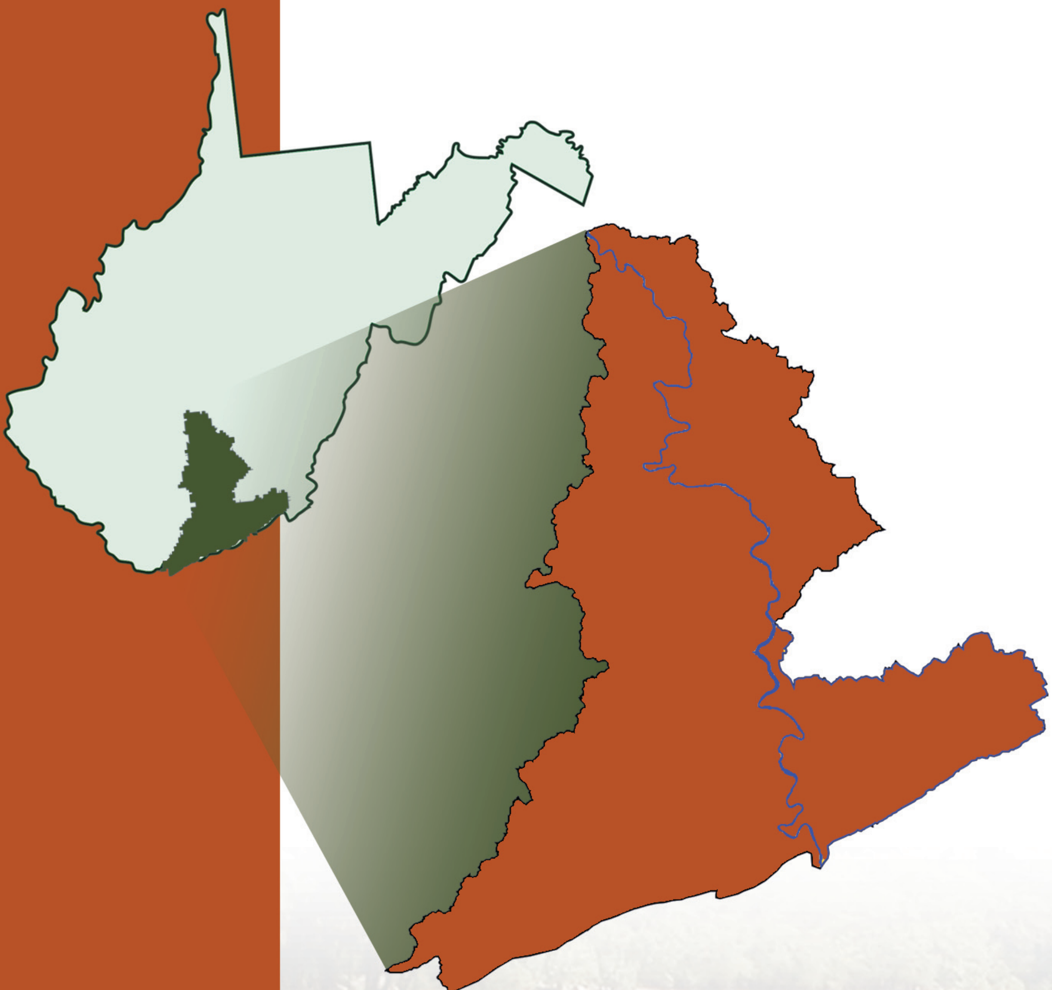
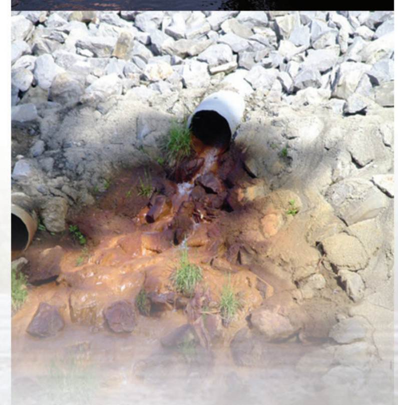
November 2008

Final Approved Report





Total Maximum Daily Loads for Streams in the New River Watershed, West Virginia

Prepared for:

West Virginia Department of Environmental Protection

Division of Water and Waste Management

Watershed Branch, TMDL Section

Prepared by:

Water Resources and TMDL Center

Tetra Tech, Inc.

405 Capitol Street, Suite 608

Charleston, WV 25301

Total Maximum Daily Loads for Selected Streams in the New River Watershed, West Virginia

FINAL APPROVED REPORT

November 2008

CONTENTS

FIGURES

TABLES

ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

7Q10	7-day, 10-year low flow
AMD	acid mine drainage
AML	abandoned mine land
AML&R	[WVDEP] Office of Abandoned Mine Lands & Reclamation
BMP	best management practice
BOD	biochemical oxygen demand
BPH	[West Virginia] Bureau for Public Health
CFR	Code of Federal Regulations
CSO	combined sewer overflow
CSR	Code of State Rules
DEM	Digital Elevation Model
DESC-R	Dynamic Equilibrium Instream Chemical Reactions model
DMR	[WVDEP] Division of Mining and Reclamation
DNR	West Virginia Division of Natural Resources
DO	dissolved oxygen
DWWM	[WVDEP] Division of Water and Waste Management
ERIS	Environmental Resources Information System
GAP	Gap Analysis Land Cover Project
GIS	geographic information system
gpd	gallons per day
GPS	global positioning system
HAU	home aeration unit
LA	load allocation
µg/L	micrograms per liter
MDAS	Mining Data Analysis System
mg/L	milligrams per liter
mL	milliliter
MF	membrane filter counts per test
MPN	most probable number
MOS	margin of safety
MS4	Municipal Separate Storm Sewer System
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	[WVDEP] Office of Oil and Gas
POTW	publicly owned treatment works
SI	stressor identification
SMCRA	Surface Mining Control and Reclamation Act
SRF	State Revolving Fund

SSO	sanitary sewer overflow
STATSGO	State Soil Geographic database
TMDL	Total Maximum Daily Load
TSS	total suspended solids
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UNT	unnamed tributary
WLA	wasteload allocation
WVDEP	West Virginia Department of Environmental Protection
WVDOH	West Virginia Division of Highways
WVSCI	West Virginia Stream Condition Index
WVU	West Virginia University

Watershed

A general term used to describe a drainage area within the boundary of a United States Geologic Survey's 8-digit hydrologic unit code. Throughout this report, the New River watershed refers to the mainstem of the New River and all of the tributary streams that eventually drain to the New River (Figure I-1). The term "watershed" is also used more generally to refer to the land area that contributes precipitation runoff that eventually drains to the New River. In West Virginia, the New River and drainage area from the West Virginia/Virginia border downstream to Bluestone Dam is referred to as the Upper New River watershed. The Lower New River watershed refers to the mainstem segment and drainage area from Bluestone Dam downstream to the New River and Gauley River confluence.

TMDL watershed

This term is used to describe the total land area draining to an impaired stream for which a TMDL is being developed. This term also takes into account the land area drained by un-impaired tributaries of the impaired stream. This report addresses 88 impaired streams contained within 36 TMDL watersheds in the New River watershed.

Subwatershed

The subwatershed delineation is the most detailed scale of the delineation that breaks each TMDL watershed into numerous catchments for modeling purposes. The 36 TMDL watersheds have been subdivided into 691 modeled subwatersheds. Pollutant sources, allocations and reductions are presented at the subwatershed scale to facilitate future permitting actions and TMDL implementation.

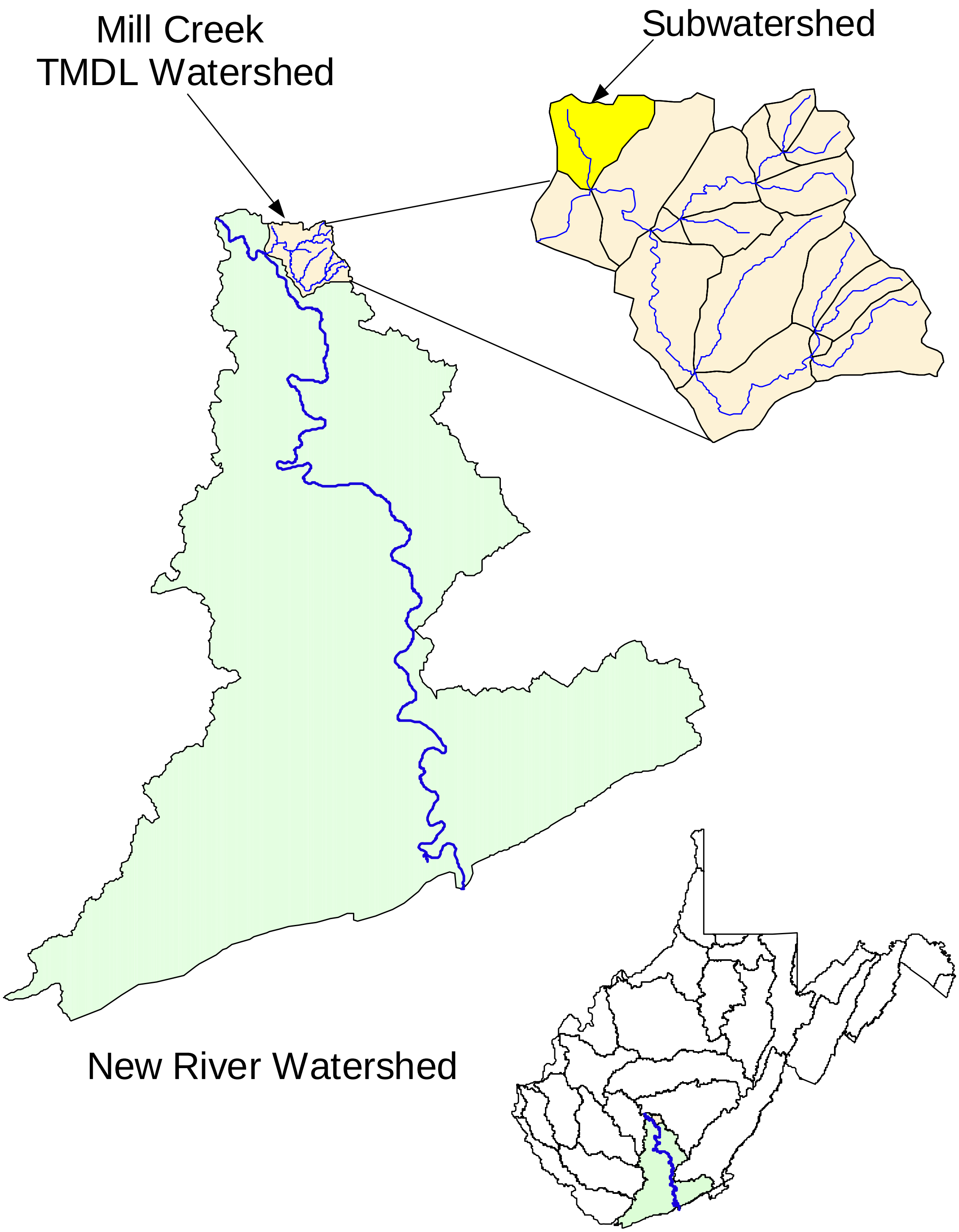


Figure I-1. Examples of a watershed, TMDL watershed, and subwatersheds

EXECUTIVE SUMMARY

This report includes Total Maximum Daily Loads (TMDLs) for 88 impaired streams in the New River watershed in southern West Virginia.

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 actions needed to restore water quality. West Virginia's water quality standards are codified at Title 47 of the *Code of State Rules* (CSR), Series 2, and titled *Legislative Rules, Department of Environmental Protection: 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 with criteria and reports impaired waters every two 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.

All of the subject streams are included on West Virginia's 2006 Section 303(d) list. Documented impairments are related to numeric water quality criteria for total iron, dissolved aluminum, pH, and fecal coliform bacteria. Certain waters are also biologically impaired based on the narrative water quality criterion of 47 CSR 2–3.2.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.

From 1997 through September 2003, the U.S. Environmental Protection Agency (USEPA), Region 3, 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 has been recently modified to extend TMDL development dates to September 2009.

Since October 2003, West Virginia's TMDLs have been developed by WVDEP. This report accommodates the timely development of the remaining New River watershed TMDLs required by the consent decree (mine drainage impairments of Floyd Creek, Batoff Creek, Bowyer Creek, and Laurel Creek/Piney Creek) and also presents TMDLs for additional impairments of those streams.

Impaired waters were organized into 36 TMDL watersheds. For hydrologic modeling purposes, impaired and unimpaired streams in these 36 TMDL watersheds were further divided into 691 smaller subwatershed units for modeling. The subwatershed delineation provided a basis for georeferencing pertinent source information, monitoring data, and presentation of the TMDLs.

The Mining Data Analysis System (MDAS) was used to represent the linkage between pollutant sources and instream responses for fecal coliform bacteria, iron, and aluminum. The 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 instream processes.

Both point and nonpoint sources contribute to the fecal coliform bacteria and metals impairments in the watershed. Failing on-site systems, direct discharges of untreated sewage, and precipitation runoff from agricultural and residential areas are significant nonpoint sources of fecal coliform bacteria. Point sources of fecal coliform bacteria include the effluents of sewage treatment facilities and collection system overflows from publicly owned treatment works (POTWs). The permitted discharges from mining activities are the most prevalent metals point sources throughout the watershed. Nonpoint metals sources include abandoned mine lands (AML), roads, oil and gas operations, timbering, agriculture, urban/residential land disturbance and streambank erosion. The presence of individual nonpoint source categories and their relative significance varies by subwatershed. Because iron is a naturally-occurring element that is present in soils, the iron loading from many of the identified sources is associated with sediment contributions.

Because metals are modeled in the MDAS in the total recoverable form, it was necessary to link the MDAS with the Dynamic Equilibrium In-stream Chemical Reactions (DESC-R) model to appropriately address the dissolved aluminum TMDLs presented for certain streams in the watershed. TMDLs for pH impairments were developed using a surrogate approach in which it was assumed that reducing instream concentrations of metals (iron and aluminum) 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 model. The methodologies and technical approaches for dissolved aluminum and pH are discussed in Section 4 of the Technical Report.

Biological integrity/impairment is based on a rating of the stream's benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index (WVSCI). The first step in TMDL development for biologically impaired waters is stressor identification (SI). Section 4 discusses the SI process. SI was followed by stream-specific determinations of the pollutants for which TMDLs must be developed. Metals and pH toxicity, organic enrichment and sedimentation were identified as causative stressors for the biologically impaired streams addressed in this effort. Metals and pH toxicity stressors were identified in waters that also violated water quality criteria for iron, aluminum, or pH. It was determined that implementation of those pollutant-specific TMDLs would address the impacts of those stressors. Where organic enrichment was identified as the biological stressor, the waters also demonstrated violations of the numeric criteria for fecal coliform bacteria. It was determined that implementation of fecal coliform TMDLs would remove untreated sewage and significantly reduce animal wastes, thereby reducing the organic and nutrient loading causing the biological impairment. Sediment TMDLs were initially developed within the MDAS using a reference watershed approach. The MDAS was configured to examine upland sediment loading and streambank erosion and depositional processes. Load reductions for sediment-impaired waters were projected based upon the sediment loading present in an unimpaired reference watershed.

In the biologically impaired waters for which the SI process identified sedimentation as a significant stressor, a strong, positive correlation between iron and total suspended solids (TSS) was identified. Iron TMDLs are also presented for all of those waters, and it has been universally determined that the sediment reductions necessary for the attainment of iron water quality criteria exceed those necessary to address biological stress from sedimentation. As such, the iron TMDLs serve as surrogates for the biological impairments caused by sedimentation.

Within this effort, the iron TMDLs presented for troutwaters do not assure complete attainment of the chronic aquatic life protection iron criterion. Criterion attainment would require pollutant reductions from existing sources that are well beyond practical levels, coupled with significant reductions of undisturbed upland and streambank background loadings, and no provisions for future growth. The relatively high iron content of the soils in the New River watershed is the primary influencing factor. An adaptive implementation approach is proposed (Section 8.5) under which source allocations necessary to universally achieve the iron criterion for warmwater fisheries (1.5 mg/L, 4-day average, once per three years average exceedance frequency) are implemented concurrently with additional study of the situation.

The main section of the report describes the TMDL development and modeling processes, identifies impaired streams and existing pollutant sources, discusses future growth and TMDL achievability, 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. Various provisions attempt to ensure the attainment of criteria throughout the watershed, achieve equity among categories of sources, and target pollutant reductions from the most problematic sources. Nonpoint source reductions were not specified beyond natural (background) levels. Similarly, point source wasteload allocations (WLAs) were no more stringent than numeric water quality criteria.

The TMDL watershed appendices focus on the impaired waters and applicable TMDLs (sum of wasteload allocations + sum of load allocations + margin of safety) in their respective watersheds. Applicable TMDLs are displayed in each appendix.

Accompanying spreadsheets provide TMDLs and example allocations of loads to categories of point and nonpoint sources that achieve the total TMDL. Also provided is an interactive ArcExplorer geographic information system (GIS) project that allows for the exploration of spatial relationships among the source assessment data.

Considerable resources were used to acquire recent water quality and pollutant source information upon which the TMDLs are based. The TMDL modeling 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.

1.0 REPORT FORMAT

This report consists of a main section, appendices, a supporting GIS application, and spreadsheet data tables. The main section describes the overall total maximum daily load (TMDL) development process for the New River watershed, identifies impaired streams, and outlines the source assessment for metals, pH, fecal coliform bacteria, and biological stressors. It also describes the modeling and allocation processes and lists measures that will be taken to ensure that the TMDLs are met. The main section is followed by four appendices that describe the specific conditions in each of the 36 TMDL watersheds for which TMDLs were developed. The applicable TMDLs are displayed in each appendix. The main section and appendices are supported by a compact disc containing an interactive ArcExplorer GIS project that provides further details on the data and allows the user to explore the spatial relationships among the source assessment data. With this tool, users can magnify streams and other features of interest. Also included on the CD are spreadsheets (in Microsoft Excel format) that provide detailed source allocations associated with successful TMDL scenarios. A Technical Report is also included that describes the detailed technical approaches used in the process and displays data upon which the TMDLs are based.

2.0 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 that do not meet 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 the actions needed to restore water quality.

