pollutants currently causing use impairments and distributes those reduction goals to the appropriate nonpoint sources. Reaching the reduction goals established by this TMDL will only occur through BMPs. BMPs that would be helpful in lowering the amount of nutrients and sediment reaching Little Wiconisco Creek include streambank fencing, riparian buffer strips, strip cropping, stormwater retention wetlands, and heavy use area protection, among many others.

The Wiconisco Creek Watershed has been the focus of numerous assessment and restoration initiatives. After PADEP's biological assessment of Wiconisco Creek in 1996, the watershed was the focus of an intensive biological survey conducted by the SRBC in the late 1990s. The purpose of the study was to provide an overall assessment of the streams for targeting BMP installation, as well as provide baseline data for later use in evaluating their effectiveness. The study indicated that most of the tributaries to Little Wiconisco Creek were severely impaired (Stoe, 1999).

The DCCD and the WCRA, as well as other project partners, have been involved in inventorying and promoting the installation of BMPs such as streambank fencing in the watershed, as well as manure storage facilities. Most of the efforts have been concentrated in the Little Wiconisco Creek watershed, identified by the USEPA assessment as a priority for BMP implementation. Although measuring a stream's recovery as a result of BMP installation is generally considered a long-term and complex exercise (~10 years), a study by the U.S. Geological Survey (1999) indicates that total phosphorus levels decreased 31 percent over the study period. Since phosphorus is generally tied to sediment runoff during storm events, it may indicate that fencing efforts have contributed to reducing the runoff by stabilizing streambanks.

Numerous other entities, both public and private, have assisted with similar efforts throughout the county. Specific BMPs implemented in the county include stream fencing, manure storage systems, treatment of runoff from animal confinement areas and riparian tree planting. A number of projects in the Wiconisco Creek watershed are also addressing streambank erosion through the use of natural stream design and stabilization.

The Natural Resources Conservation Service maintains a *National Handbook of Conservation Practices* (NHCP), which provides information on a variety of BMPs. The NHCP is available online at http://www.ncg.nrcs.usda.gov/nhcp_2.html. Many of the practices described in the handbook could be used in the Little Wiconisco Creek watershed to help limit nutrient and sediment impairments. Determining the most appropriate BMPs, where they should be installed, and actually putting them into practice, will require the development and implementation of restoration plans. Development of any restoration plan will involve the gathering of site-specific information regarding current land uses and existing conservation practices. This type of assessment would be recommended for the Little Wiconisco Creek watershed prior to BMP implementation.

By developing TMDLs for the Little Wiconisco Creek watershed, the PADEP has set the stage for the design and implementation of restoration plans to correct current use impairments. The PADEP welcomes local efforts to support a watershed restoration plan. For more information about this TMDL, interested parties should contact the appropriate watershed manager in PADEP's Southcentral Regional Office (717-705-4700).

REFERENCES

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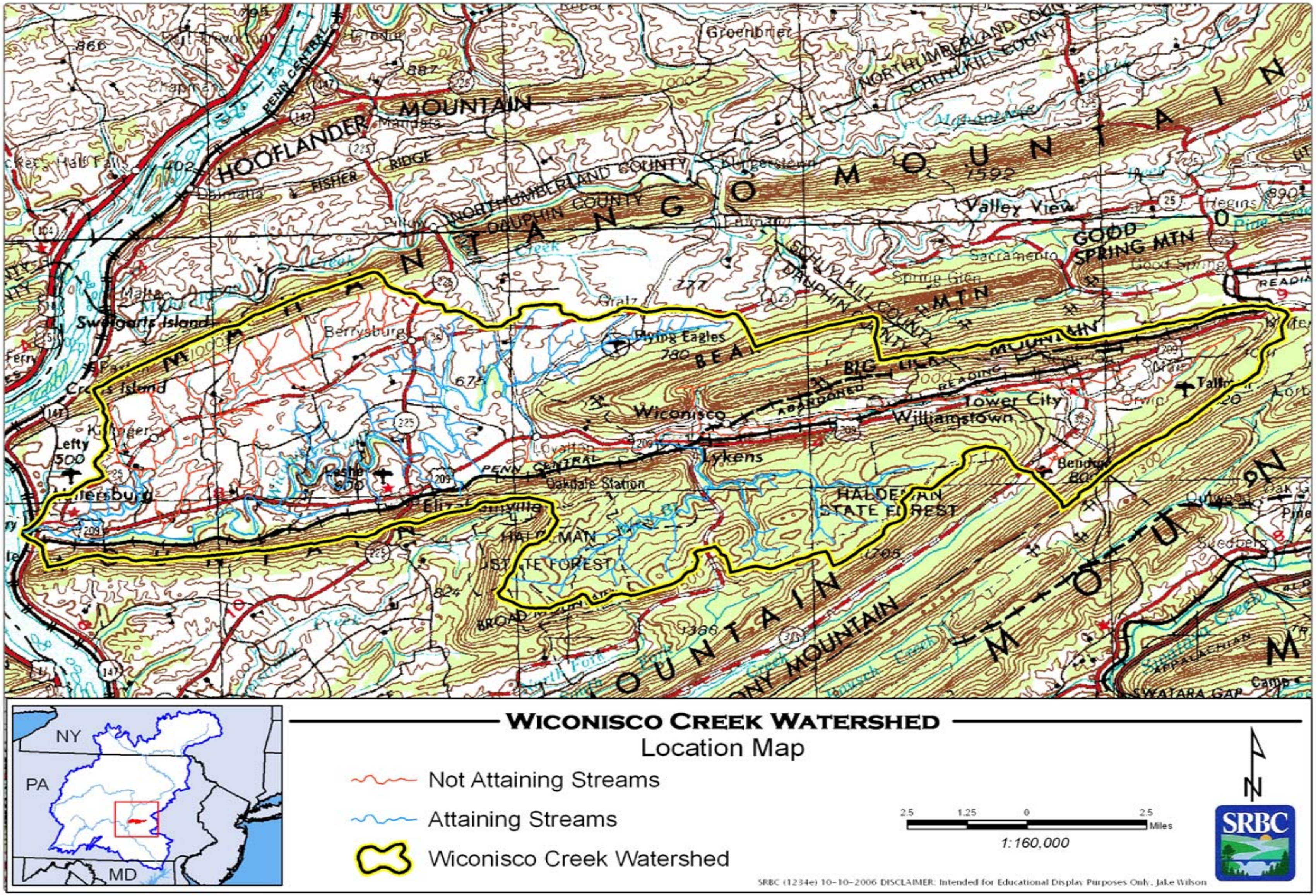
ATTACHMENT A

WICONISCO CREEK WATERSHED MAP



WICONISCO CREEK WATERSHED
Location Map
Not Attaining Streams
Attaining Streams
Wiconisco Creek Watershed
2.5 1.25 0 2.5 Miles
1:160,000
N
SRBC
NY
PA
MD
SRBC (1234e) 10-10-2006 DISCLAIMER: Intended for Educational Display Purposes Only. Jake Wilson
HOOFLANDER MOUNTAIN
MAHANTANGO MOUNTAIN
BERRY MOUNTAIN
BIG LICK MOUNTAIN
GOOD SPRING MTN
HALDEMAN STATE FOREST
NORTHUMBERLAND COUNTY
DAUPHIN COUNTY
SCHUYLKILL COUNTY
Berrysburg
Wiconisco
Lykens
Williamstown
Tower City
Valley View
Oakdale Station
Millersburg
Elizabethville
Swigarts Island
Flying Eagles
Loyalton
Sacramento
Spring Glen
Gratz

Attachment B

Excerpts Justifying Changes Between The 1996, 1998, Draft 2000, and Draft 2002 Section 303(d) Lists

The following are excerpts from the PADEP Section 303(d) narratives that justify changes in listings between the 1996, 1998, Draft 2000, and Draft 2002 list. The Section 303(d) listing process has undergone an evolution in Pennsylvania since the development of the 1996 list.

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

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

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

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

The most notable difference between the 1998 and Draft 2000 303(d) lists are the listing of unnamed tributaries in 2000. In 1998, the GIS stream layer was coded to the named stream level so there was no way to identify the unnamed tributary records. As a result, the unnamed tributaries were listed as part of the first downstream named stream. The GIS stream coverage used to generate the 2000 list had the unnamed tributaries coded with the PADEP's five-digit stream code. As a result, the unnamed tributary records are now split out as separate records on the 2000 303(d) list. This is the reason for the change in the appearance of the list and the noticeable increase in the number of pages. After due consideration of comments from EPA and PADEP on the Draft 2000 Section 303(d) list, the Draft 2002 Pa Section 303(d) list was written in a manner similar to the 1998 Section 303(d) list.

