TETRA TECH

June 2020

Draft Report

Total Maximum Daily Loads for the Upper Guyandotte River Watershed, West Virginia

Prepared for
West Virginia Department of Environmental Protection
Division of Water and Waste Management
Watershed Assessment Branch, TMDL Section

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On the cover:
Devils Fork in Raleigh County, Southeast of Madeline
Photographer: Jason Morgan, WVDEP Division of Water and Waste Management

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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
CFR	Code of Federal Regulations
CSGP	Construction Stormwater General Permit
CSR	Code of State Rules
DEM	Digital Elevation 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
GIS	geographic information system
gpd	gallons per day
GPS	global positioning system
HAU	home aeration unit
HPU	Hydrologic Protection Unit (refers to NPDES permits issued by DMR)
LA	load allocation
ug/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
MRLC	Multi-Resolution Land Characteristics Consortium
MS4	Municipal Separate Storm Sewer System
NED	National Elevation Dataset
NLCD	National Land Cover Dataset
NOAA-NCDC	National Oceanic and Atmospheric Administration, National Climatic Data Center
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OGCSGP	Oil and Gas Construction Stormwater General Permit
OOG	WVDEP Office of Oil and Gas
POTW	publicly owned treatment works
SI	stressor identification
SRF	State Revolving Fund
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
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 Upper Guyandotte River watershed refers to the tributary streams that ultimately drain to the Upper Guyandotte River (**Figure I-1**). The Upper Guyandotte River has been dammed to create R.D. Bailey Lake near the community of Justice in Wyoming County. However, TMDLs for R.D Bailey Lake were not developed in this effort because it is not impaired for parameters addressed in this TMDL. The term "watershed" is also used more generally to refer to the land area that contributes precipitation runoff that eventually drains to the mouth of the Upper Guyandotte River.

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, and may include impaired tributaries for which additional TMDLs are presented. This report addresses 257 impaired streams contained within 47 TMDL watersheds in the Upper Guyandotte 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. During data preparation and model setup, the 47 TMDL watersheds have been subdivided into 595 modeled subwatersheds. During TMDL development, on additional subwatershed was created for the selenium modeling effort. Pollutant sources, allocations and reductions are presented at the subwatershed scale to facilitate future permitting actions and TMDL implementation.

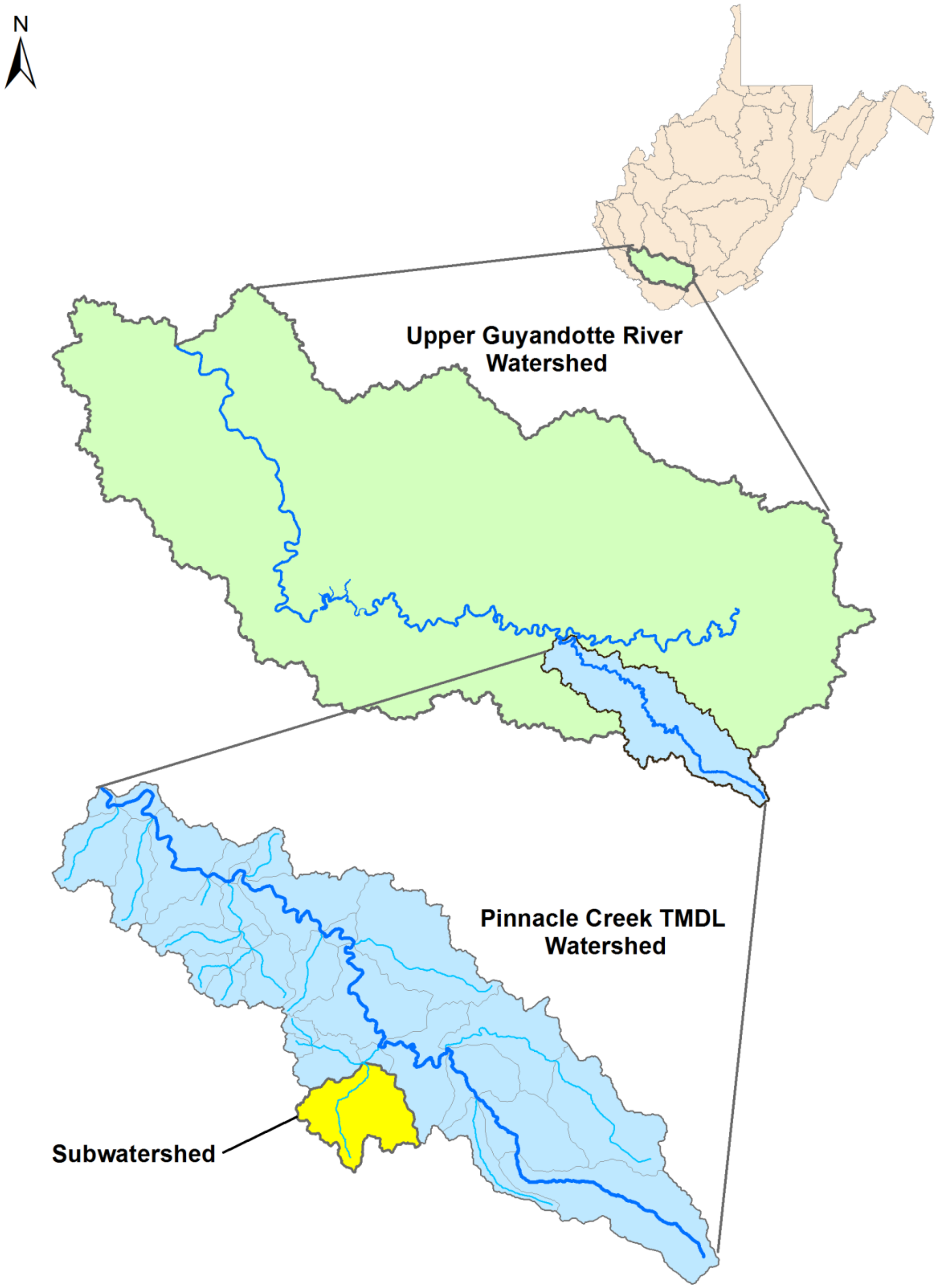

Figure I-1. Examples of a watershed, TMDL watershed, and subwatershed.

EXECUTIVE SUMMARY

This report includes Total Maximum Daily Loads (TMDLs) for 257 impaired streams in the Upper Guyandotte River watershed. This project was organized into 47 TMDL watersheds, which account for all streams draining to the Upper Guyandotte River.

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 in 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.

Many of the impaired streams in this TMDL project are included on the West Virginia's 2016 Section 303(d) List. Documented impairments are related to numeric water quality criteria for total iron, pH, aluminum, selenium, manganese, and fecal coliform bacteria. TMDLs for pH and aluminum are not presented in this report because of ongoing coordination with USEPA regarding the proposed water quality standard for dissolved aluminum. Given the dynamic relationships between dissolved aluminum, pH, and manganese, no TMDLs are presented in this project. These TMDLs will be the subject of a future addendum once dissolved aluminum criteria and endpoint are resolved. Previously developed 2004 TMDLs for pH, aluminum, and manganese are still currently in effect.

The narrative water quality criterion of 47 CSR 2–3.2.i prohibits the presence of wastes in state waters that cause or contribute to significant adverse impact to the chemical, physical, hydrologic, and biological components of aquatic ecosystems. Historically, WVDEP based assessment of biological integrity on a rating of the stream's benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index (WVSCI). WVSCI-based "biological impairments" were included on West Virginia's Section 303(d) lists from 2002 through 2010.

In 2012, legislative action (codified in §22-11-7b) directed the agency to develop and secure legislative approval of new rules to interpret the narrative criterion for biological impairment found in 47 CSR 2-3.2.i.

§22-11-7b indicates, rules promulgated may not establish measurements that would establish standards less protective than requirements that existed during the 2012 regular session. Thus, WVDEP has continued to list biological impairment based on WVSCI for subsequent 303d lists, including the most recent list in 2016. In response to the legislation, WVDEP prepared a procedural rule (47 CSR 2B) in 2019 establishing the methodology for determining compliance with the biological component of narrative criteria. A public comment period extended through May 6, 2019 and a public hearing was held the same day. Response to comment and final filing was delayed, requiring that the same procedural rule be proposed again in 2020. The public comment period ran through April 20, 2020 and a public hearing was held the same day. At the time of this TMDL completion, WVDEP was responding to comments and preparing to finalize the procedural rule. WVDEP has suspended biological impairment TMDL development pending approval of the procedural rule.

Although "biological impairment" TMDLs are not presented in this project, streams for which available benthic information demonstrates non-attainment of the threshold described in the assessment methodology presented in 47CSR2B, were subjected to a biological stressor identification (SI) process. The results of the SI process are discussed in **Section 4** of this report and displayed in **Appendix K** of the Technical Report. **Section 4** of this report also discusses the relationship of the pollutant-specific TMDLs developed herein to WVSCI-based biological impacts.

Impaired waters were organized into 47 TMDL watersheds. For hydrologic modeling purposes, impaired and unimpaired streams in these 47 TMDL watersheds were further divided into 595 smaller subwatershed units. 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 linkage between pollutant sources and instream responses for fecal coliform bacteria, selenium, and iron. 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.

In general, point and nonpoint sources contribute to the fecal coliform bacteria impairments in the watershed. Failing on-site septic systems, direct discharges of untreated sewage, and precipitation runoff from agricultural and residential areas are nonpoint sources of fecal coliform bacteria. Point sources of fecal coliform bacteria include the effluents of sewage treatment facilities, both public and private. The presence of individual source categories and their relative significance varies by subwatershed.

Iron impairments are also attributable to both point and nonpoint sources. Nonpoint sources of iron include abandoned mine lands (AML), roads, oil and gas operations, timbering, agriculture, urban/residential land disturbance and streambank erosion. Iron point sources include the permitted discharges from mining activities, bond forfeiture sites, non-mining industrial stormwater and construction sites. The presence of individual source categories and their relative significance also varies by subwatershed. Iron is a naturally-occurring element that is present in soils and the iron loading from many of the identified sources is associated with sediment contributions.

Forty selenium impaired streams in 13 TMDL watersheds are addressed in this report. Active, reclaimed, and abandoned mining sites are dominant landuse in these TMDL watersheds and are presumed to be the contributing sources of selenium.

This 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. This 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 WLAs were no more stringent than numeric water quality criteria.

In 2004, USEPA, with support from WVDEP, developed TMDLs for pH, metals, and fecal coliform impaired streams in the Guyandotte River Watershed (USEPA, 2004). These older TMDLs were developed with a less robust stream monitoring and source tracking dataset and a lower resolution modeling approach. While pursuing TMDL development for other impairments, WVDEP obtained more comprehensive data and developed new TMDLs under a more refined modeling approach. All impaired streams for which TMDLs were developed in 2004 have been re-evaluated. TMDLs, consistent with currently effective water quality criteria, are presented for all identified impairments of the iron, selenium, and fecal coliform water quality criteria. Upon approval, all of the iron and fecal coliform TMDLs presented herein shall supersede those developed previously. Previously developed 2004 TMDLs for pH, dissolved aluminum, and manganese remain in effect awaiting resolution of the dissolved aluminum criteria. A future addendum to this project will determine which TMDLs will be superseded.

Considerable resources were used to acquire recent water quality and pollutant source information upon which the TMDLs are based. TMDL modeling is among the most sophisticated methods available, and incorporates sound scientific principles. TMDL outputs are presented in various formats to assist user comprehension and facilitate use in implementation, including allocation spreadsheets, an ArcGIS Viewer Project, and Technical Report.

Applicable TMDLs are displayed in **Section 9** of this report. The accompanying spreadsheets provide TMDLs and allocations of loads to categories of point and nonpoint sources that achieve the total TMDL. Also provided is the ESRI StoryMap at https://arcg.is/04uiSa that allows for the exploration of spatial relationships among the source assessment data. A Technical Report is available that describes the detailed technical approaches used in the process and displays the data upon which the TMDLs are based.

1.0 REPORT FORMAT

The following report describes the overall total maximum daily load (TMDL) development process for select streams in the Upper Guyandotte River watershed, identifies impaired streams, and outlines the source assessment for all pollutants for which TMDLs are presented. Also described are the modeling process, allocation approach, and measures that will be taken to ensure that the TMDLs are met. The applicable TMDLs are displayed in **Section 8** of this report. An ArcGIS Viewer Project supports this report by providing further details on the data and allows the user to explore the spatial relationships among the source assessment data, magnify streams and view other features of interest. In addition to the TMDL report, a CD is provided that contains spreadsheets (in Microsoft Excel format) that display detailed source allocations associated with successful TMDL scenarios. A Technical Report is included that describes the detailed technical approaches used in the process and displays the 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:

TMDL = sum of WLAs + sum of LAs + MOS

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 2019 TMDLs should be pursued in Hydrologic Group E, which includes the Upper Guyandotte River watershed. **Figure 2-1** depicts the hydrologic groupings of West Virginia's watersheds.

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. The draft TMDL is advertised for public review and comment, and an informational meeting is held during the public comment period. Public comments are addressed, and the draft TMDL is submitted to USEPA for approval.

In 2004 USEPA, with support from WVDEP, developed TMDLs for metals, pH and fecal coliform impaired streams in the Guyandotte Watershed (USEPA, 2004). In total, TMDLs were developed for 66 streams within the Upper and Lower Guyandotte River Watersheds. Iron, aluminum, manganese, selenium, pH, and fecal coliform impairments were addressed. These older TMDLs were developed with a less robust stream monitoring and source tracking dataset and a lower resolution modeling approach. Without a stressor identification process, it was assumed that impairments to aquatic life would be resolved through pollutants TMDLs. Stream for which this assumption were made have been re-evaluated in this project through a formal stressor identification process and specific pollutant TMDLs are identified that will address stress (e.g., total iron to resolve sedimentation stress). In this current project, all impaired streams for which TMDLs were developed in 2004 have been re-evaluated. While pursuing TMDL development for other impairments, WVDEP obtained more comprehensive data and developed new TMDLs under a more refined modeling approach. Upon approval, the TMDLs presented herein for iron and fecal coliform shall supersede those developed previously. 2004 TMDLs for pH, dissolved aluminum, and manganese remain in effect. A future addendum to this project will determine which TMDLs will be superseded.

Appendix A of the Technical Report lists TMDLs by pollutant and waterbody developed for this effort.

