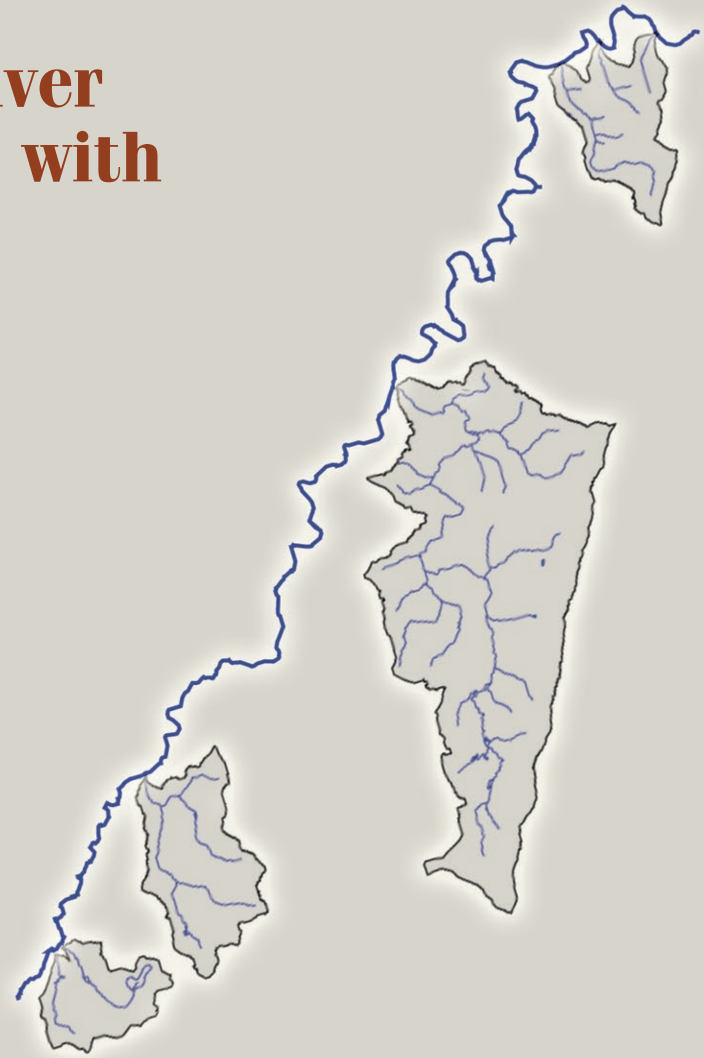
North Branch Potomac River Watershed—FINAL APPROVED REPORT

Total Maximum Daily Loads for Selected Streams in the North Branch/Potomac River Watershed, West Virginia, with Dissolved Aluminum Addendum



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FINAL APPROVED

REPORT

September 2006

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6. **Slaughterhouse Run**

APPENDIX CONTENTS

ACRONYMS AND ABBREVIATIONS

7Q10	7-day, 10-year low flow
AMD	acid mine drainage
AML	abandoned mine land
AML&R	Abandoned Mine Lands & Reclamation
AnnAGNPS	Annualized Agricultural Nonpoint Source
BMP	best management practice
BOD	biochemical oxygen demand
CD	compact disk
CFR	Code of Federal Regulations
CSR	Code of State Regulations
DEM	Digital Elevation Model
DESC-R	Dynamic Equilibrium In-stream Chemical Reactions model
DMR	[WVDEP] Division of Mining and Reclamation
DNR	Department of Natural Resources
DO	dissolved oxygen
DWWM	[WVDEP] Division of Water and Waste Management
ERIS	Environmental Resources Information System
FS	Forest Service
GAP	Gap Analysis Land Cover Project
GIS	geographic information system
GPS	global positioning system
GWLF	Generalized Watershed Loading Functions
LA	load allocation
MDAS	Mining Data Analysis System
MOS	margin of safety
MRLC	Multi-Resolution Landuse Characteristic
NED	National Elevation Dataset
NOAA-NCDC	National Oceanic and Atmospheric Administration, National Climatic Data Center
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OOG	Office of Oil and Gas
ORSANCO	Ohio River Valley Water Sanitation Commission
SMCRA	Surface Mining Control and Reclamation Act
STATSGO	State Soil Geographic database
TMDL	Total Maximum Daily Load
TSS	total suspended solids
UNT	unnamed tributary
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USLE	Universal Soil Loss Equation
WLA	wasteload allocation
WVDEP	West Virginia Department of Environmental Protection

WVSCI	West Virginia Stream Condition Index
WVU	West Virginia University

EXECUTIVE SUMMARY

The North Branch/Potomac River watershed is in the eastern panhandle of West Virginia and extends northward into western Maryland and a small portion of southern Pennsylvania. The watershed encompasses nearly 583 square miles in West Virginia. The area of study covered in this report is a portion of the watershed along the Allegheny Front in the eastern panhandle of West Virginia. The area of study includes approximately 67 square miles in Mineral and Grant counties. Major tributaries in the area of study include Piney Swamp Run, Abram Creek, Buffalo Creek, and Elk Run/Deakin Run.

This report includes Total Maximum Daily Loads (TMDLs) for various impaired streams in the North Branch/Potomac River watershed. A TMDL establishes the maximum allowable pollutant loading for a waterbody to comply with water quality standards, distributes the load among pollutant sources, and provides a basis for taking the actions needed to restore water quality.

In West Virginia, water quality standards are codified at Title 46 of the *Code of State Rules* (CSR), Series 1, under the heading *Legislative Rules of the Environmental Quality Board: Requirements Governing Water Quality Standards*. The standards include designated uses of West Virginia waters and numeric and narrative criteria to protect those uses. The West Virginia Department of Environmental Protection routinely assesses use support by comparing observed water quality data to criteria and reports impaired waters every 2 years as required by section 303(d) of the Clean Water Act ("303(d) list"). The act requires that TMDLs be developed for listed impaired waters.

West Virginia's final 2004 section 303(d) list includes 24 impaired streams in the North Branch/Potomac River watershed. TMDLs for 19 of the streams are presented in this report; the remaining 5 impaired streams are to be addressed in the future. The impairments are related to numeric water quality criteria for dissolved aluminum, total iron and pH. Some of the listed waters are also biologically impaired based on the narrative water quality criterion of 46 CSR 1–3.2.i, which prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems.

A recently approved revision to the applicability of the manganese water quality criterion altered the manganese impairment decisions for fifteen waters previously identified as impaired. No portions of the subject waters are within the five-mile zone of any existing water supply intakes used for human consumption. As such, the manganese criterion is not applicable and TMDLs are not presented. Please reference Section 2.2 of the report for a detailed discussion of the criterion revision.

Since 1997, the U.S. Environmental Protection Agency (USEPA), Region 3, has developed West Virginia TMDLs under the settlement of a 1995 lawsuit, *Ohio Valley Environmental Coalition, Inc., West Virginia Highlands et al.* v. *Browner et al*. The lawsuit resulted in a consent decree between the plaintiffs and USEPA. The consent decree established a rigorous schedule for TMDL development and required TMDLs for the impaired waters on West Virginia's 1996 section 303(d) list. The schedule included TMDL development dates that extend through March

2008. This report accommodates the timely development of the remaining North Branch/Potomac River watershed TMDLs as required by the consent decree.

The impaired waters were organized into six TMDL subwatersheds. Those subwatersheds were further divided into 45 subwatersheds for modeling purposes. The subwatershed delineation provided a basis for georeferencing pertinent source information and monitoring data, and for presenting the TMDLs.

The Mining Data Analysis System (MDAS) was used to represent the source-response linkage for total aluminum, and iron. MDAS is a comprehensive data management and modeling system that is capable of representing loads from nonpoint and point sources in the watershed and simulating in-stream processes. MDAS was linked with the Dynamic Equilibrium In-stream Chemical Reactions model (DESC-R) to appropriately address dissolved aluminum TMDLs in the watershed. TMDLs for pH impairments were developed using a surrogate approach in which it was assumed that reducing in-stream metals (iron and aluminum) concentrations to meet water quality criteria (or TMDL endpoints) would result in meeting the water quality standard for pH. This assumption was verified by applying the DESC-R. West Virginia's numeric water quality criteria and an explicit margin of safety were used to identify endpoints for TMDL development.

Sediment TMDLs were developed under a reference watershed approach. The Generalized Watershed Loading Functions (GWLF) watershed-loading model was integrated with a stream routing model (Tetra Tech Stream Module) that examined stream bank erosion and depositional processes. Load reductions for sediment-impaired waters were based on the sediment loading present in the unimpaired reference watershed.

Metals and pH impairments were present in each of the six TMDL subwatersheds. Abandoned mine lands and land disturbance activities that introduce excess sediment are problematic sources of metals in the watersheds. In addition, there are also active mining operations in the subwatersheds.

Point sources of sediment include permitted mining activities. Nonpoint sources of sediment include roads, timbering, and abandoned mine lands. The presence of individual nonpoint source categories and their relative significance of impact vary by subwatershed.

Biological integrity/impairment is based on a rating of the stream's benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index. The first step in TMDL development for biologically impaired waters is stressor identification. Section 6 discusses the stressor identification process. Causative stressors to the benthic communities include metals toxicity, pH toxicity, and sedimentation.

Stressor identification facilitated stream-specific determinations of the pollutants for which TMDLs must be developed. Metals toxicity and pH toxicity stressors were identified in Abram Creek, Emory Creek, Montgomery Run, and Piney Swamp Run, which also demonstrated violations of the iron, aluminum, or pH numeric water quality criteria for aquatic life protection. It was determined that implementation of certain pollutant-specific TMDLs would address the biological impairment. The stressor identification process determined that Slaughterhouse Run was also impaired by aluminum toxicity. The source was a seep in the headwaters that was discovered during the source-tracking investigation. Sedimentation was identified as a significant biological stressor in UNT[unnamed tributary]/ Abram Creek. Where the stressor identification process indicated sedimentation as a causative stressor, sediment TMDLs were developed.

The main section of the report describes the TMDL development and modeling processes, identifies impaired streams and existing pollutant sources, discusses future growth, provides assurance that the TMDLs are achievable, and documents the public participation associated with the process. The main report also contains a detailed discussion of the allocation methodologies applied for various impairments. The employed methodologies prescribe allocations that achieve water quality criteria throughout the watershed. Various provisions attempt equity between categories of sources and the targeting of pollutant reductions from the most problematic sources. The nonpoint source reductions did not result in loading contributions less than the natural conditions, and the point source allocations were not more stringent than numeric water quality criteria.

The subwatershed appendices provide additional detail relative to their respective impaired waters and the applicable TMDLs (sum of wasteload allocations + sum of load allocations + margin of safety). The applicable TMDLs are displayed in Section 4 of each appendix. Accompanying spreadsheets provide applicable TMDLs, wasteload allocations to individual point sources, and example allocations of loads to categories of nonpoint sources that achieve the TMDL load allocations. Also provided is an interactive ArcExplorer geographic information system project that allows exploration of the spatial relationships of the source assessment data and expedient determination of subwatershed allocations.

This report and those developed simultaneously for the impaired waters of the Lower Kanawha River and the Coal River watersheds represent the second major batch of West Virginia TMDLs developed by WVDEP. Considerable resources were applied to generate the recent and robust water quality and pollutant source information on which the TMDLs are based. The modeling applied is among the most sophisticated available and incorporates sound scientific principles. TMDL outputs are presented in various formats to assist user comprehension and facilitate use in implementation.

1 REPORT FORMAT

This report consists of a main section, appendices, a supporting geographic information system (GIS) application, and spreadsheet data tables. The main section describes the overall Total Maximum Daily Load (TMDL) development process for the North Branch/Potomac River watershed, identifies impaired streams, and outlines the source assessment of metals, pH, and biological stressors. It also describes the modeling process and TMDL allocations, and it lists actions that will be taken to ensure that the TMDLs are met. The main section is followed by six appendices that describe specific conditions in each of the subwatersheds for which TMDLs are developed. The applicable TMDLs are displayed in Section 5 of each appendix. The main section and appendices are supported by a compact disc (CD). The CD contains an interactive ArcExplorer GIS project that allows the user to explore the spatial relationships of the source assessment data, as well as further details related to the data. Users can "zoom in" on streams and other features of interest. Also included on the CD are spreadsheets (in Microsoft Excel format) that provide the data used during the TMDL development process, as well as detailed source allocations associated with successful TMDL scenarios. In addition, a Technical Report that describes the detailed technical approaches used throughout the TMDL development process is available.

2 INTRODUCTION

The West Virginia Department of Environmental Protection (WVDEP), Division of Water and Waste Management (DWWM), is responsible for the protection, restoration, and enhancement of the state's waters. Along with this duty comes the responsibility for TMDL development in West Virginia.

2.1 Total Maximum Daily Loads

Section 303(d) of the federal Clean Water Act and the U.S. Environmental Protection Agency's (USEPA) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to identify waterbodies not meeting water quality standards and to develop appropriate TMDLs. A TMDL establishes the maximum allowable pollutant loading for a waterbody to achieve compliance with applicable standards. It also distributes the load among pollutant sources and provides a basis for taking the actions needed to restore water quality.

A TMDL is composed of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. TMDLs can be expressed in terms of mass per time or other appropriate measures. Conceptually, this definition is denoted by the following equation:

$$\text{TMDL} = \text{sum of WLAs} + \text{sum of LAs} + \text{MOS}$$

Since 1997 West Virginia's TMDLs have been developed by USEPA Region 3 under the settlement of a 1995 lawsuit, *Ohio Valley Environmental Coalition, Inc., West Virginia Highlands et al*. v. *Browner et al*. The lawsuit resulted in a consent decree between the plaintiffs and USEPA. The consent decree established a rigorous schedule for TMDL development and required TMDLs for the impaired waters on West Virginia's 1996 section 303(d) list. The schedule included TMDL development dates that extend through March 2008. WVDEP's TMDL program accommodates the timely development of the remaining TMDLs required by the consent decree.

WVDEP is developing TMDLs in concert with a geographically based approach to water resource management in West Virginia—the Watershed Management Framework. Adherence to the Framework ensures efficient and systematic TMDL development. Each year TMDLs are developed in specific geographic areas. The Framework dictates that 2005 TMDLs should be pursued in Hydrologic Group B, which includes the North Branch/Potomac River watershed. Figure 2-1 depicts the hydrologic groupings of West Virginia's watersheds; the legend includes the year of each TMDL finalization target.

WVDEP is committed to implementing a TMDL process that reflects the requirements of the TMDL regulations, provides for the achievement of water quality standards, and ensures that ample stakeholder participation is achieved in the development and implementation of TMDLs. A 48-month development process enables the agency to carry out an extensive data generating and gathering effort to produce scientifically defensible TMDLs. It also allows ample time for modeling, report drafting, and frequent public participation opportunities.

The TMDL development process begins with pre-TMDL water quality monitoring and source identification and characterization. Informational public meetings are held in the affected watersheds. Data obtained from pre-TMDL efforts are then compiled, and the impaired waters are modeled to determine baseline conditions and the gross pollutant reductions needed to achieve water quality standards. WVDEP then presents its allocation strategies in a second public meeting, after which Draft TMDL reports are developed. The Draft TMDL is advertised for public review and comment, and a third informational meeting is held during the public comment period. Public comments are addressed, and the final draft TMDL is submitted to USEPA for approval. The TMDLs in this report are scheduled to be finalized by December 2005.