ATTACHMENT C

AMD METHODOLOGY, THE pH METHOD, AND SURFACE MINING CONTROL AND RECLAMATION ACT

AMD Methodology

Two approaches are used for the TMDL analysis of AMD-affected stream segments. Both of these approaches use the same statistical method for determining the instream allowable loading rate at the point of interest. The difference between the two is based on whether the pollution sources are defined as discharges that are permitted or have a responsible party, which are considered point sources. Nonpoint 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 only point-source impacts or a combination of point and 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.

TMDLs and load allocations for each pollutant were determined using Monte Carlo simulation. 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[2] by performing 5,000 iterations to determine any required percent reduction so that the water quality criteria 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 99^{th} 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

---

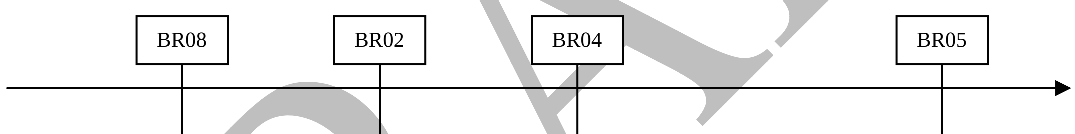
[2] @Risk – Risk Analysis and Simulation Add-in for Microsoft Excel, Palisade Corporation, Newfield, NY, 1990-1997.

Once the required percent reduction for each pollutant source was determined, a second series of Monte Carlo simulations were performed to determine if the cumulative loads from multiple sources allow instream water quality criteria to be met at all points at least 99 percent of the time. The second series of simulations combined the flows and loads from individual sources in a step-wise fashion, so that the level of attainment could be determined immediately downstream of each source. Where available data allowed, pollutant-source flows used were the average flows. Where data were insufficient to determine a source flow frequency distribution, the average flow derived from linear regression was used.

In general, these cumulative impact evaluations indicate that, if the percent reductions determined during the first step of the analysis are achieved, water quality criteria will be achieved at all upstream points, and no further reduction in source loadings is required.

Accounting for Upstream Reductions in AMD TMDLs

In AMD TMDLs, sample points are evaluated in headwaters (most upstream) to stream mouth (most downstream) order. As the TMDL evaluation moves downstream the impact of the previous, upstream, evaluations must be considered. The following examples are from the Beaver Run AMD TMDL (2003):



In the first example BR08 is the most upstream sample point and BR02 is the next downstream sample point. The sample data, for both sample points, are evaluated using @Risk (explained above) to calculate the existing loads, allowable loads, and a percentage reduction for aluminum, iron, manganese, and acidity (when flow and parameter data are available).

Any calculated load reductions for the upstream sample point, BR08, must be accounted for in the calculated reductions at sample point BR02. To do this (see Table A) the allowable load is subtracted from the existing load, for each parameter, to determine the total load reduction.

Table A	Alum.	Iron	Mang.	Acidity
BR08	(#/day)	(#/day)	(#/day)	(#/day)
existing load=	3.8	2.9	3.5	0.0
allowable load=	3.8	2.9	3.5	0.0
Total Load Reduction=	**0.0**	**0.0**	**0.0**	**0.0**

In Table B the Total Load Reduction BR08 is subtracted from the Existing Loads at BR02 to determine the Remaining Load. The Remaining Load at BR02 has the previously calculated Allowable Loads at BR02 subtracted to determine any load reductions at sample point BR02. This results in load reductions for aluminum, iron and manganese at sample point BR02.

Table B. Necessary Reductions at Beaver Run BR02

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR02	13.25	38.44	21.98	6.48
Total Load Reduction BR08	0.00	0.00	0.00	0.00
Remaining Load (Existing Load at BR02 - BR08)	13.25	38.44	21.98	6.48
Allowable Loads at BR02	2.91	9.23	7.03	6.48
Percent Reduction	78.0%	76.0%	68.0%	NA
Additional Removal Required at BR02	10.33	29.21	14.95	0.00

At sample point BR05 this same procedure is also used to account for calculated reductions at sample points BR08 and BR02. As can be seen in Tables C and D this procedure results in additional load reductions for iron, manganese and acidity at sample point BR04.

At sample point BR05 (the most downstream) no additional load reductions are required (see Tables E and F).

Table C	Alum.	Iron	Mang.	Acidity
BR08 & BR02	(#/day)	(#/day)	(#/day)	(#/day)
Total Load Reduction=	**10.33**	**29.21**	**14.95**	**0.0**

Table E	Alum.	Iron	Mang.	Acidity
BR08 BR02 &BR04	(#/day)	(#/day)	(#/day)	(#/day)
Total Load Reduction=	10.3	29.2	14.9	0.0

Table D. Necessary Reductions at Beaver Run BR04

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR04	12.48	138.80	54.47	38.76
Total Load Reduction BR08 & BR02	10.33	29.21	14.95	0.00
Remaining Load (Existing Load at BBR04 - TLR Sum	2.15	109.59	39.53	38.76
Allowable Loads at BR04	8.99	19.43	19.06	38.46
Percent Reduction	NA	82.3%	51.8%	0.8%
Additional Removal Required at BR04	0.00	90.16	20.46	0.29

Table F. Necessary Reductions at Beaver Run BR05

	Al (#/day)	Fe (#/day)	Mn (#/day)	Acidity (#/day)
Existing Loads at BR05	0.0	31.9	22.9	4.1
Total Load Reduction BR08, BR02 & BR04	10.3	119.4	35.4	0.3
Remaining Load (Existing Load at BBR05 - TLR Sum	NA	NA	NA	3.8
Allowable Loads at BR05	0.0	20.4	15.1	4.1
Percent Reduction	NA	NA	NA	NA
Additional Removal Required at BR05	0.0	0.0	0.0	0.0

Although the evaluation at sample point BR05 results in no additional removal this does not mean there are no AMD problems in the stream segment BR05 to BR04. The existing and allowable loads for BR05 show that iron and manganese exceed criteria and any abandoned mine discharges in this stream segment will be addressed.

Method for Addressing 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 PADEP demonstrates that by plotting net alkalinity (alkalinity-acidity) vs. pH for 794 mine sample points, the resulting pH value from a sample possessing a net alkalinity of zero is approximately equal to six (Figure 1). Where net alkalinity is positive (greater than or equal to zero), the pH range is most commonly six to eight, which is within the USEPA's acceptable range of six to nine and meets Pennsylvania water quality criteria in Chapter 93.

The pH, a measurement of hydrogen ion acidity presented as a negative logarithm, is not conducive to standard statistics. Additionally, pH does not measure latent acidity. For this reason, and based on the above information, Pennsylvania is using the following approach to address the stream impairments noted on the 303(d) list due to pH. The concentration of acidity in a stream is at least partially chemically dependent upon metals. For this reason, it is extremely difficult to predict the exact pH values, which would result from treatment of abandoned mine drainage. 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 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. 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 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 meet a minimum net alkalinity of zero.

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. Department of Environmental Protection, Harrisburg, Pennsylvania.*