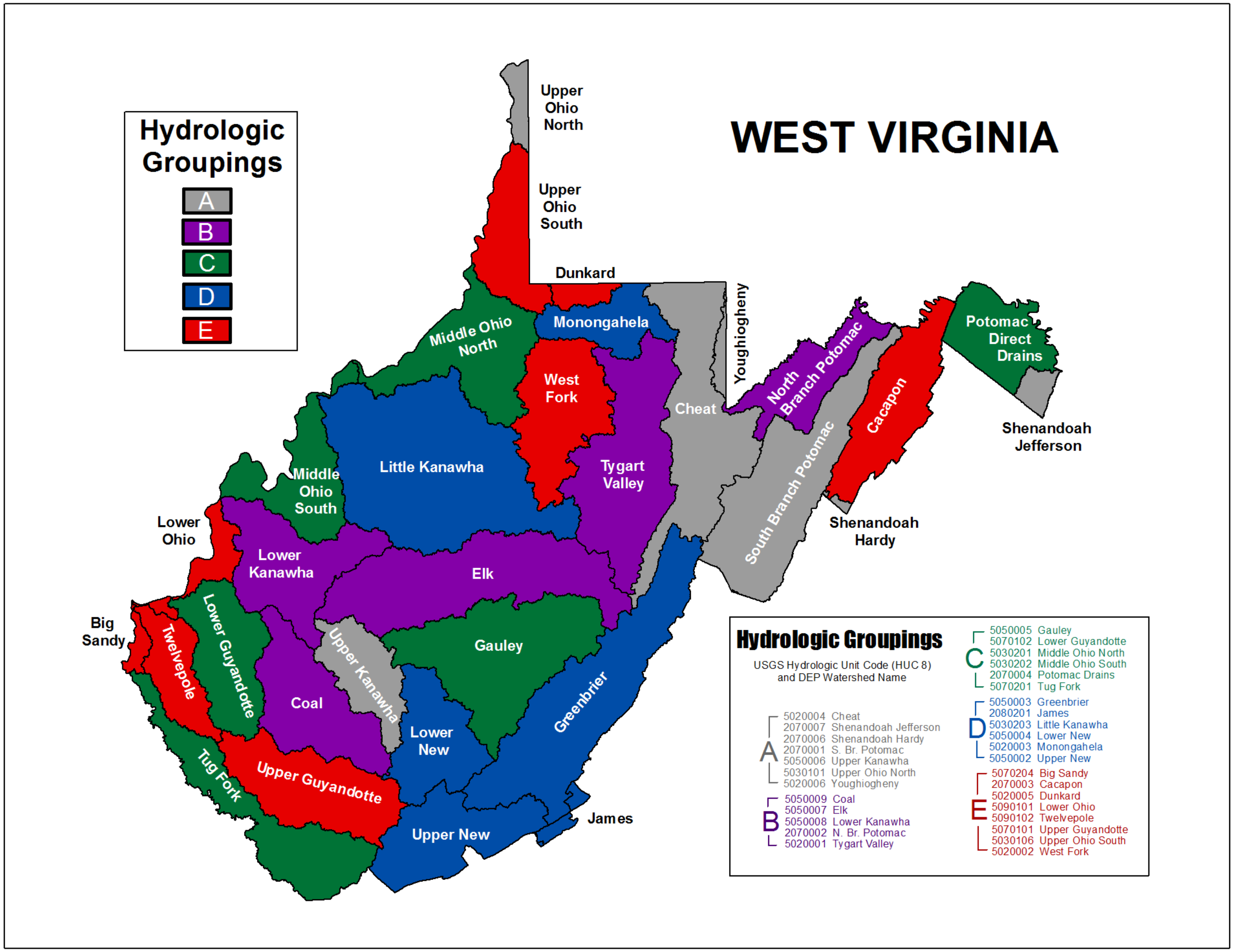

Figure 2-1. Hydrologic groupings of West Virginia's watersheds

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 in 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://apps.sos.wv.gov/adlaw/csr/rule.aspx?rule=47-02)

According to 40 CFR Part 130, TMDLs must be designed to implement applicable water quality standards. The TMDL presented herein is based upon the water quality standards that are currently effective. To be "effective" a water quality standard must be approved by the USEPA. At the time of this TMDL development, revisions to the dissolved aluminum standard passed by the West Virginia State Legislature in 2015 as an Emergency Rule 47CSR2, have not been approved by the USEPA. Correspondence between the WVDEP and the USEPA indicate that a decision on hardness based dissolved aluminum limits are imminent. For this reason, dissolved aluminum and related pH TMDLs have been excluded from this TMDL at this time. Once a decision is final for the dissolved aluminum criteria, water quality data from Upper Guyandotte streams will be reassessed based on effective water quality standards to determine impairment.

If in the future, the West Virginia Legislature adopts any other water quality standard revisions that alter the basis upon which the TMDL is developed, then the TMDL and allocations may be modified as warranted. Any future water quality standard revision and/or TMDL modification must receive USEPA approval prior to implementation.

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 in the Upper Guyandotte River watershed include: propagation and maintenance of aquatic life in warmwater fisheries and troutwaters, water contact recreation, and public water supply. In various streams in the Upper Guyandotte River watershed, warmwater fishery aquatic life use impairments have been determined pursuant to exceedances of total iron, and total selenium numeric water quality criteria. Troutwater aquatic life use impairments have been determined pursuant to exceedances of total selenium, total iron, numeric water quality criteria. Water contact recreation and/or public water supply use impairments have also been determined in various waters pursuant to exceedances of numeric water quality criteria for fecal coliform bacteria, total manganese, total selenium, and total iron.

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 has historically been the basis for "biological impairment" determinations.

Recent legislation has altered procedures used by WVDEP to assess biological integrity and, therefore, biological impairment TMDLs are not being developed. The legislation and related issues are discussed in detail in **Section 4** of this report.

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 numeric 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** [3, 4]
	Acute[1]	**Chronic**[2]	**Acute**[1]	**Chronic**[2]	
Iron, total (mg/L)	--	1.5	--	1.0	1.5
Selenium, total (µg/L) [f]		5		5	50
Selenium (ug/g) [g] (based on instantaneous measurement) 8.0 ug/g Fish Whole-Body Concentration or 11.3 ug/g Fish Muscle (skinless, boneless filet)		X		X	
Selenium (ug/g) Fish Egg/Ovary Concentration [h] (based on instantaneous measurement)		15.8		15.8	
Fecal coliform bacteria	**Human Health Contact Recreation/Public Water Supply**: 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.				

[1] One-hour average concentration not to be exceeded more than once every 3 years on the average, unless otherwise noted.
[2] Four-day average concentration not to be exceeded more than once every 3 years on the average, unless otherwise noted.
[3] These criteria have been calculated to protect human health from toxic effects through fish consumption, unless otherwise noted. Annual geometric mean concentrations not to be exceeded, unless otherwise noted.
[4] These criteria have been calculated to protect human health from toxic and or organoleptic effects through drinking water and fish consumption, unless otherwise noted. Annual geometric mean concentration not be exceeded, unless otherwise noted.
[f] Water column values take precedence over fish tissue values when new inputs of selenium occur in waters previously unimpacted by selenium, until equilibrium is reached between the water column and fish tissue.
[g] Overrides any water column concentration when water concentrations and either fish whole body or fish muscle (skinless, boneless filet) are measured, except in situations described in footnote [c]
[h] Overrides any fish whole-body, fish muscle (skinless, boneless filet), or water column concentration when fish egg/ovary concentrations are measured, except in situations described in footnote [c]
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

Located within the Central Appalachian ecoregion, the Guyandotte River is a tributary of the Ohio River, which joins the Mississippi and flows to the Gulf of Mexico. The Upper Guyandotte River watershed consists of land draining to the Upper Guyandotte River, which begins at the confluence of Winding Gulf and Stonecoal Creek in Raleigh County, and ends where the Upper Guyandotte becomes the Lower Guyandotte at the confluence with Island Creek in Logan, WV. The Upper Guyandotte River is approximately 88.2 miles (142 km) long, and its watershed encompasses 939.1 square miles (2,432.3 km^2). The Upper Guyandotte River is dammed above the community of Justice in Wyoming County to make R.D. Bailey Lake. For TMDL purposes, the lake is considered its own water body separate from the river. The lake is not considered impaired for iron or fecal coliform bacteria, and does not receive TMDL allocations. Flow and pollutant loads from the R.D. Bailey Lake was included in the modeling effort for TMDL development for the Upper Guyandotte River below the lake.

The Upper Guyandotte River watershed is located in southwestern West Virginia, and occupies all of Wyoming County, approximately half of Logan County, and portions of Mingo and Raleigh Counties (**Figure 3-1**). Cities and towns in the vicinity of the area of study are Logan, Man, Gilbert, Oceana, Mullens, and Pineville. The highest point in the Upper Guyandotte River watershed is 3,557 feet above sea level at Ivy Knob on Guyandotte Mountain in the headwaters of Clear Fork. The lowest point in the watershed is 623 feet at the confluence of the Upper Guyandotte River and Island Creek in the City of Logan. The average elevation in the watershed is 1,750 feet. Major tributaries of the Upper Guyandotte River include Island Creek, Buffalo Creek, Huff Creek, Clear Fork, Indian Creek, Pinnacle Creek, and Stonecoal Creek. The total population living in the subject watersheds of this report is estimated to be 40,000 people.

Figure 3-1. Location of the Upper Guyandotte River watershed TMDL Project Area in West Virginia

Landuse and land cover estimates were originally obtained from vegetation data gathered from the National Land Cover Dataset (NLCD) (USGS 2011). The Multi-Resolution Land Characteristics Consortium (MRLC) produced the NLCD coverage. The NLCD database for West Virginia was derived from satellite imagery taken during the mid-2000s, and it includes detailed vegetative spatial data. Enhancements and updates to the NLCD coverage were made to create a modeled landuse by custom edits derived primarily from WVDEP source tracking information and 2016 aerial photography with 1-meter resolution. Additional information regarding the NLCD spatial database is provided in **Appendix D** of the Technical Report.

Table 3-1 displays the landuse distribution for the TMDL watersheds derived from NLCD as described above. The dominant landuse is forest, which constitutes 70.86 percent of the total landuse area. Other important modeled landuse types are mining (11.59 percent), grassland (7.51 percent), urban/residential (3.98 percent), forestry (3.43 percent) and burned forest (1.00 percent). Individually, all other land cover types compose less than one percent of the total watershed area each.

Table 3-1. Modified landuse for the Upper Guyandotte TMDL watersheds

Landuse Type	Area of Watershed		
	Acres	Square Miles	Percentage
Barren	2,910.35	4.55	0.49
Burned Forest	5941.25	9.28	1.00
Cropland	305.95	0.48	0.05
Forest	419,990.74	656.24	70.86
Forestry	20,303.58	31.72	3.43
Grassland	44,505.02	69.54	7.51
Mining	68,700.51	107.34	11.59
Oil and Gas	4,382.07	6.85	0.74
Pasture	1,054.36	1.65	0.18
Urban/Residential	23,592.03	36.86	3.98
Water	1,045.95	1.63	0.18

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 J**. The geographic information is provided in the ArcGIS Viewer Project.

Table 3-2. Datasets used in TMDL development

Type of Information		Data Sources
Watershed physiographic data	Stream network	USGS National Hydrography Dataset (NHD)
	Landuse	National Land Cover Dataset 2011 (NLCD)
	National Agriculture Imagery Program (NAIP) 2014 Aerial Photography (1-meter resolution)	U.S. Department of Agriculture (USDA)
	Counties	U.S. Census Bureau
	Cities/populated places	U.S. Census Bureau
	Soils	State Soil Geographic Database (STATSGO) 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	2015 U.S. Census Bureau Topologically Integrated Geographic Encoding and Referencing database (TIGER), WVU WV Roads, West Virginia Trail Inventory (WVDOT)
	Water quality monitoring station locations	WVDEP, USEPA Storage and Retrieval database (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 Office of Abandoned Mine Lands and Reclamation
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

Type of Information		Data Sources
	Cloud cover	NOAA-NCDC
	Water quality monitoring data	USEPA STORET, WVDEP
	National Pollutant Discharge Elimination System (NPDES) data	WVDEP DMR, WVDEP DWWM
	Discharge Monitoring Report data	WVDEP DMR, Mining Companies
	Abandoned mine land data	WVDEP Office of Abandoned Mine Lands and Reclamation, WVDEP DWWM
Regulatory or policy information	Applicable water quality standards	WVDEP
	Section 303(d) list of impaired waterbodies	WVDEP, USEPA
	Nonpoint Source Management Plans	WVDEP

3.3 Impaired Waterbodies

WVDEP conducted extensive water quality monitoring throughout the Upper Guyandotte River watershed from 2015 through 2016. 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 confidently 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 47 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.