This document provides TMDLs for most North Branch/Potomac River watershed stream/impairment listings from West Virginia's 2004 Clean Water Act section 303(d) list. All remaining North Branch/Potomac River impairments for which USEPA committed to TMDL development by 2008 are addressed.

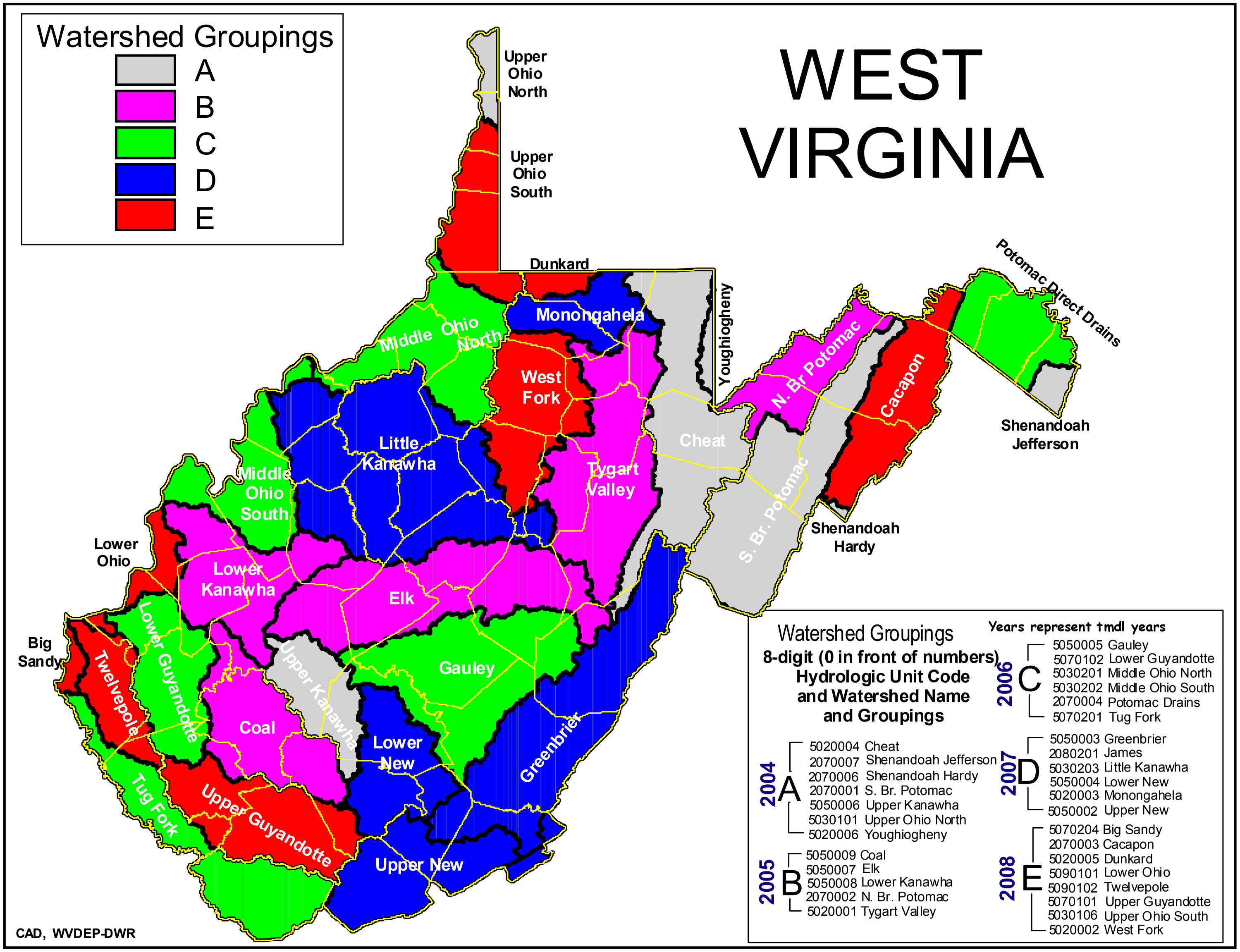


Figure 2-1. Hydrologic groupings of West Virginia's watersheds.

2.2 Water Quality Standards

The determination of impaired waters involves comparing in-stream conditions to applicable water quality standards. In West Virginia, water quality standards are codified at Title 46 of the *Code of State Rules* (CSR), series 1, titled *Legislative Rules of the Environmental Quality Board: Requirements Governing Water Quality Standards* (Standards). The Standards can be obtained online from the West Virginia Secretary of State Web site (http://www.wvsos.com/csrdocs/worddocs/46-01.doc). At the time the TMDLs in this report were developed, EPA had not formally approved the aluminum water quality standards published on the West Virginia Secretary of State Web site. Therefore, the aluminum TMDLs in this report reflect the previously approved EPA and state standards for this parameter.

The West Virginia 2004 Section 303(d) list includes 15 waters in the North Branch/Potomac River watershed identified as manganese impaired. On June 29, 2005, EPA approved a revision to the West Virginia Water Quality Standards that altered the zone of applicability of the manganese water quality criterion for the public water supply designated use. The criterion is now applicable only in the five-mile zone upstream of known public or private water supply intakes used for human consumption. The revision necessitated DEP's identification of intakes and revaluation of prior impairment decisions.

DEP secured the Bureau of Public Health's (BHP) database of water supply intakes and determined locations where surface waters are currently used for human consumption. County sanitarians and BPH regional offices were also contacted to seek their guidance relative to any existing intakes that may not be contained in the database. Based upon the intake locations derived from the aforementioned sources, five-mile distances were delineated in an upstream direction along watercourses to determine streams within the zone of applicability of the criterion. After reevaluation, the criterion was determined to not be applicable to any section of any of the waters that were previously identified as impaired relative to manganese. As such, manganese TMDLs are not presented and the subject waters will be delisted relative to manganese in the upcoming West Virginia 2006 Section 303(d) list.

Water quality standards have three components: designated uses, narrative and/or numeric water quality criteria necessary to support those uses, and an antidegradation policy. Appendix E of the Standards contains the numeric water quality criteria for a wide range of parameters, while Section 3 contains the narrative water quality criteria.

The applicable designated uses for all the waters addressed in this report are aquatic life protection, water contact recreation, and public water supply. Most of the waters are designated as warmwater fisheries. Johnnycake Run (PNB-16-B) and Wycroff Run (PNB-16-B-1) are the only streams in the study area considered troutwaters. For the impaired waters of this report, West Virginia numeric water quality criteria for warmwater fisheries and troutwaters vary only with respect to iron, and neither Johnnycake Run nor Wycroff Run is impaired with respect to the troutwater iron criterion.

The standards include numeric criteria for aquatic life protection for dissolved aluminum, total iron, and pH. Human health protection criteria are provided for iron and pH. Applicable numeric criteria are shown in Table 2-1.

Table 2-1. Applicable West Virginia water quality criteria

POLLUTANT	USE DESIGNATION				
	Aquatic Life				Human Health
	Warmwater Fisheries		Troutwaters		Contact Recreation/Public Water Supply
	Acute[a]	Chronic[b]	Acute[a]	Chronic[b]	
Aluminum, dissolved (μg/L)	750	87	750	87	—
Iron, total (mg/L)	—	1.5	—	0.5	1.5
pH	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0	No values below 6.0 or above 9.0

[a] One-hour average concentration not to be exceeded more than once every 3 years on the average.
[b] Four-day average concentration not to be exceeded more than once every 3 years on the average.
Source: West Virginia Water Quality Standards 2003.

All West Virginia waters are subject to the narrative criteria in Section 3 of the Standards. That section, titled *Conditions Not Allowable in State Waters*, contains various general provisions relative to water quality. The narrative water quality criterion at 46 CSR 1–3.2.i prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems. This provision is the basis for "biological impairment" determinations. Biological impairment signifies a stressed aquatic community, and it is discussed in detail in Section 5.

3 WATERSHED DESCRIPTION AND DATA INVENTORY

3.1 Watershed Description

The North Branch/Potomac River watershed, U.S. Geological Survey (USGS) 8-digit hydrologic unit code 02070002, is in the eastern panhandle of West Virginia and extends northward into western Maryland and southern Pennsylvania. The watershed encompasses nearly 583 square miles in West Virginia. The area of study covered in this report consists of a 67-square-mile portion of the North Branch/Potomac River watershed in the eastern panhandle of West Virginia (Figure 3-1). Major tributaries in the area of study include Piney Swamp Run, Abram Creek, Buffalo Creek, and Elk Run. The study area occupies portions of Mineral, Grant, and Tucker counties. Cities and towns in the vicinity of the area of study are Keyser, Gormania, Mount Storm, and Thomas.

The average elevation in the North Branch/Potomac River watershed is approximately 1,900 feet. Cabin Mountain, with an elevation of 4,098 feet above mean sea level, is the highest point in the watershed. The minimum elevation is 597 feet at the confluence of the North and South branches of the Potomac. The average elevation in the area of study is approximately 2,600 feet above mean sea level. The highest elevation in the study area, 3,491 feet, is near the Pigeonroost formation on the Allegheny Front. The minimum elevation in the study area, 1,040 feet, is at the confluence of Slaughterhouse Run and the North Branch of the Potomac.

Land use and land cover estimates were obtained from vegetation data gathered from the West Virginia Gap Analysis Land Cover Project (GAP), produced by the Natural Resource Analysis Center and the West Virginia Cooperative Fish and Wildlife Research Unit of West Virginia University (WVU). The GAP database for West Virginia was derived from satellite imagery taken during the early 1990s, and it includes detailed vegetative spatial data. Additional information regarding the GAP spatial database is provided in the appendices of the Technical Report. The categories for vegetation cover were consolidated to create six land use categories, summarized in Table 3-1.

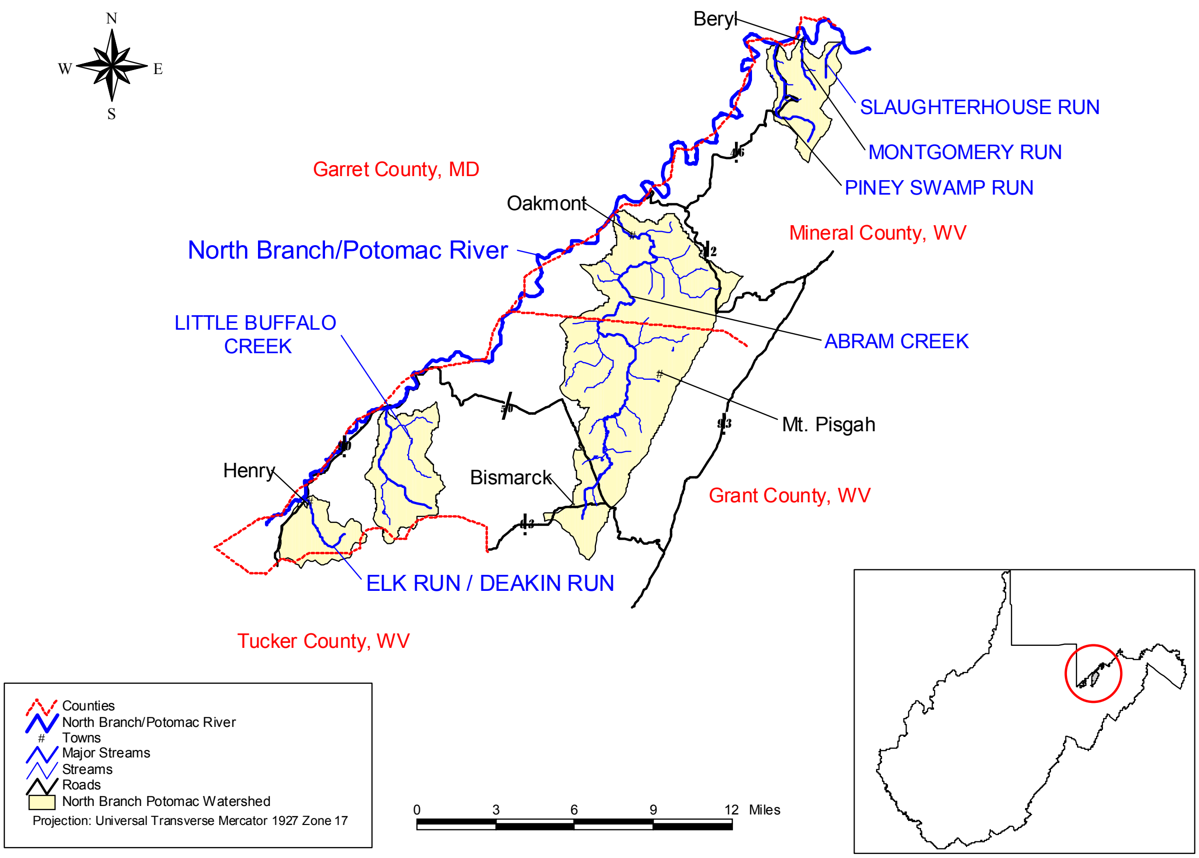


Figure 3-1. Location of the North Branch/Potomac River watershed.

Table 3-1. Land use and land cover in the North Branch/Potomac River watershed

Land Use Type	Area of Watershed		Percentage
	Acres	Square Miles	
Agriculture	62.9	0.1	0.1
Barren/Mining	999.4	1.6	2.3
Forest	32451.3	50.7	75.0
Pasture	8703.6	13.6	20.1
Urban/Residential	687.9	1.1	1.6
Water	364.9	0.6	0.8
Total	43270.1	67.6	100.0

As shown in Table 3-1, the dominant land use type in the North Branch/Potomac River watershed is forest, which constitutes 75 percent of the study area. Other important land use types in the area of study are pasture and grassland (20.1 percent), barren/mining (2.3 percent), and urban/residential (1.6 percent). Individually, all other land cover types constitute less than 1 percent of the total watershed area.

3.2 Data Inventory

Various sources of data were used in the TMDL development process. The data were used to identify and characterize sources of pollution and to establish the water quality response to those sources. Review of the data included a preliminary assessment of the watershed's physical and socioeconomic characteristics and current monitoring data. Table 3-2 identifies the data used to support the TMDL assessment and modeling effort for the North Branch/Potomac River watershed. These data describe the physical conditions of the watershed, the potential pollutant sources and their contributions, and the impaired waterbodies for which TMDLs need to be developed. A summary of the data obtained for the North Branch/Potomac River watershed during the pre-TMDL monitoring effort is provided in the Technical Report. The geographic information is provided in the ArcExplorer GIS project included on the CD version of this report.

3.3 Impaired Waterbodies

WVDEP conducted extensive water quality monitoring from July 2002 through June 2003 in the North Branch/Potomac River watershed. The results of that effort were used to confirm the impairments of waterbodies identified on previous 303(d) lists and to identify other impaired waterbodies that were not previously listed as such.