A TMDL is composed of the sum of individual wasteload allocations (WLAs) for point sources and 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 units. Conceptually, this definition is denoted by the following equation:

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

From 1997 through September 2003, the U.S. Environmental Protection Agency (USEPA), Region 3, 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 has been recently modified to extend TMDL development dates to September 2009.

Since October 2003, West Virginia's TMDLs have been developed by WVDEP. This report accommodates the timely development of the remaining New River watershed TMDLs required by the consent decree (mine drainage impairments of Floyd Creek, Batoff Creek, Bowyer Creek, and Laurel Creek/Piney Creek) and also presents TMDLs for additional impairments of those streams.

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 in 2007 TMDLs should be pursued in Hydrologic Group D, which includes the New River watershed. Figure 2-1 depicts the hydrologic groupings of West Virginia's watersheds; the legend includes the target year for finalization of each TMDL.

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 finalization, 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 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 final 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 draft TMDL is submitted to USEPA for approval.

This report includes Total Maximum Daily Loads (TMDLs) for 88 impaired streams in the New River watershed. All of the subject streams are included on West Virginia's 2006 Section 303(d) list.

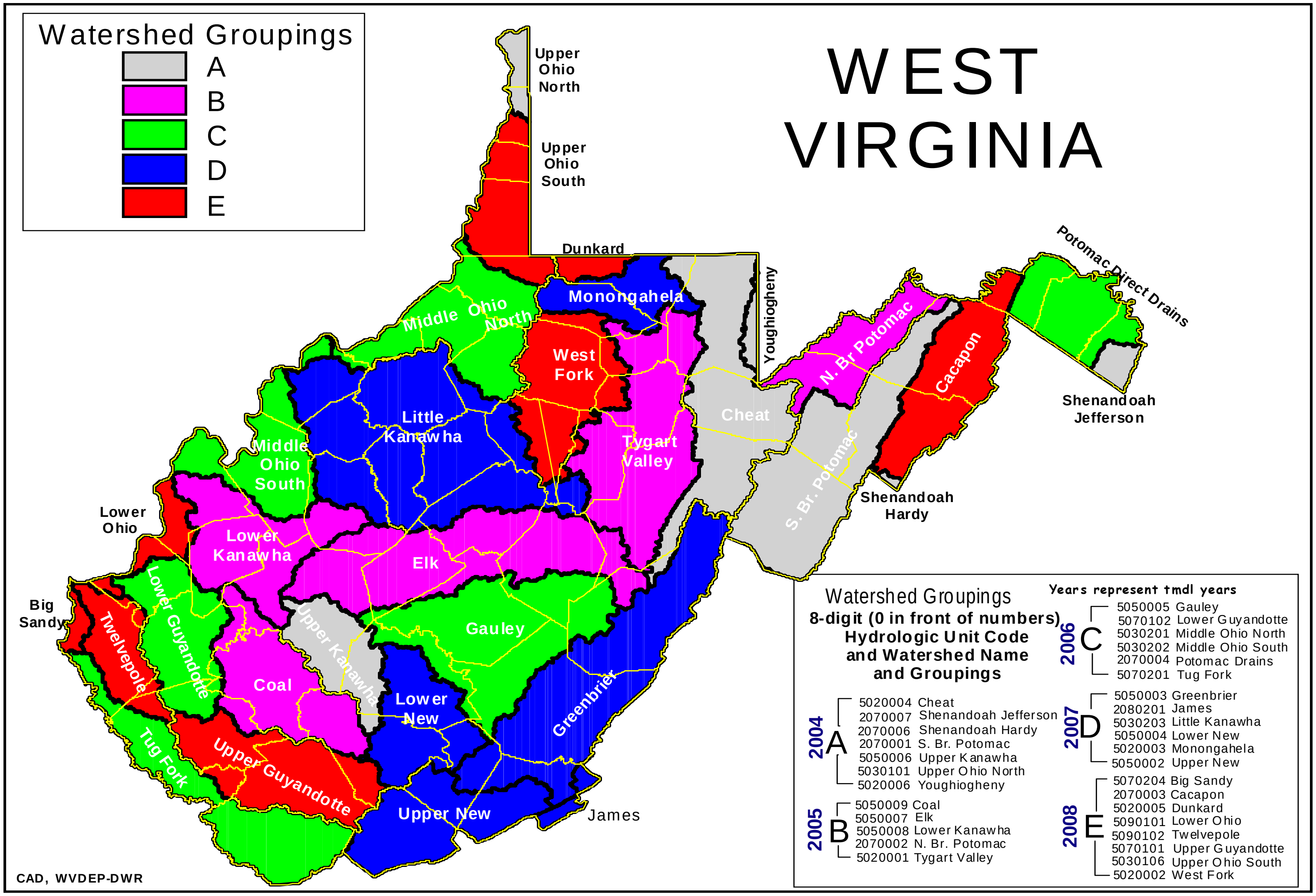


Figure 2-1. Hydrologic groupings of West Virginia's watersheds

2.2 Water Quality Standards

The determination of impaired waters involves comparing instream conditions to applicable water quality standards. West Virginia's water quality standards are codified at Title 47 of the *Code of State Rules* (CSR), Series 2, titled *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*. These standards can be obtained online from the West Virginia Secretary of State internet site (http://www.wvsos.com/csr/verify.asp?TitleSeries=47-02).

Water quality standards consist of 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 of the Standards contains the narrative water quality criteria.

Designated uses include: propagation and maintenance of aquatic life in warmwater fisheries and troutwaters, water contact recreation, and public water supply. Most of the waterbodies in the New River watershed are designated as warmwater fisheries, but there are 18 impaired streams designated as troutwaters. For the impaired waters of this report, West Virginia iron and aluminum aquatic life protection numeric water quality criteria vary with respect to warmwater fisheries and troutwaters.

In various streams in the New River watershed, the warmwater fishery and troutwater aquatic life use impairments have been determined pursuant to exceedances of iron, dissolved aluminum, and/or pH numeric water quality criteria. Water contact recreation and public water supply use impairments have also been determined pursuant to exceedances of numeric water quality criteria for fecal coliform bacteria.

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 related to water quality. The narrative water quality criterion at Title 47 CSR Series 2 – 3.2.i prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts to 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 is discussed in detail in Section 4.

The numeric water quality criteria applicable to the impaired streams addressed by this report are summarized in Table 2-1. The stream-specific impairments related to both numeric and narrative water quality criteria are displayed in Table 3-3.

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	750	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
Fecal coliform bacteria	**Human Health Criteria** Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month.				

[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: 47 CSR, Series 2, *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*.

3.0 WATERSHED DESCRIPTION AND DATA INVENTORY

3.1 Watershed Description

As shown in Figure 3-1, the New River watershed in West Virginia lies mostly within Fayette, Mercer, Monroe, Raleigh, and Summers Counties. In West Virginia, its drainage area encompasses nearly 1600 square miles, exclusive of the Greenbrier River watershed. The New River mainstem runs Northwest through the watershed. Major West Virginia tributaries include Indian Creek, the Bluestone River, the Greenbrier River, Glade Creek and Piney Creek. The average elevation in the watershed is 2,338 feet. The highest point is at 4,069 feet on East River Mountain, which is on the West Virginia-Virginia border. The minimum elevation is 648 feet at the Town of Gauley Bridge, at the confluence of the New and Gauley Rivers. The total West Virginia population living in the subject watersheds of this report is estimated to be 185,000 people.

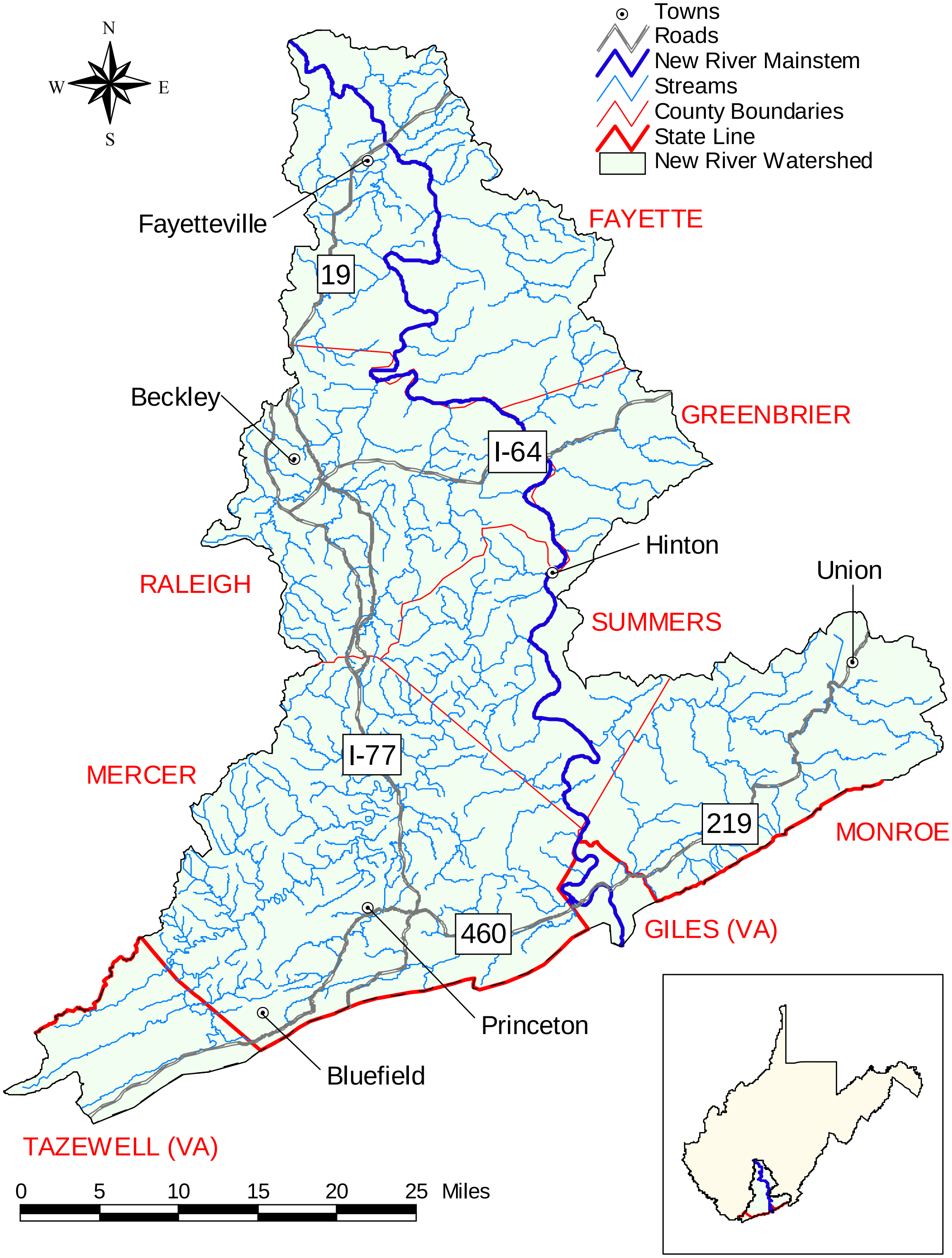


Figure 3-1. Location of the New River watershed in West Virginia

Table 3-1 displays the modeled landuses in the New River watershed. The dominant landuse is forest, which constitutes 75.5 percent of the total landuse area. Other important modeled landuse types are grassland (12.4 percent), pasture (5.1 percent), urban/residential (4.4 percent), mining (0.5%), and AML (0.5%) landuse. Individually, all other land cover types compose one percent or less of the total watershed area.

Landuse and land cover estimates were originally obtained from vegetation data gathered from the West Virginia Gap Analysis Land Cover Project (GAP). The Natural Resource Analysis Center and the West Virginia Cooperative Fish and Wildlife Research Unit of West Virginia University (WVU) produced the GAP coverage. The GAP database for West Virginia was derived from satellite imagery taken during the early 1990s, and it includes detailed vegetative spatial data. Enhancements and updates to the GAP coverage were made to create a modeled landuse by custom edits derived primarily from WVDEP source tracking information and 2003 aerial photography with 1-meter resolution. Additional information regarding the GAP spatial database is provided in Appendix C of the Technical Report.

Table 3-1. Modified landuse for the New River TMDL watersheds

Landuse Type	Area of Watershed		
	Acres	Square Miles	Percentage
Water	10,908.4	17.0	1.2%
Wetland	1,114.2	1.7	0.1%
Barren	2,659.1	4.2	0.3%
Forest	715,876.9	1,118.6	75.5%
Grassland	117,491.3	183.6	12.4%
Cropland	848.1	1.3	0.1%
Pasture	48,424.4	75.7	5.1%
Urban/Residential	41,990.0	65.6	4.4%
Mining	4,713.6	7.4	0.5%
AML	4,558.5	7.1	0.5%
Total Area	948,584.5	1,482.2	100.00%

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. These data describe the physical conditions of the TMDL watersheds, the potential pollutant sources and their contributions, and the impaired waterbodies for which TMDLs need to be developed. Prior to TMDL development, WVDEP collected comprehensive water quality data throughout the watershed. This pre-TMDL monitoring effort contributed the largest amount of water quality data to the process and is summarized in the Technical Report, Appendix I. The geographic information is provided in the ArcExplorer GIS project included on the CD version of this report. Boundary conditions for pollutant loadings from the Virginia headwaters of Bluestone River and Laurel Fork (a tributary of Bluestone River) were derived from the existing sediment and bacteria TMDLs developed by the Virginia Department of Environmental Quality. TMDL conditions of the Virginia TMDLs were used as the boundary conditions in the development of the West Virginia TMDLs. Loading from Virginia TMDLs were incorporated into the load allocation component of the West Virginia TMDLs for Laurel Fork and the Bluestone River.

Table 3-2. Datasets used in TMDL development

Type of Information		Data Sources
Watershed physiographic data	Stream network	West Virginia Division of Natural Resources (WVDNR)
	Landuse	WV Gap Analysis Project (GAP)
	2003 Aerial Photography (1-meter resolution)	WVDEP
	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 (NRCS) soil surveys
	Hydrologic Unit Code 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	U.S. Census Bureau, 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	WV Division of Forestry
	Oil and gas operations coverage	WVDEP Office of Oil and Gas (OOG)
	Abandoned mining coverage	WVDEP DMR
Monitoring data	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
	Water quality monitoring data	USEPA STORET, WVDEP

Type of Information		Data Sources
	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
	Existing Virginia headwater TMDLs	Virginia Department of Environmental Quality

3.3 Impaired Waterbodies

WVDEP conducted extensive water quality monitoring throughout the New River watershed from July 2004 through June 2005. 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.

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

TMDLs were developed for impaired waters in 36 TMDL watersheds (Figure 3-2). The impaired waters for which TMDLs have been developed are presented in Table 3-3. The table includes the TMDL watershed, stream code, stream name, and impairments for each stream.