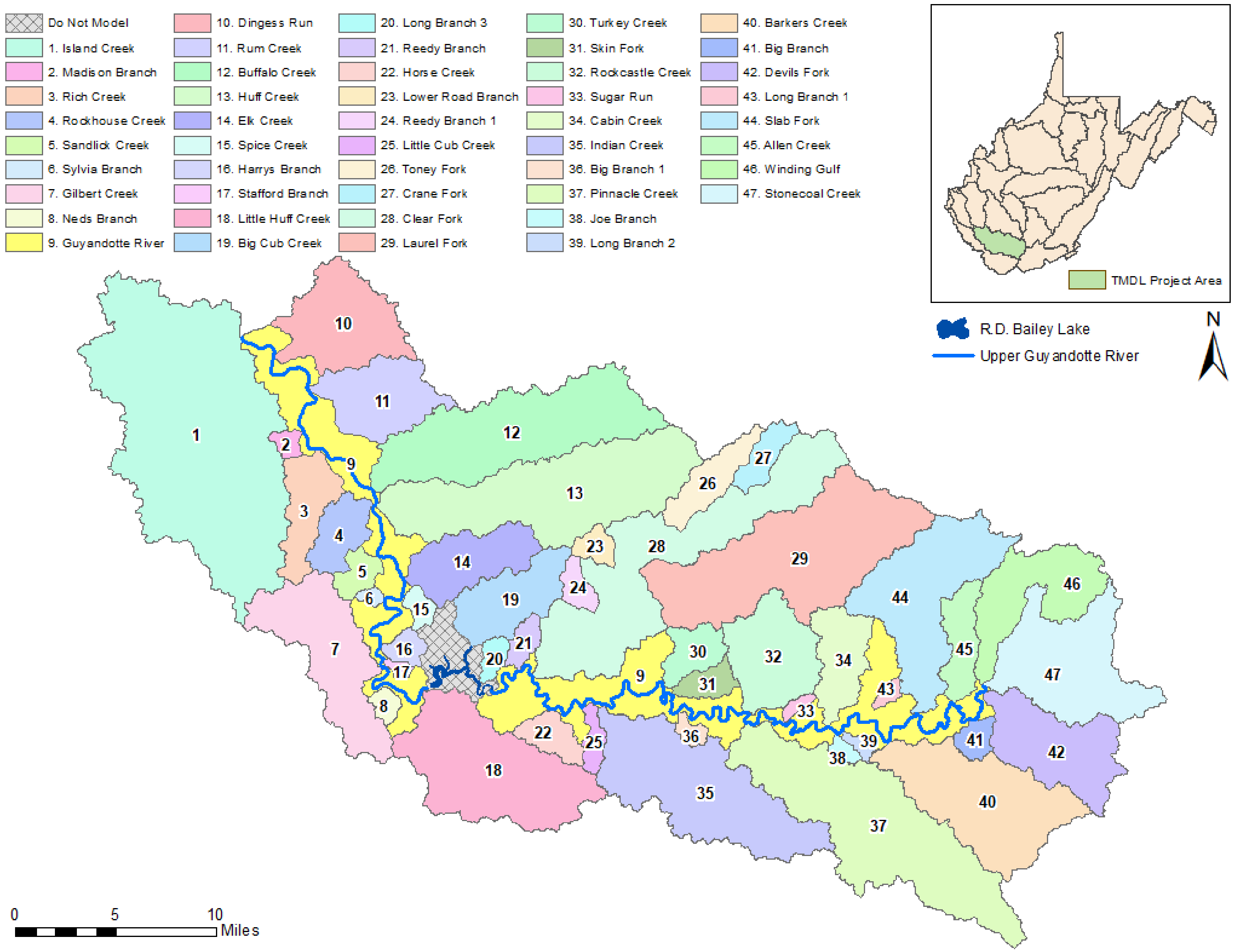

Figure 3-2. Upper Guyandotte TMDL Watersheds

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

TMDL Watershed	NHD Code	Stream Name	WV Code	Trout	Fe	Se	FC
Guyandotte River (Upper)	WV-OGU	Guyandotte River (Upper)	WVOG-Up		X		X
Island Creek	WV-OGU-1	Island Creek	WVOG-65		M		X
Island Creek	WV-OGU-1-A	Coal Branch	WVOG-65-A		M		X
Island Creek	WV-OGU-1-B	Copperas Mine Fork	WVOG-65-B		X		X
Island Creek	WV-OGU-1-B-1	Mud Fork	WVOG-65-B-1		X		X
Island Creek	WV-OGU-1-B-1-C	Lower Dempsey Branch	WVOG-65-B-1-A		X		X
Island Creek	WV-OGU-1-B-1-D	Ellis Branch	WVOG-65-B-1-B		M		X
Island Creek	WV-OGU-1-B-1-G	Upper Dempsey Branch	WVOG-65-B-1-E		M		X
Island Creek	WV-OGU-1-B-1-H	Rockhouse Branch	WVOG-65-B-1-F		M		X
Island Creek	WV-OGU-1-B-1-L	UNT/Mud Fork RM 6.12			M		
Island Creek	WV-OGU-1-B-3	Whitman Creek	WVOG-65-B-2		M		X
Island Creek	WV-OGU-1-B-3-B	Left Fork/Whitman Creek	WVOG-65-B-2-A		M		X
Island Creek	WV-OGU-1-B-3-B-2	Poleroad Fork	WVOG-65-B-2-A-1		M		
Island Creek	WV-OGU-1-B-3-E	UNT/Whitman Creek RM 3.83 (Skifus Branch)	WVOG-65-B-2-C			X	
Island Creek	WV-OGU-1-B-3-G	Pine Gap Branch	WVOG-65-B-2-D		M		
Island Creek	WV-OGU-1-B-4	Aldrich Branch	WVOG-65-B-3		M		
Island Creek	WV-OGU-1-B-6	Trace Fork	WVOG-65-B-4		M		X
Island Creek	WV-OGU-1-B-6-E	UNT/Trace Fork RM 2.95	WVOG-65-B-4-G		M		
Island Creek	WV-OGU-1-B-8	Curry Branch	WVOG-65-B-5		X		X
Island Creek	WV-OGU-1-B-15	Dingess Fork	WVOG-65-B-8		M		
Island Creek	WV-OGU-1-H	Mill Creek	WVOG-65-C				X
Island Creek	WV-OGU-1-N	Steele Branch	WVOG-65-E		M		X
Island Creek	WV-OGU-1-Q	Middle Fork/Island Creek	WVOG-65-G		X		X
Island Creek	WV-OGU-1-T	Pine Creek	WVOG-65-H		X DMR	X	X
Island Creek	WV-OGU-1-T-6	Right Fork/Pine Creek	WVOG-65-H-1		M	X	
Island Creek	WV-OGU-1-T-6-A	Little Right Fork	WVOG-65-H-1-A		M		
Island Creek	WV-OGU-1-T-6-I	Laurel Fork	WVOG-65-H-1-B		M		

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Island Creek	WV-OGU-1-T-6-J	Tin Branch	WVOG-65-H-1-C		M		
Island Creek	WV-OGU-1-T-8	Twin Branch	WVOG-65-H-2		M	X	
Island Creek	WV-OGU-1-T-10	Left Fork/Pine Creek	WVOG-65-H-3		M	X	
Island Creek	WV-OGU-1-U	Rockhouse Branch	WVOG-65-I		M	X	
Island Creek	WV-OGU-1-V	Cow Creek	WVOG-65-J		M	X DMR	X
Island Creek	WV-OGU-1-V-4	Left Fork/Cow Creek	WVOG-65-J-3		M		X
Island Creek	WV-OGU-1-V-8	UNT/Cow Creek RM 5.35			M		
Island Creek	WV-OGU-1-X	Littles Creek	WVOG-65-K		M		
Island Creek	WV-OGU-1-Y	Conley Branch	WVOG-65-L		M		
Island Creek	WV-OGU-1-Z	Lower Dempsey Branch	WVOG-65-L.5				
Island Creek	WV-OGU-1-AA	Left Fork/Island Creek	WVOG-65-M		M		
Island Creek	WV-OGU-1-AC	Upper Dempsey Branch	WVOG-65-O		M		
Dingess Run	WV-OGU-4	Dingess Run	WVOG-68		M	X	X
Dingess Run	WV-OGU-4-A	Bandmill Hollow	WVOG-68-A		X DMR	X	
Dingess Run	WV-OGU-4-A-4	UNT/Bandmill Hollow RM 1.84	WVOG-68-A-4			X	
Dingess Run	WV-OGU-4-B	Fort Branch	WVOG-68-B		M		
Dingess Run	WV-OGU-4-E	Ethel Hollow	WVOG-68-E		M		
Dingess Run	WV-OGU-4-E-3	Big Dark Hollow			M		
Dingess Run	WV-OGU-4-E-4	Little Dark Hollow			M		
Dingess Run	WV-OGU-4-G	Freeze Fork	WVOG-68-G		X	X	X
Dingess Run	WV-OGU-4-G-1	UNT/Freeze Fork RM 1.05	WVOG-68-G-1		M	X	
Dingess Run	WV-OGU-4-J	Georges Creek	WVOG-68-H		M	X	
Dingess Run	WV-OGU-4-J-1	UNT/Georges Creek RM 1.07	WVOG-68-H-1		M	X	
Dingess Run	WV-OGU-4-J-2	UNT/Georges Creek RM 1.50	WVOG-68-H-2		M	X DMR	
Guyandotte River (Upper)	WV-OGU-8	Beech Branch	WVOG-69		M		
Rum Creek	WV-OGU-10	Rum Creek	WVOG-70		M	X	X
Rum Creek	WV-OGU-10-B	Right Hand Fork/Rum Creek	WVOG-70-A		M	X	
Rum Creek	WV-OGU-10-B-2	Burgess Branch	WVOG-70-A-1		M		
Rum Creek	WV-OGU-10-C	UNT/Rum Creek RM 1.83	WVOG-70-A.2		X DMR	X DMR	
Rum Creek	WV-OGU-10-D	Slab Fork	WVOG-70-B		M	X	

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Rum Creek	WV-OGU-10-I	Cub Branch	WVOG-70-D		M		
Rum Creek	WV-OGU-10-J	Big Lick Branch	WVOG-70-E		M	X	
Guyandotte River (Upper)	WV-OGU-16	Camp Branch	WVOG-71.5		M		
Madison Branch	WV-OGU-17	Madison Branch	WVOG-72		X		X
Madison Branch	WV-OGU-17-A	UNT/Madison Branch RM 0.68	WVOG-72-A		X	X	X
Rich Creek	WV-OGU-18	Rich Creek	WVOG-73		M		
Rich Creek	WV-OGU-18-A	Left Fork/Rich Creek	WVOG-73-A		M	X DMR	
Rich Creek	WV-OGU-18-A-1	UNT/Left Fork rm 1.02/Rich Creek	WVOG-73-A-1		M	X DMR	
Rich Creek	WV-OGU-18-G	Laurel Branch	WVOG-73-D		M	X DMR	
Guyandotte River (Upper)	WV-OGU-21	Pine Branch	WVOG-73.5		M		
Guyandotte River (Upper)	WV-OGU-24	Henry Hollow	WVOG-74		M		
Buffalo Creek	WV-OGU-27	Buffalo Creek	WVOG-75	X	X DMR		X
Buffalo Creek	WV-OGU-27-B	Bingo Hollow			M		
Buffalo Creek	WV-OGU-27-E	Right Fork/Buffalo Creek	WVOG-75-A		M		X
Buffalo Creek	WV-OGU-27-E-1	Perry Branch	WVOG-75-A-1			X	
Buffalo Creek	WV-OGU-27-F	Ruffner Hollow	WVOG-75-B			X DMR	
Buffalo Creek	WV-OGU-27-I	Proctor Hollow (Mudlick Branch)	WVOG-75-C.5		X		
Buffalo Creek	WV-OGU-27-I-1	UNT/Proctor Hollow RM 0.54	WVOG-75-C.5-1		X DMR	X DMR	
Buffalo Creek	WV-OGU-27-J	Robinette Branch	WVOG-75-D		M		X
Buffalo Creek	WV-OGU-27-R	Dingess Branch	WVOG-75-H		M	X	
Buffalo Creek	WV-OGU-27-T	Davy Branch	WVOG-75-I		M		
Buffalo Creek	WV-OGU-27-U	Toney Fork	WVOG-75-J		M		X
Buffalo Creek	WV-OGU-27-W	Elklick Branch	WVOG-75-K		X DMR		
Buffalo Creek	WV-OGU-27-W-1	UNT/Elklick Branch RM 0.89	WVOG-75-K-1		X DMR		
Buffalo Creek	WV-OGU-27-Y	Lee Fork	WVOG-75-L		M		
Buffalo Creek	WV-OGU-27-Y-1	Middle Fork/Buffalo Creek	WVOG-75-L-1		M		
Huff Creek	WV-OGU-28	Huff Creek	WVOG-76		M		X
Huff Creek	WV-OGU-28-C	Big Springs Branch	WVOG-76-C		M		
Huff Creek	WV-OGU-28-G	Sandlick Branch	WVOG-76-F		M		
Huff Creek	WV-OGU-28-N	Beech Branch	WVOG-76-K		M	X DMR	X

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Huff Creek	WV-OGU-28-Q	Toney Fork	WVOG-76-L		M		
Huff Creek	WV-OGU-28-S	Paynter Branch	WVOG-76-M		M		X
Huff Creek	WV-OGU-28-S-1	Elk Trace Branch	WVOG-76-M-1		M		
Huff Creek	WV-OGU-28-S-3	Cub Trace Branch	WVOG-76-M-2		M		
Huff Creek	WV-OGU-28-S-4	UNT/Paynter Branch RM 1.86	WVOG-76-M-3		M		
Huff Creek	WV-OGU-28-W	Road Branch	WVOG-76-O		M		X
Huff Creek	WV-OGU-28-W-4	UNT/Road Branch RM 1.79	WVOG-76-O-3		M		
Huff Creek	WV-OGU-28-Z	Sycamore Creek	WVOG-76-P		M		
Huff Creek	WV-OGU-28-AE	Straight Fork	WVOG-76-U		M		
Huff Creek	WV-OGU-28-AG	Brushy Fork	WVOG-76-W		M		
Rockhouse Creek	WV-OGU-29	Rockhouse Creek	WVOG-77		X DMR		
Rockhouse Creek	WV-OGU-29-A	Spring Branch	WVOG-77-A		M	X DMR	
Rockhouse Creek	WV-OGU-29-A-1	UNT/Spring Branch RM 0.56	WVOG-77-A-1		M	X DMR	
Rockhouse Creek	WV-OGU-29-B	Oldhouse Branch	WVOG-77-A.5		X		
Rockhouse Creek	WV-OGU-29-C	Lefthand Fork/Rockhouse Creek	WVOG-77-D		X		
Sandlick Creek	WV-OGU-31	Sandlick Creek	WVOG-78		M		X
Sandlick Creek	WV-OGU-31-A	Right Fork/Sandlick Creek	WVOG-78-A		M		
Elk Creek	WV-OGU-34	Elk Creek	WVOG-80		M		
Elk Creek	WV-OGU-34-F	Right Hand Fork/Elk Creek	WVOG-80-E		M		
Elk Creek	WV-OGU-34-M	Stonecoal Branch	WVOG-80-I		M		
Spice Creek	WV-OGU-36	Spice Creek	WVOG-82		M		X
Sylvia Branch	WV-OGU-38	Sylvia Branch	WVOG-84		M		X
Guyandotte River (Upper)	WV-OGU-42	Canebrake Branch	WVOG-86		M		
Harrys Branch	WV-OGU-45	Harrys Branch	WVOG-87		M		
Stafford Branch	WV-OGU-46	Stafford Branch	WVOG-88		M		X
Gilbert Creek	WV-OGU-47	Gilbert Creek	WVOG-89		M	X DMR	X
Gilbert Creek	WV-OGU-47-A	Skillet Creek	WVOG-89-A		M		X
Gilbert Creek	WV-OGU-47-B	Horsepen Creek	WVOG-89-B		M	X DMR	X
Gilbert Creek	WV-OGU-47-B-3	Browning Fork	WVOG-89-B-1		M		X
Gilbert Creek	WV-OGU-47-B-3-E	Right Fork/Browning Fork	WVOG-89-B-1-B		M		