In this TMDL development effort, modeling at baseline conditions demonstrated additional pollutant impairments to those identified via monitoring. The prediction of impairment through modeling is validated by applicable federal guidance for 303(d) listing. Despite best efforts, WVDEP could not perform water quality monitoring and source characterization at frequencies or sample location resolution sufficient to comprehensively assess water quality under the terms of applicable water quality standards, and modeling was needed to complete the assessment. Also, the baseline condition portrayal of the cumulative impact of multiple point sources discharging at existing permit limits sometimes resulted in model prediction of impairment.

Where existing pollutant sources were predicted to cause noncompliance with a particular criterion, the subject water was characterized as impaired for that pollutant.

TMDLs have been developed for impaired waters in six subwatersheds (Figure 3-2): Abram Creek, Little Buffalo Creek, Elk Run/Deakin Run, Slaughterhouse Run, Montgomery Run, and Piney Swamp Run. The waterbody/impairment combinations for which TMDLs are developed are presented in Table 3-3. The table includes the stream code, subwatershed, stream name, and impairments for each stream.

Table 3-2. Datasets used in TMDL development

Type of Information		Data Source(s)
Watershed physiographic data	Stream network	West Virginia Division of Natural Resources (DNR)
	Land use	Multi-Resolution Land Characterization (MRLC) Database
	Counties	U.S. Census Bureau
	Cities/populated places	U.S. Census Bureau
	Soils	State Soil Geographic Database (STATSGO) U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NCRS) soil surveys
	Cataloging Unit boundaries	U.S. Geological Survey (USGS)
	Topographic and digital elevation models (DEMs)	National Elevation Dataset (NED)
	Dam locations	USGS
	Roads	U.S. Census Bureau TIGER, WVU WV Roads
	Water quality monitoring station locations	WVDEP, USEPA STORET
	Meteorological station locations	National Oceanic and Atmospheric Administration, National Climatic Data Center (NOAA-NCDC)
	Permitted facility information	WVDEP Division of Water and Waste Management (DWWM) , WVDEP Division of Mining and Reclamation (DMR)
	Timber harvest data	USDA Forest Service (FS)
	Oil and gas operations coverage	WVDEP, Office of Oil and Gas (OOG)
	Abandoned mining coverage	WVDEP DMR
	Wastewater disposal methods	WVDEP
	Livestock counts	USDA Agricultural Census
Monitoring data	Physical data	WVDEP DNR
	Historical flow record (daily averages)	USGS
	Rainfall	NOAA-NCDC
	Temperature	NOAA-NCDC
	Wind speed	NOAA-NCDC
	Dew point	NOAA-NCDC
	Humidity	NOAA-NCDC
	Cloud cover	NOAA-NCDC

Type of Information		Data Source(s)
	Water quality monitoring data	USEPA STORET, WVDEP
	National Pollutant Discharge Elimination System (NPDES) data	WVDEP DMR, WVDEP DWMM
	Discharge Monitoring Report data	WVDEP DMR, mining companies
	Abandoned mine land data	WVDEP DMR, WVDEP DWMM
Regulatory or policy information	Applicable water quality standards	WVDEP
	Section 303(d) list of impaired waterbodies	WVDEP, USEPA
	Nonpoint Source Management Plans	WVDEP

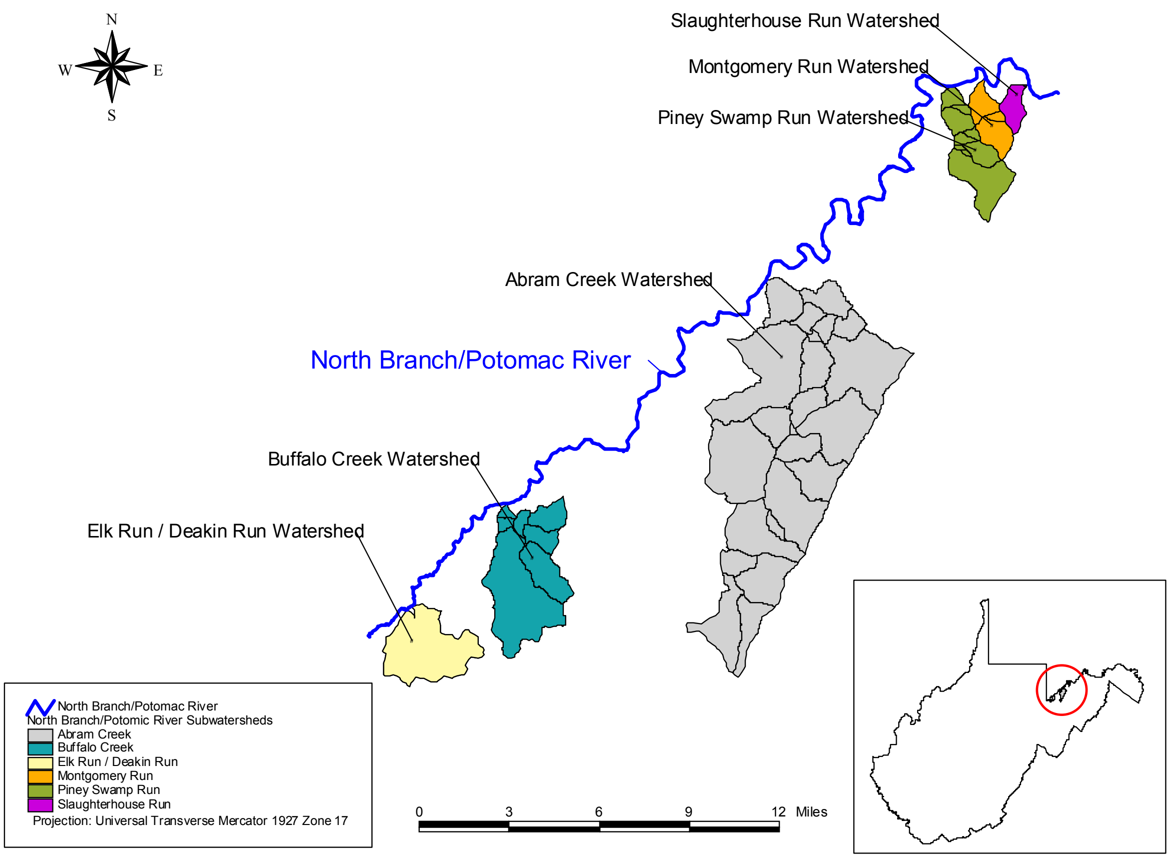


Figure 3-2. Impaired waterbodies in the six selected subwatersheds of the North Branch/Potomac River watershed.

4 METALS AND PH SOURCE ASSESSMENT

This section identifies and examines the potential sources of aluminum, iron, pH impairment, and sediment in the North Branch/Potomac River watershed. Sources can be classified as point (permitted) or nonpoint (non-permitted) sources.

A point source, according to 40 CFR 122.3, is any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel or other floating craft from which pollutants are or may be discharged. The National Pollutant Discharge Elimination System (NPDES) program, established under Clean Water Act sections 318, 402, and 405, requires permits for the discharge of pollutants from point sources. For purposes of this TMDL, NPDES-permitted discharge points are considered point sources.

Table 3-3. Waterbodies and impairments for which TMDLs have been developed

Subwatershed	Stream Code	Stream	Al	Fe	pH	Bio
Abram Creek	WVPNB-16	Abram Creek	X	X	X	X
	WVPNB-16-0.5A	UNT/Abram Creek RM 1.9				X
	WVPNB-16-A	Emory Creek	X	X	X	X
	WVPNB-16-A-1	UNT/Emory Creek RM 0.8	X		X	
	WVPNB-16-B.5	Glade Run	X	X	X	
	WVPNB-16-B.5-1	UNT/Glade Run RM 0.3	X	X	X	
	WVPNB-16-C	Laurel Run	X	X	X	
	WVPNB-16-C.4	UNT/Abram Creek RM 13.6	X	X	X	
	WVPNB-16-C.8	UNT/Abram Creek RM 15.9	X	X	X	
	WVPNB-16-D	Little Creek	X	X	X	
Little Buffalo Creek	WVPNB-19-A	Little Buffalo Creek	X	X	X	
Elk Run/Deakin Run	WVPNB-22-A	Elk Run/Deakin Run		X		
Slaughterhouse Run	WVPNB-10	Slaughterhouse Run	X	X		X
Montgomery Run	WVPNB-11	Montgomery Run	X	X	X	X
	WVPNB-11-A	UNT/Montgomery Run RM 1.4	X		X	
Piney Swamp Run	WVPNB-12	Piney Swamp Run	X	X	X	X
	WVPNB-12-B	UNT/Piney Swamp Run RM 0.7	X	X	X	
	WVPNB-12-E	UNT/Piney Swamp Run RM 1.8	X	X	X	
	WVPNB-12-F	UNT/Piney Swamp Run RM 2.2	X	X	X	

Note: UNT = unnamed tributary; Al = aluminum; Fe = iron; Bio = biological impairment.

For purposes of these TMDLs only, wasteload allocations are given to NPDES-permitted discharge points, and load allocations are given to discharges from activities that do not have an associated NPDES permit, such as mine forfeiture sites and abandoned mine lands (including tunnel discharges, seeps, and surface runoff). The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by WVDEP or USEPA 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, WVDEP and USEPA are not determining that these discharges are exempt from NPDES permitting requirements.

The physiographic data discussed in the previous section enabled the characterization of pollutant sources. As part of the TMDL development process, WVDEP performed additional field-based source-tracking activities; the resulting information was supplemental to the other available source characterization data. WVDEP staff recorded physical descriptions of pollutant sources and the general condition of the stream in the vicinity of the sources. WVDEP collected global positioning system (GPS) data and water quality samples for laboratory analysis as necessary to characterize the sources and their impacts. Source-tracking information was compiled and electronically plotted on maps using GIS software. Detailed information, including the locations of pollutant sources, is provided in the subwatershed appendices, the Technical Report, and the ArcExplorer project on the CD version of this report.

4.1 Metals and pH Point Sources

Metals and pH point sources are classified by the mining and non-mining-related permits issued by WVDEP. The following sections discuss the potential impacts and the characterization of these source types.

4.1.1 Mining Point Sources

The Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) and its subsequent revisions were enacted to establish a nationwide program to protect the beneficial uses of land or water resources, protect public health and safety from the adverse effects of current surface coal mining operations, and promote the reclamation of mined areas left without adequate reclamation prior to August 3, 1977. The SMCRA requires a permit for 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 a regulatory authority in the event that the applicant forfeits its permit. Mines that ceased operations before the effective date of the SMCRA (often called “pre-law” mines) are not subject to the requirements of the SMCRA.

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

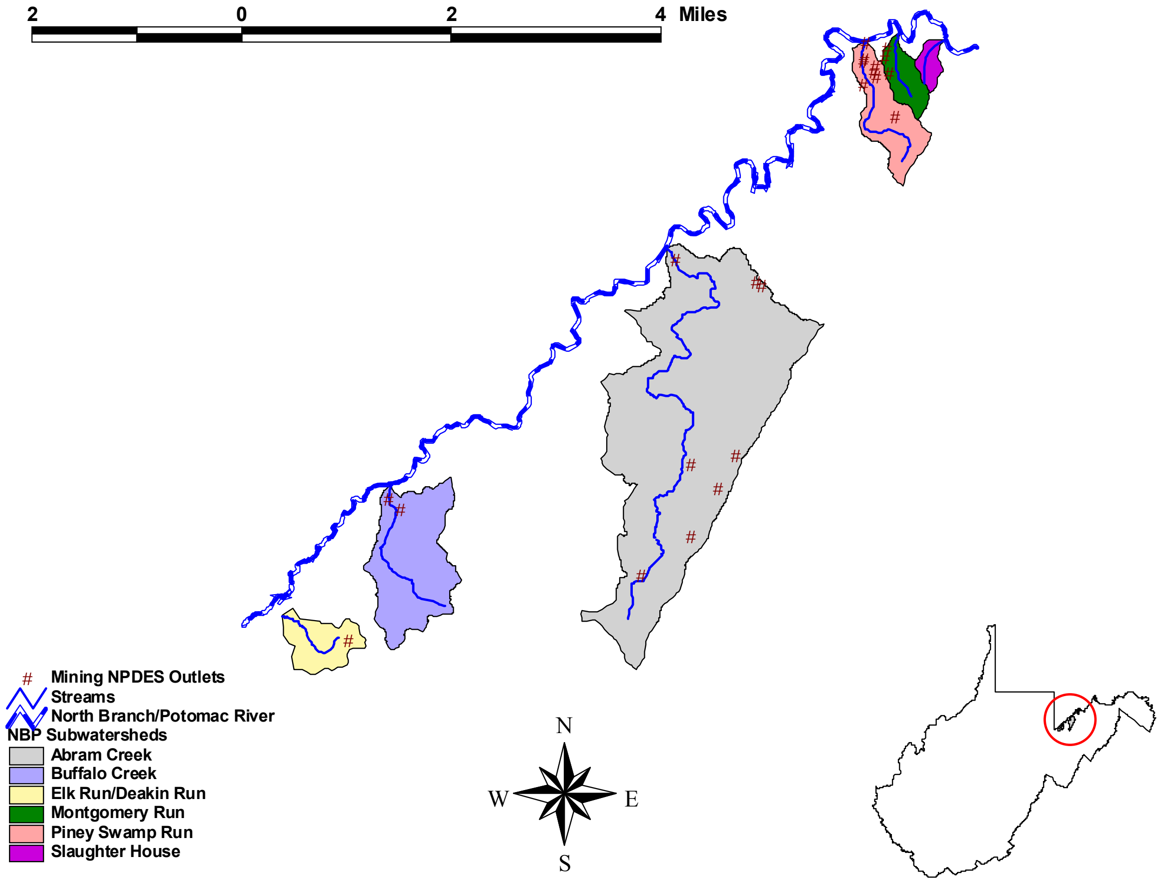
- Restoring the land affected to a condition capable of supporting the uses that it was capable of supporting prior to any mining
- Backfilling and compacting (to ensure stability or to prevent leaching of toxic materials) to restore the approximate original contour of the land, including all highwalls
- Minimizing disturbances to the hydrologic balance and to the quality and quantity of water in surface water and groundwater systems both during and after surface coal mining operations and during reclamation by avoiding acid or other toxic mine drainage

Untreated mining-related point source discharges from deep, surface, and other mines typically have low pH values (that is, they are acidic) and contain high concentrations of metals (iron and aluminum). Mining-related activities are commonly issued NPDES discharge permits that contain effluent limits for total iron, nonfilterable residue, and pH. Most permits also include effluent monitoring requirements for total aluminum. WVDEP's Division of Mining and Reclamation (DMR) provided a spatial coverage of the mining-related NPDES permit outlets. The discharge characteristics, related permit limit, and discharge data for these NPDES outlets were acquired from West Virginia's ERIS database system. The spatial coverage was used to determine the location of the permit outlets. Additional information was needed, however, to determine the areas of the mining activities.

WVDEP DMR also provided a spatial coverage of the mining permit areas and related SMCRA Article 3 permit information. This information includes both active and inactive mining facilities, which are classified by type of mine and facility status. The mines are classified into eight different categories: coal surface mine, coal underground mine, haul road, coal preparation plant, coal reprocessing, prospective mine, quarry, and other. The haul road and prospective mine categories represent mining access roads and potential coal mining areas.