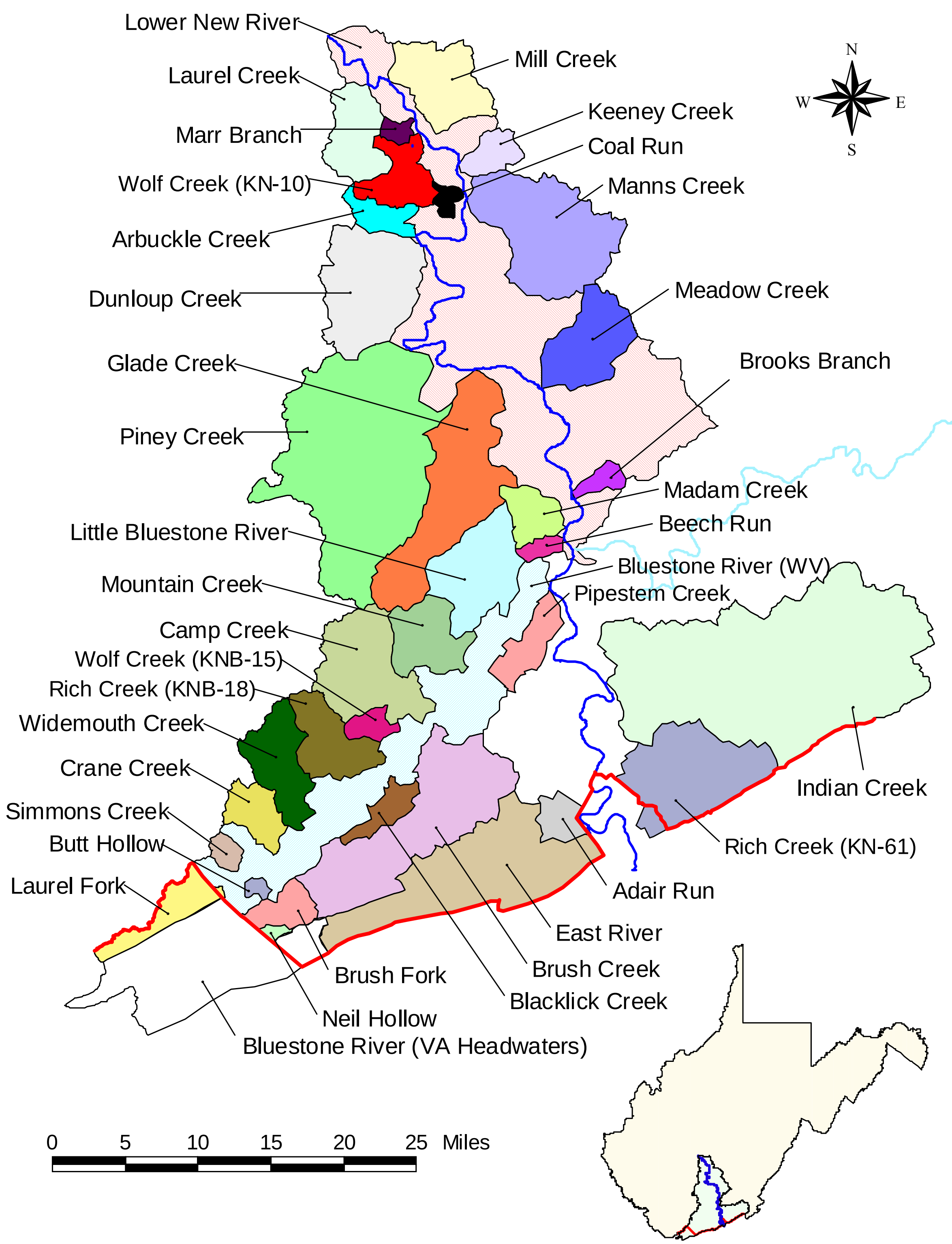


Figure 3-2. 36 New River TMDL watersheds

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

TMDL Watershed	Code	Trout	Stream Name	Fe	Al	pH	FC	BIO
Lower New River	WVKN-lo		New River (Bluestone Outlet-Mouth)				X	
Laurel Creek	WVKN-5		Laurel Creek				X	
Mill Creek	WVKN-7	T	Mill Creek				X	
Mill Creek	WVKN-7-0.5A		UNT/Mill Creek RM 1.7				X	
Mill Creek	WVKN-7-B		Osborne Creek	X			X	X
Mill Creek	WVKN-7-B-0.3		UNT/Osborne Creek RM 0.7				X	
Marr Branch	WVKN-9		Marr Branch	X			X	X
Marr Branch	WVKN-9-A		UNT/Marr Branch RM 0.9	X			X	X
Wolf Creek (WVKN-10)	WVKN-10	T	Wolf Creek (WVKN-10)	X			X	X
Wolf Creek (WVKN-10)	WVKN-10-A		House Branch				X	
Wolf Creek (WVKN-10)	WVKN-10-B		Crooked Run				X	
Wolf Creek (WVKN-10)	WVKN-10-C		Short Creek				X	
Wolf Creek (WVKN-10)	WVKN-10-M		UNT/Wolf Creek RM 8.7	X	X	X		
Keeney Creek	WVKN-15	T	Keeney Creek				X	
Coal Run	WVKN-16		Coal Run				X	
Manns Creek	WVKN-17-B		Floyd Creek	X	X	X		X
Arbuckle Creek	WVKN-21	T	Arbuckle Creek	X			X	X
Arbuckle Creek	WVKN-21-A		Rocklick Creek				X	
Dunloup Creek	WVKN-22-K		Mill Creek	X	X	X		X
Glade Creek	WVKN-29	T	Glade Creek				X	X
Meadow Creek	WVKN-32	T	Meadow Creek				X	
Brooks Branch	WVKN-42		Brooks Branch				X	
Madam Creek	WVKN-44		Madam Creek				X	
Beech Run	WVKN-45		Beech Run				X	
Piney Creek	WVKN-26	T	Piney Creek	X			X	
Piney Creek	WVKN-26-A	T	Batoff Creek	X	X	X		
Piney Creek	WVKN-26-E	T	Cranberry Creek	X			X	X
Piney Creek	WVKN-26-E-1		Little Whitestick Creek				X	
Piney Creek	WVKN-26-F	T	Beaver Creek	X			X	X
Piney Creek	WVKN-26-F-2		Little Beaver Creek				X	X
Piney Creek	WVKN-26-G		Whitestick Creek				X	X
Piney Creek	WVKN-26-K		Soak Creek				X	
Piney Creek	WVKN-26-N		Laurel Creek	X			X	
Piney Creek	WVKN-26-M		Bowyer Creek	X			X	

Table 3-3. (continued)

TMDL Watershed	Code	Trout	Stream Name	Fe	Al	pH	FC	BIO
Bluestone River	WVKNB		Bluestone River				X	X
Pipestem Creek	WVKNB-1		Pipestem Creek				X	
Little Bluestone River	WVKNB-3-A		Suck Creek				X	
Little Bluestone River	WVKNB-3-C-1-D		UNT/Jumping Branch RM 2.0				X	
Little Bluestone River	WVKNB-3-C-1-E		UNT/Jumping Branch RM 2.5				X	
Mountain Creek	WVKNB-5	T	Mountain Creek				X	
Mountain Creek	WVKNB-5-B		North Fork/Mountain Creek				X	
Brush Creek	WVKNB-12		Brush Creek	X			X	X
Brush Creek	WVKNB-12-B	T	Laurel Creek				X	
Brush Creek	WVKNB-12-H		Glady Fork				X	
Brush Creek	WVKNB-12-J		South Fork/Brush Creek				X	
Brush Creek	WVKNB-12-J-2		Middle Fork/South Fork/Brush Creek				X	
Camp Creek	WVKNB-13	T	Camp Creek				X	
Wolf Creek (WVKNB-15)	WVKNB-15		Wolf Creek (WVKNB-15)				X	
Rich Creek (WVKNB-18)	WVKNB-18		Rich Creek (WVKNB-18)	X			X	
Blacklick Creek	WVKNB-22		Blacklick Creek				X	
Blacklick Creek	WVKNB-22-A		Rocky Branch				X	
Blacklick Creek	WVKNB-22-C		Barn Branch				X	
Widemouth Ck	WVKNB-28		Widemouth Creek				X	
Widemouth Ck	WVKNB-28-B		Righthand Fork/Widemouth Creek	X			X	X
Widemouth Ck	WVKNB-28-C		Lefthand Fork/Widemouth Creek				X	
Crane Creek	WVKNB-30	T	Crane Creek	X			X	X
Crane Creek	WVKNB-30-C		Belcher Branch	X				
Crane Creek	WVKNB-30-D.5		UNT/Crane Creek RM 4.5				X	
Simmons Creek	WVKNB-33		Simmons Creek	X			X	X
Laurel Fork	WVKNB-34.5		Laurel Fork				X	X
Butt Hollow	WVKNB-35		Butt Hollow				X	
Brush Fork	WVKNB-36		Brush Fork	X			X	X
Neil Hollow	WVKNB-37		Neil Hollow				X	
Indian Creek	WVKN-51		Indian Creek				X	X
Indian Creek	WVKN-51-A		Bradshaw Creek				X	
Indian Creek	WVKN-51-B		Stinking Lick Creek				X	
Indian Creek	WVKN-51-D		Hans Creek				X	
Indian Creek	WVKN-51-G		Indian Draft				X	
Indian Creek	WVKN-51-G-1		UNT/Indian Draft RM 1.5				X	

Table 3-3. (continued)

TMDL Watershed	Code	Trout	Stream Name	Fe	Al	pH	FC	BIO
Indian Creek	WVKN-51-H-(S)	T	Laurel Creek				X	
Indian Creek	WVKN-51-I		Cooks Run				X	
Indian Creek	WVKN-51-K		Rock Camp Creek				X	
Indian Creek	WVKN-51-O	T	Turkey Creek				X	
Indian Creek	WVKN-51-R		Gin Hollow				X	
Indian Creek	WVKN-51-S-1-(S)		Burnside Branch				X	
Adair Run	WVKN-59		Adair Run				X	
East River	WVKN-60	T	East River				X	
East River	WVKN-60-C		Fivemile Creek				X	
East River	WVKN-60-C-2		Possum Hollow				X	
East River	WVKN-60-C-3		Hales Branch				X	
East River	WVKN-60-C-4		Payne Branch				X	
Rich Creek (WVKN-61)	WVKN-61	T	Rich Creek (WVKN-61)				X	
Rich Creek (WVKN-61)	WVKN-61-A		Brush Creek				X	
Rich Creek (WVKN-61)	WVKN-61-B		Scott Branch				X	
Rich Creek (WVKN-61)	WVKN-61-C		Crooked Creek				X	
Rich Creek (WVKN-61)	WVKN-61-D		Mud Run				X	
Rich Creek (WVKN-61)	WVKN-61-E		Dry Creek	X			X	X
Rich Creek (WVKN-61)	WVKN-61-E-1		Painter Run				X	

Note:
UNT = unnamed tributary.
FC indicates fecal coliform bacteria impairment
BIO indicates a biological impairment

4.0 BIOLOGICAL IMPAIRMENT AND STRESSOR IDENTIFICATION

Initially, TMDL development in biologically impaired waters requires identification of the pollutants that cause the stress to the biological community. Sources of those pollutants are often analogous to those already described: mine drainage, untreated sewage, and sediment. Section 2 of the Technical Report discusses biological impairment and the SI process in detail.

4.1 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 fewer than 60.6 points, on a normalized 0–100 scale, are considered biologically impaired.

Biological assessments are useful in detecting impairment, but they may not clearly identify the causes 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 SI process were used to evaluate and identify the significant 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 SI process entailed reviewing available information, forming and analyzing possible stressor scenarios, and implicating causative stressors. The SI method provides a consistent process for evaluating available information. TMDLs were established for the responsible pollutants at the conclusion of the SI process. As a result, the TMDL process established a link between the impairment and benthic community stressors.

4.2 Data Review

WVDEP generated the primary data used in SI 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, WVDEP mining activities data, GAP 2000 landuse information, Natural Resources Conservation Service (NRCS) State Soil Geographic database (STATSGO) soils data, NPDES point source data, and literature sources.

4.3 Candidate Causes/Pathways

The first step in the SI 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 4-1) depicts the sources, stressors, and pathways that affect the biological community.

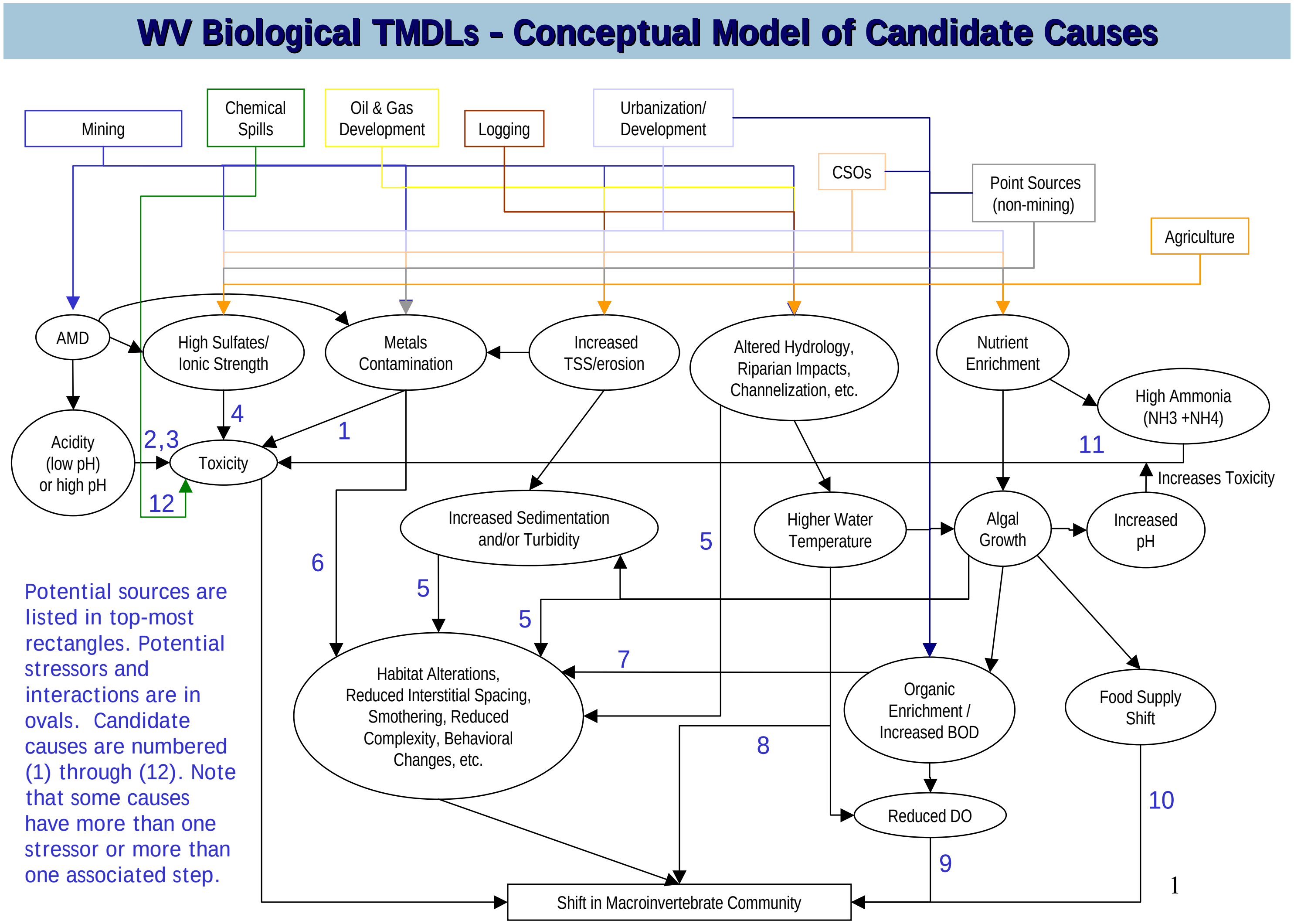


Figure 4-1. Conceptual model of candidate causes and potential biological effects

4.4 Stressor Identification Results

As shown in Table 4-1, organic enrichment, metals and pH toxicity, and sedimentation have been identified as the causative stressors for the biologically impaired streams addressed in this effort.

Where the SI process identified organic enrichment as the cause of biological impairment, data also indicated violations of the fecal coliform water quality criteria. The predominant sources of both organic enrichment and fecal coliform bacteria in the watershed are inadequately treated sewage and runoff from pasture landuse. WVDEP determined that implementation of fecal coliform TMDLs would remove untreated sewage and reduce agricultural runoff thereby reducing the organic and nutrient loading causing the biological impairment in these streams. Therefore, fecal coliform TMDLs will serve as a surrogate where organic enrichment was identified as a stressor. Likewise, where metals and/or pH toxicity were identified as the cause of biological impairment, data also indicated violations of metals and/or pH water quality criteria and the metals and pH TMDLs will serve as a surrogate for the biological impairment.

WVDEP initially pursued the development of TMDLs directly for sediment to address the sedimentation biological stressor. The intended approach involved selection of a reference stream with an unimpaired biological condition, prediction of the sediment loading present in the reference stream, and use of the area-normalized sediment loading of the reference stream as the TMDL endpoint for sediment impaired waters.

Glade Creek (WVKN-29) was selected as the achievable reference stream as it shares similar landuse, ecoregion and geomorphologic characteristics with the sediment impaired streams. The location of Glade Creek is shown in Figure 4-2.

Most of the sediment-impaired waters are also impaired pursuant to total iron water quality criteria and the TMDL assessment for iron included representation and allocation of iron loadings associated with sediment. In each stream, the sediment loading reduction necessary for attainment of water quality criteria for iron exceeds that which was determined to be necessary using the reference approach. As such, the iron TMDLs are acceptable surrogates for biological impairments from sedimentation.

Table 4-1. Significant stressors of biologically impaired streams in the New River watershed

TMDL Watershed	Stream	Stream Code	Biological Stressors	TMDLs Developed
Mill Creek	Osborne Creek	WVKN-7-B	Organic enrichment Sedimentation	Fecal coliform Total iron
Marr Branch	Marr Branch	WVKN-9	Organic enrichment Sedimentation	Fecal coliform Total iron
Marr Branch	UNT/Marr Branch RM 0.9	WVKN-9-A	Organic enrichment Sedimentation	Fecal coliform Total iron
Wolf Creek	Wolf Creek	WVKN-10	Organic enrichment Sedimentation	Fecal coliform Total iron
Manns Creek	Floyd Creek	WVKN-17-B	pH Toxicity (acidity) Metals Toxicity (Aluminum, Iron) Sedimentation	pH Aluminum Total iron
Arbuckle Creek	Arbuckle Creek	WVKN-21	Organic enrichment, Sedimentation	Fecal coliform Total iron
Dunloup Creek	Mill Creek	WVKN-22-K	pH Toxicity (acidity) Sedimentation	pH Total iron
Glade Creek	Glade Creek	WVKN-29	Organic enrichment	Fecal coliform
Piney Creek	Cranberry Creek	WVKN-26-E	Organic enrichment Sedimentation	Fecal coliform Total iron
Piney Creek	Beaver Creek	WVKN-26-F	Organic enrichment	Fecal coliform
Piney Creek	Little Beaver Creek	WVKN-26-F-2	Organic enrichment	Fecal coliform
Piney Creek	Whitestick Creek	WVKN-26-G	Organic enrichment	Fecal coliform
Bluestone River	Bluestone River	WVKNB	Organic enrichment Sedimentation	Fecal coliform (Bluestone River and Laurel Fork fecal coliform TMDLs) (Virginia sediment TMDL)
Brush Creek	Brush Creek	WVKNB-12	Organic enrichment Sedimentation	Fecal coliform Total iron
Widemouth Creek	Righthand Fork/ Widemouth Creek	WVKNB-28-B	Organic enrichment Sedimentation	Fecal coliform Total iron
Crane Creek	Crane Creek	WVKNB-30	Organic enrichment Sedimentation	Fecal coliform Total iron
Simmons Creek	Simmons Creek	WVKNB-33	Organic enrichment Sedimentation	Fecal coliform Total iron
Laurel Fork	Laurel Fork	WVKNB-34.5	Organic enrichment Sedimentation	Fecal coliform (Virginia sediment and fecal coliform TMDLs)
Brush Fork	Brush Fork	WVKNB-36	Organic enrichment Sedimentation	Fecal coliform Total iron
Indian Creek	Indian Creek	WVKN-51	Organic enrichment	Fecal coliform
Rich Creek	Dry Creek	WVKN-61-E	Organic enrichment Sedimentation	Fecal coliform Total iron

Organic enrichment and sedimentation stressors are associated with the biological impairment of Laurel Fork (WVKNB-34.5). The majority (98%) of the Laurel Fork drainage area is within Virginia. Virginia has also determined that Laurel Fork is biologically impaired and has developed bacteria and sediment TMDLs. WVDEP is developing a fecal coliform TMDL for the West Virginia portion of the stream that incorporates the Virginia TMDL output as a boundary condition and applies the allocation methodology described in Section 8.5.2 to sources in the West Virginia portion of the watershed (208 acres). This TMDL, coupled with the Virginia sediment and bacteria TMDLs, will resolve the biological impairment of Laurel Fork.