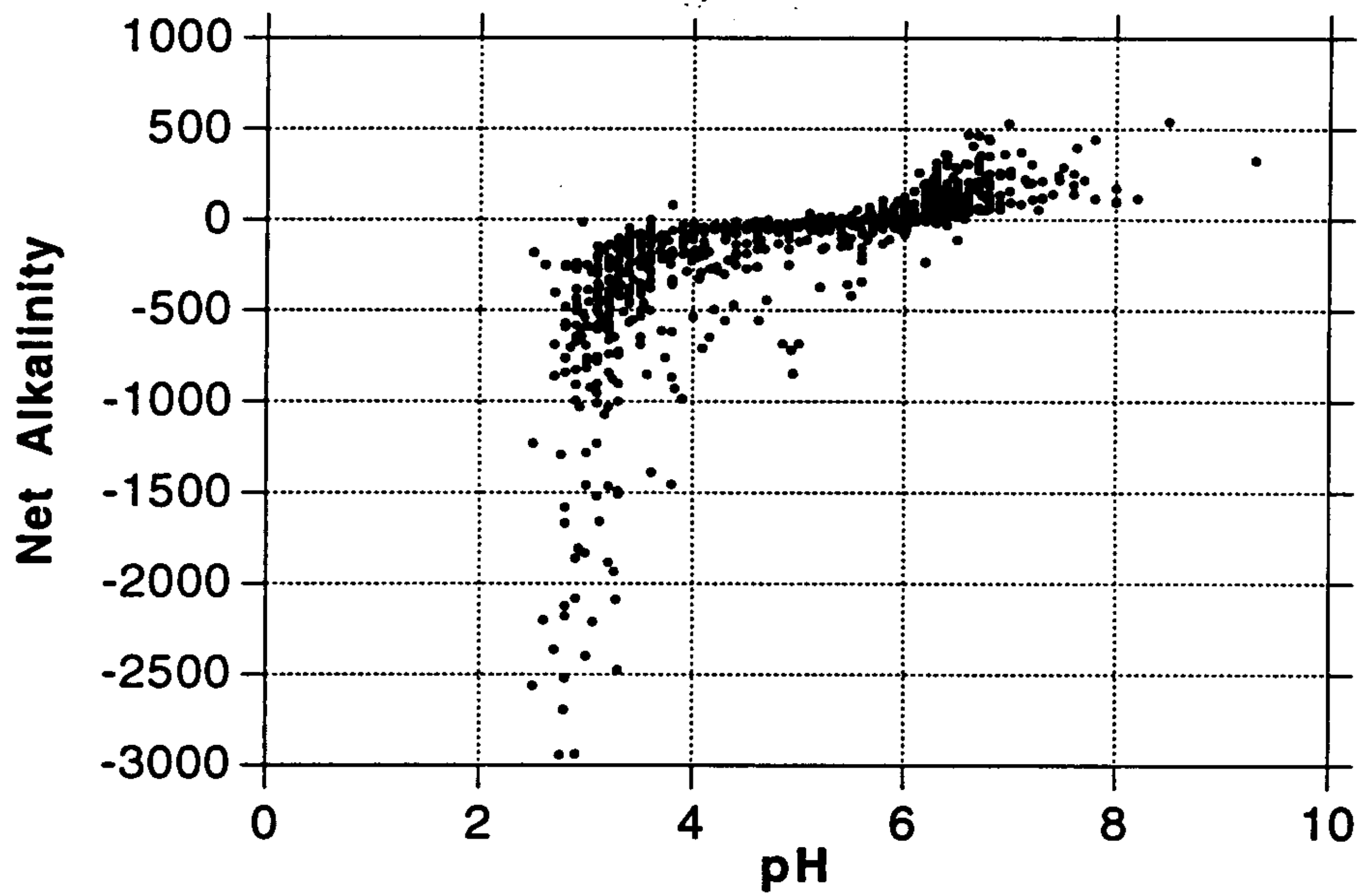


Figure 1. Net Alkalinity vs. pH. Taken from Figure 1.2 Graph C, pages 1-5, of Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania

Surface Mining Control and Reclamation Act

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to established a nationwide program to, among other things, protect the beneficial uses of land or water resources, and public health and safety from the adverse effects of current surface coal mining operations, as well as promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. SMCRA requires a permit for the development of new, previously mined, or abandoned sites for the purpose of surface mining. Permittees are required to post a performance bond that will be sufficient to ensure the completion of reclamation requirements by the regulatory authority in the event that the applicant forfeits. Mines that ceased operating by the effective date of SMCRA, (often called "pre-law" mines) are not subject to the requirements of SMCRA.

Title IV of the Act is designed to provide assistance for reclamation and restoration of abandoned mines, while Title V states that any surface coal mining operations shall be required to meet all applicable performance standards. Some general performance standards include:

- Restoring the affected land to a condition capable of supporting the uses which it was capable of supporting prior to any mining,

- Backfilling and compacting (to insure stability or to prevent leaching of toxic materials) in order to restore the approximate original contour of the land with all highwalls being eliminated, and topsoil replaced to allow revegetation, and

- Minimizing the disturbances to the hydrologic balance and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by avoiding acid or other toxic mine drainage.

For purposes of these TMDLs, point sources are identified as NPDES-permitted discharge points, and non-point sources include discharges from abandoned mine lands, including but not limited to, tunnel discharges, seeps, and surface runoff. Abandoned and reclaimed mine lands were treated in the allocations as non-point sources because there are no NPDES permits associated with these areas. In the absence of an NPDES permit, the discharges associated with these land uses were assigned load allocations.

The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by EPA as to whether there are, in fact, unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, EPA is not determining that these discharges are exempt from NPDES permitting requirements.

Related Definitions

Pre-Act (Pre-Law) - Mines that ceased operating by the effective date of SMCRA and are not subject to the requirements of SMCRA.

Bond – A instrument by which a permittee assures faithful performance of the requirements of the acts, this chapter, Chapters 87-90 and the requirements of the permit and reclamation plan.

Postmining pollution discharge – A discharge of mine drainage emanating from or hydrologically connected to the permit area, which may remain after coal mining activities have been completed, and which does not comply with the applicable effluent requirements described in Chapters 87.102, 88.92, 88.187, 88.292, 89.52 or 90.102. The term includes minimal-impact postmining discharges, as defined in Section of the Surface Mining Conservation and Reclamation Act.

- Forfeited Bond – Bond money collected by the regulatory authority to complete the reclamation of a mine site when a permittee defaults on his reclamation requirements.

ATTACHMENT D

TMDLS BY SEGMENT

Wiconisco Creek

The TMDL for the Wiconisco Creek Watershed consists of load allocations to one tributary, Bear Creek. The Bear Creek TMDL document was completed on March 2, 2001 and was approved by the USEPA. Bear Creek is a tributary entering Wiconisco Creek in the town of Lykens, Pa. The TMDLs completed for Bear Creak at its mouth are included in this document and are used to account for the upstream reductions at the AMD portion of the 303(d) listed segments of Wiconisco Creek. The data and calculations for Bear Creek are found in the Bear Creek Watershed TMDL document and are not included in this report.

The Wiconisco Creek Watershed is listed as impaired on the Section 303(d) list by high metals, low pH and siltation from AMD as 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. The method and rationale for addressing pH is contained in Attachment C.

An allowable long-term average instream concentration for iron, manganese, aluminum, and acidity was determined at each sample point. The analysis is designed to produce a long-term average value that, when met, will be protective of the water quality criterion for that parameter 99 percent 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 percent of the time. The simulation was run assuming the data set was lognormally distributed. Using the mean and the standard deviation of the data set, 5,000 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 percent of the time. The mean value from this data set represents that long-term daily average concentration that needs to be met to achieve water quality standards.

WICO 7.0: Wiconisco Creek Upstream of Muir, Pa.

The headwaters of Wiconisco Creek begin outside of Muir, Pa. Anthracite mining in the watershed severely disturbed the land surface and underground structure. This portion of the stream is visibly impaired by abandoned mine drainage along with the presence orange iron precipitate. The point WICO 7.0 is located at the upstream side of the bridge on Township Route 426. Flow measurements were available for WICO 7.0; therefore loading values could be calculated at this point. The concentrations of metals and acidity indicate that the stream is not meeting water quality standards at this station.

The major contributing factors to decreased water quality include Porter and Keffers Tunnels. Keffers Tunnel is the first AMD discharge to impact the watershed downstream from its headwaters. Keffers Tunnel, at an elevation of 1250.0 feet, is located just a couple miles southwest of the town of Keffers. The tunnel flows off the south side of Porter Mountain just above State Route 209. Keffers Tunnel was constructed in the early 1900s to drain portions of the Joliett Mine Pool, which is located in the Good Spring Creek Watershed. Porter Tunnel can be found just down stream of Keffers Tunnel. Porter Tunnel, at an elevation of 980.0 feet, is located on the south side of Porter Mountain just below State Route 209. Porter Tunnel flows into a passive treatment plant that includes the construction of two limestone wells and a man-made wetland, before entering Wiconisco Creek.

The TMDL for this section of Wiconisco Creek consists of a load allocation to the watershed area above WICO 7.0. Addressing the mining impacts above this point addresses the impairment for the stream segment. An average instream flow measurement was available for point WICO 7.0 (5.46 MGD). The load allocations made at point WICO 7.0 for this stream segment are presented in Table E1.

Table E1. TMDL Calculations at Point WICO 7.0

Flow = 5.18 MGD	***Measured Sample Data***		***Allowable***	
Parameter	***Conc. (mg/l)***	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
Fe	1.53	66.22	0.64	27.78
Mn	0.94	40.46	0.52	22.35
Al	1.02	44.09	0.22	9.70
Acidity	42.85	1,852.28	2.14	92.51
Alkalinity	3.20	138.33		

The TMDL for point WICO 7.0 does require a load allocation for total iron, total manganese, total aluminum, and acidity (Table E2).

Table E2. Calculation of Load Reduction Necessary at Point WICO 7.0

	Fe (lbs/day)	***Mn (lbs/day)***	***Al (lbs/day)***	***Acidity (lbs/day)***
Existing load	66.2	40.5	44.1	1,852.3
Existing load from upstream points (none)	*	*	*	*
Difference of existing load and upstream existing load	66.2	40.5	44.1	1,852.3
Allowable loads from upstream points	*	*	*	*
Total load at WICO 7.0	66.2	40.5	44.1	1,852.3
Allowable load at WICO 7.0	27.8	22.4	9.7	92.5
Load Reduction at WICO 7.0 (Total load at WICO 7.0 - Allowable load at WICO 7.0)	38.4	18.1	34.4	1,759.8
Percent reduction required at WICO 7.0	58	45	78	95

WICO 6.0: Wiconisco Creek at Tower City, Pa.