WVDEP DWWM personnel used the information contained in the SMCRA Article 3 and NPDES permits to further characterize the mining point sources. Information gathered included type of discharge, pump capacities, and drainage areas (including total and disturbed areas). Using this information, the mining point sources were then represented in the model and assigned individual wasteload allocations for metals.

There are a total of 12 mining-related NPDES permits, with 22 associated outlets, in the 6 TMDL watersheds. A complete list of the permits and outlets is provided in the appendices of the Technical Report. Figure 4-1 illustrates the extent of the mining NPDES outlets in the watershed.



Note: Some outlets in close proximity to each other may appear as overlapping points.

Figure 4-1. Mining NPDES outlets in the six selected subwatersheds of the North Branch/Potomac River watershed.

4.1.2 Non-mining Point Sources

WVDEP DWWM controls water quality impacts from non-mining activities with point source discharges through the issuance of NPDES permits. WVDEP's OWRNPDES GIS coverage was used to determine the locations of these sources, and detailed permit information was obtained from WVDEP's ERIS database.

Non-mining point sources of metals may include the wastewater discharges from water treatment plants and industrial manufacturing operations. In addition, the discharges from construction activities that disturb more than 1 acre of land are legally defined as point sources. The sediment introduced from such discharges can contribute metals.

In the North Branch/Potomac River watershed, two non-mining NPDES permits regulate iron, aluminum and pH. The permits are issued to the Upper Potomac River Commission for the disposal of POTW sludge on previously mined lands. The Green Mountain Site (Permit No. WV0110868) is located in the Slaughterhouse Run watershed and the Hampshire Hill Site (Permit No. WV0113441) is located in the Piney Swamp Run and Montgomery Run watersheds.

No active disposal or mining operations occur on the Green Mountain Site. The site has been completely reclaimed and operates under a stormwater permit that requires Stormwater Pollution Prevention Plan development and implementation, and includes self-monitoring benchmarks to gauge effectiveness. The wasteload allocations prescribed for this site recognize its reclaimed status, and do not require pollutant reductions. Continued operation under the terms and conditions of the existing stormwater permit is acceptable.

At the Hampshire Hill Site, six permitted outlets exist with effluent limitations for iron, aluminum and pH. The outlets are co-regulated by UPRC Permit No. WV0113441 and mining NPDES Permit No. WV0046329 issued to NewPage Corporation. The wasteload allocation display of the co-regulated outlets on the allocated spreadsheets occurs primarily on the "Mining WLAs Metals" tab under Permit No. WV0046329. On the "Non-Mining WLAs" tab, Permit No. WV0113441 allocations are referenced to those for the corresponding outlets of Permit No. WV0046329.

4.1.3 Construction Stormwater Permits

WVDEP issued a general NPDES permit (permit WV0115924) to regulate stormwater flowing into streams from discharges associated with construction activities. Registration under the permit is required for construction activities with a land disturbance greater than 1 acre. Both the land disturbance and the permitting process associated with construction activities are transient. After construction is completed and sites are stabilized, water quality impacts are minimized. Individual registrations under the general permit are typically limited to a period of less than 1 year. These permits require that the sites have properly installed best management practices (BMPs; e.g., silt fences, sediment traps, seeding and mulching, riprap) to prevent or reduce erosion and sediment runoff. At the time of TMDL development, no active construction sites were registered under the general permit.

4.2 Metals and pH Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to metals- and pH-related water quality impairments. Abandoned mines contribute acid mine drainage (AMD), which produces low pH and high metals concentrations in surface and subsurface waters. Similarly, facilities that were subject to the SMCRA during active operations, but subsequently forfeited their bonds and abandoned operations, can be a significant source of metals and low pH. Land-disturbing activities that introduce excess sediment are additional nonpoint sources of metals.

4.2.1 Abandoned Mine Lands

WVDEP's Office of Abandoned Mine Lands and Reclamation (AML&R) was created in 1981 to manage the reclamation of lands and waters affected by mining prior to passage of the SMCRA in 1977. The mission of the office is to protect public health, safety, and property from past coal mining and to enhance the environment through the reclamation and restoration of land and water resources. A fee placed on coal funds the Abandoned Mine Lands (AML) program. Allocations from the AML fund are made to state and tribal agencies through the congressional budgetary process.

Source-tracking efforts by WVDEP DWWM and AML&R identified a number of AML sources (discharges, seeps, portals, culverts, refuse piles, diversion ditches, and ponds). Field data, such as GPS locations, water samples, and flow measurements, were collected to locate these sources and characterize their impact on water quality. AML sources are the primary cause of metals and pH impairments in the watersheds addressed by this report.

Abandoned mine lands were modeled in the North Branch/Potomac River TMDLs. In total, 692 acres of AML area, 26 AML seeps, and 12.7 miles of highwall were identified in the North Branch/Potomac River watershed.

4.2.2 Bond Forfeiture

A mining permittee is required to post a performance bond to ensure the completion of reclamation. When a bond is forfeited, WVDEP assumes the responsibility for the reclamation requirements. The Office of Special Reclamation in WVDEP's Division of Land Restoration made information and data associated with bond forfeiture sites available. There are two bond forfeiture sites in the six selected subwatersheds in the North Branch/Potomac River watershed.

4.2.3 Sediment Sources

On the basis of previous watershed modeling (e.g., *Metals and pH TMDLs for the Elk River Watershed* [USEPA 2001] and *Metals, pH, and Fecal Coliform TMDLs for the Upper Kanawha River Watershed, West Virginia* [WVDEP 2005]), which evaluated sediment/metal interactions and general soil properties in West Virginia, it was concluded that certain sediments contain high levels of aluminum and iron (Watts et al. 1994). Land disturbance can increase sediment loading to impaired waters, and the control of sediment-producing sources might be necessary to meet water quality criteria for metals during high-flow conditions. Potential sediment-related nonpoint sources of metals are forestry operations, oil and gas operations, roads, and barren lands. The number and size of these sources in the North Branch/Potomac River watershed are summarized below and presented in detail in the appendices of this report.

In the Abram Creek watershed, UNT/Abram Creek RM 1.9, sediment was identified as a stressor for biological impairment where forestry, roads, and other land-disturbing activities are present.

Forestry

The West Virginia Bureau of Commerce's Division of Forestry provided information on forest industry sites (registered logging sites) in the watershed. This information included the harvested area and the subset of land disturbed by roads and landings for four registered logging sties in the watersheds addressed by this report.

West Virginia recognizes the water quality issues posed by sediment from logging sites. In 1992 the West Virginia Legislature passed the Logging Sediment Control Act. The act requires the use of BMPs to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and the land disturbance associated with the creation and use of roads to serve logging sites can increase sediment loading to streams.

According to the Division of Forestry, illicit logging operations account for approximately an additional 2.5 percent of the total harvested forest (registered logging sites) throughout West Virginia. These illicit operations do not have properly installed BMPs and can contribute sediment to streams.

Oil and Gas

The WVDEP Office of Oil and Gas (OOG) is responsible for monitoring and regulating all actions related to the exploration, drilling, storage, and production of oil and natural gas in West Virginia. It maintains records on more than 40,000 active and 25,000 inactive oil and gas wells, manages the Abandoned Well Plugging and Reclamation Program, and ensures that surface water and groundwater are protected from oil and gas activities.

Oil and gas data incorporated into the TMDL model were obtained from the WVDEP OOG GIS coverage. There is only one active oil or gas well in the subwatersheds addressed in this report.

Roads

Runoff from paved and unpaved roadways can contribute significant sediment loads to nearby streams. Heightened stormwater runoff from paved roads can increase erosion potential. Unpaved roads can contribute sediment through precipitation-driven runoff. Roads that traverse stream paths elevate the potential for direct deposition of sediment. Road construction and repair can further increase sediment loads if BMPs are not properly employed.

Information on roads was obtained from various sources, including the 2000 TIGER/Line GIS shapefiles from the U.S. Census Bureau and the WV Roads GIS coverage prepared by WVU.

Agriculture

Agricultural activities can contribute sediment loads to nearby streams; however, there is very little agricultural activity in the North Branch/Potomac River watershed. Row crop agriculture occurs on approximately 0.1 percent of the watershed, as shown by the GAP data (Table 3-1) and source-tracking efforts throughout the watershed.

Other Land-Disturbing Activities

As stated previously, WVDEP issues general NPDES permits to regulate sediment contributions to streams from discharges associated with construction activities that disturb more than 1 acre. Construction activities that disturb less than 1 acre are not subject to construction stormwater permitting and are uncontrolled sources of sediment. At the time of TMDL development, no active construction sites were registered under the general permit.

5. BIOLOGICAL IMPAIRMENT AND STRESSOR IDENTIFICATION

Initially, TMDL development in biologically impaired waters requires the identification of pollutants that cause the stress to the biological community. Sources of those pollutants are often analogous to those already described: mine drainage and sediment are known stressors in this watershed. The Technical Report discusses biological impairment and the stressor identification (SI) process in detail.

5.1 Introduction

Assessment of the biological integrity of a stream is based on a survey of the stream's benthic macroinvertebrate community. Benthic macroinvertebrate communities are rated using a multimetric index developed for use in wadeable streams of West Virginia. The West Virginia Stream Condition Index (WVSCI; Gerritsen et al. 2000) is composed of six metrics that were selected to maximize discrimination between streams with known impairments and reference streams. In general, streams with WVSCI scores of less than 60.6 points, on a normalized 0–100 scale, are considered biologically impaired.

Biological assessments are useful in detecting impairment, but they might not clearly identify the cause(s) of impairment, which must be determined before TMDL development can proceed. USEPA developed *Stressor Identification: Technical Guidance Document* (Cormier et al. 2000) to assist water resource managers in identifying stressors and stressor combinations that cause biological impairment. Elements of the stressor identification process were used to evaluate and identify the primary stressors to the impaired benthic communities. In addition, custom analyses of biological data were performed to supplement the framework recommended by the guidance document.

The general stressor identification process entailed reviewing available information, forming and analyzing possible stressor scenarios, and implicating causative stressors. The stressor identification method provides a consistent process for evaluating available information. TMDLs were established for the responsible pollutants at the conclusion of the stressor identification process. As a result, the TMDL process established a link between the impairment and benthic community stressors.

5.2 Data Review

WVDEP generated the primary data used in stressor identification through its pre-TMDL monitoring program. The program included water quality monitoring, benthic sampling, and habitat assessment. In addition, the biologists' comments regarding stream condition and potential stressors and sources were captured and considered. Other data sources were source-tracking data, GAP 2000 land use information, Natural Resources Conservation Service (NRCS) STATSGO soils data, NPDES point source data, and literature sources.

5.3 Candidate Causes/Pathways

The first step in the stressor identification process was to develop a list of candidate causes, or stressors. The candidate causes responsible for biological impairments are listed below:

- Metals contamination (including metals contributed through soil erosion) causes toxicity.

- Acidity (low pH) causes toxicity.
- High sulfates and increased ionic strength cause toxicity.
- Increased total suspended solids (TSS)/erosion and altered hydrology cause sedimentation and other habitat alterations.
- Altered hydrology causes higher water temperature, resulting in direct impacts.
- Altered hydrology, nutrient enrichment, and increased biochemical oxygen demand (BOD) cause reduced dissolved oxygen (DO).
- Algal growth causes food supply shift.
- High levels of ammonia cause toxicity (including increased toxicity due to algal growth).
- Chemical spills cause toxicity.

A conceptual model was developed to examine the relationship between candidate causes and potential biological effects. The conceptual model (Figure 5-1) depicts the sources, stressors, and pathways that affect the biological community.

5.4 Stressor Identification Results

The stressor identification process determined the primary causes of biological impairment. In some cases, biological impairment was linked to a single stressor; in others, multiple stressors were responsible for the impairment. The stressor identification process identified the following stressors for the biologically impaired waters of the North Branch/Potomac River watershed:

- Metals toxicity
- pH toxicity
- Sedimentation

The stressor identification process identified metals toxicity and pH toxicity as biological stressors in waters that also demonstrated violations of the iron, aluminum, or pH numeric water quality criteria for protection of aquatic life. In addition, aluminum, which originates from an AML seep in the headwaters, was identified as a stressor in Slaughterhouse Run. WVDEP determined that implementation of TMDLs for those pollutants would address the biological impairment.

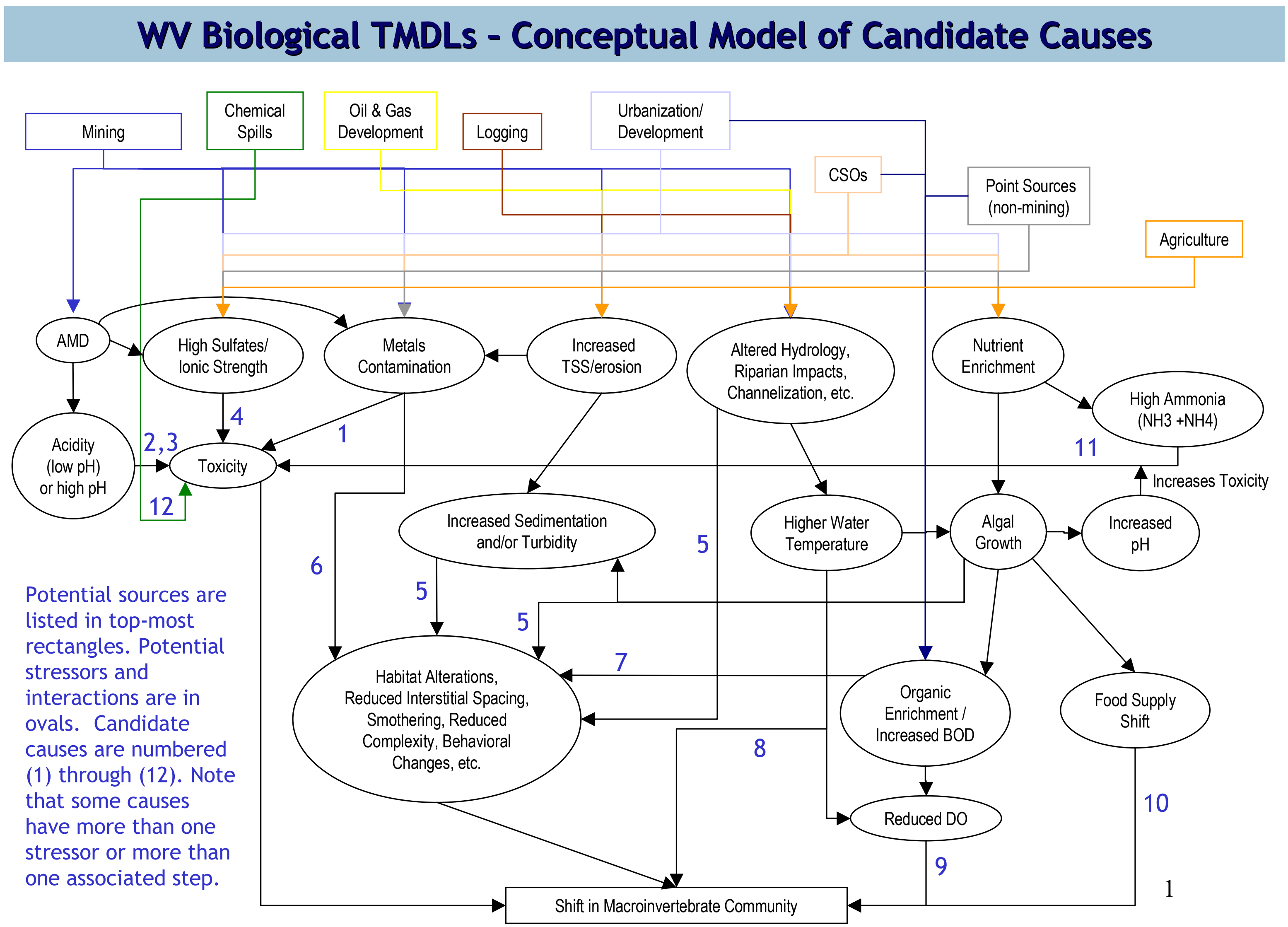


Figure 5-1. Conceptual model of candidate causes and potential biological effects for the North Branch/Potomac River watershed.