Numerous biological assessments have been performed in the Bluestone River between the Virginia/West Virginia border and the headwaters of Bluestone Lake as displayed in Table 4-2. Most indicate an unimpaired biological condition. The exceptions are the two assessments performed at the same location at river mile 62.7. This location was initially selected and sampled in 2003 under WVDEP's Probabilistic Monitoring Program and was resampled during the pre-TMDL monitoring effort. The location is immediately (50 meters) downstream of, and strongly influenced by, the contribution of Laurel Fork. The Laurel Fork bacteria and sediment TMDLs, Virginia and West Virginia bacteria TMDLs for the Bluestone River, and the Virginia Bluestone River sediment TMDL will resolve the biological impairment.

Table 4-2. West Virginia Bluestone River biological assessments

Location	River Mile Point	Assessment Date	WVSCI Score
North of Pipestem	6.0	08/04/1999	72.9
Pipestem	11.8	08/09/1999	77.7
East of Eads Mill	20.4	08/10/1999	83.1
South of Camp Creek	23.5	08/03/1999	74.2
South of Lashmeet	43.1	08/04/1999	72.8
South of Lashmeet	44.9	08/03/1999	79.9
Downstream of Laurel Fork	62.7	04/05/2006	27.5
Downstream of Laurel Fork	62.7	06/04/2003	38.2

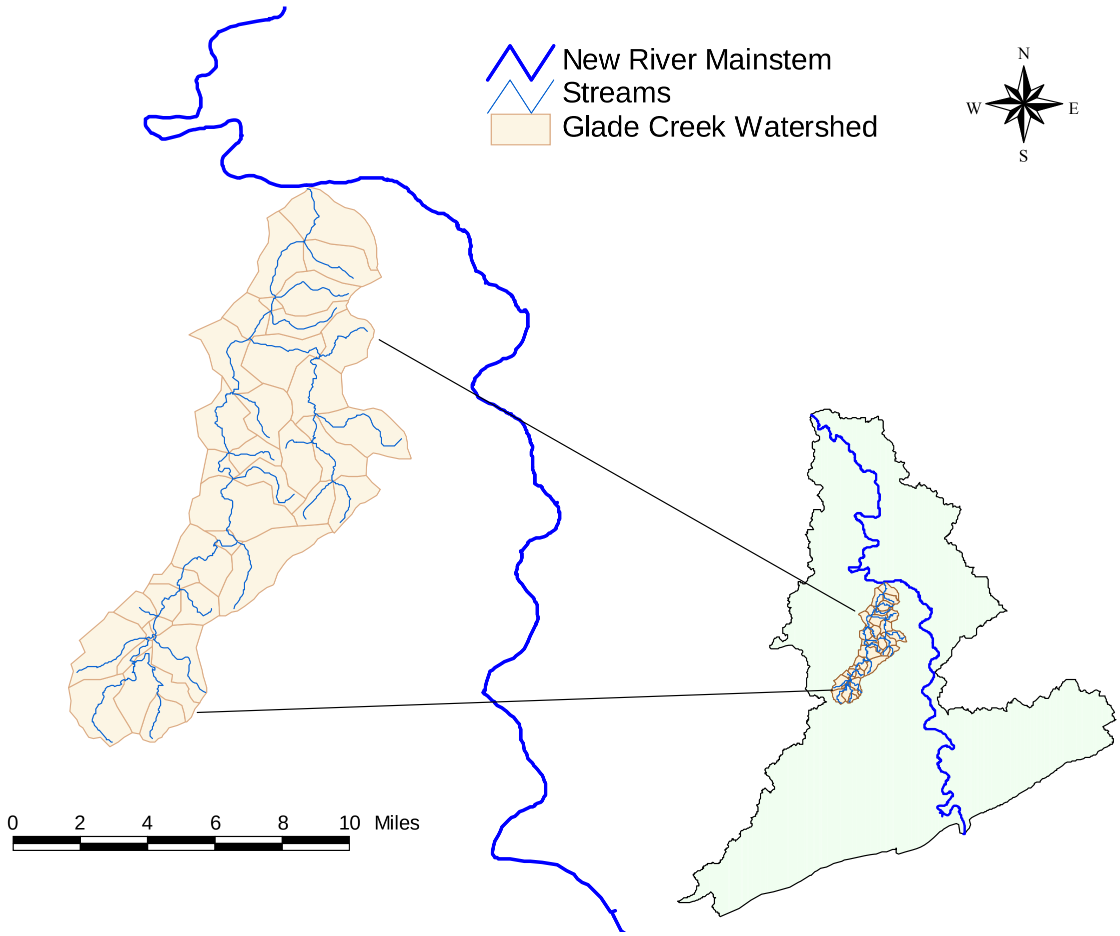


Figure 4-2. Location of the sediment reference stream, Glade Creek

5.0 METALS SOURCE ASSESSMENT

This section identifies and examines the potential sources of iron, aluminum, and pH impairments in the New 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.

Nonpoint sources of pollutants are diffuse, non-permitted sources. They most often result from precipitation-driven runoff. For the purposes of these TMDLs only, WLAs are given to NPDES-permitted discharge points, and LAs are given to discharges from activities that do not have an associated NPDES permit, such as bond forfeiture sites and AML. The assignment of LAs to AML and bond forfeiture sites does not reflect any determination by WVDEP or USEPA as to whether there are, in fact, unpermitted point source discharges within these landuses. Likewise, by establishing these TMDLs with mine drainage discharges treated as LAs, 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 to supplement the available source characterization data. WVDEP staff recorded physical descriptions of pollutant sources and the general stream condition 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 following sections, the Technical Report, and the ArcExplorer project on the CD version of this TMDL report.

5.1 Metals Point Sources

Metals 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.

5.1.1 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. 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 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; whereas, 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 affected land 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 (i.e. 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. Many permits also include effluent monitoring requirements for total aluminum and some, more recently issued permits include aluminum water quality based effluent limits. WVDEP's Division of Mining and Reclamation (DMR) provided a spatial coverage of the mining-related NPDES permit outlets. The discharge characteristics, related permit limits 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 spatial coverage of the mining permit areas and related SMCRA Article 3 and NPDES permit information. 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 WLAs for metals.

There are six mining-related NPDES permits, with 36 associated outlets in the metals impaired watersheds of the New River. Some permits discharge to one or more adjacent TMDL watersheds through multiple outlets. A complete list of the permits and outlets is provided in Appendix G of the Technical Report. Figures illustrating the extent of the mining NPDES outlets in the watershed can be found in the applicable subwatershed appendices associated with this report.

5.1.2 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. Sources may include the process wastewater discharges from water treatment plants and industrial manufacturing operations, and stormwater discharges associated with industrial activity.

There are 63 non-mining NPDES permits in the watersheds of metals impaired streams. All of the non-mining permits regulate stormwater associated with industrial activity and implement stormwater benchmark values of 100 mg/L TSS and/or 1.0 mg/L total Iron. The assigned WLAs allow for continued discharge under existing permit requirements. A complete list of the permits and outlets is provided in Appendix G of the Technical Report.

5.1.3 Construction Stormwater Permits

The discharges from construction activities that disturb more than one acre of land are legally defined as point sources and the sediment introduced from such discharges can contribute iron and aluminum. WVDEP issues a General NPDES Permit (permit WV0115924) to regulate stormwater discharges associated with construction activities with a land disturbance greater than one acre. These permits require that the site have properly installed best management practices (BMPs), such as silt fences, sediment traps, seeding / mulching, and riprap, to prevent or reduce erosion and sediment runoff. The BMPs will remain intact until the construction is complete and the site has been stabilized. Individual registration under the General Permit is usually limited to less than one year.

There are 17 active construction sites with a total disturbed acreage of 230.51 acres registered under the Construction Stormwater General Permit in the watersheds of metals or sediment impaired waters. Although specific wasteload allocations are not prescribed for these sites, the associated disturbed areas conform to the subwatershed-based allocations for registrations under the permit, as described in Section 9.0.

5.1.4 Municipal Separate Storm Sewer Systems

Runoff from residential and urbanized areas during storm events can be a significant sediment source. USEPA's stormwater permitting regulations require public entities to obtain NPDES permit coverage for stormwater discharges from MS4s in specified urbanized areas. An urbanized area is contained in the Piney Creek watershed where the City of Beckley; the West Virginia Department of Transportation, Division of Highways (DOH); and West Virginia Parkways, Economic Development and Tourism Authority (Parkways) are designated MS4 entities. As such, their stormwater discharges are considered point sources and are prescribed wasteload allocations. MS4 source representation was based upon precipitation and runoff from landuses determined from the modified GAP 2000 landuse data, the jurisdictional boundary of the City, and the associated drainage areas for which DOH and Parkways have MS4 responsibility.

5.2 Metals Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to water quality impairments related to metals. AML may contribute acid mine drainage (AMD), which produces low pH and high metals concentrations in surface and subsurface water. Similarly, facilities that were subject to the Surface Mining Control and Reclamation Act of 1977 (SMCRA, Public Law 95-87) during active operations and subsequently forfeited their bonds and abandoned operations can be a significant source of metals and low-pH. Also, land disturbing activities that introduce excess sediment are considered nonpoint sources of metals. These sources are shown in a figure in each of the applicable subwatershed appendices associated with this report.

5.2.1 Abandoned Mine Lands

WVDEP's Office of Abandoned Mine Lands & Reclamation (AML&R) was created in 1981 to manage the reclamation of lands and waters affected by mining prior to passage of SMCRA in 1977. AML&R's mission 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. The AML program is funded by a fee placed on coal mining. Allocations from the AML fund are made to state and tribal agencies through the congressional budgetary process.

The Office of AML&R identified locations of AML in the New River watershed from their records. In addition, source tracking efforts by WVDEP DWWM and AML&R identified additional AML sources (discharges, seeps, portals, and refuse piles). Field data, such as GPS locations, water samples, and flow measurements, were collected to represent these sources and characterize their impact on water quality. Based on this work, AML represent a significant source of metals in certain metals and pH impaired streams for which TMDLs are presented. In TMDL watersheds with metals and pH impairments, a total of 1,358 acres of AML area, 15 AML seeps, and 107 miles of highwall were incorporated into the TMDL model. The remaining 2,657 acres of AML area, as referenced in Table 3-1, are located in watersheds which are not metals impaired.

5.2.2 SMCRA Bond Forfeiture Sites

Mining permittees are required to post a performance bond to ensure the completion of reclamation requirements. 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 provided bond forfeiture site locations and information regarding the status of land reclamation and water treatment activities. Sites with unreclaimed land disturbance and unresolved water quality impacts were represented, as were sites with ongoing water treatment activities. There are nine bond forfeiture sites in the metals impaired TMDL watersheds of the New River.

5.2.3 Sediment Sources

Land disturbance can increase sediment loading to impaired waters. The control of sediment-producing sources has been determined to be necessary to meet water quality criteria for total iron during high-flow conditions. Nonpoint sources of sediment include forestry operations, oil and gas operations, roads, agriculture, stormwater from construction sites less than one acre, and stormwater from urban and residential land. Additionally, streambank erosion represents a significant sediment source throughout the watershed. Upland sediment nonpoint sources are summarized below.

Forestry
The West Virginia Bureau of Commerce's Division of Forestry provided information on forest industry sites (registered logging sites) in the metals impaired TMDL watersheds. This information included the harvested area (1,697 acres) and the subset of land disturbed by roads and landings (100 acres) for 29 registered logging sites in the metals impaired TMDL watersheds.

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 best management practices (BMPs) to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and associated access roads can increase sediment loading to streams. According to the Division of Forestry, illicit logging operations represent approximately 2.5 percent of the total harvested forest area (registered logging sites) throughout West Virginia. These illicit operations do not have properly installed BMPs and can contribute sediment to streams. This rate of illicit activity has been represented in the model.

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, and manages the Abandoned Well Plugging and Reclamation Program. The OOG also 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 are 129 active oil and gas wells in the metals impaired TMDL watersheds addressed in this report. Runoff from unpaved access roads to these wells and the disturbed areas around the wells contribute sediment to adjacent streams.

Roads

Heightened stormwater runoff from paved roads (impervious surface) 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 shapefiles from the U.S. Census Bureau and the WV Roads GIS coverage prepared by WVU. Unpaved roads that were not included in either GIS coverage were digitized from topographic maps.

Agriculture

Agricultural activities can contribute sediment loads to nearby streams. However, there is minimal agricultural activity in the metals and pH impaired TMDL watersheds, with agricultural landuses accounting for approximately 5.2 percent of the modeled landuses in those watersheds.

Streambank Erosion

Streambank erosion has been determined to be a significant sediment source. The sediment loading from bank erosion is considered a nonpoint source and LAs are assigned. The streambank erosion modeling process is discussed in Section 8.1.3.

Other Land-Disturbance Activities

Stormwater runoff from residential and urban landuses in non-MS4 areas is a significant source of sediment in parts of the watershed. The modified GAP 2000 landuse data were used to determine the extent of residential and urban areas. These landuses are considered to be nonpoint sources and load allocations are prescribed. The modified GAP 2000 landuse data were used to determine the extent of residential and urban areas not subject to MS4 permitting requirements and source representation was based upon precipitation and runoff.

The GAP 2000 landuse data also classifies certain areas as “barren” land. In the model configuration process, portions of the barren landuse were reclassified to account for known abandoned mine lands sources. The remainder is represented as a specific nonpoint source category in the model.

Construction activities disturbing less than one acre are not subject to construction stormwater permitting. While not specifically represented in the model, their impact is indirectly accounted for in the loading rates established for the urban/residential landuse category.

5.3 pH Sources

Where the discharges from historical mining activities were determined to be the cause of low pH impairments, iron and/or aluminum impairments also existed. Because of the complex chemical interactions that occur between dissolved metals and acidity, the TMDL approach focused on reducing metals concentrations to meet metals water quality criteria and then verifying that the resultant pH associated with the metals TMDL condition would be in compliance with pH criteria. The historical mining sources are described in Section 5.2.

6.0 FECAL COLIFORM SOURCE ASSESSMENT

6.1 Fecal Coliform Point Sources

Publicly and privately owned sewage treatment facilities and home aeration units (HAUs) are point sources of fecal coliform bacteria. Combined sewer overflows (CSOs) and discharges from MS4s are additional point sources that may contribute loadings of fecal coliform bacteria to receiving streams. The following sections discuss the specific types of fecal coliform point sources that were identified in the New River watershed.

6.1.1 Individual NPDES Permits

WVDEP issues individual NPDES permits to both publicly owned and privately owned wastewater treatment facilities. Publicly owned treatment works (POTWs) are relatively large facilities with extensive wastewater collection systems, whereas private facilities are usually used in smaller applications such as subdivisions and shopping centers.

In the subject watersheds of this report, 23 individually permitted POTWs discharge treated effluent at 26 outlets. Five additional privately owned sewage treatment plants operating under individual NPDES permits discharge treated effluent at 12 outlets. These sources are regulated by NPDES permits that require effluent disinfection and compliance with strict fecal coliform effluent limitations (200 counts/100 mL [average monthly] and 400 counts/100 mL [maximum daily]). Compliant facilities do not cause fecal coliform bacteria impairments because effluent limitations are more stringent than water quality criteria.

6.1.2 Overflows

CSOs are outfalls from POTW sewer systems that carry untreated domestic waste and surface runoff. CSOs are permitted to discharge only during precipitation events. Sanitary sewer overflows (SSOs) are unpermitted overflows that occur as a result of excess inflow and/or infiltration to POTW separate sanitary collection systems. Both types of overflows contain fecal coliform bacteria. 10 CSO outlets are associated with the POTWs operated by Beckley, Fayetteville, Hinton, and Princeton. No SSO have been identified in the watershed.

6.1.3 Municipal Separate Storm Sewer Systems

Runoff from residential and urbanized areas during storm events can be a significant fecal coliform source, delivering bacteria from the waste of pets and wildlife to the waterbody. USEPA's stormwater permitting regulations require public entities to obtain NPDES permit coverage for stormwater discharges from MS4s in specified urbanized areas. An urbanized area is contained in the Piney Creek watershed where the City of Beckley; the West Virginia Department of Transportation, Division of Highways (DOH); and West Virginia Parkways, Economic Development and Tourism Authority (Parkways) are designated MS4 entities. As such, their stormwater discharges are considered point sources and are prescribed wasteload allocations. MS4 source representation was based upon precipitation and runoff from landuses determined from the modified GAP 2000 landuse data, the jurisdictional boundary of the City, and the associated drainage areas for which DOH and Parkways have MS4 responsibility.

6.1.4 General Sewage Permits

General sewage permits are designed to cover like discharges from numerous individual owners and facilities throughout the state. General Permit WV0103110 regulates small, privately owned sewage treatment plants ("package plants") that have a design flow of less than 50,000 gallons per day (gpd). General Permit WV0107000 regulates HAUs. HAUs are small sewage treatment plants primarily used by individual residences where site considerations preclude typical septic tank and leach field installation. Both general permits contain fecal coliform effluent limitations identical to those in individual NPDES permits for sewage treatment facilities. In the New River watershed, 58 facilities are registered under the "package plant" general permit and 20 are registered under the "HAU" general permit.

6.2 Fecal Coliform Nonpoint Sources

6.2.1 On-site Treatment Systems

Failing septic systems and straight pipes are significant nonpoint sources of fecal coliform bacteria. Information collected during source tracking efforts by WVDEP yielded an estimate of 31,606 homes that are not served by centralized sewage collection and treatment systems. Estimated septic system failure rates across the watershed range from 3 percent to 28 percent.

Due to a wide range of available literature values relating to the bacteria loading associated with failing septic systems, a customized Microsoft Excel spreadsheet tool was created to represent the fecal coliform bacteria contribution from failing on-site septic systems. WVDEP's pre-TMDL monitoring and source tracking data were used in the calculations. To calculate loads, values for both wastewater flow and fecal coliform concentration are needed.

To calculate failing septic wastewater flows, the TMDL watersheds were divided into four septic failure zones. During the WVDEP source tracking process, septic failure zones were delineated by soil characteristics (soil permeability, depth to bedrock, depth to groundwater and drainage capacity) as shown in United States Department of Agriculture (USDA) county soil survey maps. Two types of failure were considered, complete failure and periodic failure. For the purposes of this analysis, complete failure was defined as 50 gallons per house per day of untreated sewage escaping a septic system as overland flow to receiving waters and periodic failure was defined as 25 gallons per house per day. A figure is presented in each of the applicable subwatershed appendices showing the failing septic flows represented in the model by subwatershed.