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Gilbert Creek	WV-OGU-47-B-1	Lower Pete Branch	WVOG-89-B-0.3		M	X DMR	
Gilbert Creek	WV-OGU-47-B-12	Donaldson Branch	WVOG-89-B-6		M		
Gilbert Creek	WV-OGU-47-F	Adams Fork	WVOG-89-C.3		M	X DMR	
Gilbert Creek	WV-OGU-47-K	Lefthand Fork/Gilbert Creek	WVOG-89-F		M		
Neds Branch	WV-OGU-48	Neds Branch	WVOG-90		M		X
Little Huff Creek	WV-OGU-54	Little Huff Creek	WVOG-92		X		X
Little Huff Creek	WV-OGU-54-C	Little Cub Creek	WVOG-92-B		M		X
Little Huff Creek	WV-OGU-54-C-5	Trace Fork	WVOG-92-B-1		M		
Little Huff Creek	WV-OGU-54-D	Lizard Creek	WVOG-92-C		X		X
Little Huff Creek	WV-OGU-54-I	Nelson Branch	WVOG-92-G		M		
Little Huff Creek	WV-OGU-54-K	Muzzle Creek	WVOG-92-I		M		X
Little Huff Creek	WV-OGU-54-K-1	Right Fork/Muzzle Creek	WVOG-92-I-1		M		
Little Huff Creek	WV-OGU-54-M	Buffalo Creek	WVOG-92-K		X		X
Little Huff Creek	WV-OGU-54-M-3	Kezee Fork	WVOG-92-K-1		X		
Little Huff Creek	WV-OGU-54-O	Suke Creek	WVOG-92-M		X		X
Little Huff Creek	WV-OGU-54-T	Pad Fork	WVOG-92-Q		M		X
Little Huff Creek	WV-OGU-54-T-5	Righthand Fork/Pad Fork	WVOG-92-Q-1		M		
Big Cub Creek	WV-OGU-62	Big Cub Creek	WVOG-96		M		X
Big Cub Creek	WV-OGU-62-C	Sturgeon Branch	WVOG-96-A		M		
Big Cub Creek	WV-OGU-62-G	Road Branch	WVOG-96-B		M	X	X
Big Cub Creek	WV-OGU-62-G-2	UNT/Road Branch RM 1.13	WVOG-96-B-2		M		X
Big Cub Creek	WV-OGU-62-H	Elk Trace Branch	WVOG-96-C		M		
Big Cub Creek	WV-OGU-62-O	Toler Hollow	WVOG-96-F		M	X	X
Big Cub Creek	WV-OGU-62-S	McDonald Fork	WVOG-96-H		M		
Long Branch	WV-OGU-65	Long Branch	WVOG-97		M		X
Reedy Branch	WV-OGU-68	Reedy Branch	WVOG-99		M	X	X
Clear Fork	WV-OGU-70	Clear Fork	WVOGC		M		X
Clear Fork	WV-OGU-70-E	Cedar Creek	WVOGC-4		M		
Clear Fork	WV-OGU-70-F	Laurel Branch	WVOGC-5		M		
Reedy Branch	WV-OGU-70-L	Reedy Branch	WVOGC-8		M		
Clear Fork	WV-OGU-70-N	McDonald Mill Creek	WVOGC-10		M		
Lower Road Branch	WV-OGU-70-S	Lower Road Branch	WVOGC-12		M		

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Clear Fork	WV-OGU-70-W	Dry Branch			M		
Laurel Fork	WV-OGU-70-X	Laurel Fork	WVOGC-16		M		X
Laurel Fork	WV-OGU-70-X-6	Coon Branch	WVOGC-16-B		M		X
Laurel Fork	WV-OGU-70-X-6-C	Chestnut Flats Branch	WVOGC-16-B-1		M		X
Laurel Fork	WV-OGU-70-X-10	Cabin Branch	WVOGC-16-C		M		X
Laurel Fork	WV-OGU-70-X-13	Acord Branch	WVOGC-15		M		
Laurel Fork	WV-OGU-70-X-19	Glen Fork	WVOGC-16-J				X
Laurel Fork	WV-OGU-70-X-19-A	Tom Bailey Branch	WVOGC-16-J-1		M		X
Laurel Fork	WV-OGU-70-X-23	Laurel Branch	WVOGC-16-K		X		X
Laurel Fork	WV-OGU-70-X-27	Milam Fork	WVOGC-16-M		M		X
Laurel Fork	WV-OGU-70-X-32	White Oak Branch	WVOGC-16-N		M		
Laurel Fork	WV-OGU-70-X-36	Trough Fork	WVOGC-16-P		M		
Laurel Fork	WV-OGU-70-X-47	Franks Fork	WVOGC-16-U		M		X
Toney Fork	WV-OGU-70-AC	Toney Fork	WVOGC-19		M		X
Crane Fork	WV-OGU-70-AM	Crane Fork	WVOGC-26		M		
Crane Fork	WV-OGU-70-AW	Knob Fork	WVOGC-28		M		
Guyandotte River (Upper)	WV-OGU-73	Brickle Branch	WVOG-102		M		
Horse Creek	WV-OGU-77	Horse Creek	WVOG-105		M		
Horse Creek	WV-OGU-77-B	Hound Fork	WVOG-105-B		M		
Little Cub Creek	WV-OGU-81	Little Cub Creek	WVOG-108		M		X
Indian Creek	WV-OGU-84	Indian Creek	WVOG-110		M		X
Indian Creek	WV-OGU-84-D	Brier Creek	WVOG-110-A		X		X
Indian Creek	WV-OGU-84-D-2	Trace Fork	WVOG-110-A-1		M		
Indian Creek	WV-OGU-84-D-6	Marsh Fork	WVOG-110-A-2		X		X
Indian Creek	WV-OGU-84-F	Shop Branch	WVOG-110-B		M		
Indian Creek	WV-OGU-84-P	Wolf Pen Branch	WVOG-110-G		M		X
Indian Creek	WV-OGU-84-Q	Lick Branch	WVOG-110-H		M		
Indian Creek	WV-OGU-84-R	Turkeywallow Branch	WVOG-110-I		M		
Indian Creek	WV-OGU-84-U	Nancy Fork	WVOG-110-J		M		

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Indian Creek	WV-OGU-84-U-7	Stanley Fork	WVOG-110-J-1		M		
Indian Creek	WV-OGU-84-X	UNT/Indian Creek RM 11.15	WVOG-110-K.3		M		
Indian Creek	WV-OGU-84-AC	White Oak Branch	WVOG-110-M		M		
Indian Creek	WV-OGU-84-AI	Fort Branch	WVOG-110-O		M		
Guyandotte River (Upper)	WV-OGU-88	Doublecamp Branch	WVOG-113		M		
Guyandotte River (Upper)	WV-OGU-93	Shannon Mill Creek	WVOG-116		M		
Turkey Creek	WV-OGU-94	Turkey Creek	WVOG-118		X		X
Turkey Creek	WV-OGU-94-B	Right Fork/Turkey Creek	WVOG-118-A		M		
Skin Fork	WV-OGU-95	Skin Fork	WVOG-119		X		X
Skin Fork	WV-OGU-95-A	Left Fork/Skin Fork	WVOG-119-A		M		
Big Branch	WV-OGU-97	Big Branch	WVOG-120		M		
Big Branch	WV-OGU-97-C	UNT/Big Branch RM 1.54	WVOG-120-C		M		
Rockcastle Creek	WV-OGU-107	Rockcastle Creek	WVOG-123		M		X
Rockcastle Creek	WV-OGU-107-A	Bearhole Fork	WVOG-123-A		X		X
Rockcastle Creek	WV-OGU-107-A-1	Bird Branch	WVOG-123-A-1		M		X
Pinnacle Creek	WV-OGU-108	Pinnacle Creek	WVOG-124	X	X		X
Pinnacle Creek	WV-OGU-108-B	Baldwin Branch	WVOG-124-A		M		
Pinnacle Creek	WV-OGU-108-C	Lambert Branch	WVOG-124-B		M		
Pinnacle Creek	WV-OGU-108-K	Smith Branch	WVOG-124-D		M		
Pinnacle Creek	WV-OGU-108-M	Little White Oak Creek	WVOG-124-E		X		
Pinnacle Creek	WV-OGU-108-M-3	Sulphur Branch	WVOG-124-E-0.5		X		
Pinnacle Creek	WV-OGU-108-M-4	Jenny Branch	WVOG-124-E-1		M		
Pinnacle Creek	WV-OGU-108-M-4-A	UNT/Jenny Branch RM 0.67	WVOG-124-E-1-A		M		
Pinnacle Creek	WV-OGU-108-T	Laurel Branch/Pinnacle Creek	WVOG-124-H		M		
Pinnacle Creek	WV-OGU-108-U	Spider Creek	WVOG-124-I		X		X
Pinnacle Creek	WV-OGU-108-Z	White Oak Branch	WVOG-124-J		M		X
Pinnacle Creek	WV-OGU-108-Z-1	Payne Branch	WVOG-124-J-1		X DMR		
Pinnacle Creek	WV-OGU-108-Z-1-C	UNT/Payne Branch RM1.37	WVOG-124-J-1-C		X DMR		
Pinnacle Creek	WV-OGU-108-AD	Beartown Fork	WVOG-124-N		X		X

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Pinnacle Creek	WV-OGU-108-AJ	Little Pinnacle	WVOG-124-P		M		
Sugar Run	WV-OGU-111	Sugar Run	WVOG-125		M		
Cabin Creek	WV-OGU-118	Cabin Creek	WVOG-127		X		X
Cabin Creek	WV-OGU-118-C	Meadow Fork	WVOG-127-B		M		X
Cabin Creek	WV-OGU-118-G	Marsh Fork	WVOG-127-D		X		X
Cabin Creek	WV-OGU-118-H	Black Fork	WVOG-127-E		M		
Joe Branch	WV-OGU-119	Joe Branch	WVOG-128		M	X	
Long Branch	WV-OGU-120	Long Branch	WVOG-129		M		
Long Branch	WV-OGU-124	Still Run	WVOG-130		M		
Long Branch	WV-OGU-124-D	UNT/Still Run RM 1.00	WVOG-130-A.2		X		
Barkers Creek	WV-OGU-128	Barkers Creek	WVOG-131	X	X		X
Barkers Creek	WV-OGU-128-E	Hickory Branch	WVOG-131-B		M	X	
Barkers Creek	WV-OGU-128-G	Mill Branch	WVOG-131-C				X
Barkers Creek	WV-OGU-128-K	Gooney Otter Creek	WVOG-131-F	X	X		X
Barkers Creek	WV-OGU-128-K-5	Jims Branch	WVOG-131-F-1		M		X
Barkers Creek	WV-OGU-128-K-6	Noseman Branch	WVOG-131-F-2		M		
Barkers Creek	WV-OGU-128-K-9	UNT/Gooney Otter Creek RM 3.64	WVOG-131-F-5		M		X
Barkers Creek	WV-OGU-128-O	Milam Fork	WVOG-131-I		M		X
Barkers Creek	WV-OGU-128-P	UNT/Barkers Creek RM 8.71	WVOG-131-J		M		
Barkers Creek	WV-OGU-128-Q	UNT/Barkers Creek RM 9.91			M		
Barkers Creek	WV-OGU-128-U	UNT/Barkers Creek RM 12.19			M		
Slab Fork	WV-OGU-132	Slab Fork	WVOG-134	X	X		X
Slab Fork	WV-OGU-132-E	Cedar Creek	WVOG-134-B		M		X
Slab Fork	WV-OGU-132-E-1	Right Fork/Cedar Creek	WVOG-134-B-1		M		
Slab Fork	WV-OGU-132-H	Marsh Fork	WVOG-134-C	X	M		X
Slab Fork	WV-OGU-132-J	Measle Fork	WVOG-134-D		X		X
Slab Fork	WV-OGU-132-L	UNT/Slab Fork RM 7.96	WVOG-134-D.5		M		
Slab Fork	WV-OGU-132-V	Burnt Fork	WVOG-134-H		M		X
Slab Fork	WV-OGU-132-V-3	Richardson Branch	WVOG-134-H-1		M		
Slab Fork	WV-OGU-132-Y	Low Gap Branch	WVOG-134-I		X		X
Allen Creek	WV-OGU-136	Allen Creek	WVOG-135		X		X
Allen Creek	WV-OGU-136-D	Left Fork/Allen Creek	WVOG-135-A		X		

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Big Branch	WV-OGU-138	Big Branch	WVOG-136		M		X
Devils Fork	WV-OGU-140	Devils Fork	WVOG-137	X	X		X
Devils Fork	WV-OGU-140-C	Beetree Branch	WVOG-137-A		X		
Devils Fork	WV-OGU-140-K-1	UNT/Bluff Fork RM 0.17	WVOG-137-B-0.1		X		
Devils Fork	WV-OGU-140-J	Wiley Spring Branch	WVOG-137-C	X	X		
Winding Gulf	WV-OGU-142	Winding Gulf	WVOG-138	X	X		X
Winding Gulf	WV-OGU-142-E	Berry Branch	WVOG-138-A		M		X
Winding Gulf	WV-OGU-142-I	Alderson Branch	WVOG-138-D		M		
Winding Gulf	WV-OGU-142-K	Mullens Branch	WVOG-138-E		X		
Winding Gulf	WV-OGU-142-V	West Fork/Winding Gulf	WVOG-138-G		M		
Stonecoal Creek	WV-OGU-141	Stonecoal Creek	WVOG-139	X	X		X
Stonecoal Creek	WV-OGU-141-B	Tommy Creek	WVOG-139-A	X	X		X
Stonecoal Creek	WV-OGU-141-B-4	Bragg Branch	WVOG-139-A-1		X		
Stonecoal Creek	WV-OGU-141-B-8	Lefthand Fork/Tommy Creek	WVOG-139-A-3		X		
Stonecoal Creek	WV-OGU-141-G	Riffe Branch	WVOG-139-B	X	X DMR		X
Stonecoal Creek	WV-OGU-141-H	Farley Branch	WVOG-139-C		M		
Stonecoal Creek	WV-OGU-141-L	Pines Creek	WVOG-139-D		M		X

Note:
RM river mile
UNT unnamed tributary
Trout trout stream cold-water fishery
Fe iron impairment
Se selenium impairment
FC fecal coliform bacteria impairment
M impairment determined via modeling
X impairment determined via sampling
X DMR impairment determined via discharge monitoring reports provided by the Division of Mining and Reclamation.

4.0 BIOLOGICAL IMPAIRMENT AND STRESSOR IDENTIFICATION

The narrative water quality criterion of 47 CSR 2 §3.2.i prohibits the presence of wastes in State waters that cause or contribute to significant adverse impact to the chemical, physical, hydrologic, or biological components of aquatic ecosystems. Historically, WVDEP based assessment of biological integrity on a rating of the stream's benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index (WVSCI). WVSCI-based "biological impairments" were included on West Virginia's Section 303(d) lists from 2002 through 2010. In 2012, legislative action (codified in §22-11-7b) directed the agency to develop and secure legislative approval of new rules to interpret the narrative criterion for biological impairment found in 47 CSR 2-3.2.i.