After stressors were identified, WVDEP determined the pollutant(s) for which TMDLs were required to address the impairment.

Sedimentation was identified as a stressor in UNT/Abram Creek RM 1.9. Where the stressor identification process indicated sedimentation as a causative stressor, WVDEP developed sediment TMDLs.

Table 5-1 summarizes the biological stressors' contributions to biological impairments in the North Branch/Potomac River watershed.

Table 5-1. Primary stressors of biologically impaired streams in the North Branch/Potomac River watershed

Major Watershed	Stream	Biological Stressors	TMDL Required
Abram Creek	Abram Creek	Metals toxicity (aluminum, iron) pH toxicity (acidity)	Aluminum Iron pH
	UNT/Abram Creek RM 1.9	Sedimentation	Sediment
	Emory Creek	Metals toxicity (aluminum, iron) pH toxicity (acidity)	Aluminum Iron pH
Slaughterhouse Run	Slaughterhouse Run	Metals toxicity (aluminum)	Aluminum
Montgomery Run	Montgomery Run	Metals toxicity (aluminum, iron) pH toxicity (acidity)	Aluminum Iron pH
Piney Swamp Run	Piney Swamp Run	Metals toxicity (aluminum, iron) pH toxicity (acidity)	Aluminum Iron pH

6. MODELING PROCESS

Establishing the relationship between the in-stream water quality targets and source loadings is a critical component of TMDL development. It allows for evaluation of management options that will achieve the desired source load reductions. The link can be established through a range of techniques, from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses with flow and loading conditions.

This section presents the approach taken to develop the linkage between sources and in-stream response for TMDL development in the North Branch/Potomac River watershed.

6.1 Modeling Technique for Metals and pH

Selection of the appropriate analytical technique for TMDL development was based on an evaluation of technical and regulatory criteria. The following key technical factors were considered in the selection process:

- Scale of analysis is important.

- Point and nonpoint sources must be considered.
- Metals and pH impairments are temporally variable and occur at low, average, and high flow conditions.
- Time-variable aspects of land practices have a large effect on in-stream metals and bacteria concentrations.
- Metals and bacteria transport mechanisms are highly variable and often weather-dependent.

The primary regulatory factor that drove the selection process was West Virginia's water quality criteria. According to 40 CFR Part 130, TMDLs must be designed to implement applicable water quality standards. The applicable water quality standards for metals and pH in West Virginia are presented in Section 2, Table 2-1. Compliance with the criteria requires attaining conditions that protect against both short-term (acute) effects and long-term (chronic) effects. West Virginia water quality criteria are applicable at all stream flows greater than the 7-day, 10-year low flow (7Q10). The approach or modeling technique must permit representation of in-stream concentrations under a variety of flow conditions to evaluate critical flow periods for comparison to chronic and acute criteria.

The TMDL development approach must also consider the dominant processes affecting pollutant loadings and in-stream fate. For the North Branch/Potomac River watershed, primary sources contributing to metals and pH impairments include an array of point and nonpoint sources. Nonpoint sources are typically rainfall-driven with pollutant loadings primarily related to surface runoff. Point source discharges might or might not be induced by rainfall.

A variety of modeling tools were used to develop the TMDLs, including the Mining Data Analysis System (MDAS) and the Dynamic Equilibrium In-stream Chemical Reactions model (DESC-R).

MDAS is a system designed to support TMDL development for areas affected by nonpoint and point sources. The MDAS component most critical to TMDL development is the dynamic watershed model because it provides the linkage between source contributions and in-stream response. MDAS is used to simulate watershed hydrology and pollutant transport, as well as stream hydraulics and in-stream water quality. It is capable of simulating different flow regimes and pollutant loading variations. Metals were modeled using MDAS.

Metals are modeled in MDAS in the total recoverable form. Therefore, it was necessary to link MDAS with the DESC-R to appropriately address dissolved aluminum TMDLs for the North Branch/Potomac River watershed. The DESC-R was also used to represent the source-response linkage for pH. The model selection process, modeling methodologies, and technical approaches are discussed further in the Technical Report.

6.1.1 MDAS Setup

Configuration of the MDAS model involved subdivision of the North Branch/Potomac River watershed into modeling units. Flow and water quality for those units were continuously simulated using meteorological, land use, point source loading, and stream data.

The watershed was broken into six separate watershed units based on the watershed groupings of impaired streams shown in Table 3-1. These subwatersheds were further subdivided to allow evaluation of water quality and flow at pre-TMDL monitoring stations. This subdivision process also ensured a proper stream network configuration within the basin. The subwatershed delineation for each of the six watersheds is shown in Figure 6-1.

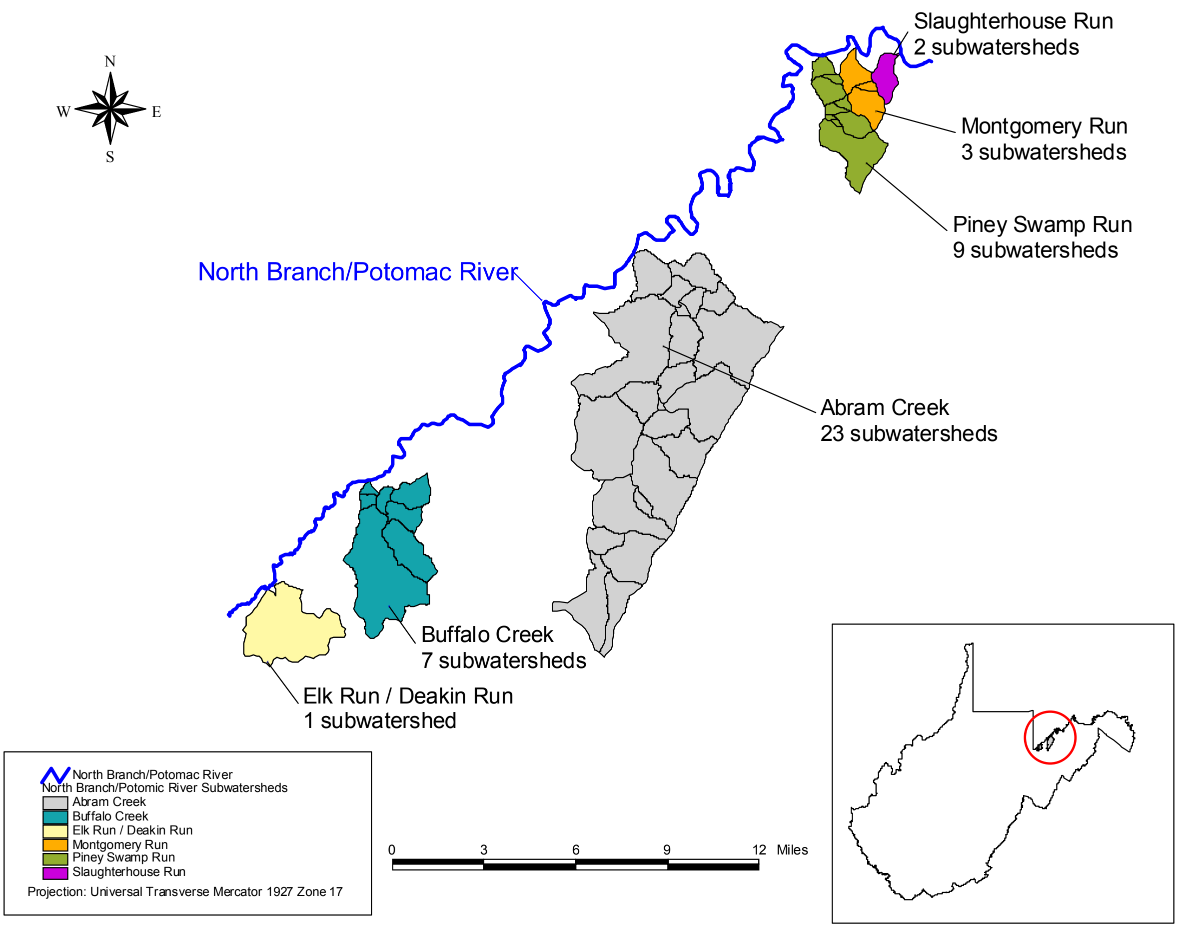


Figure 6-1. North Branch/Potomac River subwatershed delineation.

Modeled land uses contributing to metals loads include forest, cropland, pasture, urban/residential pervious lands, urban/residential impervious lands, barren areas, roads, harvested forest, and abandoned mines. These sources were represented explicitly by consolidating existing GAP2000 land use categories to create model land use groupings. Several additional land use categories were created to account for recent land disturbance activities (e.g., harvested forest, oil and gas operations, unpaved roads, and active mining) that are not represented in the GAP2000 land use coverage. The process of consolidating and updating the modeled land uses is explained in further detail in the Technical Report. Other sources, such as

AML seeps identified by WVDEP's source-tracking efforts, were modeled as direct, continuous-flow sources in the model.

6.1.2 Hydrology Calibration

Hydrology and water quality calibration were performed in sequence because water quality modeling is dependent on an accurate hydrology simulation. Hydrology calibration typically involves a comparison of model results to in-stream flow observations from USGS flow gauging stations throughout the watershed. The USGS flow gauging station in the North Branch/Potomac River watershed (Abram Creek at Oakmont, West Virginia) had adequate data records for hydrology calibration. Key considerations for hydrology calibration included the overall water balance, the high-flow and low-flow distribution, storm flows, and seasonal variation. The model was calibrated to the observed data recorded on Abram Creek from 1980 to 1982. Hydrology calibration was based on observed data from this station and land uses present in the watershed at that time. Final adjustments to model hydrology were based on flow measurements obtained during WVDEP's pre-TMDL monitoring in the North Branch/Potomac River watershed. Further description and a summary of the results of the hydrology calibration and validation are presented in the Technical Report.

6.1.3 Water Quality Calibration

Following hydrology calibration, the water quality was calibrated by comparing modeled versus observed in-stream metals concentrations. The water quality calibration consisted of executing MDAS, comparing the model results to available observations, and adjusting water quality parameters within a reasonable range. Ranges were based on previous watershed modeling experience in West Virginia (e.g., *Metals and pH TMDLs for the Elk River Watershed* [USEPA 2001] and *Metals, pH, and Fecal Coliform TMDLs for the Upper Kanawha River Watershed, West Virginia* [WVDEP 2005]). Parameters for background conditions were established using observations from undisturbed areas.

As stated in Section 6.1, it was necessary to link MDAS with the DESC-R to appropriately address dissolved aluminum TMDLs. The DESC-R was calibrated by adjusting water quality parameters to match the observed in-stream water quality data. Further description and a summary of the results of the DESC-R water quality calibration and validation are presented in the Technical Report.

6.2 Modeling Technique for Sediment

Stressor identification results indicated a need to reduce the contribution of excess sediment to certain biologically impaired streams in the North Branch/Potomac River watershed, as discussed in Section 5. As a result, sediment TMDLs were developed by integrating a watershed loading model that quantified land-based loads and a stream-routing model that examined stream bank erosion and deposition processes.

Selection of this modeling system for the development of sediment TMDLs was based on the evaluation of available technical and regulatory criteria. The key technical factors listed in Section 6.1 were also considerations in the model selection process for sediment TMDL development. Adequately representing erosion processes and nonpoint source loads in the watershed was of primary concern in selecting the appropriate modeling system.

Narrative criteria are included in West Virginia's water quality standards (46 CSR 1–3.2.i), as discussed in Section 2 of this report. The narrative water quality criterion prohibits the presence in state waters of wastes that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems. This provision is the basis for "biological impairment" determinations. WVDEP assesses compliance with the narrative criteria by monitoring the benthic macroinvertebrate community. Sediment reductions are required to restore water quality and habitat conditions in one of the biologically impaired streams in the North Branch/Potomac River watershed, UNT/Abram Creek RM 1.9 (WVPNB-16-0.5A).

A reference watershed approach was used to establish the acceptable level of sediment loading for each impaired stream on a watershed-specific basis. This approach was based on selecting a non-impaired watershed that shares similar land use, ecoregion, and geomorphologic characteristics with the impaired watershed. Stream conditions in the reference watershed are assumed to represent the conditions needed for the impaired stream to attain its designated uses. Given these parameters and a non-impaired WVSCI score, the Johnnycake Run watershed was selected as the reference. The location of the Johnnycake Run watershed is shown in Figure 6-2.

Sediment loading rates were determined for impaired and reference watersheds. Both point and nonpoint sources were considered in the analysis, and numeric endpoints were based on the calculated sediment loading from the reference watershed. Sediment load reductions necessary to meet these endpoints were then determined. TMDL allocation scenarios were developed based on an analysis of the degree to which contributing sources could be reasonably reduced.

TMDLs were developed using BasinSim 1.0 (Dai et al. 2000), the Generalized Watershed Loading Functions (GWLF) model (Haith and Shoemaker 1987), and the Stream Module (Tetra Tech 2003). A variety of GIS tools, local watershed data, and site visit observations were used to develop the input data needed for modeling and TMDL development.

The GWLF model was used to estimate the sediment loads contributed by each modeled watershed. GWLF is a continuous-simulation model that simulates runoff, sediment, and nutrient loadings. GWLF modeling was accomplished using the BasinSim 1.0 watershed simulation program. BasinSim 1.0 is a Windows-based GIS platform that facilitates execution of the GWLF model and development of model input data.

The Stream Module was used to model sediment transport/routing and stream bank erosion/deposition processes. The stream bank erosion simulation module employed the algorithm used in the Annualized Agricultural Nonpoint Source (AnnAGNPS) model (Bingner and Theurer 2002). Subwatershed loads calculated by GWLF and point source loads were input into the Stream Module to calculate the sediment loading to each stream channel and the load routed downstream. The Technical Report provides more detailed discussions on the technical approaches used for sediment modeling.