WICO 6.0 is located at the 4th Street Bridge in the town of Tower City, Pa.. This monitoring point is located within a portion of Wiconisco Creek that is surrounded on both sides of the banks by wetlands and open areas. All measurements were recorded on the upstream side of the bridge at this monitoring point. Two larger UNTs join Wiconisco Creek just above this monitoring point.

The TMDL for this section of Wiconisco Creek consists of a load allocation to the watershed area between WICO 6.0 and WICO 7.0. Addressing the mining impacts above this point addresses the impairment for the stream segment. An average instream flow measurement was available for point WICO 6.0 (19.90 MGD). The load allocations made at point WICO 6.0 for this stream segment are presented in Table E3.

Table E3. TMDL Calculations at Point WICO 6.0

Flow 17.22 MGD	***Measured Sample Data***		***Allowable***	
Parameter	***Conc. (mg/l)***	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
Fe	0.41	58.92	0.41	58.92
Mn	0.35	50.29	0.35	50.29
Al	0.24	24.57	0.12	16.55
Acidity	48.30	6,940.75	3.38	485.71
Alkalinity	9.80	1,408.27		

The TMDL for point WICO 6.0 requires a load allocation for acidity (Table E4).

Table E4. Calculation of Load Reduction Necessary at Point WICO 6.0

	Fe (lbs/day)	***Mn (lbs/day)***	***Al (lbs/day)***	***Acidity (lbs/day)***
Existing load	58.9	50.3	24.6	6,940.8
Existing load from upstream points (WICO 7.0)	66.2	40.5	44.1	1,852.3
Difference of existing load and upstream existing load	-7.3	9.8	-19.5	5,088.5
Allowable loads from upstream points	27.8	22.4	9.7	92.5
Percent load loss due to instream process	11	0	44	0
Percent load remaining at WICO 6.0	89	100	56	100
Total load at WICO 6.0	24.7	32.2	5.4	5,181.0
Allowable load at WICO 6.0	58.9	50.3	16.6	485.7
Load Reduction at WICO 6.0 (Total load at WICO 6.0 - Allowable load at WICO 6.0)	0.0	0.0	0.0	4,695.3
Percent reduction required at WICO 6.0	0	0	0	91

WICO 5.0: Wiconisco Creek at Williamstown, Pa.

WICO 5.0 is located at the Water Street Bridge in the town of Williamstown, Pa. All measurements were recorded on the upstream side of the bridge. This monitoring point accounts for the erosion and sedimentation accumulated from Sheridan Banks. Sheridan Banks, located north of Sheridan, is a large coal refuse pile that regularly contributes coal fines to Wiconisco Creek.

The TMDL for this section of Wiconisco Creek consists of a load allocation to the watershed area between WICO 5.0 and WICO 6.0. Addressing the mining impacts above this point addresses the impairment for the stream segment. An average instream flow measurement was available for point WICO 5.0 (28.92 MGD). The load allocations made at point WICO 5.0 for this stream segment are presented in Table E5.

Table E5. TMDL Calculations at Point WICO 5.0				
Flow = 23.86 MGD	***Measured Sample Data***		***Allowable***	
Parameter	***Conc. (mg/l)***	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
Fe	0.00	0.00	0.00	0.00
Mn	0.30	59.73	0.30	59.73
Al	0.00	0.00	0.00	0.00
Acidity	30.80	6,132.64	7.08	1,409.71
Alkalinity	10.60	2,110.58		

The TMDL for point WICO 5.0 does not require a load allocation (Table E6).

Table E6. Calculation of Load Reduction Necessary at Point WICO 5.0				
	Fe (lbs/day)	***Mn (lbs/day)***	***Al (lbs/day)***	***Acidity (lbs/day)***
Existing load	0.0	59.7	0.0	6,132.6
Existing load from upstream points (WICO 6.0)	58.9	50.3	24.6	6,940.8
Difference of existing load and upstream existing load	-58.9	9.4	-24.6	-808.2
Allowable loads from upstream points	58.9	50.3	16.6	485.7
Percent load loss due to instream process	100	0	100	12
Percent load remaining at WICO 5.0	0	100	0	88
Total load at WICO 5.0	0.0	59.7	0.0	711.2
Allowable load at WICO 5.0	0.0	59.7	0.0	1,409.71
Load Reduction at WICO 5.0 (Total load at WICO 5.0 - Allowable load at WICO 5.0)	0.0	0.0	0.0	0.0
Percent reduction required at WICO 5.0	0	0	0	0

WICO 4.0: Wiconisco Creek at Wiconisco, Pa.

WICO 4.0 is located at the Center Street Bridge in the town of Wiconisco, Pa. All measurements were recorded on the upstream side of the bridge. This monitoring point accounts for Big Lick Tunnel entering Wiconisco Creek.

One major contributing factor to decreased water is the presence of Big Lick Tunnel. Big Lick Tunnel is an AMD discharge that severely impacts the watershed downstream of its confluence. Big Lick Tunnel, at an elevation of 940.0 feet, is located just a couple miles southwest of Williamstown. The tunnel flows off the south side of Big Lick Mountain just above State Route 209. Big Lick Tunnel was constructed in the early 1900s to drain portions of the Williamstown Mine Pool, which extends into the Rausch Creek Watershed.

The TMDL for this section of Wiconisco Creek consists of a load allocation to the watershed area between WICO 4.0 and WICO 5.0. Addressing the mining impacts above this point addresses the impairment for the stream segment. An average instream flow measurement was available for point WICO 4.0 (42.57 MGD). The load allocations made at point WICO 4.0 for this stream segment are presented in Table E7.

Table E7. TMDL Calculations at Point WICO 4.0

Flow = 35.30 MGD	***Measured Sample Data***		***Allowable***	
Parameter	***Conc. (mg/l)***	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
Fe	0.81	238.61	0.28	83.51
Mn	0.32	94.27	0.32	94.27
Al	0.14	41.24	0.09	25.57
Acidity	27.47	8,092.07	19.23	5,664.74
Alkalinity	22.45	6,613.29		

The TMDL for point WICO 5.0 requires a load allocation for total iron, and total aluminum (Table E8).

Table E8. Calculation of Load Reduction Necessary at Point WICO 4.0

	Fe (lbs/day)	***Mn (lbs/day)***	***Al (lbs/day)***	***Acidity (lbs/day)***
Existing load	238.6	94.3	41.2	8,092.1
Existing load from upstream points (WICO 5.0)	0.0	59.7	0.0	6,132.6
Difference of existing load and upstream existing load	238.6	34.6	41.2	1,959.5
Allowable loads from upstream points	0.0	59.7	0.0	1,409.7
Percent load loss due to instream process	0	0	0	0
Percent load remaining at WICO 4.0	100	100	100	100
Total load at WICO 4.0	238.6	94.3	41.2	3,369.2
Allowable load at WICO 4.0	83.5	94.3	25.6	5,664.7
Load Reduction at WICO 4.0 (Total load at WICO 4.0 - Allowable load at WICO 4.0)	155.1	0.0	15.6	0.0
Percent reduction required at WICO4.0	35	0	62	0

B 3: Bear Creek at its mouth

Bear Creek enters Wiconisco Creek in the borough of Lykens, from its mouth it is highly polluted by AMD. The TMDLs assigned in Tables E9 and E10 are based on the data and calculations found in the Bear Creek Watershed TMDL completed by SRBC and approved by the USEPA in February 2001.

The TMDL for Bear Creek consists of a load allocation to the watershed area above B 3. Addressing the mining impacts above this point addresses the impairment for the stream segment. An average instream flow measurement was available for point B 3 (6.68 MGD). The load allocations made at point B 3 for this stream segment are presented in Table E9 (Orr, 2001).

Table E9. TMDL Calculations at Point B 3

Flow = 6.68 MGD	***Measured Sample Data***		***Allowable***	
Parameter	***Conc. (mg/l)***	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
Fe	2.60	144.80	0.10	5.60
Mn	1.55	86.40	0.43	24.00
Al	0.51	28.40	0.19	10.60
Acidity	6.94	386.60	0.27	15.00
Alkalinity	70.17	3,909.30		

The TMDL for point B3 requires a load allocation for, total manganese, and total aluminum (Table E10).