§22-11-7b indicates, rules promulgated may not establish measurements that would establish standards less protective than requirements that existed during the 2012 regular session. Thus, WVDEP has continued to list biological impairment based on WVSCI for subsequent 303d lists, including the most recent list in 2016. In response to the legislation, WVDEP prepared a procedural rule (47 CSR 2B) establishing the methodology for determining compliance with the biological component of narrative criteria. A public comment period extended through May 6, 2019 and a public hearing was held the same day. Response to comment and final filing was delayed, requiring that the same procedural rule be proposed again in 2020. The public comment period ran through April 20, 2020 and a public hearing was held the same day. At the time of this TMDL completion, WVDEP was responding to comments and preparing to finalize the procedural rule. WVDEP has suspended biological impairment TMDL development pending approval of the procedural rule.

The above notwithstanding, streams for which available benthic information demonstrates non-attainment of the threshold described in the assessment methodology presented in 47CSR2B, were subjected to the biological stressor identification (SI) process described in this section. The biological SI process allowed stream-specific identification of the significant stressors associated with benthic macroinvertebrate community impact. If those stressors are resolved through the attainment of numeric water quality criteria, and TMDLs addressing such criteria are developed and approved, then additional "biological TMDL" development work is not needed. SI results are presented for streams with benthic macroinvertebrate impacts in **Appendix K** of the Technical Report, so that they may be considered in listing/delisting decision-making in future 303(d) processes. This project does not include "biological impairment" TMDLs. However, the SI process demonstrated that biological stress would be resolved in 26 streams through the implementation of numeric criterion TMDLs developed in this project.

4.1 Introduction

Impacts to benthic macroinvertebrate communities were rated using a multimetric index developed for use in the wadeable streams of West Virginia. The WVSCI (Gerritsen et al., 2000) was designed to identify streams with benthic communities that differ from the reference condition presumed to constitute biological integrity. WVSCI is composed of six metrics that were selected to maximize discrimination between streams with known impairments and reference streams. Streams are assessed using WVSCI if the data was comparable (e.g., collected utilizing the same methods used to develop the WVSCI, adequate flow in riffle/run habitat, and within the index period). A WVSCI score of 72 (representing the 5th percentile of reference scores) is considered the attainment threshold. Streams with WVSCI scores less than 72 were included in the SI process to identify significant stressors associated with impacts to aquatic life.

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 impact. Elements of that guidance were used and custom analyses of biological data were performed to supplement the recommended framework.

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. **Section 7** of the Technical Report discusses biological impairment and the SI process in detail.

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, NLCD 2011 landuse information, Natural Resources Conservation Service (NRCS) State Soil Geographic database (STATSGO) soils data, National Pollutant Discharge Elimination System (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 considered are listed below:

1. Metals contamination (including metals contributed through soil erosion) causes toxicity
2. Acidity (low pH <6) causes toxicity
3. Basic (high pH >9) causes toxicity
4. Increased ionic strength causes toxicity
5. Increased total suspended solids (TSS)/erosion and altered hydrology cause sedimentation and other habitat alterations
6. Increased metals flocculation and deposition causes habitat alterations (e.g., embeddedness)
7. Organic enrichment (e.g., sewage discharges and agricultural runoff cause habitat alterations)
8. Altered hydrology causes higher water temperature, resulting in direct impacts
9. Altered hydrology, nutrient enrichment, and increased biochemical oxygen demand (BOD) cause reduced dissolved oxygen (DO)
10. Algal growth causes food supply shift
11. High levels of ammonia cause toxicity (including increased toxicity due to algal growth)
12. 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.

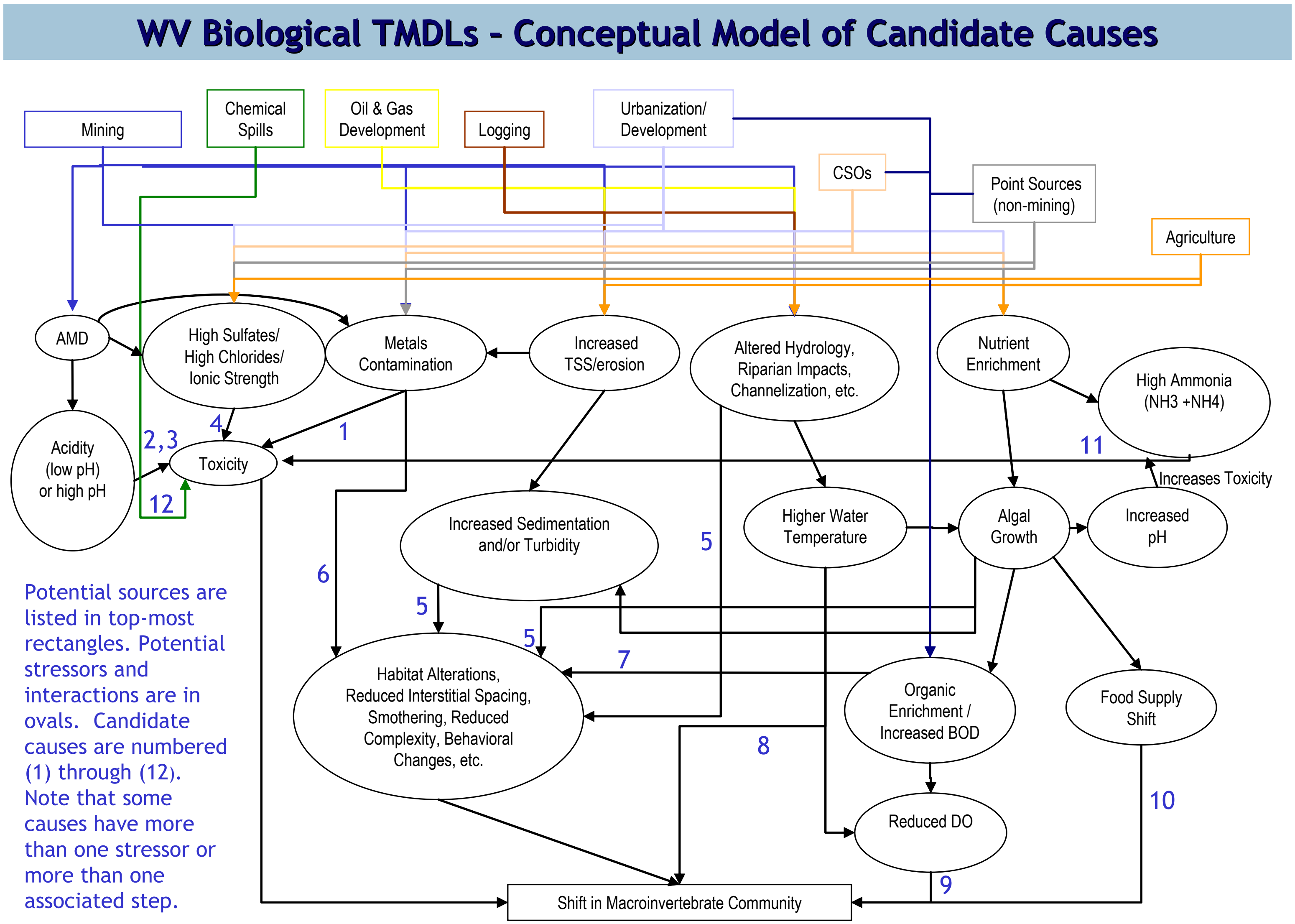


Figure 4-1. Conceptual model of candidate causes and potential biological effects

4.4 Stressor Identification Results

The SI process identified significant biological stressors for each stream. Biological impact was linked to a single stressor in some cases and multiple stressors in others. The SI process identified the following stressors as present in the impacted waters in the Upper Guyandotte River watershed:

- Organic enrichment (the combined effects of oxygen-demanding pollutants, nutrients, and the resultant algal growth and habitat alteration)
- Sedimentation
- Aluminum toxicity
- pH toxicity
- Ionic toxicity

After stressors were identified, WVDEP also determined the pollutants in need of control to address the impacts. In all streams for which the SI process identified organic enrichment as a significant biological stressor, 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 agricultural landuses. WVDEP determined that implementation of fecal coliform TMDLs would remove untreated sewage and significantly reduce loadings in agricultural runoff and thereby resolve organic enrichment stress.

Certain streams for which the SI process identified sedimentation as a significant stressor are also impaired pursuant to total iron water quality criteria. The TMDL assessment for iron included representation and allocation of iron loadings associated with sediment. WVDEP compared the amount of sediment reduction necessary in the iron TMDLs to the amount of reduction needed to achieve the normalized sediment loading of an unimpacted reference stream. In these streams, 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. Implementation of the iron TMDLs will resolve biological stress from sedimentation in these streams. See the Technical Report for further descriptions of the correlation between sediment and iron and the comparisons of sediment reductions under iron criterion attainment and reference watershed approaches.

The streams for which biological stress to benthic macroinvertebrates would be resolved through the implementation of the pollutant-specific TMDLs developed in this project are presented in **Table 4-1**. There are 83 streams for which the SI process did not indicate that TMDLs for numeric criteria would resolve the biological impacts. These streams are listed in **Appendix K**.

Table 4-1. Biological impacts resolved by implementation of pollutant-specific TMDLs

Stream Name	NHD Code	WV Code	Significant Stressors	TMDLs Developed
Pines Creek	OGU-141-L	WVOG-139-D	organic enrichment	fecal coliform
Mill Creek	OGU-1-H	WVOG-65-C	organic enrichment	fecal coliform
Laurel Fork	OGU-70-X	WVOGC-16	organic enrichment	fecal coliform
Laurel Fork	OGU-70-X	WVOGC-16	organic enrichment	fecal coliform
Glen Fork	OGU-70-X-19	WVOGC-16-J	organic enrichment	fecal coliform
Long Branch	OGU-120	WVOG-129	sedimentation	iron
Rockcastle Creek	OGU-107	WVOG-123	sedimentation and organic enrichment	iron and fecal coliform
Bearhole Fork	OGU-107-A	WVOG-123-A	sedimentation and organic enrichment	iron and fecal coliform
Marsh Fork	OGU-118-G	WVOG-127-D	sedimentation and organic enrichment	iron and fecal coliform
Barkers Creek	OGU-128	WVOG-131	sedimentation and organic enrichment	iron and fecal coliform
Gooney Otter Creek	OGU-128-K	WVOG-131-F	sedimentation and organic enrichment	iron and fecal coliform
Jims Branch	OGU-128-K-5	WVOG-131-F-1	sedimentation and organic enrichment	iron and fecal coliform
UNT/Gooney Otter Creek RM 3.64	OGU-128-K-9	WVOG-131-F-5	sedimentation and organic enrichment	iron and fecal coliform
Tommy Creek	OGU-141-B	WVOG-139-A	sedimentation and organic enrichment	iron and fecal coliform
Rockhouse Branch	OGU-1-B-1-H	WVOG-65-B-1-F	sedimentation and organic enrichment	iron and fecal coliform
Left Fork/Whitman Creek	OGU-1-B-3-B	WVOG-65-B-2-A	sedimentation and organic enrichment	iron and fecal coliform
Curry Branch	OGU-1-B-8	WVOG-65-B-5	sedimentation and organic enrichment	iron and fecal coliform
Steele Branch	OGU-1-N	WVOG-65-E	sedimentation and organic enrichment	iron and fecal coliform
Little Cub Creek	OGU-54-C	WVOG-92-B	sedimentation and organic enrichment	iron and fecal coliform
Suke Creek	OGU-54-O	WVOG-92-M	sedimentation and organic enrichment	iron and fecal coliform
Milam Fork	OGU-70-X-27	WVOGC-16-M	sedimentation and organic enrichment	iron and fecal coliform
White Oak Branch	OGU-70-X-32	WVOGC-16-N	sedimentation and organic enrichment	iron and fecal coliform *

Stream Name	NHD Code	WV Code	Significant Stressors	TMDLs Developed
Trough Fork	OGU-70-X-36	WVOGC-16-P	sedimentation and organic enrichment	iron and fecal coliform *
Coon Branch	OGU-70-X-6	WVOGC-16-B	sedimentation and organic enrichment	iron and fecal coliform
Chestnut Flats Branch	OGU-70-X-6-C	WVOGC-16-B-1	sedimentation and organic enrichment	iron and fecal coliform
Little Cub Creek	OGU-81	WVOG-108	sedimentation and organic enrichment	iron and fecal coliform
Skin Fork	OGU-95	WVOG-119	sedimentation and organic enrichment	iron and fecal coliform

*Note: Although a fecal coliform TMDL was not developed for this stream, reductions to fecal coliform sources in this watershed that were necessary to attain State water quality standards in downstream water bodies were prescribed.

5.0 METALS AND SELENIUM SOURCE ASSESSMENT

This section identifies and examines the potential sources of metals impairments in the Upper Guyandotte River watershed. Sources can be classified as point (permitted) or nonpoint (non-permitted) sources. For the sake of consistency, the same modeled landuse setup was used for all metals nonpoint sources. Non-mining point sources were also modeled consistently in terms of drainage area and flow, although chemical concentrations (e.g., iron and TSS) were configured specifically for different pollutant sources.