Once failing septic flows had been modeled, then a fecal coliform concentration was determined at the TMDL watershed scale. Based on past experience with other West Virginia TMDLs, a base concentration of 10,000 counts per 100 ml was used as a beginning concentration for failing septic systems. This concentration was further refined during model calibration. A sensitivity analysis was performed by varying the modeled failing septic concentrations in multiple model runs, and then comparing model output to pre-TMDL monitoring data. Additional details of the failing septic analyses are elucidated in the Technical Report.

For the purposes of this TMDL, discharges from activities that do not have an associated NPDES permit, such as failing septic systems and straight pipes, are considered nonpoint sources. The decision to assign LAs to those sources does not reflect a determination by WVDEP or USEPA as to whether they are, in fact, non-permitted point source discharges. Likewise, by establishing these TMDLs with failing septic systems and straight pipes treated as nonpoint sources, WVDEP and USEPA are not determining that such discharges are exempt from NPDES permitting requirements.

6.2.2 Urban/Residential Runoff

Stormwater runoff from residential and urbanized areas that are not subject to MS4 permitting requirements can be a significant source of fecal coliform bacteria. These landuses are considered to be nonpoint sources and load allocations are prescribed. The modified GAP 2000 landuse data were used to determine the extent of residential and urban areas not subject to MS4 permitting requirements and source representation was based upon precipitation and runoff.

6.2.3 Agriculture

Agricultural activities can contribute fecal coliform bacteria to receiving streams through surface runoff or direct deposition. Grazing livestock and land application of manure result in the deposition and accumulation of bacteria on land surfaces. These bacteria are then available for wash-off and transport during rain events. In addition, livestock with unrestricted access can deposit feces directly into streams.

Although agricultural activity is not the dominant fecal coliform bacteria nonpoint source in the watershed, it is fairly ubiquitous, with pasture/cropland landuses determined to be present in approximately two-thirds of the modeled subwatersheds. Source tracking efforts identified pastures and feedlots near impaired segments that have localized impacts on instream bacteria levels. Source representation was based upon precipitation and runoff, and source tracking information regarding number of livestock, proximity and access to stream, and overall runoff potential were used to develop accumulation rates.

6.2.4 Natural Background (Wildlife)

A certain “natural background” contribution of fecal coliform bacteria can be attributed to deposition by wildlife in forested areas. Accumulation rates for fecal coliform bacteria in forested areas were developed using reference numbers from past TMDLs, incorporating wildlife estimates obtained from West Virginia’s Division of Natural Resources (DNR). In addition, WVDEP conducted storm-sampling on a 100 percent forested subwatershed (Shrewsbury Hollow) within the Kanawha State Forest, Kanawha County, West Virginia to determine wildlife contributions of fecal coliform. These results were used during the model calibration process. On the basis of the low fecal accumulation rates for forested areas, the storm water sampling results, and model simulations, wildlife is not considered to be a significant nonpoint source of fecal coliform bacteria in the New River watershed.

7.0 SEDIMENT SOURCE ASSESSMENT

Excess sediment has been identified as a significant stressor in relation to the biological impairments of a number of streams in the New River watershed. These waters are also impaired pursuant to the numerical water quality criteria for iron. In all of the subject waters, it was determined that the sediment reductions necessary to ensure attainment of the iron water quality criteria exceed those that would be needed to address biological impairment, and that the iron TMDLs are therefore an appropriate surrogate. Sediment sources are described in Section 5.2.3.

8.0 MODELING PROCESS

Establishing the relationship between the instream water quality targets and source loadings is a critical component of TMDL development. It allows for the 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 instream response for TMDL development in the New River watershed.

8.1 Modeling Technique for Total Iron, Dissolved Aluminum, and Fecal Coliform Bacteria

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
- Point and nonpoint sources
- Metals and fecal coliform bacterial impairments are temporally variable and occur at low, average, and high flow conditions
- Dissolved aluminum impairments are related to pH water quality
- Total iron and total aluminum loadings and instream concentrations are related to sediment
- Time-variable aspects of land practices have a large effect on instream metals and bacteria concentrations
- Metals and bacteria transport mechanisms are highly variable and often weather-dependent

The primary regulatory factor that influenced 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 criteria for iron, aluminum, pH, and fecal coliform bacteria in West Virginia are presented in Section 2, Table 2-1. West Virginia numeric 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 instream concentrations under a variety of flow conditions to evaluate critical flow periods for comparison with criteria.

The TMDL development approach must also consider the dominant processes affecting pollutant loadings and instream fate. In the New River watershed, an array of point and nonpoint sources contributes to the various impairments. Most nonpoint sources are rainfall-driven with pollutant loadings primarily related to surface runoff, but some, such as AML seeps and inadequate onsite residential sewage treatment systems, function as continuous discharges. Similarly, certain point sources are precipitation-induced while others are continuous discharges. While loading function variations must be recognized in the representation of the various sources, the TMDL allocation process must prescribe WLAs for all contributing point sources and LAs for all contributing nonpoint sources.

The MDAS was developed specifically for TMDL application in West Virginia to facilitate large scale, data intensive watershed modeling applications. The 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 instream response. The MDAS is used to simulate watershed hydrology and pollutant transport as well as stream hydraulics and instream water quality. It is capable of simulating different flow regimes and pollutant loading variations. A key advantage of the MDAS' development framework is that it has no inherent limitations in terms of modeling size or upper limit of model operations. In addition, the MDAS model allows for seamless integration with modern-day, widely available software such as Microsoft Access and Excel. Sediment, total iron, total aluminum, and fecal coliform bacteria were modeled using the MDAS.

8.1.1 MDAS Setup

Configuration of the MDAS model involved subdividing the TMDL watersheds into subwatershed modeling units connected by stream reaches. Physical characteristics of the subwatersheds, weather data, landuse information, continuous discharges, and stream data were used as input. Flow and water quality were continuously simulated on an hourly time-step.

The 36 TMDL watersheds were broken into 691 separate subwatershed units, based on the groupings of impaired streams shown in Figure 8-1. The TMDL watersheds were divided to allow evaluation of water quality and flow at pre-TMDL monitoring stations. This subdivision process also ensures a proper stream network configuration within the basin.

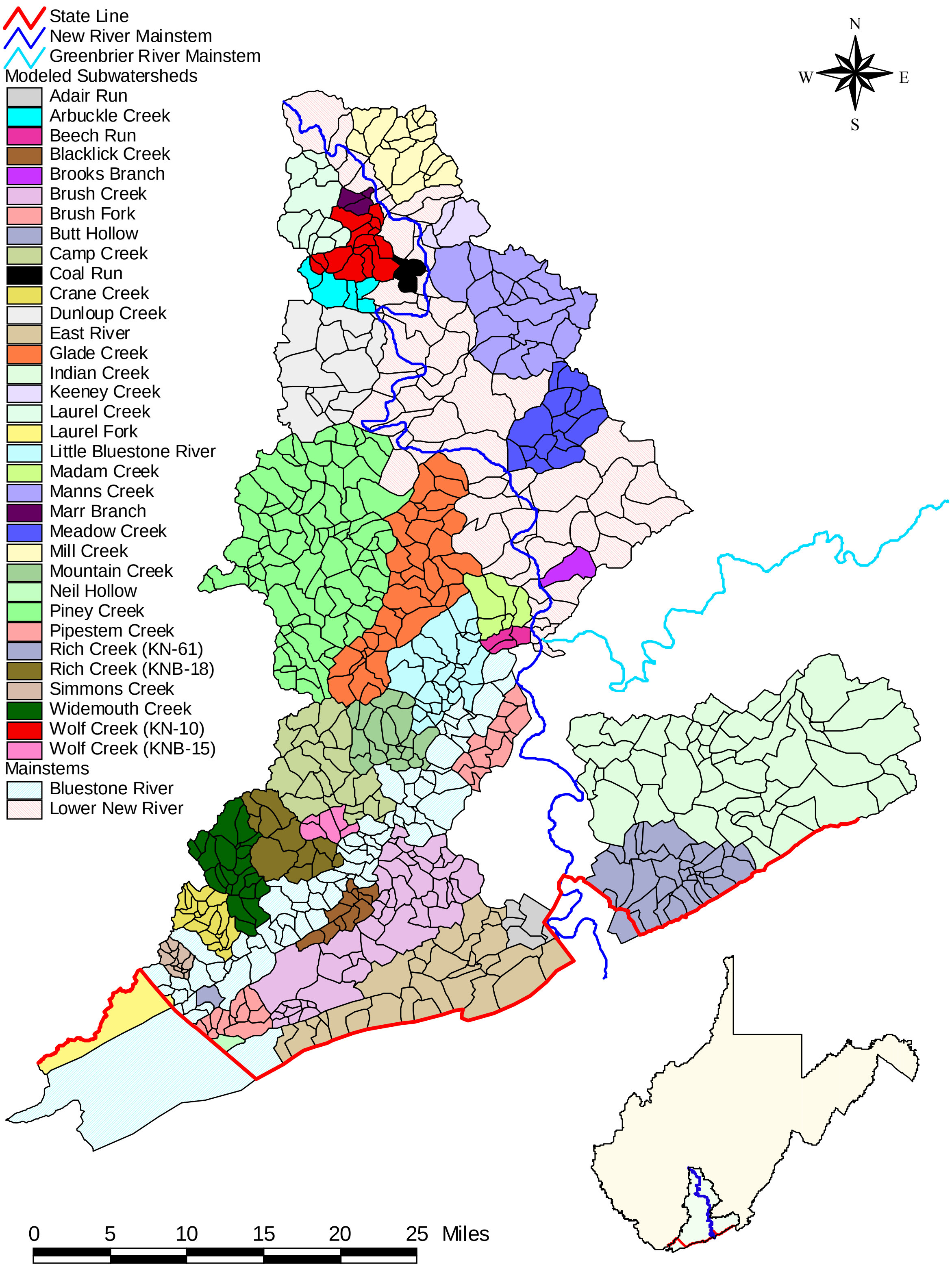


Figure 8-1. 36 TMDL watersheds and subwatershed delineation

The MDAS was configured to model hydrology and water quality for sediment, fecal coliform bacteria, total iron and total aluminum. Pollutant loads are delivered to the streams through surface runoff, subsurface flow, and continuous discharges.

The modeled landuse categories contributing metals via precipitation and runoff include forest, pasture, cropland, wetlands, barren, residential/urban impervious, and residential/urban pervious. These sources were represented explicitly by consolidating existing GAP2000 landuse categories to create modeled landuse groupings. Several additional landuse categories were created to account for landuses either not included in the GAP 2000 and/or representing recent land disturbance activities (i.e. abandoned mine lands, harvested forest and skid roads, oil and gas operations, paved and unpaved roads, and active mining). The process of consolidating and updating the modeled landuses is explained in further detail in the Technical Report. Other sources, such as AML seeps identified by WVDEP's source tracking efforts, and mining pumped discharges were modeled as direct, continuous-flow sources in the model.

Sediment-producing landuses and bank erosion are sources of iron and aluminum because these metals are associated with sediment. Statistical analyses using pre-TMDL monitoring data collected in the TMDL watersheds were performed to establish the correlation between sediment and metals concentrations and to evaluate the spatial variability of this correlation. The results were then applied to the sediment from sediment-producing landuses and bank erosion to calculate the iron and aluminum loads delivered to the streams. Generation of sediment depends on the intensity of surface runoff. It also varies by landuse and the characteristics of the land. Sediment delivery paths modeled were surface runoff erosion, and streambank erosion. Surface sediment sources were modeled using average sediment runoff concentrations by landuse. These concentrations were applied to the corresponding surface runoff flows. Bank erosion was modeled as a rate per unit area of submerged erodible area. Bank erosion will only happen after a critical flow is reached, and as the flow increases, so does the bank erosion yield. Sediment produced during bank erosion episodes is also dependent on the stability of the banks, as defined by the total bank stability score.

In addition, non-sediment related iron and aluminum land-based sources were modeled using representative average concentrations for the surface, interflow and groundwater portions of the water budget.

Metals are modeled in the MDAS in the total recoverable form. To appropriately address dissolved aluminum TMDLs for the New River watershed, it was necessary to link the MDAS with an additional model capable of representing instream aluminum speciation. The Dynamic Equilibrium In-stream Chemical Reactions (DESC-R) model was used in conjunction with the MDAS to address and develop dissolved aluminum TMDLs where necessary in the watershed. 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.

Modeled landuse categories contributing bacteria via precipitation and runoff include pasture, grassland, cropland, urban/residential pervious lands, urban/residential impervious lands, and forest (including barren and wetlands). Other sources, such as failing septic systems, straight pipes, and discharges from sewage treatment facilities, were modeled as direct, continuous-flow sources in the model.

The basis for the initial bacteria loading rates for landuses and direct sources is described in the Technical Report. The initial estimates were further refined during the model calibration. A variety of modeling tools were used to develop the fecal coliform bacteria TMDLs, including the MDAS, and a customized spreadsheet to determine the fecal loading from failing residential septic systems identified during source tracking efforts by the WVDEP. Section 6.2.1 describes the process of assigning flow and fecal coliform concentrations to failing septic systems.

8.1.2 Hydrology Calibration

Hydrology and water quality calibration were performed in sequence because water quality modeling is dependent on an accurate hydrology simulation. Typically, hydrology calibration involves a comparison of model results with instream flow observations from USGS flow gauging stations throughout the watershed. There are three USGS flow gauging stations in the New River watershed with adequate data records for hydrology calibration, USGS gauging stations:

- 03179000 Bluestone River near Pipestem, WV
- 03185400 New River at Thurmond, WV
- 03184500 New River at Hinton, WV

Hydrology calibration was based on observed data from that station and the landuses present in the watersheds at that time. Key considerations for hydrology calibration included the overall water balance, the high- and low-flow distribution, storm flows, and seasonal variation. The hydrology was validated for the time period of January 1, 1992 to September 30, 2005. As a starting point, many of the hydrology calibration parameters originated from the USGS Scientific Investigations Report 2005-5099 (Atkins, 2005). Final adjustments to model hydrology were based on flow measurements obtained during WVDEP's pre-TMDL monitoring in the New River watershed. A detailed description of the hydrology calibration and a summary of the results and validation are presented in the Technical Report.

Flow in the New River is controlled by the Bluestone Dam in Hinton, WV. The Bluestone Dam divides the upper and lower portions of the New River mainstem in West Virginia. The Greenbrier River joins the New River immediately downstream of the dam. Daily time series outfall data from Bluestone Dam (USACE data) was used to supply the model with daily flow to account for water coming from the entire watershed upstream of the dam. Streamflow from the calibrated hydrologic model concurrently developed for the Greenbrier River TMDL effort was used to supply water coming from the Greenbrier River. The combination of precipitation-driven runoff from land area in the New River watershed below the dam, Bluestone Dam outfall, and Greenbrier River flow comprise the sources of water in the Lower New River watershed.

8.1.3 Water Quality Calibration

After the model was configured and calibrated for hydrology, the next step was to perform water quality calibration for the subject pollutants. The goal of water quality calibration was to refine model parameter values to reflect the unique characteristics of the watershed so that model output would predict field conditions as closely as possible. Both spatial and temporal aspects were evaluated through the calibration process.

Sediment Calibration

The water quality parameters that were adjusted to obtain a calibrated model for sediment were the sediment concentrations by landuse, and the magnitude of the coefficient of scour for bank-erosion. Calibration parameters that were relevant for the land-based sediment calibration were the sediment concentrations (in mg/L) for runoff, interflow, and groundwater. These concentrations were defined for each modeled landuse. Initial values for these parameters were based on available landuse-specific storm-sampling monitoring data.

The relevant parameters in the bank-erosion algorithms are the threshold flow at which bank erosion starts to occur, and a coefficient for scour of the bank matrix soil for the reach. The threshold flow at which bank erosion starts to occur was estimated as the flow that occurs at bank-full depth. The coefficient for scour of the bank matrix soil was a direct function of the reach's stability factor (S-value).

Sediment calibration consisted of adjusting the sediment surface runoff concentrations by landuse, and the coefficient of scour for bank-erosion. Initial values were adjusted so that the model's suspended solids output closely matched observed instream data in watersheds with predominately one type of source.

The MDAS bank erosion model takes into account stream flow and bank stability. The bank erosion rate per unit area was defined as a function of: bank flow volume above a specified threshold and the bank erodible area. Each stream segment had a flow threshold above which streambank erosion occurred. The bank scouring process is a power function dependent on high-flow events, defined as exceeding the flow threshold. The coefficient of scour for the bank soil was related to the Bank Stability Index. Streambank erosion was modeled as a unique sediment source independent of other upland-associated erosion sources.

The wetted perimeter and reach length represent ground area covered by water (Figure 8-2). The erodible wetted perimeter is equal to the difference between the actual wetted perimeter and wetted perimeter during threshold flow conditions. The bank erosion rate per unit area was multiplied by the erodible perimeter and the reach length to obtain an estimate of sediment mass eroded corresponding to the stream segment. The Technical Report provides more detailed discussions on the technical approaches used for sediment modeling.