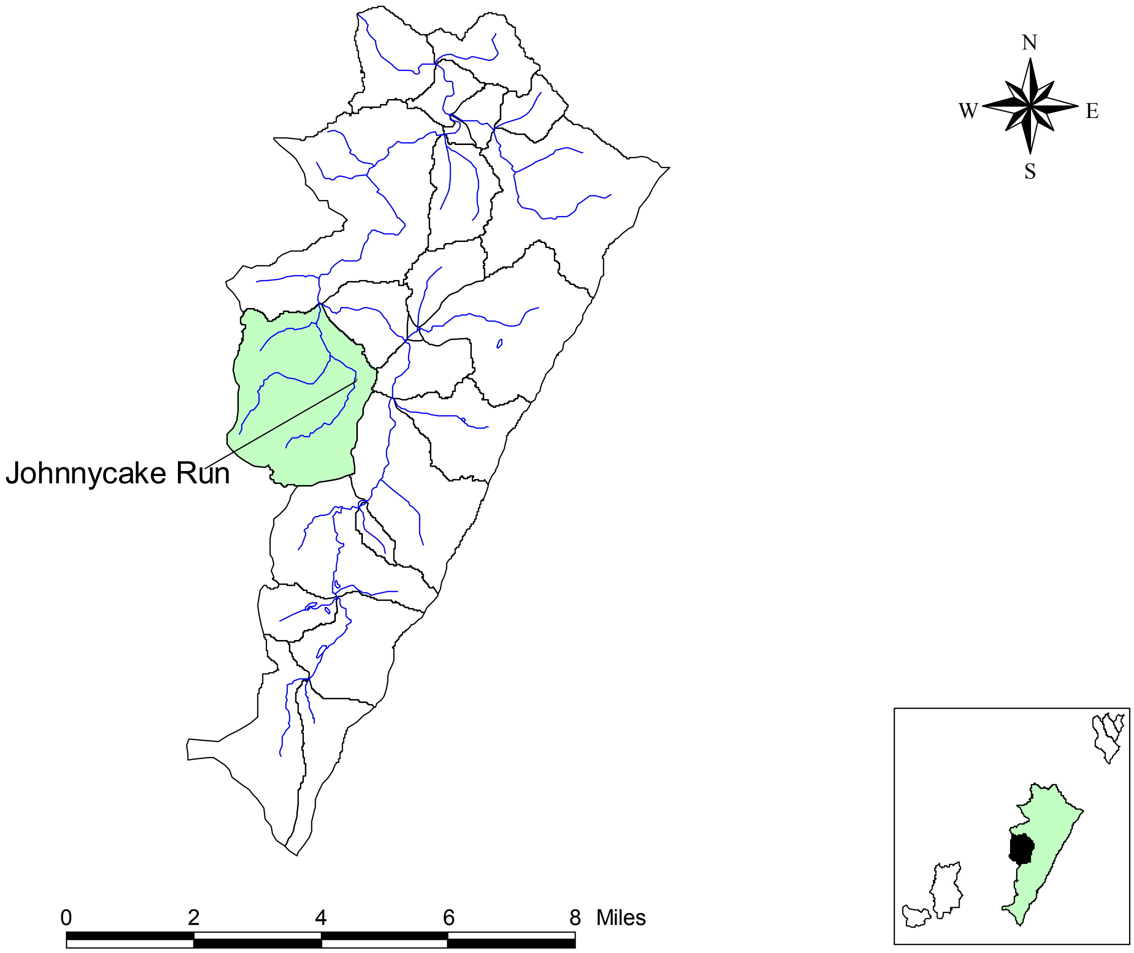


Figure 6-2. Location of the reference stream watershed.

6.2.1 GWLF/Stream Module Setup

The GWLF/Stream Module was configured for each impaired and reference stream in the watershed. Modeled watersheds were subdivided to simulate hydrologic and sediment loading characteristics using available meteorological, land use, point source loading, and stream data. Stream channel observational data provided by WVDEP were used to set up the Stream Module for the simulation of stream routing and erosion/deposition processes.

A continuous simulation period of eight years (April 1974-January 1982) was used in the hydrologic simulation analysis. An important factor driving model simulations is precipitation data. The pattern and intensity of rainfall affect erosion and the contribution of sediment from the land to the stream. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of agricultural land and forested land, land slope, soil erosion potential, and land disturbance activities, in each modeled watershed. Various parameters can be adjusted in the model to account for these conditions and practices.

Modeled land uses include forest (including wetlands), cropland, pasture, urban/residential pervious lands, urban/residential impervious lands, barren areas, roads, harvested forest, and abandoned mines.

6.2.2 Hydrology Calibration

Hydrology calibration and water quality calibration were performed in sequence because water quality modeling is dependent on an accurate hydrology simulation. The modeling period was determined on the basis of the availability of weather and flow data collected during the same period. The flow gauging station in the North Branch/Potomac River watershed described in Section 6.1.2 is the only USGS station with adequate data records for hydrology calibration. As with MDAS, the GWLF hydrology calibration was performed on the Abram Creek watershed and the model parameters were then applied to the other watersheds. The model was calibrated to the observed data recorded on Abram Creek from 1974 to 1982. Further description and a summary of the results of the hydrology calibration and validation are presented in the Technical Report.

6.2.3 Water Quality Calibration

GWLF is an empirical model that was developed based on established relationships between rainfall, erosion, and sediment transport. The Universal Soil Loss Equation (USLE) and runoff curve numbers developed by the NRCS form the basis of the GWLF model. Given proper model setup and sediment source representation, water quality calibration is usually not required for this empirically based model. Water quality calibration was performed, however, to verify the accurate representation of land uses in each watershed and the parameter values used in model simulations. GWLF predicted average annual and monthly sediment loads for each modeled watershed. Those results were compared to available water quality data (TSS and turbidity data) and habitat data collected by WVDEP for each stream.

6.3 Allocation Analysis

As explained in Section 2 of this report, a TMDL is composed of the sum of individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. TMDLs can be expressed in terms of mass per time or other appropriate measures. Conceptually, this definition is denoted by the equation:

$$\text{TMDL} = \text{sum of WLAs} + \text{sum of LAs} + \text{MOS}$$

To develop aluminum, iron, pH, and sediment TMDLs for each of the waterbodies listed in Table 3-3 of this report, the following approach was taken:

- Define TMDL endpoints.
- Simulate baseline conditions.
- Assess source loading alternatives.

- Determine the TMDL and source allocations.

6.3.1 TMDL Endpoints

TMDL endpoints represent the water quality targets used to quantify TMDLs and their individual components. Where applicable, TMDLs are presented as average annual loads because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. Analysis of available data indicated that critical conditions occur during both high- and low-flow events. To appropriately address the low- and high-flow critical conditions, the TMDLs were developed using continuous simulation (modeling over a period of several years that captured precipitation extremes), which inherently considers seasonal hydrologic and source loading variability. Therefore, because this variability is present throughout the North Branch/Potomac River watershed, the TMDLs are presented as average annual loads. Different TMDL endpoints are necessary for dissolved aluminum, total iron, pH, and sediment. West Virginia's numeric water quality criteria for the subject pollutants (identified in Section 2) and an explicit MOS were used to identify endpoints for TMDL development.

Dissolved Aluminum and Total Iron

The TMDL endpoints for dissolved aluminum were selected as 712.5 micrograms per liter (µg/L; based on the 750 µg/L acute criterion for aquatic life minus a 5 percent MOS) and 82.7 µg/L (based on the 87 µg/L chronic criterion for aquatic life minus a 5 percent MOS). The endpoint for total iron was selected as 1.425 mg/L (based on the 1.5 mg/L criterion for aquatic life minus a 5 percent MOS). Components of the TMDLs for aluminum and iron are presented as average annual loads in terms of pounds of pollutant per year.

pH

The water quality criteria for pH allow no values below 6.0 or above 9.0. With respect to acid mine drainage, pH is not a good indicator of the acidity in a waterbody and can be a misleading characteristic. Water with near-neutral pH (~ 7) but containing elevated concentrations of dissolved ferrous (Fe^{2+}) ions can become acidic after oxidation and precipitation of the iron (PADEP 2000). Therefore, a more practical approach to meeting the water quality criteria for pH is to use the concentration of metal ions as a surrogate for pH. It was assumed that reducing in-stream metals (iron and aluminum) concentrations to meet water quality criteria (or TMDL endpoints) would result in meeting the water quality standard for pH. This assumption was verified by applying DESC-R. By executing DESC-R under TMDL conditions (conditions in which TMDL endpoints for metals were met), the equilibrium pH could be predicted. The Technical Report contains a detailed description of the pH modeling approach. The TMDLs for the pH-impaired streams are presented as the median equilibrium pH that was calculated based on the daily equilibrium pH output (6-year simulation period) from DESC-R.

Sediment

The endpoints for the sediment TMDLs were based on the simulated reference watershed sediment loading (from the Johnnycake Run watershed). A 5 percent MOS was applied to the reference sediment load, and the sediment load reductions necessary to meet those endpoints were then determined. TMDL allocation scenarios were developed based on an analysis of the degree to which contributing sources could be reasonably reduced.

Components of the TMDLs for sediment are presented as average annuals loads in terms of tonnes of pollutant per year.

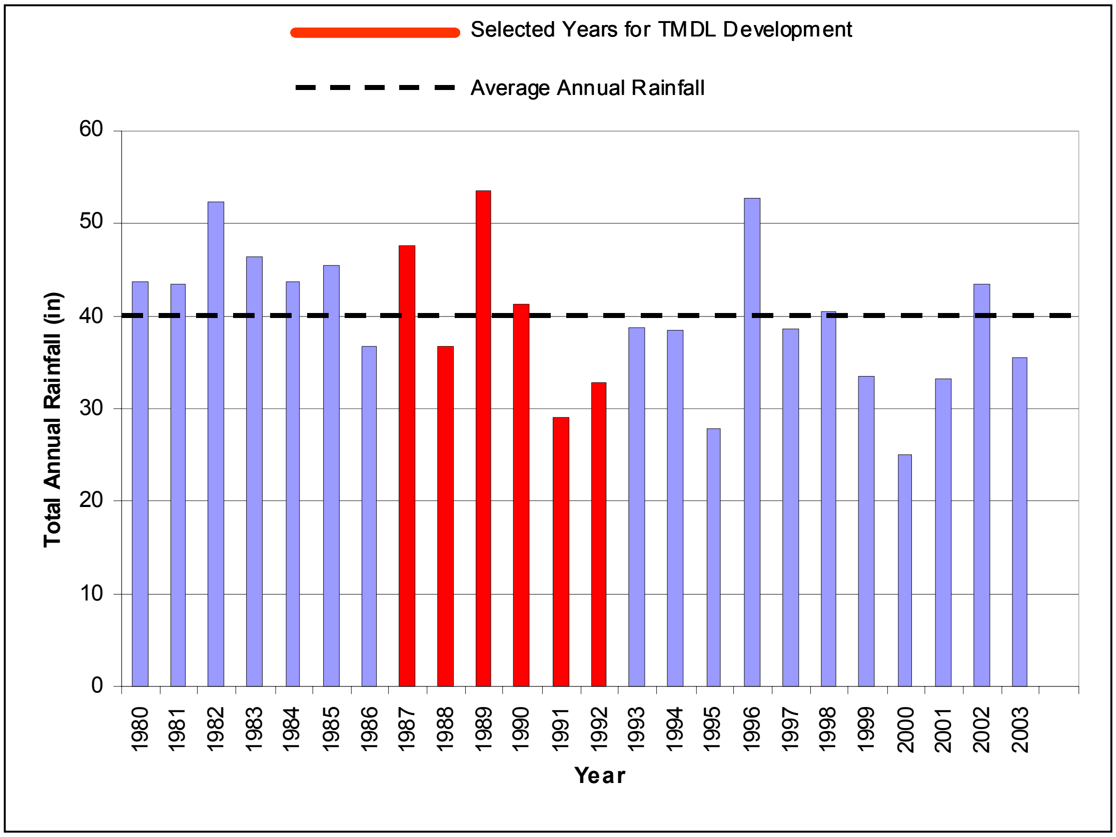
Margin of Safety
A 5 percent explicit MOS was used to counter uncertainty in the modeling process. Long-term water quality monitoring data were used for model calibration. Although these data represented actual conditions, they were not of a continuous time series and might not have captured the full range of in-stream conditions that occurred during the simulation period. The explicit 5 percent MOS also accounts for those cases where monitoring might not have captured the full range of in-stream conditions.

6.3.2 Baseline Conditions and Source Loading Alternatives

The calibrated model provided the basis for performing the allocation analysis. The first step in this analysis involved simulation of baseline conditions. Baseline conditions represent existing nonpoint source loadings and point source loadings at permit limits. Baseline conditions allow for an evaluation of in-stream water quality under the highest expected loading conditions.

Baseline Conditions for MDAS
The MDAS model was run for baseline conditions using hourly precipitation data for a representative 6-year period (1987 to 1992). The precipitation experienced over this period was applied to the land uses and pollutant sources as they existed at the time of TMDL development. Predicted in-stream concentrations were compared directly to the TMDL endpoints. Using the model linkage described in Section 6.1, total aluminum was simulated using the MDAS model, and DESC-R was used to compare predicted dissolved aluminum concentrations to the TMDL endpoint. This comparison allowed for the evaluation of the magnitude and frequency of exceedances under a range of hydrologic and environmental conditions, including dry, wet, and average periods.

Figure 6-3 presents the annual rainfall totals for the years 1980 through 2003 at the Moorefield 1 SSE weather station in Moorefield, West Virginia. The years from 1987 to 1992 are highlighted to indicate that a range of precipitation conditions was used for TMDL development.



Note: Rainfall totals for 2003 are from 1/1/2003 through 7/31/2003

Figure 6-3. Annual precipitation totals and percentile ranks for Moorefield 1 SSE weather station in Moorefield, West Virginia.

Permitted conditions for mining facilities were represented during baseline conditions using precipitation-driven flow estimations and the metals concentrations presented in Table 6-1.

Table 6-1. Metals concentrations used in representing permitted conditions for mines

Pollutant	Technology-based Permits	Water Quality-based Permits
Aluminum, total	3.95 mg/L (98th percentile DMR values)	Monitor only
Iron, total	3.2 mg/L	1.5 mg/L

Baseline Conditions for GWLF

The calibrated GWLF model provided the basis for performing the allocation analysis. The first step in the analysis involved simulation of baseline conditions. The baseline conditions allowed for an evaluation of in-stream water quality under the highest expected loading conditions. The pollutant loadings from nonpoint sources were modeled based on precipitation and runoff; non-mining point sources were represented at design flow and the TSS limits of their permits. The GWLF model was run for baseline conditions using daily precipitation data for the representative period discussed earlier. The precipitation data were applied to the land uses and pollutant sources that existed at the time of TMDL development. The resultant predicted watershed loadings were then compared directly to the TMDL endpoint. Similar to MDAS, this comparison allowed evaluation of sediment loadings under a range of hydrologic and environmental conditions, including dry periods, wet periods, and average periods.

Source Loading Alternatives

The simulation of baseline conditions allows for the evaluation of each steam's response to variations in source contributions under a variety of hydrologic conditions. This sensitivity analysis gave insight into the dominant sources and the mechanisms by which potential decreases in loads would affect in-stream pollutant concentrations. The loading contributions from abandoned mines and other nonpoint sources were individually adjusted; the modeled in-stream concentrations were then evaluated.