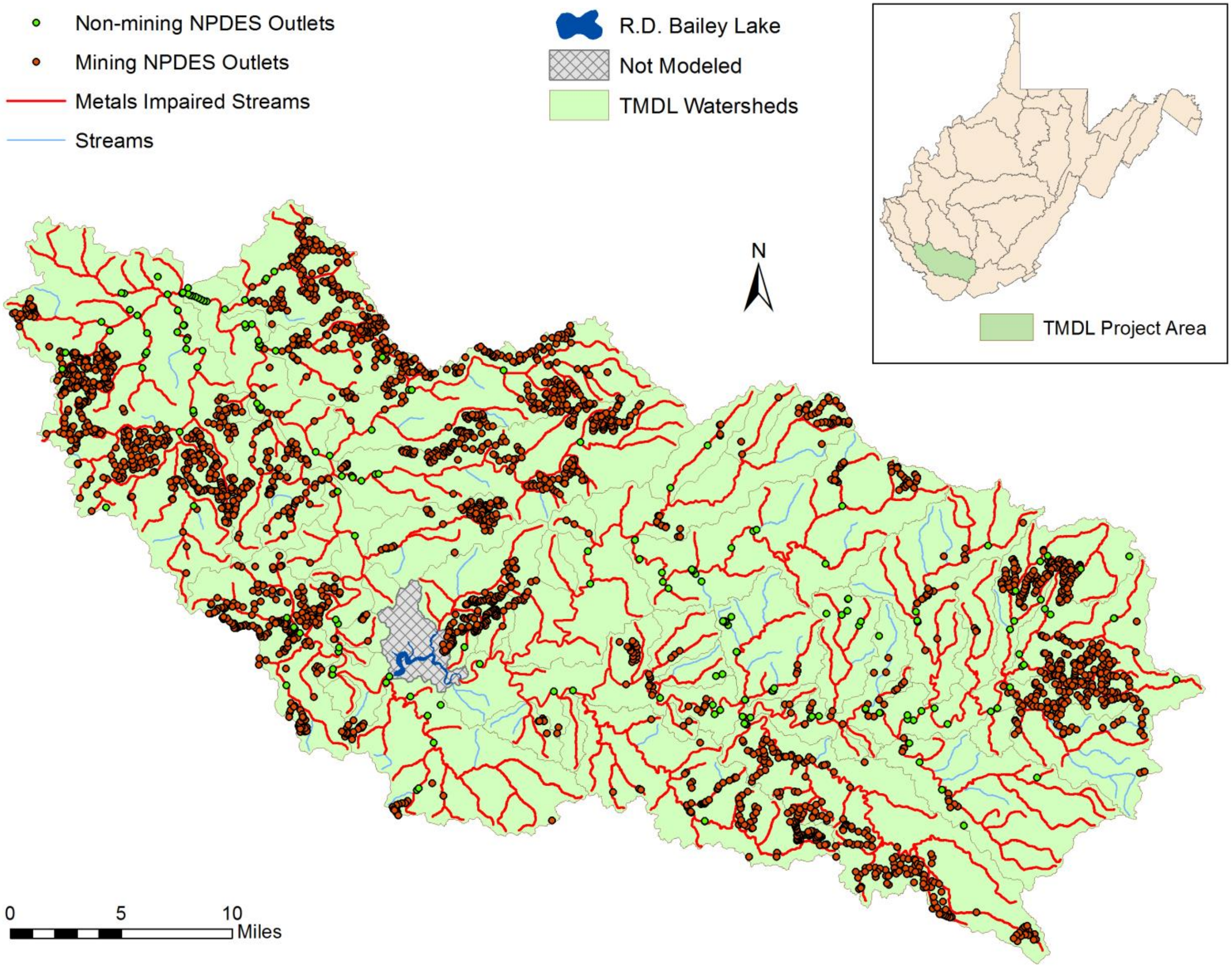
A point source, according to 40 CFR 122.2, is any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, and vessel or other floating craft from which pollutants are or may be discharged. The 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. Municipal Separate Storm Sewer Systems (MS4) are considered point sources, but there are no MS4s in the Upper Guyandotte River watershed.

Nonpoint sources of pollutants are diffuse, non-permitted sources and 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 nonpoint source pollution associated with oil and gas wells. The assignment of LAs to OOG does not reflect any determination by WVDEP or USEPA as to whether there are, in fact, unpermitted point source discharges within this landuse. Likewise, by establishing these TMDLs with OOG discharges treated as LAs, WVDEP and USEPA are not determining that these discharges are exempt from NPDES permitting requirements.

The physiographic data discussed in **Section 3.2** 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 ArcGIS Viewer Project.

5.1 Metals and Selenium Point Sources

Metals point sources are classified by the type of permits issued by WVDEP. The following sections discuss the potential impacts and the characterization of these source types, the locations of which are displayed in **Figure 5-1**.



(Note: outlets in close proximity appear to overlap in the figure)

Figure 5-1. Point sources in the Upper Guyandotte River Watershed

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. When a bond is forfeited, WVDEP assumes the responsibility for the reclamation requirements. In past TMDLs, bond forfeiture sites were classified as nonpoint sources. The judicial decision, West Virginia Highlands Conservancy, Inc., and West Virginia Rivers Coalition, Inc. v. Randy Huffman, Secretary, West Virginia Department of Environmental Protection. [1:07CV87]. 2009, requires WVDEP to obtain an NPDES permit for discharges from forfeited sites. As such, this project classifies bond forfeiture sites as point sources and provides WLAs.

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 comingle mines may have low pH values (i.e., acidic) and contain high concentrations of metals (e.g., iron and aluminum). Mining-related activities are commonly issued NPDES discharge permits that contain effluent limits for total iron, total manganese, total suspended solids, 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).

The permitted mining point sources (open NPDES outlets) were grouped into landuse categories based on the type and status of mining activity and effluent discharge characteristics. Co-mingled discharges contain effluent discharges from both surface and deep mining activities. Surface mines, and co-mingled surface mines were treated as land-based precipitation-induced sources. The deep mine portions of co-mingled mines were characterized as continuous flow point sources. Deep mines were also characterized as continuous flow point sources.

There are 219 active mining-related NPDES permits, with 2,222 associated outlets in the metals impaired watersheds of the Upper Guyandotte River watershed (Appendix F, HPU Metals Model Outlets Tab). Point sources were represented differently during model calibration than they were during allocations. To match model results to historical water quality data for calibration, it was necessary to represent the existing point sources using available historical data. During allocations, permitted sources were represented at their allowable permit limits.

For metals modeling, Phase II and Completely Released permitted facilities were represented at concentrations similar to background because reclamation of these mines is completed or nearly complete and they are assumed to have little potential as a source of metals such as total iron, total aluminum, or manganese. (WVDEP, 2000). There are 24 reclamation-related NPDES permits, with 304 associated outlets present in the watershed (Appendix F, Reclamation Outlets Tab).

Details for both active and reclaimed mining point sources are provided in **Appendix F**. of the Technical Report. **Figure 5-1** illustrates the extent of the mining NPDES outlets in the watershed.

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. DWWM NPDES 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 102 industrial wastewater discharges into metals impaired streams in the Upper Guyandotte watershed.

In the Upper Guyandotte River watershed, there are limited sewage treatment facilities existing in the watersheds of metals impaired streams. The NPDES permits for those facilities do not contain iron effluent limitations; were not considered to be substantive metals sources; and were not explicitly represented in the modeling. Existing discharges from such sources do not require wasteload allocations pursuant to the metals TMDLs. A list of such negligible sources appears in **Appendix F** of the Technical Report. Any metals loading associated with such sources is contained in the background loading and accounted for in model calibration.

There are 102 modeled non-mining NPDES permitted outlets (one groundwater remediation, one solid waste landfill, 11 water treatment plants, three industrial discharges regulated by individual permits, 68 storm water industrial general permit discharges, and 18 WV DOH stormwater discharges) in the watersheds containing or contributing to metals impaired streams, which are displayed in **Figure 5-1**. The assigned WLAs for all non-mining NPDES outlets allow for continued discharge under existing permit requirements, whether those are expressed in effluent limits or benchmark values. For non-construction stormwater permits, BMP based limits with benchmark values to monitor BMP effectiveness constitute acceptable implementation of the WLAs. A complete list of the permits and outlets is provided in **Appendix F** of the Technical Report.

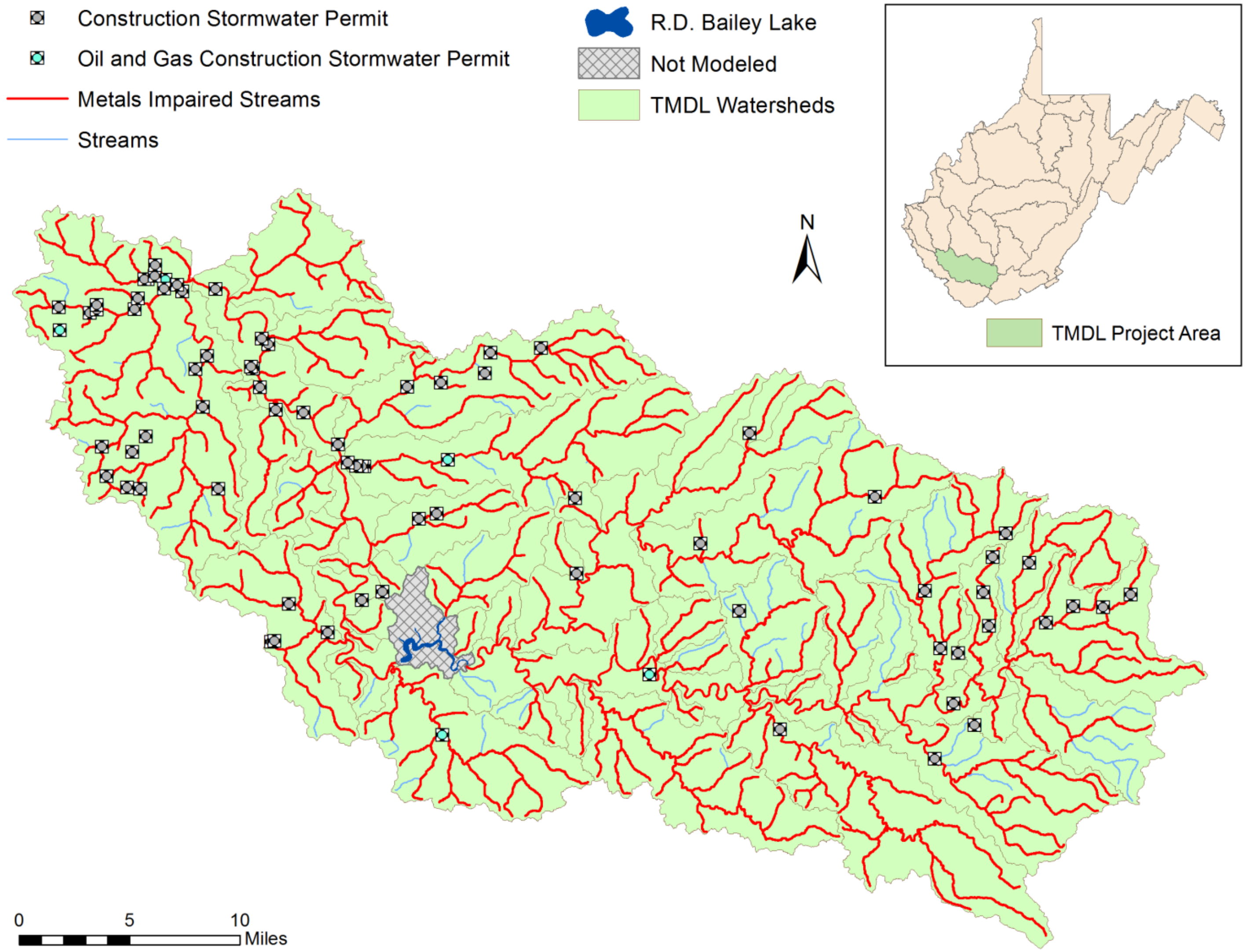
5.1.3 Construction Stormwater Permits

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. WVDEP issues a general NPDES permit (permit WV0115924, referred to as the Construction Stormwater General Permit or CSGP) to regulate stormwater discharges associated with construction activities with a land disturbance greater than one acre.

WVDEP also issues a general NPDES permit to regulate the discharge of stormwater runoff associated with oil and gas related construction activities (permit WV0116815, referred to as the Oil and Gas Construction Stormwater General Permit or OGCSGP) authorizes discharges composed entirely of stormwater associated with oil and gas field activities or operations associated with exploration, production, processing or treatment operations or transmission facilities, disturbing one acre or greater of land area, to the waters of the State.

Both of 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.

At the time of model set-up, 71 active construction sites with a total disturbed area of 1,755 acres registered under the CSGP were represented in the Upper Guyandotte River watershed. Five registrations under the OGCSGP were represented in the model with a total disturbance of 14 acres. CSGP and OGCSGP registrations are shown in **Figure 5-2.** Specific WLAs are not prescribed for individual sites. Instead, subwatershed-based allocations are provided for concurrently disturbed areas registered under the permits as described in **Sections 7.7.1** and **9.0**.



(Note: permits in close proximity appear to overlap in the figure)

Figure 5-2. Construction stormwater permits in the Upper Guyandotte River watershed

5.2 Metals Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to water quality impairments related to metals. For modeling purposes, land disturbing activities that introduce excess sediment are considered nonpoint sources of metals.

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 Upper Guyandotte 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-impaired streams for which TMDLs are presented. In TMDL watersheds with metals, aluminum, pH, and selenium impairments, a total of 46 seeps associated with legacy mine practices at AML sites, and a total of 2,234 acres AML were incorporated into the TMDL model.

5.2.2 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 in non-MS4 areas. Additionally, streambank erosion represents a significant sediment source throughout the watershed. Upland sediment nonpoint sources are summarized below.

Forestry

West Virginia recognizes the water quality issues posed by sediment from logging sites. In 1992, the West Virginia Legislature passed the Logging Sediment Control Act. The act requires the use of BMPs to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and associated access roads can increase sediment loading to streams. The West Virginia Bureau of Commerce's Division of Forestry provided information on forest industry sites (i.e., registered logging sites) in the metals-impaired TMDL watersheds. This information included the 20,303 acres of harvested area within the TMDL impaired streams watersheds, of which subset of land disturbed by roads and landings is 1,624 acres. According to the Division of Forestry, illicit logging operations represent approximately 2.5 percent of the total harvested forest area (i.e., registered logging sites) throughout West Virginia. Five hundred seven (507) acres of illicit activity has been represented in the model. These illicit operations do not have properly installed BMPs and can contribute sediment to streams. In addition, 5,941 acres of burned forest were reported and included as disturbed land for calibration purposes only. **Figure 5-3** displays nonpoint sources, burned forest and logging operations in TMDL watersheds represented in the metals model.