Table E10. Calculation of Load Reduction Necessary at Point B 3

	Fe (lbs/day)	***Mn (lbs/day)***	***Al (lbs/day)***	***Acidity (lbs/day)***
Existing load	144.8	86.4	28.4	386.6
Existing load from upstream points (B2)	505.7	72.9	7.6	1,409.9
Difference of existing load and upstream existing load	-360.9	13.5	20.8	1,023.3
Allowable loads from upstream points	5.1	29.9	7.6	12.1
Percent load loss due to instream process	71	0	0	0
Percent load remaining at B 3	29	100	100	100
Allowable load at B 3	5.6	24.0	10.6	15.0
Load Reduction at B 3 (Total load at B 3- Allowable load at B 3)	500.6	43.0	0.0	1,478.8
Percent reduction required at B 3	0	45	63	0

WICO 3.0: Wiconisco Creek at Lykens, Pa.

WICO 3.0 is located at the State Route 209 Bridge in the town of Lykens, Pa. All measurements were recorded on the upstream side of the bridge. This monitoring point accounts for Bear Creek entering Wiconisco Creek.

The Bear Creek Basin, primarily forested, accounts for most of the drainage on Short Mountain, and portions of Bear and Big Lick Mountains. The water is rust colored and heavily impacted by AMD (Stoe, 1998).

The TMDL for this section of Wiconisco Creek consists of a load allocation to the watershed area between WICO 3.0 and WICO 4.0. Addressing the mining impacts above this point addresses the impairment for the stream segment. An average instream flow measurement was available for point WICO 3.0 (62.36 MGD). The load allocations made at point WICO 3.0 for this stream segment are presented in Table E11.

Table E11. TMDL Calculations at Point WICO 3.0				
Flow = 53.13 MGD	***Measured Sample Data***		***Allowable***	
Parameter	***Conc. (mg/l)***	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
Fe	1.70	753.73	0.71	316.57
Mn	0.46	203.95	0.46	203.95
Al	0.00	0.00	0.00	0.00
Acidity	28.55	12,658.21	13.99	6,202.7
Alkalinity	24.80	10,995.57		

The TMDL for point WICO 3.0 requires a load allocation for total iron and acidity (Table E12).

Table E12. Calculation of Load Reduction Necessary at Point WICO 3.0				
	Fe (lbs/day)	***Mn (lbs/day)***	***Al (lbs/day)***	***Acidity (lbs/day)***
Existing load	753.7	204.0	0.0	12,658.2
Existing load from upstream points (B3 and WICO 4.0)	383.4	180.7	69.6	8,478.7
Difference of existing load and upstream existing load	370.3	23.3	-69.6	4,179.5
Allowable loads from upstream points (B3 and WICO 4.0)	89.1	118.3	36.2	5,679.7
Percent load loss due to instream process	0	0	100	0
Percent load remaining at WICO 3.0	100	100	0	100
Total load at WICO 3.0	459.4	141.6	0.0	9,859.2
Allowable load at WICO 3.0	316.6	204.0	0.0	6,202.7
Load Reduction at WICO 3.0 (Total load at WICO 3.0 - Allowable load at WICO 3.0)	142.8	0.0	0.0	3,656.5
Percent reduction required at WICO 3.0	31	0	0	37

WICO 2.0: Wiconisco Creek at Lykens, Pa.

WICO 2.0 is located approximately 200 meters downstream of Rattling Creek. All measurements were recorded on the upstream of a small riffle in this portion of the stream. This monitoring point accounts for Rattling Creek entering Wiconisco Creek.

Rattling Creek is an HQCWF (high quality, cold water fishery) tributary to Wiconisco Creek. Rattling Creek has a large basin within Wiconisco Creek Watershed. Rattling Creek's basin accounts for most of Broad Mountain and portions of Peters Mountain. This basin is primarily forested and has been recorded to have low pH measurements due to low buffering capacity (Stoe, 1998).

The TMDL for this section of Wiconisco Creek consists of a load allocation to the watershed area between WICO 2.0 and WICO 3.0. Addressing the mining impacts above this point addresses the impairment for the stream segment. An average instream flow measurement was available for point WICO 2.0 (66.08 MGD). The load allocations made at point WICO 2.0 for this stream segment are presented in Table E13.

Table E13. TMDL Calculations at Point WICO 2.0

Flow = 54.73 MGD	***Measured Sample Data***		***Allowable***	
Parameter	***Conc. (mg/l)***	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
Fe	1.26	575.47	0.53	242.06
Mn	0.31	141.58	0.31	141.58
Al	0.00	0.00	0.00	0.00
Acidity	35.33	16,135.98	13.43	6,133.70
Alkalinity	23.15	10,573.11		

The TMDL for point WICO 2.0 require a load allocation for acidity (Table E14).

Table E14. Calculation of Load Reduction Necessary at Point WICO 2.0

	Fe (lbs/day)	***Mn (lbs/day)***	***Al (lbs/day)***	***Acidity (lbs/day)***
Existing load	575.5	141.6	0.0	16,135.9
Existing load from upstream points (WICO 3.0)	753.7	204.0	0.0	12,658.2
Difference of existing load and upstream existing load	-178.2	-62.4	0.0	3,477.7
Allowable loads from upstream points	316.6	204.0	0.0	6,202.7
Percent load loss due to instream process	24	31	100	0
Percent load remaining at WICO 2.0	76	69	0	100
Total load at WICO 2.0	240.6	140.8	0.0	9,680.4
Allowable load at WICO 2.0	242.1	141.6	0.0	6,133.7
Load Reduction at WICO 2.0 (Total load at WICO 2.0 - Allowable load at WICO 2.0)	0.0	0.0	0.0	3,546.7
Percent reduction required at WICO 2.0	0	0	0	37

WICO 1.0: Wiconisco Creek at Loyalton, Pa.

WICO 1.0 is located at the State Route 209 Bridge in the town of Loyalton, Pa. All measurements were recorded on the upstream side of the bridge. This monitoring point accounts for the furthermost downstream section 303 (d) listing for AMD impairment.

The TMDL for this section of Wiconisco Creek consists of a load allocation to the watershed area between WICO 1.0 and WICO 2.0. Addressing the mining impacts above this point addresses the impairment for the stream segment. An average instream flow measurement was available for point WICO 1.0 (59.40 MGD). The load allocations made at point WICO 1.0 for this stream segment are presented in Table E15.

Table E15. TMDL Calculations at Point WICO 1.0

Flow = 76.68 MGD	***Measured Sample Data***		***Allowable***	
Parameter	***Conc. (mg/l)***	***Load (lbs/day)***	***LTA Conc. (mg/l)***	***Load (lbs/day)***
Fe	0.43	275.15	0.35	223.96
Mn	0.16	102.38	0.16	102.38
Al	0.00	0.00	0.00	0.00
Acidity	22.05	14,109.68	15.89	10,167.93
Alkalinity	13.57	8,683.37		

The TMDL for point WICO 1.0 does not require a load allocation (Table E16).

Table E16. Calculation of Load Reduction Necessary at Point WICO 1.0

	Fe (lbs/day)	***Mn (lbs/day)***	***Al (lbs/day)***	***Acidity (lbs/day)***
Existing load	275.2	102.4	0.0	14,109.7
Existing load from upstream points (WICO 2.0)	575.5	141.6	0.0	16,135.9
Difference of existing load and upstream existing load	-300.3	-39.2	0.0	-2,026.2
Allowable loads from upstream points	242.1	141.6	0.0	6,202.7
Percent load loss due to instream process	52	28	100	13
Percent load remaining at WICO 1.0	48	72	0	87
Total load at WICO 1.0	116.2	102.0	0.0	2,105.9
Allowable load at WICO 1.0	224.0	102.4	0.0	10,167.93
Load Reduction at WICO 1.0 (Total load at WICO 1.0 - Allowable load at WICO 1.0)	0.0	0.0	0.0	0.0
Percent reduction required at WICO 1.0	0	0	0	0

Margin of Safety (MOS)

An implicit MOS was used in these TMDLs derived from the Monte Carlo statistical analysis employing the @Risk software. Pa. Title 25 Chapter 96.3(c) states that water quality criteria must be met at least 99 percent of the time. All of the @Risk analyses results surpass the minimum 99 percent level of protection. Other MOS used for this TMDL analyses are:

- 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 MOS.

- An additional MOS is that the calculations were performed using a daily iron 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 of an active mine is conservative and an implicit MOS.