Multiple allocation scenarios were run for the impaired waterbodies. Successful scenarios were those, which achieved the TMDL endpoints under all flow conditions throughout the modeling period. For dissolved aluminum scenario development, the DESC-R output was compared directly to the TMDL endpoint. If the predicted dissolved aluminum concentrations exceeded the TMDL endpoint, the total aluminum sources represented in MDAS were reduced. The averaging period and allowable exceedance frequency associated with West Virginia water quality criteria were considered in these assessments. In general, loads contributed by sources that had the greatest impact on in-stream concentrations were reduced first. If additional load reductions were required to meet the TMDL endpoints, less significant source contributions were subsequently reduced.

Figure 6-4 is an example of model output for a baseline condition and a successful TMDL scenario.

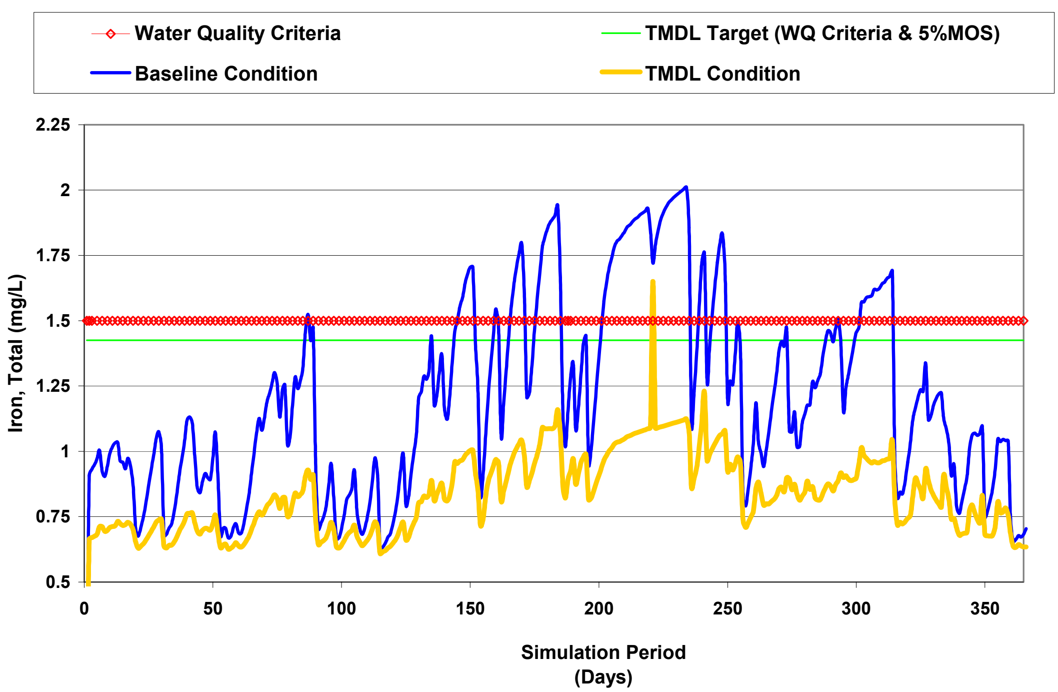


Figure 6-4. Example of baseline and TMDL conditions for total iron.

6.4 TMDLs and Source Allocations

6.4.1 Dissolved Aluminum, Total Iron, and pH TMDLs

TMDLs and source allocations were developed for impaired segments of selected steams and their tributaries on a subwatershed basis for each of the six watersheds in the North Branch/Potomac River watershed shown in Figure 3-2. A top-down methodology was followed to develop these TMDLs and allocate loads to sources. Headwaters were analyzed first because their loading affects downstream water quality. Loading contributions were reduced from applicable sources in these waterbodies, and TMDLs were developed. The loading contributions of unimpaired headwaters and the reduced loadings for impaired headwaters were then routed through downstream waterbodies. Using this method, contributions from all sources were weighted equitably. Reductions in sources affecting impaired headwaters ultimately led to improvements downstream and effectively decreased necessary loading reductions from downstream sources. Nonpoint source reductions did not result in loadings less than natural conditions.

The following general methodology was used when allocating loads to sources for the North Branch/Potomac River watershed TMDLs:

- For watersheds with AMLs but no permitted point sources, AML loads were reduced first, until in-stream water quality criteria were met or to conditions no less than those of undisturbed forest. If further reductions were required, the loads from sediment sources (barren, harvested forest, oil and gas operations, and roads) were reduced until water quality criteria were met.

- For watersheds with AMLs and point sources, point sources were set at the precipitation-induced load defined by the permit limits and AML loads were subsequently reduced. Loads from AMLs and revoked-permit mines were reduced (point sources were not reduced) until in-stream water quality criteria were met, if possible. If further reduction was required once loads from AMLs and revoked-permit mines were reduced, sediment sources and/or technology-based permitted point source discharge limits were reduced were reduced based on sensitivity analyses of their respective impacts.

- For watersheds where dissolved aluminum TMDLs were developed, source allocations for total iron were developed first because their total in-stream concentrations significantly reduce pH and consequently increase dissolved aluminum concentrations. If the dissolved aluminum TMDL endpoint was not attained after source reductions to iron, the total aluminum source loadings were reduced based on the methodology described above.

Wasteload Allocations

WLAs were made for all permitted mining operations except limestone quarries and those with a Completely Released or Phase Two Released SMCRA permit classification. Programmatic reclamation was assumed to have restored those permitted areas. On the basis of the types of activities and the nature of their discharges, permitted non-mining point sources were considered to have negligible impacts on water quality. These minor discharges were represented in the baseline condition based on existing permit requirements.

The TMDLs assign WLAs that afford continued operation under those terms and conditions. Loading from revoked-permit facilities was assumed to be a nonpoint source contribution based on the absence of a permittee.[1]

The WLAs for individual NPDES permits for aluminum and iron are shown in the allocation spreadsheets associated with this report. The dissolved aluminum TMDLs were based on a dissolved aluminum TMDL endpoint; however, sources were represented in terms of total aluminum. Wasteload allocations for aluminum are also provided in the form of total metal. The WLAs are presented as annual loads, in pounds per year and as constant concentrations. The concentration allocations can be converted to monthly averages and daily maximum effluent limitations using USEPA's *Technical Support Document for Water Quality-based Toxics Control* (USEPA 1991). WLA concentration ranges are as follows: aluminum: 0.75–3.72 mg/L, iron: 1.5–3.2 mg/L.

In certain instances, prescribed wasteload allocations may be less stringent than existing effluent limitations. The TMDLs are not intended to direct relaxation of effluent limitations developed under alternative bases.

WVDEP's implementation of the antidegradation provisions of the West Virginia water quality standards might sometimes result in more stringent allocations than those resulting from the TMDL process. Whereas TMDLs prescribe allocations that minimally achieve water quality criteria (100 percent use of a stream's assimilative capacity), the antidegradation provisions of the standards are designed to maintain the existing quality of high-quality waters and might result in more stringent allocations that limit the use of remaining assimilative capacity.

TMDL allocations reflect pollutant loadings that are necessary to achieve water quality criteria at distinct locations (i.e., the pour points of delineated subwatersheds). In the permitting process, limitation development is based on the achievement/maintenance of water quality criteria at the point of discharge. Water quality-based effluent limitation development in the permitting process may dictate more stringent effluent limitations for upstream discharge locations.

Load Allocations

LAs were made for the dominant source categories as follows:

- AMLs, including abandoned mines (surface and deep) and highwalls
- Revoked permits: loading from revoked-permit facilities/bond forfeiture sites
- Sediment sources: metals loading associated with sediment contributions from barren areas, harvested forest, oil and gas well operations, and roads

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

- Other nonpoint sources: urban/residential, agricultural, and forested land contributions (loadings from other nonpoint sources were not reduced)

The LAs for aluminum and iron are presented in the allocation spreadsheets associated with this report. The dissolved aluminum TMDLs were based on a dissolved aluminum TMDL endpoint; however, sources were represented in terms of total aluminum. The LAs for aluminum are also provided in the form of total metal. The LAs are presented as annual loads (pounds per year) because they were developed to meet TMDL endpoints under a range of flow conditions.

The iron and aluminum TMDLs are presented in the subwatershed appendices for each of the North Branch/Potomac River watersheds addressed by this report.

As stated in Section 6.3.1, a surrogate approach was used for the pH TMDLs. It was assumed that reducing in-stream metals (iron and aluminum) concentrations to meet TMDL endpoints would result in meeting the water quality standard for pH. This assumption was verified by running DESC-R for an extended period (6 years) in which TMDL endpoints for metals were met. A long-term median pH was calculated based on the daily equilibrium pH output from DESC-R. These results are also shown in the Abram Creek, Little Buffalo Creek, Montgomery Run, and Piney Swamp Run appendices. The Technical Report provides a detailed description of the pH modeling approach.

6.4.2 Sediment TMDLs

A TMDL and source allocations were developed for UNT/Abram Creek RM 1.9. Loading contributions were reduced from applicable sources for these waterbodies, and TMDLs were developed. Source reductions never resulted in loading contributions less than those under the natural conditions represented by the undisturbed forest. Model results from the selected successful scenarios were then routed downstream using the Stream Module, which incorporated sediment transport/routing and stream bank erosion/deposition processes. If necessary, reductions were made in sediment contributions from stream bank erosion.

When allocating to land use-based sediment sources, a unit area loading approach was used to establish equitable source allocations. This approach was based on the assumptions that point sources subject to water pollution control permits provide the highest degree of sediment control and that activities that are subject to programmatic best management practices (BMPs) contribute less sediment than do uncontrolled sources. Therefore, sediment sources were reduced systematically in a stepwise fashion until the TMDL endpoint was achieved.

- Step 1: Loads from uncontrolled sediment sources (barren areas and unpaved roads) were reduced to the unit area loading of programmatic BMP sources (harvested forest and oil and gas operations).

- Step 2: If further reduction was required, loads from uncontrolled sediment sources and programmatic BMP sources were together reduced to the unit area loading of point sources.

- Step 3: If even further reduction was required to meet the TMDL endpoint, loads from all sediment sources were reduced to the extent necessary to achieve the reference watershed loading. These sediment source reductions were based on their relative contribution to the overall sediment load.

In the UNT/Abram Creek RM 1.9 watershed, there are no active mining operations. Consequently, Step 1 and Step 2 were executed until the TMDL endpoints were attained.

After the land use-based sources were reduced, sediment produced from in-stream processes (bank erosion/deposition) was evaluated on a subwatershed basis. In subwatersheds where bank erosion was significant, sediment reduction was prescribed for in-stream processes and the land use-based allocations were then adjusted accordingly.

Wasteload Allocations

WLAs were made for all permitted mining operations except limestone quarries and those with a Completely Released or Phase Two Released SMCRA permit classification. Programmatic reclamation was assumed to have restored those permitted areas.

Sediment modeling of active mining operations represented the contemporaneous reclamation practices employed by the industry and the removal efficiency associated with treatment structures. WLAs are presented as average annual loads and concentrations in the allocation spreadsheets associated with this report.

Within the sediment-impaired watersheds, there are no sources that have industrial stormwater and sewage permits. The WLAs are presented as average annual loads, in tonnes per year, and are shown in the allocation spreadsheets associated with this report.

When the TMDLs were developed, there were no construction stormwater permits in the sediment-impaired watersheds. A provision for future growth related to construction activity is provided and explained in Section 7.

Load Allocations

LAs were assigned as required to the following nonpoint source categories:

- Pasture/Grassland (including pasturelands and successional grasslands)
- Barren land areas
- Harvested forest (including skid roads and landing areas)
- Residential (sediment loading associated with urban/residential runoff)
- Roads (including paved and unpaved roads)
- In-stream processes (bank erosion and deposition)
- Other nonpoint sources—forested land (loadings from other nonpoint sources were not reduced)

The sediment LAs are presented as average annuals loads, in tonnes per year, and are shown in the allocation spreadsheets associated with this report.

The sediment TMDLs are presented for UNT/Abram Creek RM 1.9 in the Abram Creek subwatershed appendix.

6.4.4 Seasonal Variation

The TMDL must consider seasonal variation. For the North Branch/Potomac River watershed TMDLs, seasonal variation was considered in the formulation of the modeling analysis. Continuous simulation (modeling over a period of several years that captured precipitation extremes) inherently considers seasonal hydrologic and source loading variability. The metals concentrations simulated on a daily time step by the model were compared to TMDL endpoints. Allocations that met these endpoints throughout the modeling period were developed.

6.4.5 Critical Conditions

TMDL developers must select the environmental conditions that will be used for defining allowable loads. Many TMDLs are designed around the concept of a "critical condition." The critical condition is the set of environmental conditions that, if met, will ensure the attainment of objectives for all other conditions. Nonpoint source loading is typically precipitation-driven. In-stream impacts tend to occur during wet weather and storm events that cause surface runoff to carry pollutants to waterbodies. During dry periods, little or no land-based runoff occurs, and elevated in-stream pollutant levels may be due to point sources (Novotny and Olem 1994). Analysis of water quality data for the North Branch/Potomac River watershed shows high pollutant concentrations during both high and low flow, indicating that there are both point and nonpoint source impacts. Both high-flow and low-flow periods were taken into account during TMDL development by using a long period of weather data that represented wet, dry, and average flow periods.

7. FUTURE GROWTH AND WATER QUALITY TRADING

7.1 Metals and pH

This TMDL does not include specific future growth allocations to each subwatershed. However, the absence of specific future growth allocations does not prohibit new mining in the subwatersheds for which iron and aluminum TMDLs have been developed. Pursuant to 40 CFR 122.44(d)(1)(vii)(B), effluent limits must be "consistent with the assumptions and requirements of any available wasteload allocation for the discharge...." In addition, the federal regulations generally prohibit issuing a permit to a new discharger "if the discharge from its construction or operation will cause or contribute to the violation of water quality standards." A discharge permit for a new discharger could be issued under the following scenarios:

1. A new facility could be permitted anywhere in the watershed, provided that effluent limitations are based on the achievement of water quality standards at end-of-pipe for the pollutants of concern in the TMDL.

NPDES permitting rules mandate that effluent limitations for metals be prescribed in the total recoverable form. For iron, the West Virginia water quality criterion is in total recoverable form and can be directly implemented. Because aluminum water quality criteria are in dissolved form, a dissolved/total pollutant translator is needed to determine effluent limitations. A new facility could be permitted in the watershed of a dissolved aluminum-impaired stream if total aluminum effluent limitations are based on the dissolved aluminum, chronic, aquatic life protection criterion and a dissolved/total aluminum translator equal to 1.0.

2. Remining (under an NPDES permit) could occur without a specific allocation to the new permittee, provided that the requirements of existing state remining regulations are met. Remining activities will not worsen water quality and in some instances might result in improved water quality in abandoned mining areas.

3. Reclamation and release of existing permits could provide an opportunity for future growth provided that permit release is conditioned on achieving discharge quality better than the WLA prescribed by the TMDL.

7.2 Sediment

There are no active mining operations in the sediment-impaired watersheds addressed by this report. However, new mining point sources may be permitted anywhere in the sediment-impaired watersheds provided that the permit contains an annual average TSS effluent limitation of 120 mg/L. This value represents the most stringent WLA assigned to existing mining sources in current and previous TMDL development efforts (Coal River and Upper Kanawha River watersheds) and WVDEP has concluded that discharges in compliance with this limitation will not cause or contribute to a violation of water quality standards.