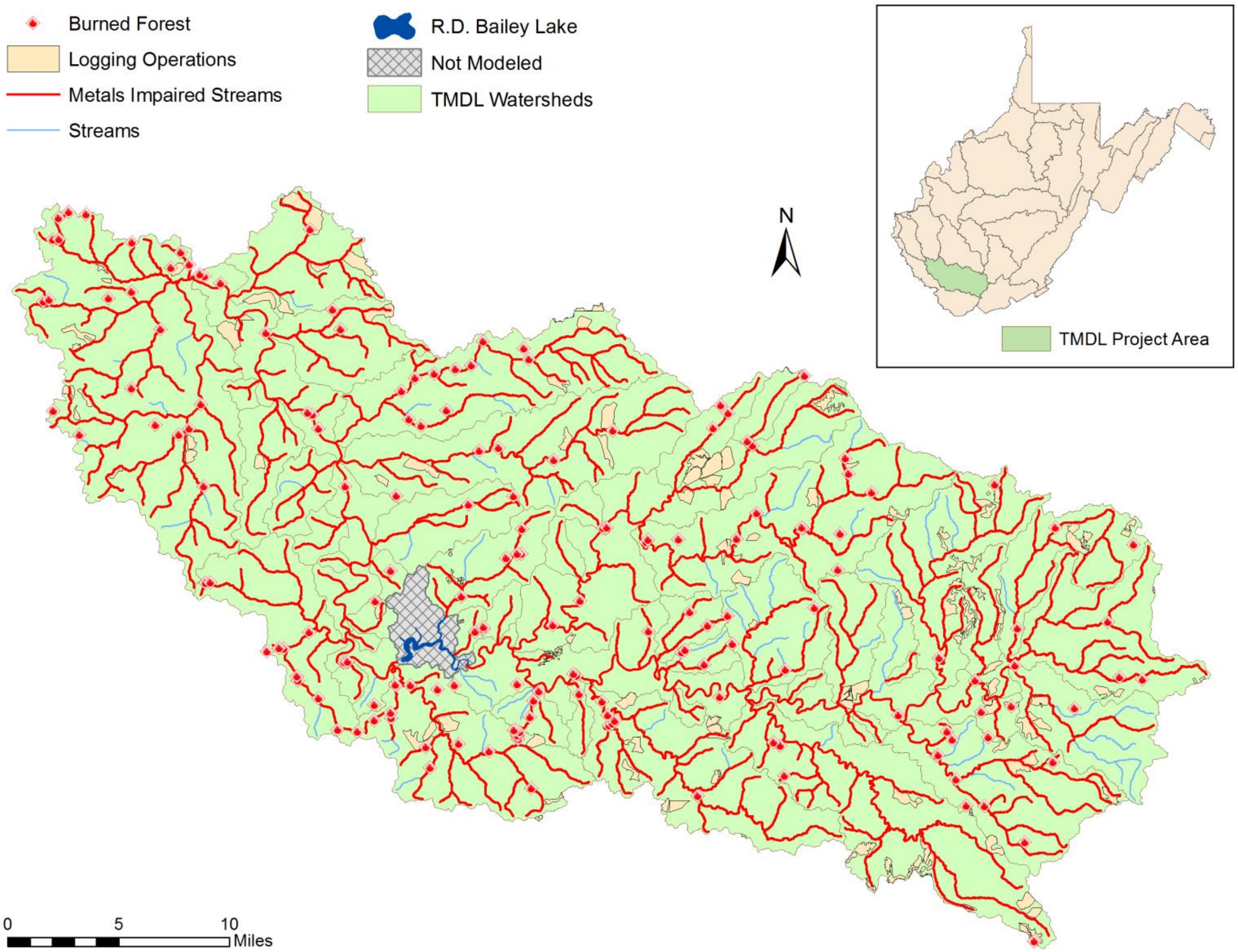


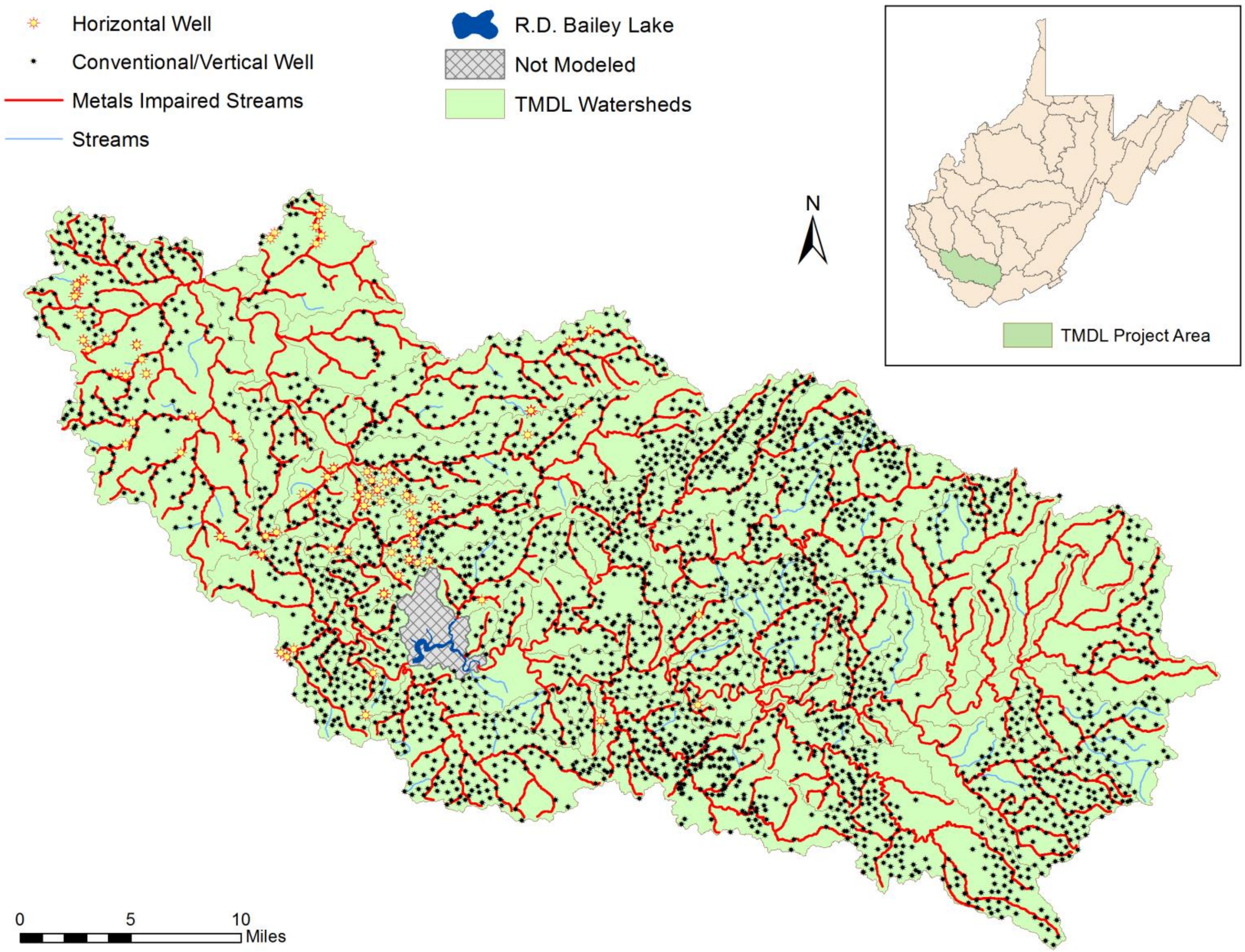
Figure 5-3. Nonpoint sources in the Upper Guyandotte River watershed

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 55,000 active and 15,000 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.

Gas wells targeting the Marcellus Shale geologic formation use hydraulic fracturing techniques that result in significantly higher land disturbance than conventional wells. Horizontal Marcellus drilling sites typically require a flat "pad" area of several acres to hold equipment, access roads capable of supporting heavy vehicle traffic, and temporary ponds for storing water used during the drilling process. Vertical and horizontal Marcellus drilling sites were identified and represented in the model, in addition to conventional wells.

Oil and gas data incorporated into the TMDL model were obtained from the WVDEP OOG GIS coverage. There are 3,051 active conventional and vertical oil and gas wells (represented as 4,166 acres) and 171 horizontal wells (represented as 216 acres) represented 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 (**Figure 5-4**).



(Note: wells in close proximity appear to overlap in the figure)

Figure 5-4. Oil and Gas Well locations in the Upper Guyandotte River watershed

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.

Modeled paved roads acreages were developed from paved road data obtained from the U.S. Census Bureau's 2015 TIGER line shapefiles. Modeled unpaved roads acreages were estimated using a combination of several sources. Baseline unpaved roads acreages were extracted from 2015 TIGER roads data. TIGER road data has been observed to be incomplete in many West Virginia rural areas, therefore an effort was made to account for additional unpaved roads present in the watershed but not captured by TIGER.

A representative sample of 20 subwatersheds was analyzed using 2014 NAIP aerial photographs to digitize unpaved roads not captured by TIGER. A 12-foot width of the digitized unpaved roads was assumed. For the Upper Guyandotte watershed, the subwatersheds analyzed indicated that there could be an additional 0.78 percent of the subwatershed that consisted of unpaved roads not captured by TIGER.

Some of the unpaved roads in the Upper Guyandotte watershed are recreational off-road vehicle trails. Many of these trails have been digitally mapped to facilitate use. West Virginia Trail Inventory GIS data is maintained by the West Virginia Department of Transportation (WVDOT 2019). Trail Inventory trails were assumed to be 12 feet wide for the purposes of calculating acreage. To avoid double counting unpaved roads in areas with significant recreational trail acreage, a formula was applied to calculate the final modeled unpaved road acreage. Where Trail Inventory unpaved roads exceeded 0.78 percent of the subwatershed, then the total modeled unpaved roads acreage equaled TIGER unpaved roads plus the Trail Inventory unpaved roads. If the Trail Inventory road acreage was less than 0.78 percent of the subwatershed (in many subwatersheds it was zero), then the total modeled unpaved roads acreage equaled the sum of the TIGER unpaved roads plus the additional unpaved road acreage estimate by subwatershed that was derived from digitizing the sample of unpaved roads from the aerial photos (0.78 percent).

Agriculture

Agricultural landuses account for less than 0.5 percent of the modeled land area in the watershed. Although agricultural activity accounts for a small percentage of the overall watershed, agriculture is a significant localized nonpoint source of iron and sediment. Upland loading representation was based on precipitation and runoff, in which accumulation rates were developed using source tracking information regarding number of livestock, proximity and access to streams, and overall runoff potential. Sedimentation/iron impacts from agricultural landuses are also indirectly reflected in the streambank erosion allocation when considering vegetative cover.

Streambank Erosion

Streambank erosion has been determined to be a significant sediment source across the watershed. In past TMDL projects, WVDEP conducted a series of special bank erosion pin studies (WVDEP, 2012) which, combined with soils data and vegetative cover assessments, formed the foundation for representation of the baseline streambank sediment and iron loadings. The sediment loading from bank erosion is considered a nonpoint source and LAs are assigned for stream segments.

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. Outside urbanized area boundaries, these landuses are considered to be nonpoint sources and thus load allocations are prescribed. The modified NLCD 2011 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 NLCD 2011 landuse data also classifies certain areas as "barren" land. In the model configuration process, portions of the barren landuse were reclassified to account for other known 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 Selenium Source Assessment

Selenium is a naturally occurring element that is found in Cretaceous marine sedimentary rocks, coal and other fossil fuel deposits (Dreher and Finkelman 1992; CCREM 1987; Haygarth 1994). When such deposits are mined, mobilization of selenium is typically enhanced from crushing of ore and waste materials along with the resulting increase in surface area of material exposed to weathering processes. Studies have shown that selenium mobilization appears to be associated with various surface disturbance activities associated with surface coal mining in Wyoming and western Canada (Dreher and Finkelman 1992; McDonald and Strosher 1998). In West Virginia, coal beds of the Middle Pennsylvanian era exhibit the highest selenium contents. Relatively lower selenium content is found in both the Lower Pennsylvanian and Upper Pennsylvanian eras (WVGES, 2002).

The Upper Guyandotte watershed is comprised of four major geologic formation(s)/group(s) within the Lower and Middle Pennsylvanian geologic systems that create the surface lithology (**Figure 5-5**). The predominant being the Kanawha formation which makes up approximately 57% of the Upper Guyandotte watershed and the New River formation comprising approximately 36.7%.

The Pocahontas formation and Allegheny group make up the remaining 5.7% and 0.6% respectively. These formations are comprised mainly of sandstone and shale interburden with coal beds and coal lenses dispersed throughout the stratigraphic column. Historic and currently mineable reserve seams such as; Winifrede, Coalburg, Stockton, Stockton A No. 5 Block and Upper No. 5 Block coal seams are found within the Allegheny and Kanawha formations.

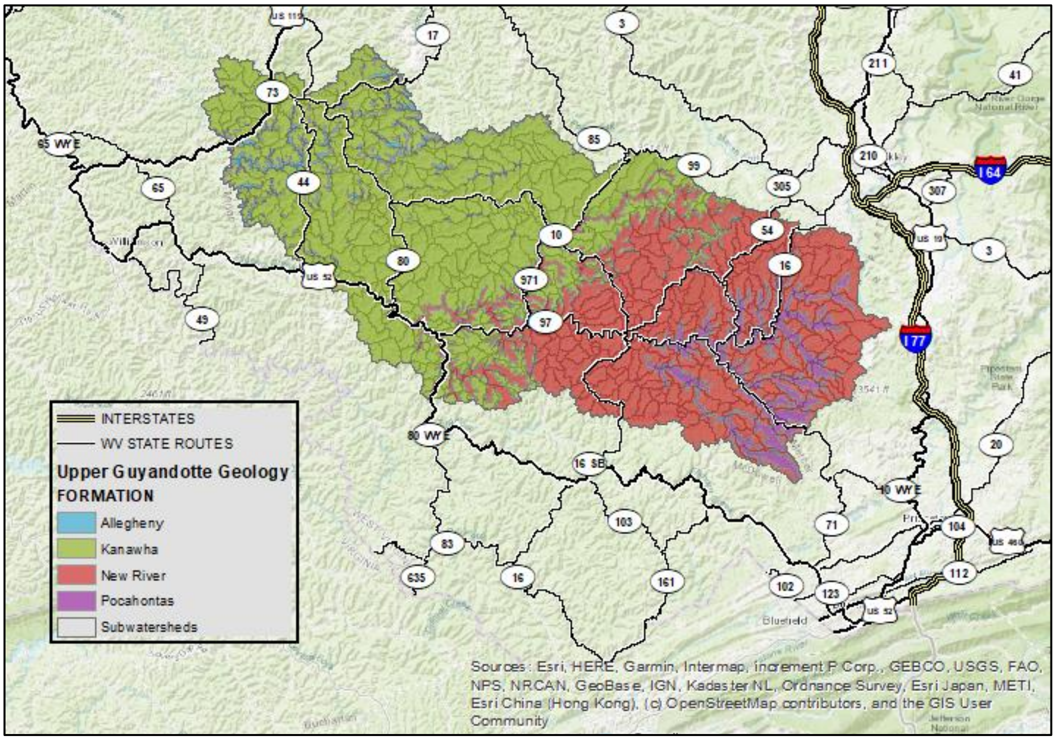


Figure 5-5: Upper Guyandotte geologic formations

Selenium concentrations are consistently higher in shale and coal formations due to type of organic material and conditions of deposition during formation. The higher concentrations found within the many interburden layers of shale and coal within the Kanawha formation, and with the Allegheny formation as a cap rock above drainage elevation, create considerable potential for discharge of excess levels of Selenium into adjacent streams. Approximately 58% of the Upper Guyandotte watershed has potential to produce above average selenium discharge rates.

A number of streams in this TMDL project have been listed in the WV 2016 303(d) list pursuant to the aquatic life criteria for selenium, based on pre-TMDL data collected by WVDEP from 2015- 2016 or from data submitted by permittees through monthly discharge reports assessed for the 303d list and TMDL work directive. Extensive surface mining operations exist in the impaired watersheds and both active and released mining are the dominant landuses. Given the selenium content of coals being mined in this region and the prevalence of mining activity in proximity to observed exceedances of the selenium water quality criterion, it can be concluded that the disturbances associated with the active and released legacy mining operations directly contribute to the selenium impairment.