Seasonal Variation

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

Critical Conditions

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

Attachment E

Water Quality Data Used in TMDL Calculations

TMDL Point	Company	Date	Flow (cfs)	pH (f)	pH (l)	Aluminum (mg/L)	Iron (mg/L)	Manganese (mg/L)	Acidity (mg/L)	Alkalinity (mg/L)	Sulfate (mg/L)
WICO 1.0	SRBC	10-27-2005	181.239	6.9	6.05	PBQ	.737	.171	31.2	16.0	31.6
WICO1.0	SRBC	10-27-2005	181.239	6.9	6.05	PBQ	.723	.165	31.0	15.6	22.9
WICO 3.0	SRBC	10-27-2005	116.832	6.9	6.55	PBQ	2.420	.555	37.4	18.6	29.3
WICO 7.0	SRBC	10-27-2005	45.677	4.9	6.1	PBQ	.740	.577	52.2	8.0	46.9
WICO 6.0	SRBC	10-27-2005	9.458	6.3	4.6	PBQ	.310	.138	28	12.2	21.6
WICO 1.0	SRBC	11-01-2005	85.959	7.0	5.9	PBQ	.363	.154	33	17.4	32.5
WICO 1.0	SRBC	11-01-2005	85.959	7.0	5.9	PBQ	.352	.150	29.4	17.4	31.6
WICO 2.0	SRBC	11-01-2005	71.072	6.9	6.7	PBQ	.606	.195	42.8	17.2	31.0
WICO 3.0	SRBC	11-01-2005	41.764	7.0	6.9	PBQ	.960	.301	27.8	22.6	41.7
WICO 7.0	SRBC	11-01-2005	4.234	4.3	4.05	.784	1.380	.875	40.2	4.8	84.7
WICO 6.0	SRBC	11-01-2005	18.336	6.2	5.95	PBQ	.5	.302	36.0	11.2	40.2
WICO 5.0	SRBC	11-01-2005	29.386	6.6	6.9	PBQ	PBQ	.195	26.6	14	40.9
WICO 6.0	SRBC	11-01-2005	35.650	6.7	6.5	PBQ	PBQ	.167	27.4	16.2	38.1
WICO 1.0	SRBC	01-30-2006	216.02	6.8	6.9	PBQ	.701	.244	39.4	18.2	38.0
WICO 1.0	SRBC	01-30-2006	216.02	6.8	6.9	PBQ	.601	.235	39.6	18.0	34.6
WICO 2.0	SRBC	01-30-2006	172.04	6.9	7.2	PBQ	.901	.283	37.2	19.0	34.6
WICO 3.0	SRBC	01-30-2006	177.47	7.0	7.2	PBQ	1.224	.402	29.8	24.4	44.6
WICO 5.0	SRBC	01-30-2006	77.89	6.2	6.25	PBQ	PBQ	.286	37.6	9.2	44.0
WICO 4.0	SRBC	01-30-2006	120.26	6.9	7.3	PBQ	.589	.338	29.2	20.8	41.5
WICO 6.0	SRBC	01-30-2006	43.97	5.1	5.0	.598	.409	.380	48.0	7.4	45.9
WICO 7.0	SRBC	01-30-2006	14.4	3.9	3.7	1.699	2.065	1.028	40.2	0.0	105.8
WICO 1.0	SRBC	03-07-2006	68.259	7.0	6.4	PBQ	.870	.375	35.0	27.0	33.8
WICO 1.0	SRBC	03-07-2006	68.259	7.0	6.4	PBQ	.819	.372	26.0	33.2	59.0
WICO 2.0	SRBC	03-07-2006	63.603	7.1	6.4	PBQ	1.439	.444	26.0	28.2	56.7
WICO 3.0	SRBC	03-07-2006	49.854	7.1	5.1	PBQ	1.828	.578	19.2	33.4	64.5
WICO 4.0	SRBC	03-07-2006	41.689	6.9	6.7	.558	2.073	.456	25.8	27.6	58.1
WICO 5.0	SRBC	03-07-2006	26.962	6.4	6.1	PBQ	PBQ	.408	36.6	12.0	61.2
WICO 6.0	SRBC	03-07-2006	15.345	5.6	5.0	.605	.454	.561	81.2	8.4	66.7
WICO 7.0	SRBC	03-07-2006	5.680	4.1	3.3	1.406	2.242	1.264	38.8	3.2	129.3
WICO 1.0	SRBC	08-08-2006	41.691	7.6	7.4	PBQ	.635	-	-	26.4	-

WICO 1.0	SRBC	08-08-2006	41.691	7.6	7.4	PBQ	.659	-	-	26.4	-
WICO 2.0	SRBC	08-08-2006	31.988	7.7	7.3	PBQ	2.111	-	-	28.2	-
WICO 3.0	SRBC	08-08-2006	25.069	-	7.45	PBQ	2.072	-	-	30.8	-
WICO 4.0	SRBC	08-08-2006	20.898	7.4	7	PBQ	.588	-	-	25.2	-
WICO 5.0	SRBC	08-08-2006	13.415	7.0	6.55	PBQ	.382	-	-	7.2	-
WICO 6.0	SRBC	08-08-2006	9.891	6.8	6.35	PBQ	.37	-	-		-
WICO 7.0	SRBC	08-08-2006	6.322	4.4	4.35	1.217	1.233	-	-	0.0	-

Attachment F

Information Sheet for the Little Wiconisco Creek TMDL

What is being proposed?

Total Maximum Daily Load (TMDL) plans have been developed to improve water quality in Little Wiconisco Creek.

Who is proposing the plans? Why?

The Pennsylvania Department of Environmental Protection (PADEP) is proposing to submit the plans to the U.S. Environmental Protection Agency (USEPA) for review and approval as required by federal regulation. In 1995, USEPA was sued for not developing TMDLs when Pennsylvania failed to do so. PADEP has entered into an agreement with USEPA to develop TMDLs for certain specified waters over the next several years. This TMDL has been developed in compliance with the state/USEPA agreement.

What is a TMDL?

A TMDL sets a ceiling on the pollutant loads that can enter a waterbody so that it will meet water quality standards. The Clean Water Act requires states to list all waters that do not meet their water quality standards even after pollution controls required by law are in place. For these waters, the state must calculate how much of a substance can be put in the water without violating the standard, and then distribute that quantity to all the sources of the pollutant on that waterbody. A TMDL plan includes waste load allocations for point sources, load allocations for nonpoint sources, and a margin of safety. The Clean Water Act requires states to submit their TMDLs to USEPA for approval. Also, if a state does not develop the TMDL, the Clean Water Act states that USEPA must do so.

What is a water quality standard?

The Clean Water Act sets a national minimum goal that all waters be “fishable” and “swimmable.” To support this goal, states must adopt water quality standards. Water quality standards are state regulations that have two components. The first component is a designated use, such as “warm water fishes” or “recreation.” States must assign a use or several uses to each of their waters. The second component relates to the instream conditions necessary to protect the designated use(s). These conditions or “criteria” are physical, chemical, or biological characteristics such as temperature and minimum levels of dissolved oxygen, and maximum concentrations of toxic pollutants. It is the combination of the “designated use” and the “criteria” to support that use that make up a water quality standard. If any criteria are being exceeded, then the use is not being met and the water is said to be in violation of water quality standards.

What is the purpose of the plans?

The Little Wiconisco Creek is impaired due to nutrients and sediment emanating from agricultural runoff. The plans include a calculation of the loading for phosphorus, the limiting nutrient, and sediment that will correct the problem and meet water quality objectives.

Why was the Little Wiconisco Creek selected for TMDL development?

In 1996, PADEP listed the Little Wiconisco Creek under Section 303(d) of the federal Clean Water Act as impaired due to causes linked to nutrients and sediment.

What pollutants do these TMDLs address?

The proposed plans provide calculations of the stream's total capacity to accept phosphorus and sediment.

Where do the pollutants come from?

The nutrient and sediment related impairments in the Little Wiconisco Creek come from nonpoint sources of pollution, primarily overland runoff from agricultural and developed areas, as well as from streambank erosion.

How was the TMDL developed?

PADEP used a reference watershed approach to estimate the necessary loading reduction of phosphorus and sediment that would be needed to restore a healthy aquatic community. The reference watershed approach is based on selecting a nonimpaired watershed that has similar land use characteristics and determining the current loading rates for the pollutants of interest. This is done by modeling the loads that enter the stream, using precipitation and land use characteristic data. For this analysis, PADEP used the AVGWLF model (the Environmental Resources Research Institute of the Pennsylvania State University's Arcview based version of the Generalized Watershed Loading Function model developed by Cornell University). This modeling process uses loading rates in the nonimpaired watershed as a target for load reductions in the impaired watershed. The impaired watershed is modeled to determine the current loading rates and determine what reductions are necessary to meet the loading rates of the nonimpaired watershed. The reference stream approach was used to set allowable loading rates in the affected watershed because neither Pennsylvania nor USEPA has instream numerical water quality criteria for nutrients or sediment.

How much pollution is too much?

The allowable amount of pollution in a waterbody varies depending on several conditions. TMDLs are set to meet water quality standards at the critical flow condition. For a free flowing stream impacted by nonpoint source pollution loading of nutrients or sediment, the TMDL is expressed as an annual loading. This accounts for pollution contributions over all stream flow conditions. PADEP established the water quality objectives for nutrients and sediment by using the reference watershed approach. This approach assumes that the impairment is eliminated when the impaired watershed achieves loadings similar to the reference watershed. Reducing the current loading rates for nutrients and sediment in the impaired watershed to the current loading rates in the reference watershed will result in meeting the water quality objectives.