Non-mining point source discharges are assigned technology-based TSS effluent limitations that would not cause biological impairment. For example, NPDES permits for sewage treatment and industrial manufacturing facilities contain monthly average TSS effluent limitations between 30 and 60 mg/L. New non-mining point sources may also be permitted in the sediment-impaired watersheds with the implementation of applicable technology-based TSS requirements.

Although construction stormwater permits are not present in the Abram Creek watershed, specific future growth allowances are provided. The successful TMDL allocation scenarios allow for 0.5 percent of the Abram Creek watershed to be disturbed subject to the terms and conditions of the Construction Stormwater General Permit. A minimum of 10 acres is reserved in all subwatersheds for future growth. In subwatersheds where 0.5 percent of the area is less than 10 acres, the minimum of 10 acres is automatically designated for future growth. The reserved acreage is expected to accommodate future development in the subject watershed. If development projects are proposed in excess of the acreage provided, they may be permitted by implementing controls beyond those afforded by the general permit. Larger areas may be permitted if it can be demonstrated that tighter controls will result in a loading condition commensurate with the general permit area allocations provided in Table 7-1.

Table 7-1. Future growth for construction stormwater permits

Watershed	West Virginia Total Watershed Area (acres)	West Virginia Future Growth Area: 0.5% Total Watershed Area (Acres)
UNT/Abram Creek RM 1.9	767	10.0

7.3 Water Quality Trading

This TMDL neither prohibits nor authorizes trading in the watersheds addressed in the document. WVDEP generally endorses the concept of trading and recognizes that it might become an effective tool for TMDL implementation. However, significant regulatory framework development is necessary before large-scale trading can be realized in West Virginia. Furthermore, WVDEP supports program development assisted by a consensus-based stakeholder process. Before the development of a formal trading program, it is conceivable that the regulation of specific point source-to-point source trades might be feasible under the framework of the NPDES program.

8. PUBLIC PARTICIPATION

8.1 Public Meetings

An informational public meeting was held on May 30, 2002 at Blackwater Falls State Park, West Virginia, to present fundamental TMDL information and introduce interested parties to the local TMDL development process. One additional meeting was held at the Mineral County Health Department on September 23, 2004, at which detailed information was presented relative to WVDEP's proposed allocation strategies. On August 22, 2005 a final public meeting to present draft TMDLs was held at the Mineral County Health Department.

8.2 Public Notice and Public Comment Period

The availability of draft TMDLs was advertised in local newspapers on various dates between August 12, 2005 and August 15, 2005. Interested parties submitted comments during the public comment period that began on August 12, 2005 and ended September 12, 2005.

8.3 Response Summary

Special Note: This Section discusses DEP response to comments received after the public notice of the original Draft North Branch/Potomac River Watershed TMDLs in September 2005. In July 2006, DEP provided public notice of revised, draft dissolved aluminum TMDLs (North Branch/Potomac River Watershed Dissolved Aluminum TMDL Addendum) and an additional public comment period. DEP responses to comments received pursuant to the dissolved aluminum addendum are contained within that document.

The West Virginia Department of Environmental Protection (WVDEP) is pleased to provide this response to comments on the draft TMDLs. The WVDEP appreciates the efforts commenters have put forth to improve the West Virginia TMDL development process. The following entities provided written comments on the draft TMDLs:

- Upper Potomac River Commission
- NewPage Corporation
- United States Environmental Protection Agency Region 3

Comments have been compiled and responded to in this response summary. Comments and comment summaries are in boldface and italic. Agency responses appear in plain text.

The EPA comments included various typographical /editorial revisions. Although not individually detailed in this summary, WVDEP considered all such comments and revised both the main report and subwatershed appendices, as appropriate.

1) Upper Potomac River Commission (UPRC) and NewPage Corporation (NP) provided technical information concerning the outlets of NPDES Permits WV0113441 (UPRC) and WV0046329 (NP).

The outlets from five treatment ponds are co-regulated by both permits. This unique scenario was not recognized and resulted in the overestimation of the baseline loading associated with the co-regulated discharges. Three outlets of Permit No. WV0046329 were not accounted for in the draft TMDL. The subject outlets (016, 017 and 018) were recently permitted (12/30/2004) and were not included in the initial model representation. Additionally, three outlets of Permit No. WV0113441 were incorrectly located in the initial model representation.

After field verification of the information provided, the model was re-configured as follows:

- Outlets 012, 013 and 015 of Permit No. WV0113441 are recognized as co-regulated as Outlets 012, 013 and 015 of Permit No. WV0046329. The outlets discharge to Montgomery Run in model subwatershed 1101.
- Outlet 009 of Permit No. WV0113441 is recognized as co-regulated as Outlet 009 of Permit No. WV0046329. This outlet discharges to Piney Swamp Run in model subwatershed 1203.
- Outlet 010 of Permit No. WV0113441 is recognized as co-regulated as Outlet 010 of Permit No. WV0046329. This outlet discharges to the unnamed tributary of Piney Swamp Run at milepoint 0.7, in model subwatershed 1202.
- Outlet 016 of Permit No. WV0113441 is recognized as co-regulated as Outlet 018 of Permit No. WV0046329. This outlet discharges to Piney Swamp Run in model subwatershed 1203.
- Outlets 016 and 017 of Permit No. WV0046329 were added. The outlets discharge to Piney Swamp Run in model subwatershed 1201.

The reconfiguration resulted in relaxation of the wasteload allocations for WV/NPDES Permits No. WV0046329 and WV0113441 in subwatersheds 1202 and 1101, as shown in the following table:

Table 8-1. Model reconfiguration results

Model SWS	Fe WLA Draft	Fe WLA Final	Al WLA Draft	Al WLA Final
	(mg/l)	(mg/l)	(mg/l)	(mg/l)
1201	NA	3.2	NA	3.95
1202	1.50	1.98	0.12	0.47
1203	3.2	3.2	3.95	3.95
1101	1.5	3.2	0.75	0.75

Note that the subwatershed 1203 wasteload allocations are unchanged and do not represent reductions from baseline conditions. The wasteload allocations for the outlets added to subwatershed 1201 also do not represent reductions from baseline conditions.

2) Mining or disposal activities no longer occur on UPRC's Green Mountain Site (Permit No. WV0110868). This site has been completely reclaimed and the permit does not include effluent limitations for the pollutants of concern for Outlets 001-004. As such, the need for wasteload allocations and the effect upon permit reissuance were questioned.

The Green Mountain Site's reclaimed status was recognized in the Draft TMDL and the wasteload allocations for iron and aluminum did not require reduction. The presentation of allocations in the concentration form raised concern that the TMDL would require the imposition of numeric effluent limitations in the NPDES permit. Section 4.1.2 and the allocation spreadsheet were revised to clearly indicate that no pollutant reduction is required for the Green Mountain Site and that operation under the terms of the existing stormwater permit is acceptable.

3) UPRC advised that they do not operate under a mining NPDES permit and wasteload allocation display on the "Mining WLAs Metals" tab is inappropriate.

This mistake also resulted from the co-regulation of outlets by permits WV0113441 and WV0046329 and has been rectified. The revised display of the co-regulated outlets on the allocated spreadsheets occurs primarily on the "Mining WLAs Metals" tab under Permit No. WV0046329. On the "Non-Mining WLAs" tab, Permit No. WV0113441 allocations are referenced to those for the corresponding outlets of Permit No. WV0046329.

4) UPRC and NewPage expressed an opinion that point source reductions will not result in the restoration of water quality in Piney Swamp Run. Instead, the bond forfeiture site "Nally Strip" should be targeted.

The Draft TMDL is consistent with this comment. The "Nally Strip" site is represented in the baseline condition, and 98% and 99% reductions are prescribed for iron and aluminum, respectively. Similar significant reductions are also specified for AML sources throughout the watershed. Point source loadings are not reduced from baseline conditions in relation to the water quality of the mainstem of Piney Swamp Run. In the limited instances where point source reductions are prescribed, they are necessary for water quality criteria compliance in the tributaries of Piney Swamp Run.

5) A discussion of the recently approved revision of the manganese criterion applicability and its impact upon waters in this TMDL development effort was requested.

The discussion has been provided in Section 2.2, the Executive Summary and the Technical Report, as requested

9. REASONABLE ASSURANCE

Reasonable assurance for maintenance and improvement of water quality in the affected watershed rests primarily with three separate programs. Two of these programs are wholly within WVDEP, and the third program is a cooperative effort involving many state and federal agencies. Within WVDEP, the programs involved in the effort include the NPDES Permitting Program and the Abandoned Mine Lands Program. In addition, WVDEP is involved with the West Virginia Watershed Management Framework, which includes many state and federal agencies dealing with the protection and restoration of water resources. The framework process allows the resources of many entities to focus on the protection or restoration of water quality in selected streams.

Historically, mine drainage research has been conducted by scientists at West Virginia University, the West Virginia Division of Natural Resources, the U.S. Office of Surface Mining, the National Mine Land Reclamation Center, the National Environmental Training Laboratory, and other agencies and by individuals within West Virginia. In addition, USEPA Section 319 Grant funding has been used to address issues resulting from acid mine drainage.

9.1 Permit Reissuance

WVDEP's Division of Water and Waste Management is responsible for issuing non-mining NPDES permits within the state. The Division of Mining and Reclamation develops NPDES permits for mining activities. As part of the permit review process, permit writers must incorporate the required TMDL WLAs into new or reissued permits. Both the permitting and TMDL development processes have been synchronized with the Watershed Management Framework cycle, such that TMDLs are completed just before the permit expiration/reissuance time frames. Permit reissuance in the North Branch/Potomac River watershed is scheduled to begin in July 2006 for non-mining facilities and in January 2007 for mining facilities. Therefore, the WLAs for existing activities will be promptly implemented. New facilities will be permitted in accordance with future growth provisions.

9.2 Watershed Management Framework Process

The framework consists of a group of state and federal agencies whose goal is to develop and implement watershed management strategies through a cooperative, long-range planning effort. The framework is incorporated by reference into West Virginia's Continuing Planning Process. The framework consists of representatives from the following partner agencies:

Bureau for Public Health
Department of Highways
Department of Environmental Protection
State Conservation Agency
Division of Forestry
Division of Natural Resources
West Virginia University (WVU) Extension Service
ORSANCO (Ohio River Valley Water Sanitation Commission)
U.S. Geological Survey
U.S. Office of Surface Mining
Monongahela National Forest
U.S. Environmental Protection Agency
Natural Resources Conservation Service
U.S. Army Corps of Engineers
U.S. Department of Agriculture

The principal area of focus for the framework is correcting problems related to nonpoint source pollution. Each of the partner agencies has placed a greater emphasis on identification and correction of nonpoint source pollution. The combined resources of these agencies are used to address all different types of nonpoint source pollution through public education and on-the-ground projects. The framework also incorporates, as part of its priority selection criteria, the state's section 303(d) list of impaired waters.

Among other things, the framework includes a management schedule for integration and implementation of TMDLs. In 2000 the schedule for TMDL development under section 303(d) was merged with the framework process. Framework Chapter 3.2.2, titled "Developing and Implementing Integrated Management Strategies," identifies a six-step process for developing integrated management strategies and action plans for achieving the state's water quality goals. Step 3 of that process includes "identifying point source and/or nonpoint source management strategies—or Total Maximum Daily Loads—predicted to best meet the needed [pollutant] reduction." Following development of the TMDL, steps 5 and 6 provide for preparation, finalization, and implementation of an "action plan" that implements the TMDL and any other appropriate water quality improvement strategy.

The framework uses the 5-year Watershed Cycle to identify watersheds where restoration efforts will be focused. Each year member agencies meet to prioritize watersheds within a certain Hydrologic Group to begin the planning process. This selection process includes a review and evaluation of TMDL recommendations for the watersheds under consideration.

The plan development process used by the framework is based on the efforts of local project teams. These teams are composed of framework members and stakeholders having interest in or residing in the watershed. Team formation is based on the type of impairment(s) occurring or protections needed within the watershed. In addition, teams have the ability to use the TMDL recommendations to help plan future activities. The team's goal is to develop a project plan that allows the most efficient use of resources from all involved parties. Once the project plan has been developed and funded, the agencies can implement the planned activities to address the actions recommended by the TMDL.

9.3 AML Projects

The primary WVDEP entity that deals with abandoned mine drainage issues is the Division of Land Restoration. As noted in section 4.2.1, within the Division, the Office of AML&R was created in 1981 to manage the reclamation of lands and waters affected by mining prior to passage of the SMCRA in 1977. A fee placed on coal mined in West Virginia funds the Office of AML&R's budget. Allocations from the AML fund are made to state and tribal agencies through the congressional budgetary process. AML&R has recently increased its emphasis on correcting water quality problems at sites primarily chosen for protection of public health, safety, and property and is actively participating in the Watershed Management Framework.

9.4 Special Reclamation Projects

The Office of Special Reclamation is part of the Division of Land Restoration. Since August 1997 Special Reclamation has been mandated by the State of West Virginia to protect public health, safety, and property by reclaiming and treating water on all bond-forfeited coal mining sites in an expeditious and cost-effective manner. Funding for this program is obtained from collection of forfeited bonds, civil penalties, and the Special Reclamation Tax placed on mined coal.

There are two bond forfeiture sites in the watersheds addressed in this report. The Office of Special Reclamation has completed land reclamation at the Glade Run Mining Company site. However, the land reclamation at The Masteller Coal Company as well as the remaining water quality impacts at both sites is to be completed in the future. Table 10-1 lists sites where the Office of Special Reclamation will fund the construction of acid mine drainage treatment facilities. The water treatment systems for The Glade Run Mining Company site is scheduled to begin construction by September 2007 and the Masteller Coal Company site is scheduled to begin construction by June 2008.

Table 9-1. North Branch/Potomac River watershed bond forfeiture sites with water treatment needs

Original Permittee	Permit No.	Affected Subwatersheds
Glade Run Mining Company	3-72	Abram Creek
The Masteller Coal Company	S-10-85	Piney Swamp Run

10. MONITORING PLAN

The following monitoring activities are recommended:

10.1 NPDES Compliance

WVDEP's DWWM is responsible for ensuring that NPDES permits contain effluent limitations as prescribed by the TMDL WLAs and to assess and compel compliance. Permits contain effluent self-monitoring and reporting requirements, which WVDEP periodically reviews. WVDEP also inspects treatment facilities and independently monitors NPDES discharges. The combination of these efforts will ensure implementation of the TMDL wasteload allocations.

10.2 Nonpoint Source Project Monitoring

All nonpoint source restoration projects should include a monitoring component specifically designed to document the local improvements in water quality that result. These data can also be used to predict expected pollutant reductions from similar future projects.

10.3 TMDL Effectiveness Monitoring

TMDL effectiveness monitoring should be performed to document water quality improvements after significant implementation activity has occurred because little change in water quality would otherwise be expected. Full TMDL implementation will take significant time and resources, particularly with respect to the abatement of nonpoint source impacts. WVDEP will continue monitoring on the rotating basin cycle and will include a specific TMDL effectiveness component in waters where significant TMDL implementation has occurred.

11. REFERENCES

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