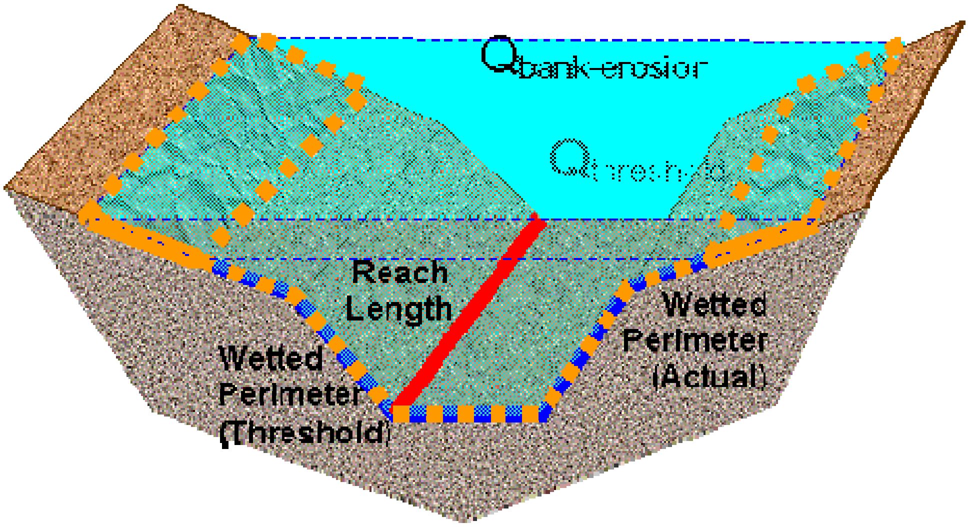


Figure 8-2. Conceptual diagram of stream channel components used in the bank erosion model

Total Iron, Total Aluminum, and Fecal Coliform Bacteria Calibration

The water quality was calibrated by comparing modeled versus observed instream metals and fecal coliform bacteria concentrations. The water quality calibration consisted of executing the MDAS model, comparing the model results to available observations, and adjusting water quality parameters within reasonable ranges. Available monitoring data in the watershed were identified and assessed for application to calibration. Monitoring stations with observations that represented a range of hydrologic conditions, source types, and pollutants were selected. The time-period for water quality calibration was selected based on the availability of the observed data and their relevance to the current conditions in the watershed. WVDEP also conducted storm monitoring on Shrewsbury Hollow in Kanawha State Forest, Kanawha County, West Virginia. The data gathered during this sampling episode was used in the calibration of fecal coliform and to enhance the representation of background conditions from undisturbed areas. The results of the storm sampling fecal coliform calibration are shown in Figure 8-3. Model parameters for sediment and total iron were derived from previous West Virginia TMDL studies, storm sampling efforts, and literature values.

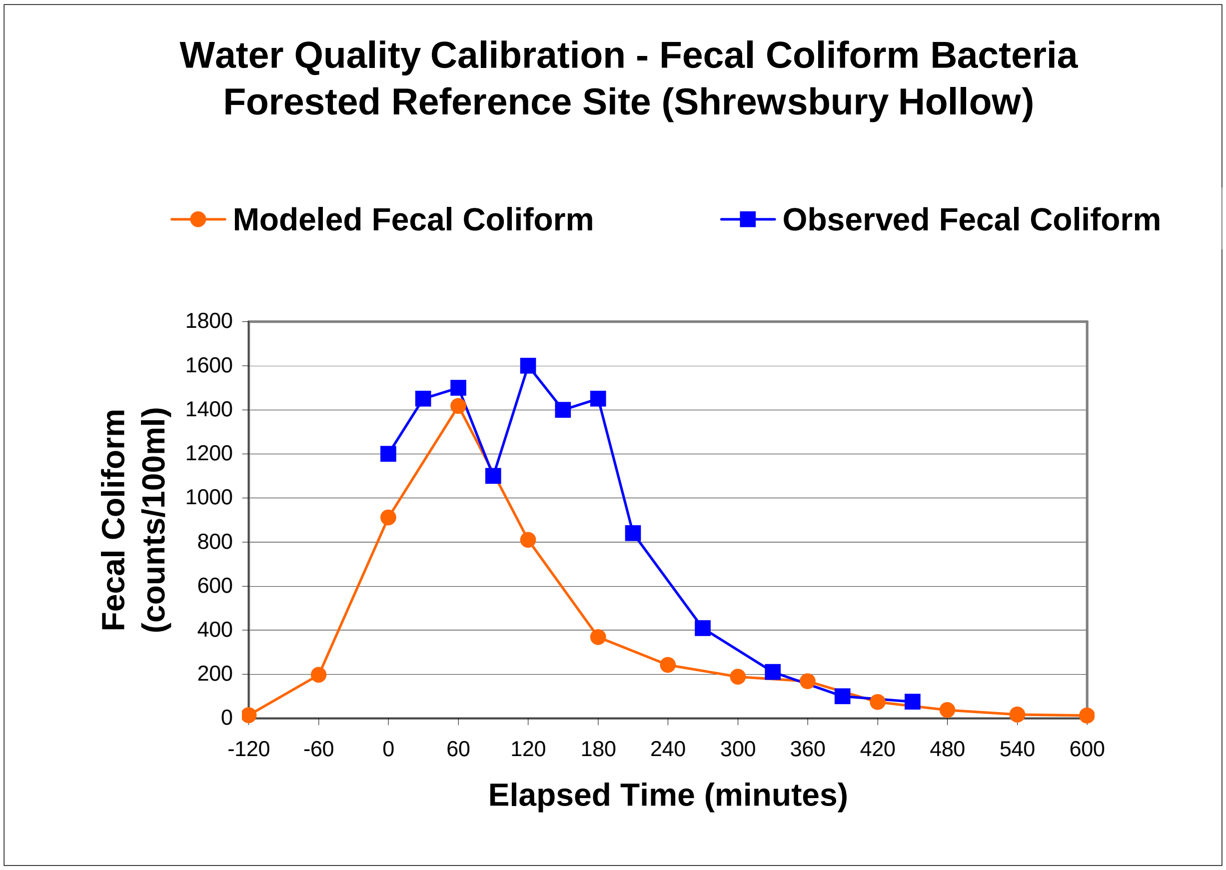


Figure 8-3. Shrewsbury Hollow fecal coliform observed data

DESC-R Calibration

As stated previously, it was necessary to link the MDAS with DESC-R to appropriately address dissolved aluminum TMDLs in the New River watershed. DESC-R was calibrated by adjusting water quality parameters to match the observed instream water quality data.

The DESC-R model is equipped with an optimization function for automatic calibration to observed water quality data (dissolved aluminum). The DESC-R model uses the simulated total recoverable metal output from the MDAS as input and, therefore, the MDAS model must be calibrated for total metals (primarily, total iron and total aluminum) prior to executing the DESC-R optimization function. The DESC-R model was calibrated against observed dissolved aluminum at key monitoring locations in watersheds impaired for dissolved aluminum. Key locations included the mouths of impaired streams, sites upstream and downstream of potential metals sources, and the mouths of significant tributaries. An example of a DESC-R calibration analysis is shown in Figure 8-4. Further description and a summary of the results of the DESC-R water quality calibration and validation are presented in the Technical Report.

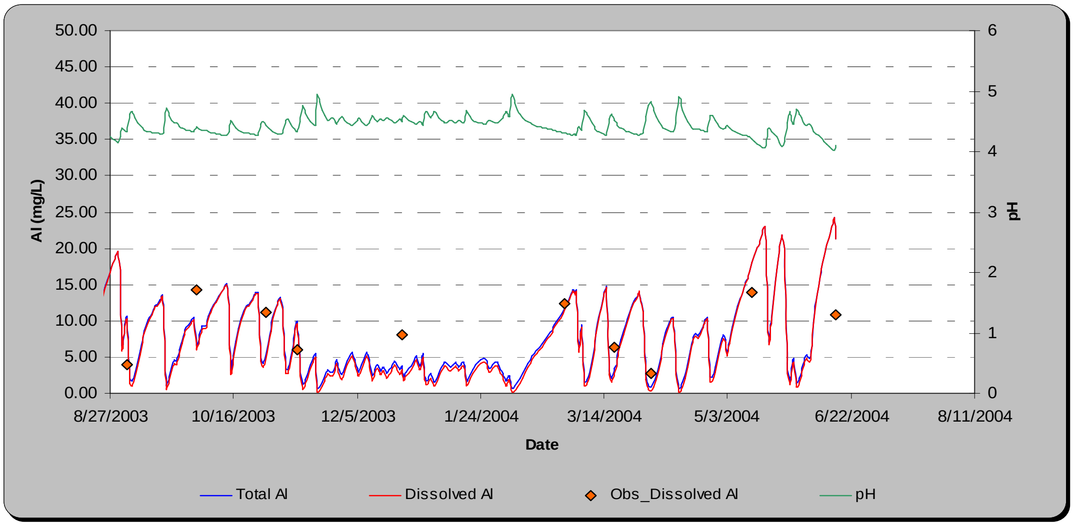


Figure 8-4. Example dissolved aluminum calibration analysis in DESC-R

8.2 Modeling Technique for pH

Where the discharges from historical mining activities were determined to be the cause of low pH impairments, iron and/or aluminum impairments also existed. Because of the complex chemical interactions that occur between dissolved metals and acidity, the TMDL approach focused on reducing metals concentrations, using the MDAS and DESC-R models previously described, to meet metals water quality criteria and then verifying that the resultant pH associated with the metals TMDL condition would be in compliance with pH criteria.

8.3 Modeling Technique for Sediment

The SI process discussed in Section 4 indicated a need to reduce the contribution of excess sediment to some of the biologically impaired streams. Initially, a “reference watershed” TMDL development approach was pursued. The approach was based on selecting a non-impaired watershed that shares similar landuse, ecoregion, and geomorphologic characteristics with the impaired watershed. Stream conditions in the reference watershed are assumed to be representative of the conditions needed for the impaired streams to attain their designated uses, and the normalized loading associated with the reference stream is used as the TMDL endpoint for the impaired streams. Given these parameters and a non-impaired WVSCI score, Glade Creek, was selected as the reference watershed. The location of the reference watershed is shown in Figure 4-2.

Adequately representing erosion processes and nonpoint source loads in the watershed was a primary concern in selecting the appropriate modeling system. The MDAS model was integrated with a stream routing model that examined streambank erosion and depositional processes.

All of the sediment-impaired streams exhibited impairments pursuant to total iron water quality criteria. Upon finalization of modeling based on the reference watershed approach, it was determined that sediment reductions necessary to ensure compliance with iron criteria are greater than those necessary to correct the biological impairments associated with sediment. As such, the iron TMDLs presented for the subject waters are appropriate surrogates for necessary sediment TMDLs. For affected streams, Table 8-1 contrasts the sediment reductions necessary to attain iron criteria with those needed to resolve biological impairment under the reference watershed approach. Please refer to the Technical Report for details regarding the reference watershed approach.

Table 8-1. Sediment loadings using different modeling approaches

Stream Name	Stream Code	Allocated Sediment Load Iron TMDL (tons/yr)	Allocated Sediment Load Reference Approach (tons/yr)
Wolf Creek	WVKN-10	431	436
Floyd Creek	WVKN-17-B	67	75
Arbuckle Creek	WVKN-21	218	236
Mill Creek	WVKN-22-K	137	173
Cranberry Creek	WVKN-26-E	341	365
Dry Creek	WVKN-61-E	101	186
Osborne Creek	WVKN-7-B	139	171
Marr Branch	WVKN-9	65	78
UNT/Marr Branch RM 0.9	WVKN-9-A	28	34
Brush Creek	WVKNB-12	1357	1435
Righthand Fork/Widemouth Creek	WVKNB-28-B	143	210
Crane Creek	WVKNB-30	170	251
Simmons Creek	WVKNB-33	79	82
Brush Fork	WVKNB-36	152	198

8.4 Allocation Analysis

As explained in Section 2, a TMDL is composed of the sum of individual WLAs for point sources, LAs for nonpoint sources, and natural background levels. In addition, the TMDL must include a 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 units. Conceptually, this definition is denoted by the equation:

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

To develop total iron, dissolved aluminum, pH, and fecal coliform bacteria 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

8.4.1 TMDL Endpoints

TMDL endpoints represent the water quality targets used to quantify TMDLs and their individual components. In general, West Virginia's numeric water quality criteria for the subject pollutants and an explicit five percent MOS were used to identify endpoints for TMDL development.

The five 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 instream conditions that occurred during the simulation period. The explicit five percent MOS also accounts for those cases where monitoring might not have captured the full range of instream conditions. The TMDL endpoints for the various criteria are displayed in Table 8-2.

Table 8-2. TMDL endpoints

Water Quality Criterion	Designated Use	Criterion Value	TMDL Endpoint
Total Iron	Aquatic life, warmwater fisheries	1.5 mg/L (4-day average)	1.425 mg/L (4-day average)
Total Iron	Aquatic life, troutwaters	0.5 mg/L (4-day average)	0.475 mg/L (4-day average)
Dissolved Aluminum	Aquatic life, warmwater fisheries	0.75 mg/L (1-hour average)	0.7125 mg/L (1-hour average)
Dissolved Aluminum	Aquatic life, troutwaters	0.087 mg/L (4-day average)	0.0827 mg/L (4-day average)
pH	Aquatic Life	6.00 Standard Units (Minimum)	6.02 Standard Units (Minimum)
Fecal Coliform	Water Contact Recreation and Public Water Supply	200 counts / 100 mL (Monthly Geometric Mean)	190 counts / 100 mL (Monthly Geometric Mean)
Fecal Coliform	Water Contact Recreation and Public Water Supply	400 counts / 100 mL (Daily, 10% exceedance)	380 counts / 100 mL (Daily, 10% exceedance)

TMDLs are presented as average daily loads that 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.

The water quality criteria for pH allow no values below 6.0 or above 9.0. With respect to AMD, 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 instream 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 is calculated based on the daily equilibrium pH output (6-year simulation period) from DESC-R.

8.4.2 Baseline Conditions and Source Loading Alternatives

The calibrated model provides the basis for performing the allocation analysis. The first step is to simulate baseline conditions, which represent existing nonpoint source loadings and point sources loadings at permit limits. Baseline conditions allow for an evaluation of instream 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 six year simulation period (January 1, 1998 through December 31, 2003). The precipitation experienced over this period was applied to the landuses and pollutant sources, as they existed at the time of TMDL development. Predicted instream concentrations were compared directly with the TMDL endpoints. This comparison allowed for the evaluation of the magnitude and frequency of exceedances under a range of hydrologic and environmental conditions, including dry periods, wet periods, and average periods. Figure 8-5 presents the annual rainfall totals for the years 1980 through 2004 at the Beckley WSO AP (WV0582) weather station in West Virginia. The years 1998 to 2003 are highlighted to indicate the range of precipitation conditions used for TMDL development in the New River watershed.

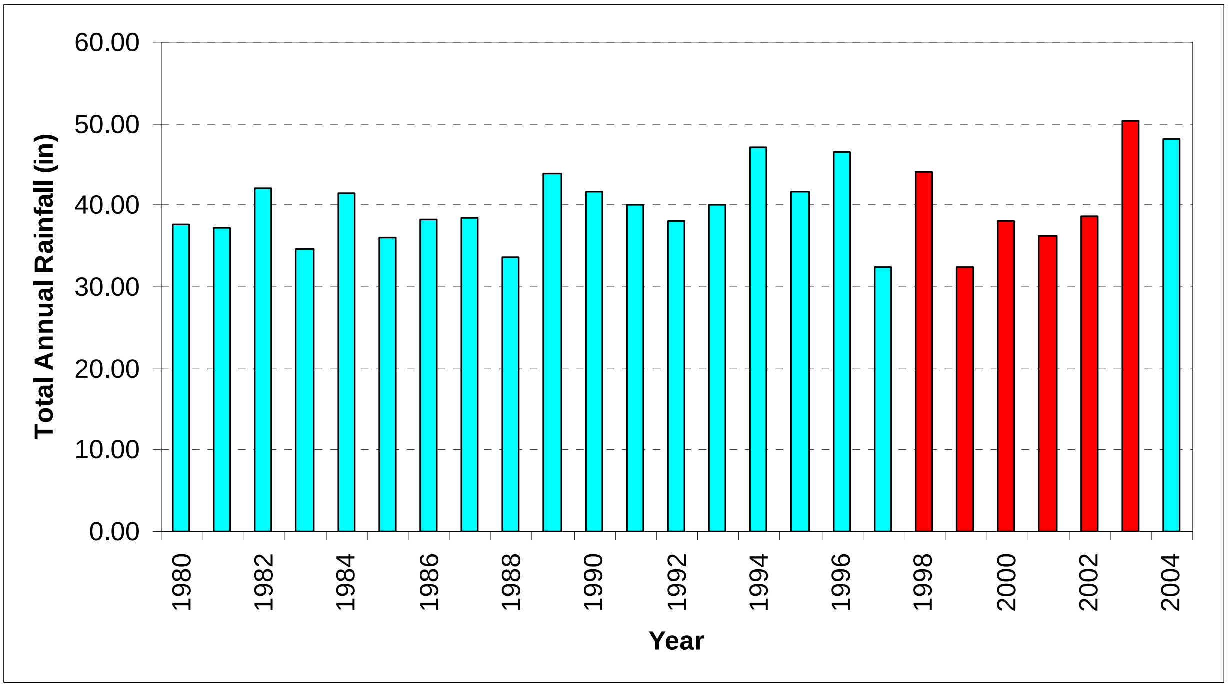


Figure 8-5. Annual precipitation totals for the Beckley WSO AP (WV0582) weather station

Mining discharges that are influenced by precipitation were represented during baseline conditions using precipitation, drainage area and applicable effluent limitations. For non-precipitation-induced mining discharges, available flow and/or pump capacity information was used in conjunction with applicable effluent limitations. The metals concentrations associated with common effluent limitations are presented in Table 8-3. The concentrations displayed in Table 8-3 accurately represent existing wasteload allocations for the majority of mining discharges. In the limited instances where existing effluent limitations vary from the displayed values, the outlets were represented at next higher condition. For example, existing iron effluent limits between 1.5 and 3.2 mg/L were represented at 3.2 mg/L.

Table 8-3. Metals concentrations used in representing permitted conditions for active mining

Pollutant	Technology-based Permits	Water Quality-based Permits
Aluminum, total	1.39 mg/L (90^{th} percentile DMR values)	1.39 mg/L (90^{th} percentile DMR values)
Iron, total	3.2 mg/L	1.5 mg/L or 0.5 mg/L

The baseline conditions for bond forfeiture sites were represented based upon precipitation, drainage area and the technology-based effluent limitations for iron. AML seeps identified were represented as continuous discharges, using the observed flows and pollutant concentrations identified by WVDEP source tracking.

Non-mining discharges (stormwater associated with industrial activity) were represented using precipitation, drainage area, and the stormwater benchmark iron value of 1.0 mg/L. Sediment producing nonpoint source and background loadings were represented using precipitation, drainage area, and the iron loading associated with their predicted sediment contributions. Effluents from sewage treatment plants were represented under baseline conditions as continuous discharges, using the design flow for each facility and the monthly average fecal coliform effluent limitation of 200 counts/100 mL.