How will the loading limits be met?

Best Management Practices (BMPs) will be encouraged throughout the watershed to achieve the necessary load reductions.

How can I get more information on the TMDL?

To request a copy of any of the TMDLs contact: Bill Brown, PADEP, Water Quality Assessment and Standards, 400 Market Street, P.O. Box 8467, Harrisburg, PA 17105, 717-783-2951.

How can I comment on the proposal?

You may provide e-mail or written comments postmarked no later than February 27, 2007 to the above address.

ATTACHMENT G

AVGWLF MODEL OVERVIEW & GIS-BASED DERIVATION OF INPUT DATA

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

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

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

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

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

In using this interface, the user is prompted to identify required GIS files and to provide other information related to "non-spatial" model parameters (e.g., beginning and end of the growing season, the months during which manure is spread on agricultural land, and the names of nearby weather stations). This information is subsequently used to automatically derive values for required model input parameters, which are then written to the TRANSPRT.DAT, NUTRIENT.DAT and WEATHER.DAT input files needed to execute the GWLF model. For use in Pennsylvania, AVGWLF has been linked with statewide GIS data layers such as land use/cover, soils, topography, and physiography; and includes location-specific default information such as background nitrogen and phosphorus concentrations and cropping practices. Complete GWLF-formatted weather files also are included for 80 weather stations around the state.

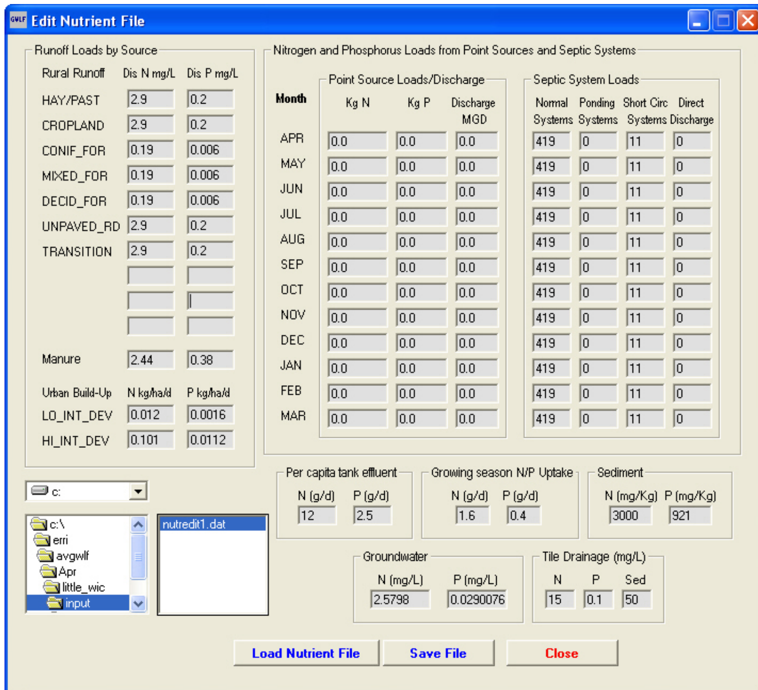
The following table lists the statewide GIS data sets and provides an explanation of how they were used for development of the input files for the GWLF model.

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

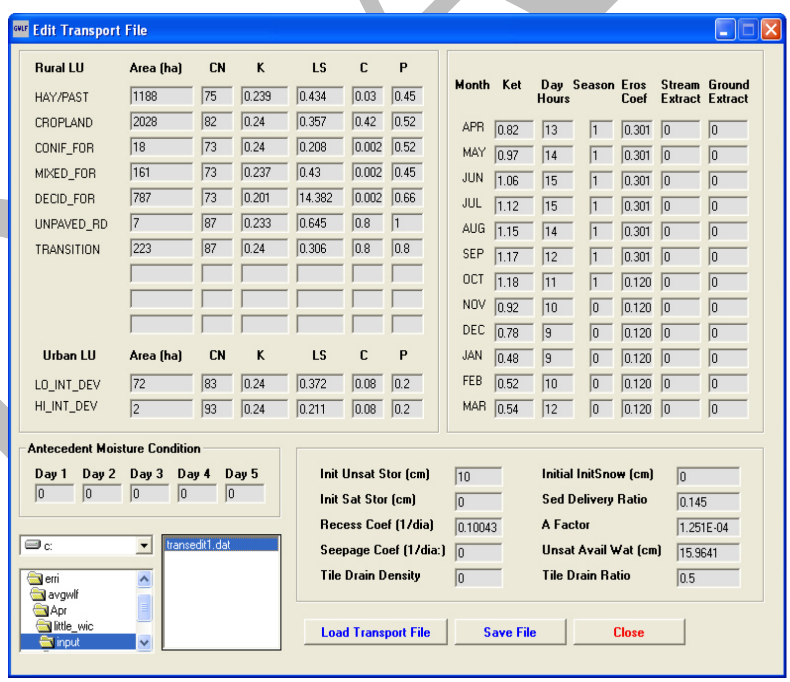
ATTACHMENT H

AVGWLF MODEL INPUTS FOR THE LITTLE WICONISCO CREEK

Little Wiconisco Creek Nutrient



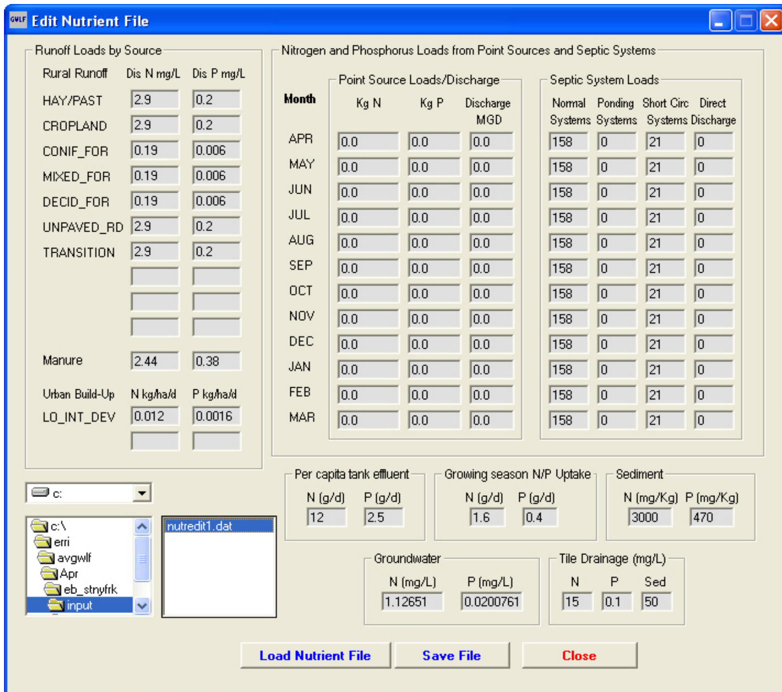
Little Wiconisco Creek Transport



ATTACHMENT I

AVGWLF MODEL INPUTS FOR THE EAST BRANCH STONY FORK REFERENCE WATERSHED

East Branch Stony Fork Ref Nutrient



Edit Nutrient File

Runoff Loads by Source

Rural Runoff	Dis N mg/L	Dis P mg/L
HAY/PAST	2.9	0.2
CROPLAND	2.9	0.2
CONIF_FOR	0.19	0.006
MIXED_FOR	0.19	0.006
DECID_FOR	0.19	0.006
UNPAVED_RD	2.9	0.2
TRANSITION	2.9	0.2
Manure	2.44	0.38
Urban Build-Up	N kg/ha/d	P kg/ha/d
LO_INT_DEV	0.012	0.0016

Nitrogen and Phosphorus Loads from Point Sources and Septic Systems

	Point Source Loads/Discharge			Septic System Loads			
Month	Kg N	Kg P	Discharge MGD	Normal Systems	Ponding Systems	Short Circ Systems	Direct Discharge
APR	0.0	0.0	0.0	158	0	21	0
MAY	0.0	0.0	0.0	158	0	21	0
JUN	0.0	0.0	0.0	158	0	21	0
JUL	0.0	0.0	0.0	158	0	21	0
AUG	0.0	0.0	0.0	158	0	21	0
SEP	0.0	0.0	0.0	158	0	21	0
OCT	0.0	0.0	0.0	158	0	21	0
NOV	0.0	0.0	0.0	158	0	21	0
DEC	0.0	0.0	0.0	158	0	21	0
JAN	0.0	0.0	0.0	158	0	21	0
FEB	0.0	0.0	0.0	158	0	21	0
MAR	0.0	0.0	0.0	158	0	21	0

Per capita tank effluent N (g/d)	P (g/d)	Growing season N/P Uptake N (g/d)	P (g/d)	Sediment N (mg/Kg)	P (mg/Kg)
12	2.5	1.6	0.4	3000	470

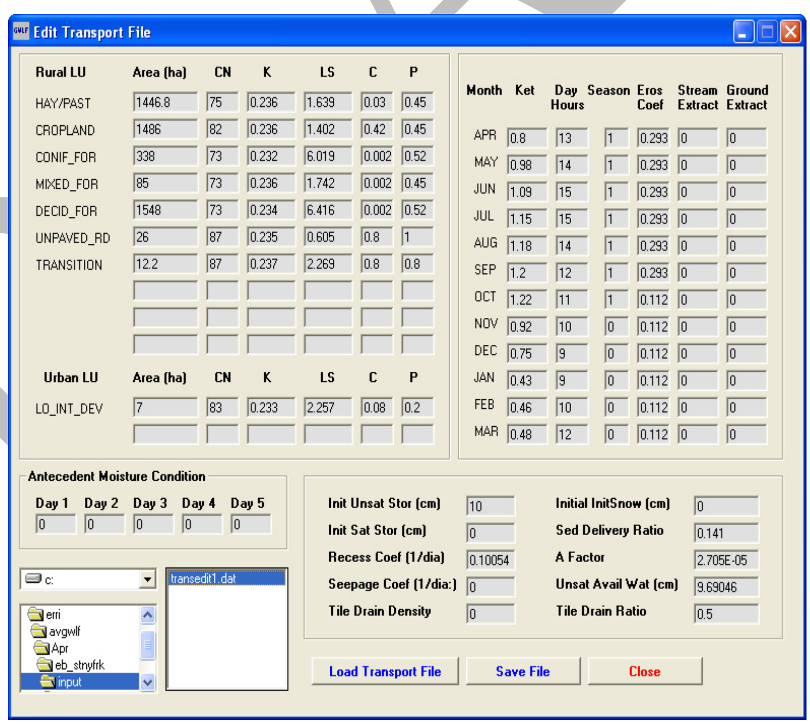
Groundwater N (mg/L)	P (mg/L)	Tile Drainage (mg/L) N	P	Sed
1.12651	0.0200761	15	0.1	50

c:
c:\
erri
avgwlf
Apr
eb_strnyfrk
input

nutredit1.dat

Load Nutrient File | Save File | Close

East Branch Stony Fork Ref Transport Final



Edit Transport File

Rural LU	Area (ha)	CN	K	LS	C	P
HAY/PAST	1446.8	75	0.236	1.639	0.03	0.45
CROPLAND	1486	82	0.236	1.402	0.42	0.45
CONIF_FOR	338	73	0.232	6.019	0.002	0.52
MIXED_FOR	85	73	0.236	1.742	0.002	0.45
DECID_FOR	1548	73	0.234	6.416	0.002	0.52
UNPAVED_RD	26	87	0.235	0.605	0.8	1
TRANSITION	12.2	87	0.237	2.269	0.8	0.8
Urban LU	**Area (ha)**	**CN**	**K**	**LS**	**C**	**P**
LO_INT_DEV	7	83	0.233	2.257	0.08	0.2

Month	Ket	Day Hours	Season	Eros Coef	Stream Extract	Ground Extract
APR	0.8	13	1	0.293	0	0
MAY	0.98	14	1	0.293	0	0
JUN	1.09	15	1	0.293	0	0
JUL	1.15	15	1	0.293	0	0
AUG	1.18	14	1	0.293	0	0
SEP	1.2	12	1	0.293	0	0
OCT	1.22	11	1	0.112	0	0
NOV	0.92	10	0	0.112	0	0
DEC	0.75	9	0	0.112	0	0
JAN	0.43	9	0	0.112	0	0
FEB	0.46	10	0	0.112	0	0
MAR	0.48	12	0	0.112	0	0

Antecedent Moisture Condition

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

Init Unsat Stor (cm)	10	Initial InitSnow (cm)	0
Init Sat Stor (cm)	0	Sed Delivery Ratio	0.141
Recess Coef (1/dia)	0.10054	A Factor	2.705E-05
Seepage Coef (1/dia:)	0	Unsat Avail Wat (cm)	9.69046
Tile Drain Density	0	Tile Drain Ratio	0.5

c:
erri
avgwlf
Apr
eb_strnyfrk
input

transedit1.dat

Load Transport File | Save File | Close

ATTACHMENT J

EQUAL MARGINAL PERCENT REDUCTION METHOD

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

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

2. Calculation of ALA based on TMDL, Margin of Safety, and existing loads not reduced.

3. Actual EMPR Process.

    a. Each land use/source load is compared with the total ALA to determine if any contributor would exceed the ALA by itself. The evaluation is carried out as if each source is the only contributor to the pollutant load of the receiving waterbody. If the contributor exceeds the ALA, that contributor would be reduced to the ALA. If a contributor is less than the ALA, it is set at the existing load. This is the baseline portion of the EMPR.
    b. After any necessary reductions have been made in the baseline, the multiple analyses are run. The multiple analyses will sum all of the baseline loads and compare them to the ALA. If the ALA is exceeded, an equal percent reduction will be made to all contributors' baseline values. After any necessary reductions in the multiple analyses, the final reduction percentage for each contributor can be computed.

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

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

ATTACHMENT K

EQUAL MARGINAL PERCENT REDUCTION CALCULATIONS FOR THE LITTLE WICONISCO CREEK TMDL

Step 1:	TMDL Total Load				Step 2:	Adjusted LA = (TMDL total load - MOS) - uncontrollable						
	Load = loading rate in ref. * Acres in Impaired					2927.26	2927					
	4434											
	PHOSPHORUS LOADING											
Step 3:		Non-MS4 Annual Average Load	Load Sum	Check	Initial Adjust	Recheck	% reduction allocation	Load Reduction	Initial LA	Acres	Allowable Loading Rate	% Reduction
	Hay/Past.	566.27	6122.74	good	566	ADJUST	0.12	209.53	356.74	2935.60	0.12	37%
	Cropland	4403.42		bad	2927	1719	0.63	1083.14	1844.12	5011.30	0.37	58%
	Developed	1110.50		good	1111		0.24	410.91	699.59	182.80	3.83	37%
	Streambank	42.55		good	43		0.01	15.74	26.81	568.30		37%
	Total	6122.74			4646.58		1.00		2927.26			
Step 4:	All Ag. Loading Rate	0.28										
Step 5:		Acres	Allowable (Target) Loading Rate	Final LA	Current Loading Rates	Current Load	% Red.					
	Final Hay/Past. LA	2935.60	0.12	356.74	0.19	566.27	37%					
	Final Cropland LA	5011.30	0.37	1844.12	0.88	4403.42	58%					
	Developed	751.10	3.83	2874.54	6.07	4562.89	37%					
	Streambank	0.00		26.81		42.55	37%					
				5102.20		9575.13	47%					
	Little Viconisco											

Step 1:	TMDL Total Load				Step 2:	Adjusted LA = (TMDL total load - MOS) - uncontrollable						
	Load = loading rate in ref. * Acres in Impaired					5862001.90	5862002					
	6846429											
	SEDIMENT LOADING											
Step 3:		Non-MS4 Annual Average Load	Load Sum	Check	Initial Adjust	Recheck	% reduction allocation	Load Reduction	Initial LA	Acres	Allowable Loading Rate	% Reduction
	Hay/Past.	165227.40	6990666.79	good	165227	ADJUST	0.02	26676.48	138550.92	2935.60	47.20	16%
	Cropland	3758885.20		good	3758885	1128665	0.54	606883.70	3152001.50	5011.30	628.98	16%
	Developed	1132622.00		good	1132622		0.16	182865.34	949756.66	182.80	5195.61	16%
	Streambank	1933932.19		good	1933932		0.28	312239.37	1621692.82	568.30		16%
	Total	6990666.79			6990666.79		1.00		5862001.90			
Step 4:	All Ag. Loading Rate	414.07										
Step 5:		Acres	Allowable (Target) Loading Rate	Final LA	Current Loading Rates	Current Load	% Red.					
	Final Hay/Past. LA	2935.60	47.20	138550.92	56.28	165227.40	16%					
	Final Cropland LA	5011.30	628.98	3152001.50	750.08	3758885.20	16%					
	Developed	751.10	5195.61	3902419.17	6195.96	4653787.66	16%					
	Streambank	0.00		1621692.82		1933932.19	16%					
				8814664.42		10511832.45	16%					
	Little Viconisco											

ATTACHMENT L

COMMENT & RESPONSE DOCUMENT FOR THE WICONISCO CREEK TMDL

No comments received.