CSO outlets were represented as discreet point sources in the model. CSO flow and discharge frequency was derived from overflow data generated by the POTWs. This information was augmented with precipitation analysis and watershed modeling to develop model inputs needed to build fecal coliform loading values for a ten-year time series from which annual average fecal coliform loading values could be calculated. Under baseline conditions, Beckley and Princeton CSO quality was represented as a concentration of 1,000 counts/100 mL to reflect the partial treatment of CSO discharges that is occurring. Fayetteville and Hinton CSO outlets were modeled at concentrations of 100,000 counts/100 mL to reflect baseline conditions for untreated CSO discharges

Nonpoint source and background loadings for fecal coliform were represented using drainage area, precipitation, and pollutant accumulation and wash off rates, as appropriate for each landuse.

Source Loading Alternatives

Simulating baseline conditions allowed for the evaluation of each stream'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 instream pollutant concentrations. The loading contributions from the various existing nonpoint sources were individually adjusted; the modeled instream concentrations were then evaluated.

Multiple allocation scenarios were run for the impaired waterbodies (Figure 8-6). Successful scenarios achieved the TMDL endpoints under all flow conditions throughout the modeling period. 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 instream concentrations were reduced first. If additional load reductions were required to meet the TMDL endpoints, less significant source contributions were subsequently reduced.

Figure 8-6 shows an example of model output for a baseline condition and a successful TMDL scenario.

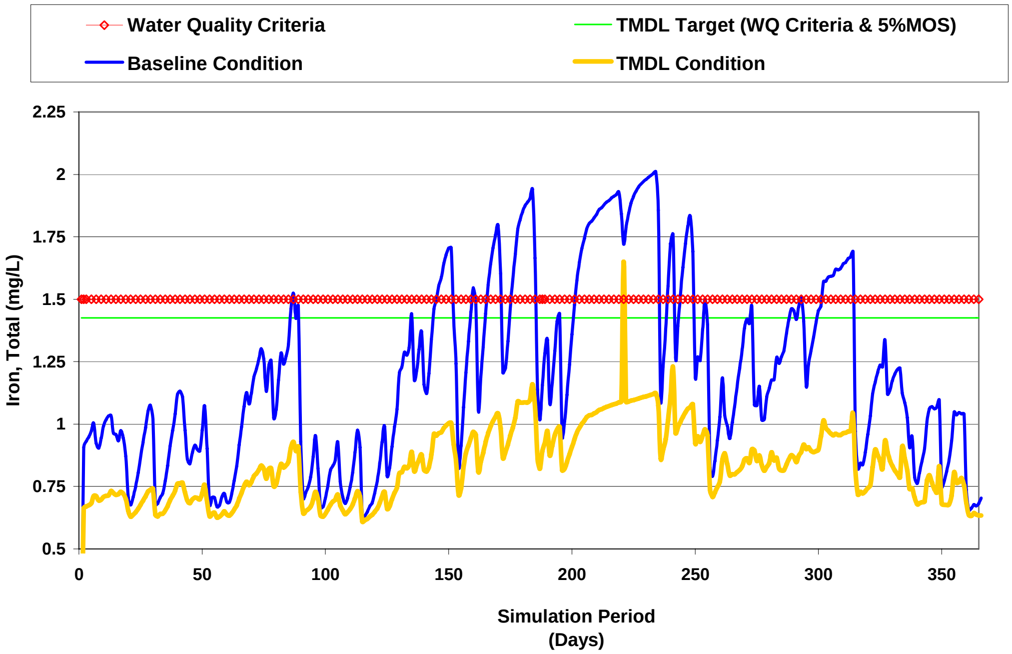


Figure 8-6. Example of baseline and TMDL conditions for total iron

8.5 TMDLs and Source Allocations

8.5.1 Dissolved Aluminum and Total Iron TMDLs

Source allocations were developed for all modeled subwatersheds contributing to the metals-impaired streams of the New River watershed. A top-down methodology was followed to allocate loads to sources. Headwaters were analyzed first because their loading affects downstream water quality. Loading contributions were reduced from applicable sources in impaired headwaters until criteria were attained at the outlet of the most downstream subwatershed. 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 allocated loadings less than natural conditions. The following methodology was used when allocating to aluminum and iron sources.

- For subwatersheds where iron impairments are associated with elevated sediment loadings and where streambank erosion was determined to be a significant source of sediment, the loading from streambank erosion was first reduced to the loading characteristics of the reference stream.

- For watersheds with AMLs but no permitted point sources or bond forfeiture sites, AML loads were reduced first until instream water quality criteria were met or until conditions were no less than those of undisturbed forest. If further reductions were required, the loads from sediment-contributing nonpoint sources were reduced until water quality criteria were met.

- For watersheds with AMLs and point sources and/or bond forfeiture sites, point sources and bond forfeiture sites were set at the loads defined by applicable permit limits and AML loads were subsequently reduced. Loads from AMLs were reduced until instream water quality criteria were met, if possible. If further reduction was required once loads from AMLs were reduced, sediment sources were reduced. If even further reduction was required, the technology-based loadings from point sources and bond forfeiture sites were reduced.

- For watersheds where dissolved aluminum TMDLs were developed, sources of total iron were reduced prior to total aluminum reduction because existing instream iron concentrations can 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)
WLAs were developed for all point sources permitted to discharge iron and/or aluminum under a NPDES permit. Because of the established relationship between iron and TSS, iron WLAs are also provided for facilities with stormwater discharges that are regulated under NPDES permits that contain TSS and/or iron effluent limitations or benchmarks values, MS4 facilities, and facilities registered under the General NPDES permit for construction stormwater.

Active Mining Operations
WLAs are provided for all existing outlets of NPDES permits for mining activities, except those where reclamation has progressed to the point where existing limitations are based upon the Post-Mining Area provisions of Subpart E of 40 CFR 434. The WLAs for active mining operations consider the functional characteristics of the permitted outlets (i.e. precipitation driven, pumped continuous flow, gravity continuous flow, commingled) and their respective impacts at high and low flow conditions.

Dissolved aluminum TMDLs were based on a dissolved aluminum TMDL endpoint; however, sources were represented in terms of total aluminum. WLAs for aluminum are also provided in total metal form.

The federal effluent guidelines for the coal mining point source category (40 CFR 434) provide various alternative limitations for discharges caused by precipitation. Under those technology-based guidelines, effluent limitations for total iron, total manganese and TSS may be replaced with an alternative limitation for “settleable solids” during certain magnitude precipitation events that vary by mining subcategory. The water quality-based WLAs and future growth provisions of the iron TMDLs preclude the applicability of the “alternative precipitation” iron provisions of 40 CFR 434. Also, the established relationship between iron and TSS requires continuous control of TSS concentration in permitted discharges to achieve iron WLAs. As such, the “alternative precipitation" TSS provisions of 40 CFR 434 should not be applied to point source discharges associated with the iron TMDLs.

In certain instances, prescribed WLAs may be less stringent than existing effluent limitations. However, the TMDLs are not intended to relax effluent limitations that were developed under the alternative basis of WVDEP's implementation of the antidegradation provisions of the Water Quality Standards, which may result in more stringent allocations than those resulting from the TMDL process. Whereas TMDLs prescribe allocations that minimally achieve water quality criteria (i.e. 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. Antidegradation provisions may result in more stringent allocations that limit the use of remaining assimilative capacity. Also, water quality-based effluent limitations developed in the NPDES permitting process may dictate more stringent effluent limitations for discharge locations that are upstream of those considered in the TMDLs. 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 contrast, effluent limitation development in the permitting process is based on the achievement/maintenance of water quality criteria at the point of discharge.

Specific WLAs are not provided for "post-mining" outlets because programmatic reclamation was assumed to have returned disturbed areas to conditions that approach background. Barring unforeseen circumstances that alter their current status, such outlets are authorized to continue to discharge under the existing terms and conditions of their NPDES permit.

Non-mining Point Sources

Individual registrations under the general permit for stormwater associated with industrial activity (Multi-sector Stormwater Permit) implement TSS and/or iron benchmark values. Facilities that are compliant with such limitations are not considered to be significant sources of sediment or iron. Facilities that are present in the watersheds of iron-impaired streams are assigned WLAs that allow for continued discharge under existing permit conditions.

Municipal Separate Storm Sewer System (MS4)

USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for stormwater discharges from MS4s. The City of Beckley; the West Virginia Department of Transportation, Division of Highways (DOH); and the West Virginia Parkways, Economic Development and Tourism Authority (Parkways) are designated MS4 entities in the subject watersheds. Each entity will be registered under, and subject to, the requirements of General Permit Number WV0110625. The stormwater discharges from MS4s are point sources for which the TMDLs prescribe wasteload allocations.

The City of Beckley has formed a stormwater utility to comprehensively control stormwater within its jurisdiction and to facilitate implementation of the requirements of the MS4 General Permit. To be consistent with those intentions and to provide the maximum flexibility for local control, the pollutant loadings associated with precipitation and runoff from most land within the Beckley corporate boundary were aggregated to represent the City's baseline MS4 conditions. Corresponding wasteload allocations were prescribed under the same basis. Only the precipitation-induced loadings from the drainage areas associated with the DOH and Parkways

MS4s that intersect Beckley were excluded from the City's baseline condition and wasteload allocation. The DOH and Parkways MS4 baseline conditions and wasteload allocations were based upon the drainage areas associated with the roads and MS4s for which they are responsible, as determined by information provided in their application for registration under General NPDES Permit Number WV0110625.

In the majority of the subwatersheds where MS4 entities have areas of responsibility, the urban, residential and road landuses strongly influence bank erosion. As such, portions of the baseline and allocated loads associated with bank erosion are included in the MS4 wasteload allocations.

The subdivision of the bank erosion component between point and nonpoint sources, and where applicable, between multiple MS4 entities, is proportional to their respective drainage areas within each subwatershed. Model representation of bank erosion is accomplished through consideration of a number of inputs including slope, soils, imperviousness, and the stability of existing streambanks. Bank erosion loadings are most strongly influenced by upland impervious area and bank stability. The decision to include bank erosion in the MS4 wasteload allocations results from the predominance of urban/residential/road landuses and impacts in MS4 areas, and the assumption that the management practices that will be implemented under the MS4 permit will directly address impacts from this source. However, even if the implementation of stormwater controls on uplands is maximized, and the volume and intensity of stormwater runoff are minimized, the existing degraded stability of streambanks may continue to accelerate erosion. The erosion of unstable streambanks is a nonpoint source of sediment that is included in the MS4 allocations. Natural attenuation of legacy impacts cannot be expected in the short term, but may be accelerated by bank stabilization projects. The inclusion of the bank erosion load component in the wasteload allocations of MS4 entities is not intended to prohibit or discourage cooperative bank stabilization projects between MS4 entities and WVDEP's Nonpoint Source Program, or to prohibit the use of Section 319 funding as a component of those projects.

Construction Stormwater

Specific WLAs for future activity under the Construction Stormwater General Permit are provided at the subwatershed scale and are described in Section 9.0. An allocation of 1.5 percent of subwatershed area was provided with loadings based upon precipitation and runoff and an assumption that proper installation and maintenance of required BMPs will achieve a TSS benchmark value of 100 mg/L. In all instances, the existing level of activity under the Construction Stormwater General Permit conforms to the subwatershed allocations. As such, specific WLAs for existing registrations under the General Permit are not presented.

Load Allocations (LAs)

LAs are made for the dominant nonpoint source categories as follows:

- AML: loading from abandoned mine lands, including loads from disturbed land, highwalls, deep mine discharges and seeps
- Bond forfeiture sites: loading from mining facilities that have not effectively reclaimed mining sites and have forfeited their SMCRA bonds

- Sediment sources: loading associated with sediment contributions from barren land, harvested forest, oil and gas well operations, and residential/urban/road landuses and streambank erosion in non-MS4 areas
- Background and other nonpoint sources: loading from undisturbed forest and grasslands, and agricultural landuses (loadings associated with this category were represented but not reduced)

Non-attainment of Trout Criteria and Phased TMDL Approach

Troutwater iron TMDLs are presented for Arbuckle Creek, Crane Creek, Wolf Creek, Piney Creek and the Piney Creek tributaries Batoff Creek, Beaver Creek, and Cranberry Creek. Implementation of the described allocation methodology does not assure complete attainment of the chronic aquatic life protection iron criterion. The unattainable iron criterion is a four-day average concentration equal to 0.5 mg/L total iron that is not to be exceeded more than once every three years. The relatively high iron content of the soils in the New River watershed is the primary influencing factor.

Initial allocation scenarios for the subject waters included the following provisions:

- All point sources and continuous flow nonpoint sources were set at the value of the troutwater criterion
- All streambank stability ratings were set to the best measured condition in the watershed
- All land disturbing nonpoint sources were reduced to the forest background loading
- No allowance for new activity under the Construction Stormwater General Permit was provided

Even under those stringent and unachievable allocation scenarios, modeling output did not ensure criterion attainment over the design period of precipitation. Non-attainment was predicted in response to extreme precipitation events or a series of significant storms that elevate instream TSS and iron concentrations. The magnitudes of the predicted exceedances under the initial allocation scenarios were not extreme, but exceedances were predicted much more often than the one per three year frequency prescribed by the criterion. Criterion attainment would require pollutant reductions from existing sources that are well beyond practical levels, coupled with significant reductions of undisturbed upland and streambank background loadings, and no construction stormwater allowances.

To address this situation, phased implementation of the TMDLs is proposed, under which the source allocations necessary to universally achieve the iron criterion for warmwater fisheries (1.5 mg/L, 4-day average, once per three years average exceedance frequency) are implemented concurrently with additional study of the situation.

In that regard, WVDEP has initiated planning of a special monitoring effort for minimally impacted and documented viable troutwaters, upon which modeling refinements and/or alternative criterion decision-making may be based. Initial plans envision intensified water quality monitoring targeted to varying stream flows, storm event monitoring, high-resolution stream channel configuration and bank vegetative condition assessments, and intensified landuse characterization. Monitoring and assessment results will be used to refine model calibration and an "existing condition" model run will be executed. Fieldwork will be performed in calendar year 2008. If an alternative criterion appears warranted, necessary revisions to Water Quality Standards will be pursued in the 2010 triennial review process. If the new information indicates that existing criterion can be attained through modeling refinements and practical allocations, then TMDL modifications will be pursued.

For the subject troutwaters, the iron TMDLs and allocations are presented under the following methodology:

- All point source and continuous flow nonpoint source allocations are set at 1.5 mg/L
- All land disturbance activities are reduced to loadings slightly greater than the background forest loading
- The iron loading associated with sediment from streambank erosion is reduced to levels commensurate with those associated with the best observed streambank condition in the New River watershed
- Allowance for new construction activity is provided such that 1.5% of the area of each subwatershed is reserved for site registrations under the Construction Stormwater General Permit

This allocation methodology results in universal attainment of the warmwater fishery iron criterion at the pour points of all subwatersheds within the impaired troutwaters.

8.5.2 Fecal Coliform Bacteria TMDLs

TMDLs and source allocations were developed for impaired steams and their tributaries on a subwatershed basis throughout the watershed. As described in Section 8.5.1, a top-down methodology was followed to develop these TMDLs and allocate loads to sources.

The following general methodology was used when allocating loads to fecal coliform bacteria sources:

- The effluents from all NPDES permitted sewage treatment plants were set at the permit limit (200 counts/100 mL monthly average)
- Because West Virginia Bureau for Public Health regulations prohibit the discharge of raw sewage into surface waters, all illicit discharges of human waste (from failing septic systems and straight pipes) were reduced by 100 percent in the model
- If further reduction was necessary, CSOs, MS4s, and non-point source loadings from agricultural lands and residential areas were subsequently reduced until in-stream water quality criteria were met

Wasteload Allocations (WLAs)

WLAs were developed for all facilities permitted to discharge fecal coliform bacteria, including MS4s, as described below.

Sewage Treatment Plant Effluents

The fecal coliform effluent limitations for NPDES permitted sewage treatment plants are more stringent than water quality criteria; therefore, all effluent discharges from sewage treatment facilities were given wasteload allocations equal to existing monthly fecal coliform effluent limitations of 200 counts/100 mL.

Combined Sewer Overflows

There are 10 CSOs associated with POTWs operated by Beckley, Fayetteville, Hinton, and Princeton (Table 8-4). The Cities of Beckley and Princeton have expended considerable effort to manage overflows from their combined collection systems. Both systems use a variety of techniques to minimize the flow and bacteria concentration of CSO discharges. The Cities of Hinton and Fayetteville do not have systems in place to store or treat CSO discharges.

Table 8-4. Combined sewer overflows in the New River watershed

City	SWS	Receiving Stream	Receiving Stream Code	Permit ID	Outlet
Beckley	1185	Little Whitestick Creek	WVKN-26-E-1	WV0023183	C002
Princeton	1394	Brush Creek	WVKNB-12	WV0023094	C002
Fayetteville	1034	UNT/Marr Branch RM 0.9	WVKN-9-A	WV0022314	C002
Fayetteville	1049	House Branch	WVKN-10-A	WV0022314	C003
Hinton	1276	New River (lower)	WVKN-lo	WV0024732	C002
Hinton	1276	New River (lower)	WVKN-lo	WV0024732	C008
Hinton	1276	New River (lower)	WVKN-lo	WV0024732	C009
Hinton	1282	New River (lower)	WVKN-lo	WV0024732	C004
Hinton	1286	New River (lower)	WVKN-lo	WV0024732	C003
Hinton	1287	New River (lower)	WVKN-lo	WV0024732	C006

All fecal coliform bacteria wasteload allocations for CSO discharges have been established at 200 counts/100mL. Implementation can be accomplished by CSO elimination or by disinfection treatment and discharge in compliance with the operable, concentration-based allocations.

Municipal Separate Storm Sewer System (MS4)

USEPA’s stormwater permitting regulations require municipalities to obtain permit coverage for stormwater discharges from MS4s. The City of Beckley; the West Virginia Parkways, Economic Development and Tourism Authority (Parkways); and the West Virginia Department of Transportation, Division of Highways (DOH) are designated MS4 entities in the subject watersheds. Each entity will be registered under, and subject to, the requirements of General Permit Number WV0110625. The stormwater discharges from MS4s are point sources for which the TMDLs prescribe wasteload allocations.

The City of Beckley has formed a stormwater utility to comprehensively control stormwater within its jurisdiction and to facilitate implementation of the requirements of the MS4 General

Permit. To be consistent with those intentions and to provide the maximum flexibility for local control, the pollutant loadings associated with precipitation and runoff from most land within Beckley's corporate boundary was aggregated to represent the City's baseline MS4 conditions. Corresponding wasteload allocations were prescribed under the same basis. Only the precipitation-induced loadings from the drainage areas associated with the MS4 areas of responsibility of DOH and Parkways that intersect Beckley were excluded from the City's baseline condition and wasteload allocation.

Load Allocations (LAs)
For West Virginia TMDLs, fecal coliform LAs are assigned as required to the following source categories:

- Pasture/Cropland
- On-site Sewage Systems — loading from all illicit discharges of human waste (including failing septic systems and straight pipes)
- Residential — loading associated with urban/residential runoff from non-MS4 areas
- Background and Other Nonpoint Sources — loading associated with wildlife sources from all other landuses (contributions/loadings from wildlife sources were not reduced)

8.5.3 Seasonal Variation

The TMDL must consider seasonal variation. For the New River watershed metals and fecal coliform 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 and fecal coliform concentrations simulated on a daily time step by the model were compared with TMDL endpoints. Allocations that met these endpoints throughout the modeling period were developed.

8.5.4 Critical Conditions

A critical condition represents a scenario where water quality criteria are most susceptible to violation. Analysis of water quality data for the impaired streams addressed in this effort shows high pollutant concentrations during both high- and low-flow thereby precluding selection of a single critical condition. 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.

Nonpoint source loading is typically precipitation-driven and impacts tend to occur during wet weather and high surface runoff. During dry periods little or no land-based runoff occurs, and elevated instream pollutant levels may be due to point sources (Novotny and Olem, 1994). Also, failing on-site sewage systems and AML seeps (both categorized as nonpoint sources but represented as continuous flow discharges) often have an associated low-flow critical condition, particularly where such sources are located on small receiving waters.

8.5.5 TMDL Presentation

The TMDLs for iron, dissolved aluminum, pH, fecal coliform bacteria and biological impairments are shown in the four watershed appendices associated with this report. The TMDLs for iron and aluminum are presented as average daily loads, in pounds per day. The TMDLs for fecal coliform bacteria are presented in number of colonies per day. All TMDLs were developed to meet TMDL endpoints under a range of conditions observed throughout the year. TMDLs and their components are also presented in the allocation spreadsheets associated with this report. The filterable spreadsheets also display detailed source allocations and include multiple display formats that allow comparison of pollutant loadings among categories and facilitate implementation.

The iron and aluminum WLAs for active mining operations are presented both as annual average loads, for comparison with other pollutant sources, and equivalent allocation concentrations. The prescribed concentrations are the operable allocations and are to be implemented by conversion to monthly average and daily maximum effluent limitations using USEPA's Technical Support Document for Water Quality-based Toxics Control (USEPA, 1991). The iron WLAs for Construction Stormwater General Permit registrations are presented as both annual average loads, for comparison with other sources, and equivalent areas registered under the permit. The registered area is the operable allocation. The iron WLAs for non mining activities registered under general NPDES permits are presented both as annual average loads, for comparison with other pollutant sources, and equivalent allocation concentrations. The prescribed concentrations are operable, and because they are equivalent to existing effluent limitations/benchmark values, they are to be directly implemented.

The dissolved aluminum TMDLs are based on a dissolved aluminum TMDL endpoint; however, sources are represented in terms of total aluminum. The WLAs and LAs for aluminum are also provided in the form of total metal.

The WLAs for individual NPDES permits for fecal coliform bacteria are presented both as annual average loads, for comparison with other pollutant sources, and equivalent allocation concentrations. The prescribed concentrations are the operable allocations for NPDES permit implementation.

9.0 FUTURE GROWTH

9.1 Iron and Aluminum

With the exception of allowances provided for Construction Stormwater General Permit registrations discussed below, this TMDL does not include specific future growth allocations for iron or aluminum. However, the absence of specific future growth allocations does not prohibit the permitting of new or expanded activities in the watersheds of streams for which metals 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 issuance of 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:

- 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 effluent limitations for metals to be prescribed in the total recoverable form. West Virginia water quality criteria for iron are in total recoverable form and may 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.

  As described previously, the alternative precipitation provisions of 40 CFR 434 that suspend applicability of TSS limitations cannot be applied to new discharges in iron TMDL watersheds.

- 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 may result in improved water quality in abandoned mining areas.

- 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.

- Most traditional 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 100 mg/L. New point sources may be permitted in the iron TMDL watersheds with the implementation of applicable technology based TSS requirements.

Subwatershed-specific future growth allowances have been provided for site registrations under the Construction Stormwater General Permit. In general, the successful TMDL allocation provides 1.5 percent of modeled subwatershed area to be registered under the general permit at any point in time. Furthermore, the iron allocation spreadsheet provides a cumulative area allowance for the immediate subwatershed and all upstream contributing subwatersheds. Projects in excess of the acreage provided for the immediate subwatershed may also be registered under the general permit, provided that the total registered disturbed area in the immediate subwatershed and all upstream subwatersheds is less than the cumulative area provided.

Furthermore, larger projects may be permitted in phases that adhere to the area allowances or by implementing controls beyond those afforded by the general permit. Larger areas may be permitted if it can be demonstrated that more stringent controls will result in a loading condition commensurate with that afforded by the management practices associated with the general permit.

9.2 Fecal Coliform Bacteria

Specific fecal coliform bacteria future growth allocations are not prescribed. The absence of specific future growth allocations does not prohibit new development in the watersheds of streams for which fecal coliform bacteria TMDLs have been developed, or preclude the permitting of new sewage treatment facilities.

In many cases, the implementation of the TMDLs will consist of providing public sewer service to unsewered areas. The NPDES permitting procedures for sewage treatment facilities include technology-based fecal coliform effluent limitations that are more stringent than applicable water quality criteria. Therefore, a new sewage treatment facility may be permitted anywhere in the watershed, provided that the permit includes monthly average and maximum daily fecal coliform limitations of 200 counts/100 mL and 400 counts/100 mL, respectively. Furthermore, WVDEP will not authorize construction of combined collection systems nor permit overflows from newly constructed collection systems.

10.0 PUBLIC PARTICIPATION

10.1 Public Meetings

Informational public meetings were held on May 13, 2004 at Woodrow Wilson High School and on June 5, 2007 at Raleigh County Solid Waste Authority office. The May 13, 2004 meeting occurred prior to pre-TMDL stream monitoring and pollutant source tracking and included a general TMDL overview and a presentation of planned monitoring and data gathering activities. The June 5, 2007 meeting occurred prior to allocation of pollutant loads and included a presentation of planned allocation strategies. A public meeting was held to present the Draft TMDLs on May 16, 2008 at the Hinton Technology Center in Hinton, WV. The meeting, which began at 6:30 PM, provided information to stakeholders and was intended to facilitate comments on the Draft TMDLs.

10.2 Public Notice and Public Comment Period

The availability of Draft TMDLs was advertised in various local newspapers between April 29 and May 2, 2008. Interested parties were invited to submit comments during the public comment period, which began on May 2 and ended June 3, 2008. The electronic documents are available on the WVDEP's internet site at http://www.wvdep.org/wvtmdl.

10.3 Response Summary

Written comments were received from Paul Calamita, AquaLaw PLC in regard to wasteload allocations for the combined sewer overflows (CSOs) of the Town of Fayetteville. Comments were provided on behalf of West Virginia American Water Company which is contemplating purchase of the Town's wastewater utility. Two specific requests for TMDL revision were requested:

First give the CSO discharges a placeholder allocation based on 200 monthly geometric mean for fecal coliform. Allocation should be explained as simply a placeholder until the ultimate level of CSO control is established in Fayetteville's approved CSO LTCP.

Second, add the following explanatory language to either the loading allocation or CSO section of any TMDL that will affect Fayetteville's CSO discharges:

This TMDL presents one scenario where the available bacteria loadings have been allocated among the various sources of bacteria. This allocation is based upon current information and can be changed to an alternative scenario, as long as all applicable water quality standards will be met under the alternative scenario. For example, the City of Fayetteville will develop a Long-Term Control Plan for its Combined Sewer Overflow discharges. The national CSO Policy contains four key principles, including the "review and revision, as appropriate, of water quality standards and their implementation procedures when developing CSO control plans to reflect the site-specific wet weather impacts of CSOs."

WVDEP Response:

The placeholder allocation concept and proposed language suggest the prescription of wasteload allocations that would be inconsistent with TMDL development requirements and cannot be accommodated. The allocations presented in the subject TMDLs are necessary to attain the currently effective fecal coliform bacteria water quality criteria.

Notwithstanding the above, the wasteload allocations applicable to the Fayetteville CSOs in the original draft TMDLs were modified. Because Fayetteville had not proposed treatment and discharge CSO controls, via Long-Term Control Plan development or otherwise, WVDEP assumed that control would be accomplished through CSO elimination, and originally prescribed fecal coliform wasteload allocations equal to zero for the Fayetteville CSOs. Those allocations differed from the 200 counts/100 mL allocations prescribed for permittees with control plans involving treatment and discharge. During the public meeting associated with the draft TMDLs, West Virginia American Water Company representatives advised that there was potential for treatment/discharge CSO control at Fayetteville. In response to that information, WVDEP reconsidered its allocation approach, remodeled all CSO discharges that were originally prescribed zero wasteload allocations with discharge quality equal to the value of water quality criteria, and determined those allocations would attain the currently effective criteria. The final draft TMDLs have been revised to incorporate the allocation modifications. Section 8.5.2 was modified to state that compliance with the allocations can be achieved by CSO elimination, or treatment and discharge in compliance with the operable, concentration-based wasteload allocations equal to 200 counts/ 100 mL.

The TMDL implementation language of Section 11.1 clarifies agency expectations regarding implementation of the CSO wasteload allocations. Although the wasteload allocations prescribed for CSOs are necessary to achieve currently effective criteria, the TMDLs are not to be construed to supersede the prioritization and scheduling of CSO controls pursuant to the national CSO program. Nor are the TMDLs intended to prohibit the pursuit of the water quality standard revisions envisioned in the national policy. TMDLs may be modified to properly implement future water quality standard revisions (designated use and/or criteria), if enacted and approved by USEPA.

11.0 REASONABLE ASSURANCE

Reasonable assurance for maintenance and improvement of water quality in the affected watershed rests primarily with two programs. The NPDES permitting program is implemented by WVDEP to control point source discharges. The West Virginia Watershed Network is a cooperative nonpoint source control effort involving many state and federal agencies, whose task is protection and/or restoration of water quality.

11.1 NPDES Permitting

WVDEP’s Division of Water and Waste Management (DWWM) is responsible for issuing non-mining NPDES permits within the State. WVDEP’s Division of Mining and Reclamation (DMR) develops NPDES permits for mining activities. As part of the permit review process, permit writers have the responsibility to incorporate the required TMDL WLAs into new or reissued permits. New facilities will be permitted in accordance with future growth provisions described in Section 9.

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. Permits for existing sewage treatment facilities in the New River watershed will be reissued beginning in July 2008 and the reissuance of mining permits will begin January 1, 2009.

DWWM also implements a program to control discharges from CSOs. Specified fecal coliform wasteload allocations for CSOs will be implemented in accordance with the provisions of the national Combined Sewer Overflow Control Policy and the state Combined Sewer Overflow Strategy. Those programs recognize that comprehensive CSO control may require significant resources and an extended period of time to accomplish. The wasteload allocations prescribed for CSOs are necessary to achieve current fecal coliform water quality criteria. However, the TMDL should not be construed to supersede the prioritization and scheduling of CSO controls and actions pursuant to the national CSO program.

11.2 Watershed Management Framework Process

The Watershed Management Framework is a tool used to identify priority watersheds and coordinate efforts of state and federal agencies with the goal of developing and implementing watershed management strategies through a cooperative, long-range planning effort.

The West Virginia Watershed Network is an informal association of state and federal agencies, and nonprofit organizations interested in the watershed movement in West Virginia. Membership is voluntary and everyone is invited participate. The Network uses the Framework to coordinate existing programs, local watershed associations, and limited resources. This coordination leads to the development of Watershed Based Plans to implement TMDLs and document environmental results.

The principal area of focus of watershed management through the Framework process is correcting problems related to nonpoint source pollution. Network partners have placed a greater emphasis on identification and correction of nonpoint source pollution. The combined resources of the partners are used to address all different types of nonpoint source pollution through both public education and on-the-ground projects.

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. The Framework 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 a Watershed Based Plan to improve water quality.

Each year, the Framework is included on the agenda of the Network to evaluate the restoration potential of watersheds within a certain Hydrologic Group. This evaluation includes a review of TMDL recommendations for the watersheds under consideration. Development of Watershed Based Plans is based on the efforts of local project teams. These teams are composed of Network members and stakeholders having interest in or residing in the watershed. Team formation is based on the type of impairment(s) occurring or protection(s) needed within the watershed. In addition, teams have the ability to use the TMDL recommendations to help plan future activities. Additional information regarding upcoming Network activities can be obtained from the Nonpoint Source Program Southern Basin Coordinator, Jennifer DuPree (jdupree@wvdep.org).

There are six active watershed associations in the New River watershed: the Arbuckle Creek Watershed Association, Dunloup Creek Watershed Association, Piney Creek Watershed Association, Upper Glade Creek Watershed Association, Plateau Action Network, and Indian Creek Watershed Association. For additional information concerning the associations contact the above mentioned Nonpoint Source Program Southern Basin Coordinator.

11.3 Public Sewer Projects

Within WVDEP DWWM, the Engineering and Permitting Branch's Engineering Section is charged with the responsibility of evaluating sewer projects and providing funding, where available, for those projects. All municipal wastewater loans issued through the State Revolving Fund (SRF) program are subject to a detailed engineering review of the engineering report, design report, construction plans, specifications, and bidding documents. The staff performs periodic on-site inspections during construction to ascertain the progress of the project and compliance with the plans and specifications. Where the community does not use SRF funds to undertake a project, the staff still performs engineering reviews for the agency on all POTWs prior to permit issuance or modification. For further information on upcoming projects, a list of funded and pending water and wastewater projects in West Virginia can be found at http://www.wvinfrastructure.com/projects/index.html.

11.4 AML Projects

Within WVDEP, the primary entity that deals with abandoned mine drainage issues is the Division of Land Restoration. Within the Division, the 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 the passage of 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 that were primarily chosen for protection of public health, safety, and property. This new emphasis on improving water quality, in conjunction with Framework participation, will aid in the cleanup of sites already selected for remediation activities.

11.5 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. Table 11-1 displays nine bond forfeiture sites in the watersheds addressed in this report.

Table 11-1. New River watershed bond forfeiture sites with water treatment needs

Original Permittee	Permit No.	TMDL Watershed	Subwatershed ID	Stream
COAL VALLEY MINING, INC.	UO-342	Piney Creek	1158	Bowyer Creek
COAL VALLEY MINING, INC.	U-26-83	Piney Creek	1158	Bowyer Creek
E. J. & L. CO., INC.	S-3041-87	Piney Creek	1195	Batoff Creek
HARVEY ENERGY CORP.	S-3081-87	Dunloup Creek	1099	Mill Creek
PREMIUM ROCK COAL COMPANY, INC.	P-3027-99	Piney Creek	1158	Bowyer Creek
RIDGEWAY DEV.	U-3037-89	Piney Creek	1158	Bowyer Creek
SMITH & STOVER	EM-29	Piney Creek	1158	Bowyer Creek
STAR INDUSTRIES, INC.	R-3-81	Piney Creek	1188	Cranberry Creek
WILLIAMS CONSTRUCTION CO.	S-3079-86	Mill Creek	1007	Osborne Creek

Representation of the baseline condition for bond forfeiture sites incorporates the disturbed area associated with the forfeited permit and technology-based NPDES effluent limitations. The Office of Special Reclamation is charged with providing reclamation as required by the forfeited permit. Where the load allocation for bond forfeitures indicates a reduction from baseline conditions, pollutant reduction beyond technology-based effluent limitations and the responsibility of Office of Special Reclamation were determined to be necessary to meet water quality criteria.

12.0 MONITORING PLAN

The following monitoring activities are recommended:

12.1 NPDES Compliance

WVDEP's DWWM and DMR have the responsibility to ensure that NPDES permits contain effluent limitations as prescribed by the TMDL WLAs and to assess and compel compliance. Permits for any new discharges will contain effluent limitations that are consistent with the TMDLs and will also contain self-monitoring and reporting requirements that are periodically reviewed by WVDEP. WVDEP also inspects treatment facilities and independently monitors NPDES discharges. The combination of these efforts will ensure implementation of the future growth provisions of the TMDLs.

12.2 Nonpoint Source Project Monitoring

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

12.3 TMDL Effectiveness Monitoring

TMDL effectiveness monitoring should be performed to document water quality improvements after significant implementation activity has occurred where 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.

13.0 REFERENCES

Atkins, John T. Jr., Jeffery B. Wiley, Katherine S. Paybins. 2005. *Calibration Parameters Used to Simulate Streamflow from Application of the Hydrologic Simulation Program-FORTRAN Model (HSPF) to Mountainous Basins Containing Coal Mines in West Virginia.* Scientific Investigations Report 2005-5099. U.S. Department of the Interior, U.S. Geological Survey.

Cormier, S., G. Sutter, and S.B. Norton. 2000. *Stressor Identification: Technical Guidance Document*. USEPA-822B-00-25. U.S. Environmental Protection Agency, Office of Water and Office of Research and Development, Washington, DC.

Gerritsen, J., J. Burton, and M.T. Barbour. 2000. *A Stream Condition Index for West Virginia Wadeable Streams*. Tetra Tech, Inc., Owings Mills, MD.

Novotny, V., and H. Olem. 1994. *Water Quality: Prevention, Identification, and Management of Diffuse Pollution*. Van Nostrand Reinhold, New York, NY.

Scientific notation. Dictionary.com. *The American Heritage® Dictionary of the English Language, Fourth Edition*. Houghton Mifflin Company, 2004. http://dictionary.reference.com/browse/scientific notation (accessed: May 22, 2007).

USEPA (U.S. Environmental Protection Agency). 1991. *Technical Support Document for Water Quality-based Toxics Control*. USEPA/505/2-90-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.