Other nonpoint sources associated with surface disturbances (i.e., barren areas, unpaved roads, and oil and gas well operations) were considered to be negligible sources of selenium because these land disturbances typically do not disrupt subsurface strata that contain selenium. In this and prior TMDL development efforts, WVDEP did not identify selenium impairments in streams where surface-disturbing sources were prevalent in the watershed and mining activities were absent.

6.0 FECAL COLIFORM SOURCE ASSESSMENT

6.1 Fecal Coliform Point Sources

Publicly and privately owned sewage treatment facilities and home aeration units are point sources of fecal coliform bacteria. The following sections discuss the specific types of fecal coliform point sources that were identified in the Upper Guyandotte 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 sewage treatment facilities with extensive wastewater collection systems, whereas private facilities are usually used in smaller applications such as subdivisions and shopping centers. Additionally, specific discharges from industrial facilities are regulated for fecal coliform bacteria.

In the subject watersheds of this report, six individually permitted POTWs discharge treated effluent at six outlets. These POTWs are Buffalo Creek Public Service District (PSD) (WV0038351), Town of Gilbert (WV0103748), Town of Oceana (WV0024431), Glen Rogers PSD (WV0080390), Center PSD (WV0027138), and the City of Mullens Sanitary Board (WV0020681). One additional individually permitted non-POTW wastewater treatment plant (Cecil I Walker Machinery Co – Rita Facility) discharges from two outlets. Also, 13 mining bathhouse permits discharge to TMDL streams in the Upper Guyandotte River TMDL watersheds via 16 outlets.

These sources are regulated by NPDES permits that require effluent disinfection and compliance with strict fecal coliform effluent limitations (200 counts/100 mL [monthly geometric mean] and 400 counts/100 mL [daily maximum]). Compliant facilities do not cause fecal coliform bacteria impairments because effluent limitations are more stringent than water quality criteria. Refer to the Technical Report **Appendix F** for details regarding NPDES permits.

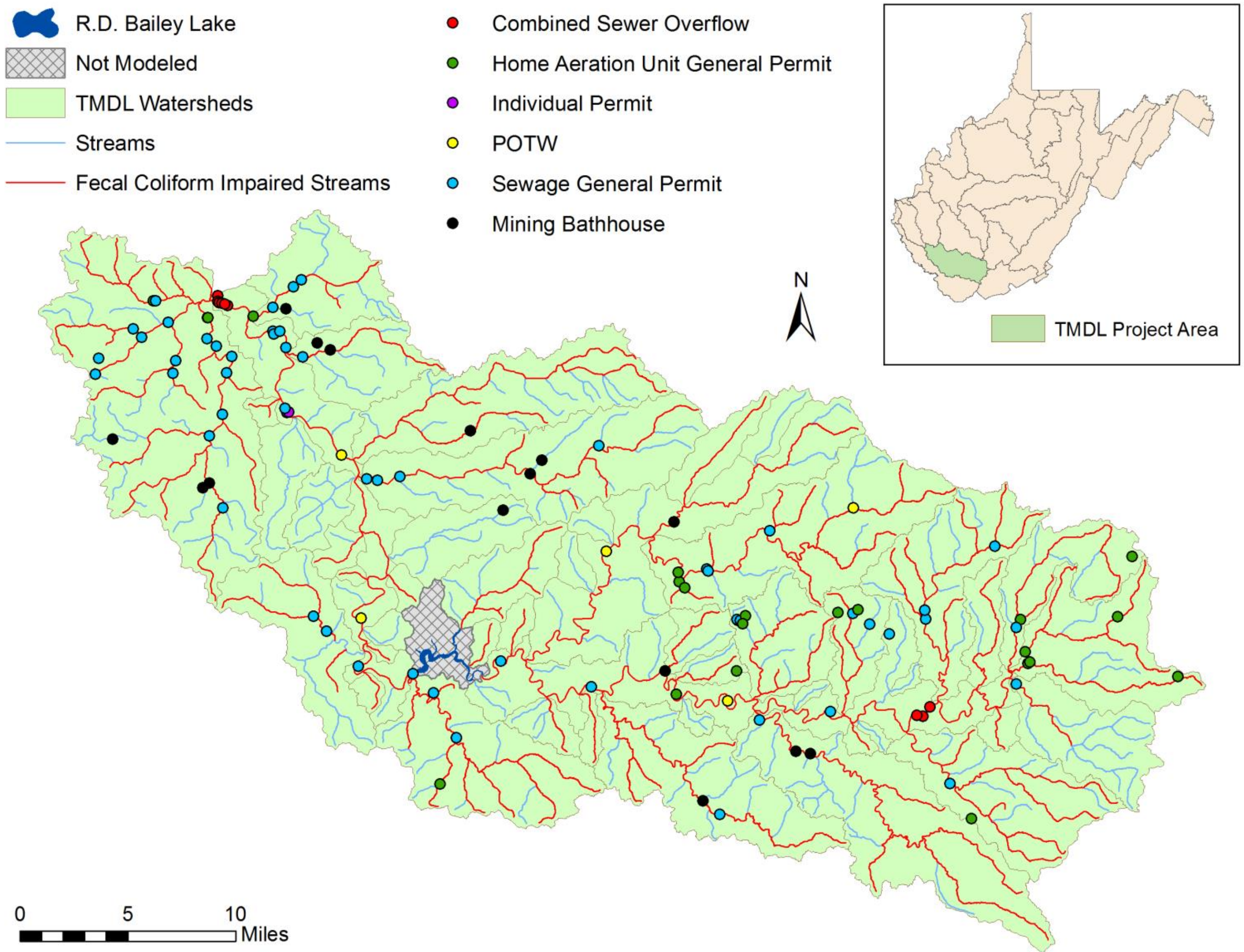
6.1.2 Overflows

Combined sewer overflows (CSOs) are outfalls from POTW sewer systems that discharge 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.

In the watershed, there were a total of nine CSO outlets associated with POTW collection systems operated by the City of Logan (six CSO outlets), and the City of Mullens Sanitary Board (three CSO outlets). No significant SSO discharges were represented in the model.

6.1.3 General Sewage Permits

General sewage permits are designed to cover a class of facilities with similar type discharges from numerous individual owners and facilities throughout the state under one permit. General Permit WV0103110 regulates small, privately owned sewage treatment plants ("package plants") that have a design flow of 50,000 gallons per day (gpd) or less. General Permit WV0107000 regulates home aeration units (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 areas draining to streams for which fecal coliform TMDLs have been developed, 54 facilities are registered under the "package plant" general permit and 21 are registered under the HAU general permit. Modeled point source locations are shown on **Figure 6-1.**



(Note: outlets in close proximity appear to overlap in the figure)

Figure 6-1. Fecal coliform point sources

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 13,500 homes that are not served by centralized sewage collection and treatment systems and are within 100 meters of a stream. Homes located more than 100 meters from a stream were not considered significant potential sources of fecal coliform because of the natural attenuation of fecal coliform concentrations that occurs because of bacterial die-off during overland travel (Walsh and Kunapo, 2009). Estimated septic system failure rates across the watershed range from 3 percent to 28 percent. Section 3.1.4 of the Technical Report describes the methods used to characterize failing septic systems.

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 three 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. **Figure 6-2** shows the annual fecal coliform counts represented in the model from failing septic systems relative to the total stream length in meters for each subwatershed.

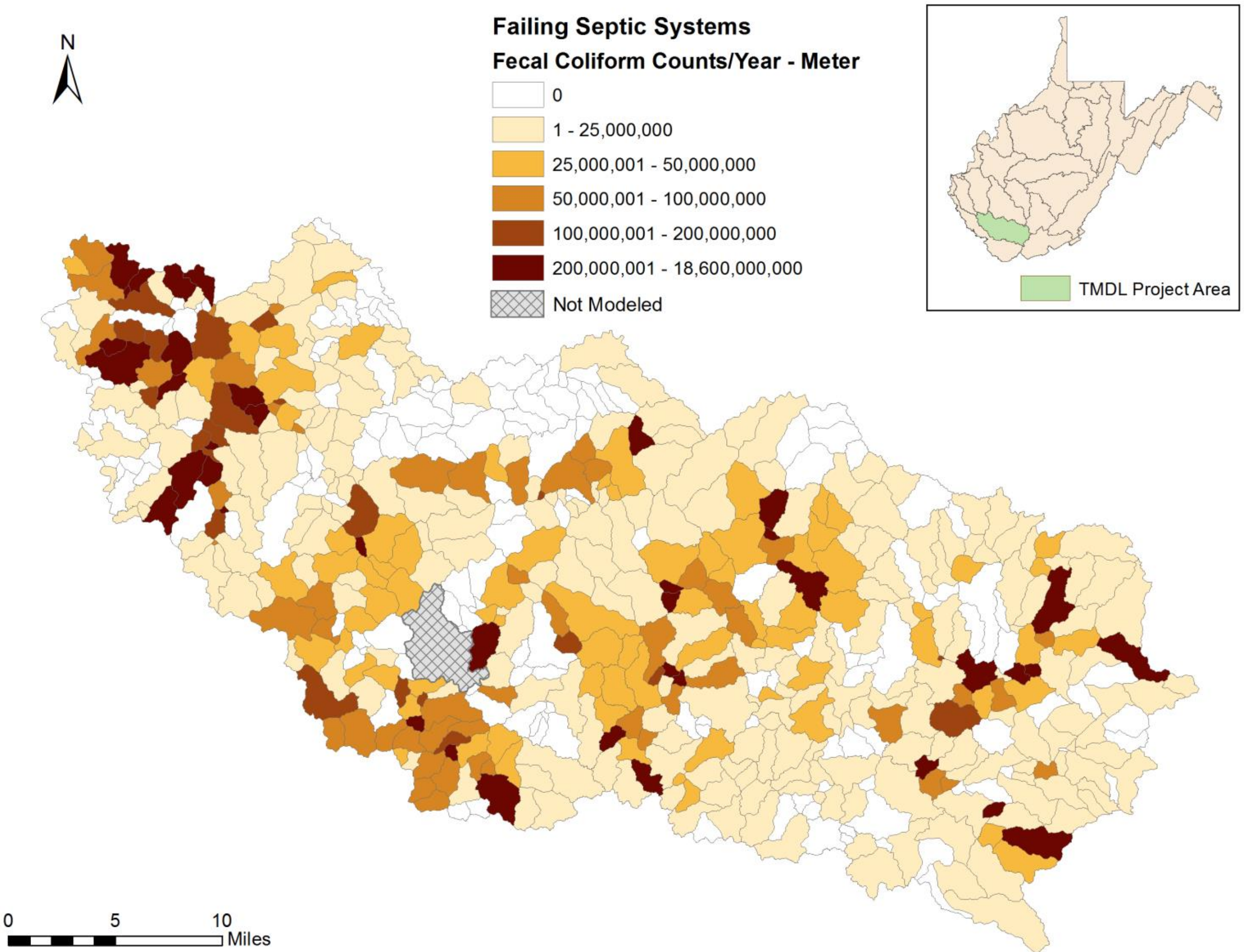


Figure 6-2. Fecal coliform counts attributed to failing septic systems per year relative to the stream lengths (meters) in each subwatershed in the Upper Guyandotte River watershed as represented in modeling.

Once failing septic flows were modeled, 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, and 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.

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 NLCD 2011 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 accounts for a small percentage of the overall watershed, agriculture is a significant localized nonpoint source of fecal coliform bacteria. 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, which incorporated wildlife estimates obtained from West Virginia’s Division of Natural Resources (WVDNR). 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 and 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 watershed.

7.0 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 Upper Guyandotte River watershed.

7.1 Model Selection

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 bacteria impairments are temporally variable and occur at low, average, and high flow conditions
- Total iron loadings and instream concentrations are related to sediment
- Time-variable aspects of land practices have a large effect on instream pollutant concentrations
- Pollutant transport mechanisms are 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, selenium, and fecal coliform bacteria in West Virginia are presented in **Section 2.2**, **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), defined as the lowest flow for seven day average flow that occurs (on average) once every ten years. 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 Upper Guyandotte 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 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, selenium, and fecal coliform bacteria were modeled using the MDAS.

7.2 Model Setup

Model setup consisted of configuring the following three separate MDAS models: iron/sediment, selenium, and fecal coliform bacteria.

7.2.1 General MDAS Configuration

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 inputs. Flow and water quality were continuously simulated on an hourly time-step.

Two grid-based weather data products were used to develop MDAS model weather input files for TMDL modeling. The Parameter-Elevation Regressions on Independent Slopes Model (PRISM) and the North American Land Data Assimilation System (NLDAS-2) are both publicly available weather datasets. PRISM data features daily weather on a 4 km grid spatial scale and NLDAS-2 data has hourly weather on a 12 km grid scale. Both datasets combine rain gauge data with radar observations to predict hourly weather parameters such as precipitation, solar radiation, wind, and humidity. For more information on PRISM and NLDAS-2, refer to Section 2 of the Technical Report.

PRISM daily weather data and NLDAS-2 hourly precipitation data were obtained and processed to create a time series for each PRISM grid cell that contained modeled TMDL watersheds. Using the precipitation and temperature time series, a model weather input file was developed for each PRISM grid cell. Given that only slight variability was observed between the grid cells at the 12-digit Hydrologic Unit Code (HUC) scale, and to allow for faster model run times, one weather input file per each of the twenty-two 12-digit HUCs in the Upper Guyandotte River watershed was developed by taking an area-weighted average of PRISM values within each 12-digit HUC. Modeled subwatersheds falling within each 12-digit HUC were then assigned the appropriate weather input file for hydrologic modeling purposes.

The 47 TMDL watersheds were broken into 595 separate subwatershed units, based on the groupings of impaired streams shown in **Figure 3-2**. 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.

7.2.2 Metals and Sediment Configuration

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 NLCD 2011 landuse categories to create modeled landuse groupings. Several additional landuse categories were created to account for landuses either not included in the NLCD 2011 and/or representing recent land disturbance activities (e.g., harvested forests and skid roads, oil and gas operations, and paved and unpaved roads). The process of consolidating and updating the modeled landuses is explained in further detail in the Technical Report. Non-sediment related, iron land-based sources were modeled using representative average concentrations for the surface, interflow and groundwater portions of the water budget.

Traditional point sources (e.g., industrial discharges) were modeled as direct, continuous-flow sources in the model, with the baseline flow and pollutant characteristics obtained from permitting databases.

Sediment-producing landuses and bank erosion are sources of iron because of the relatively high iron content of the soils in the watershed. Statistical analyses, using pre-TMDL monitoring data collected in the TMDL watersheds, were performed to establish the correlation between in-stream sediment and iron metals concentrations. The results were then applied to the sediment from sediment-producing landuses and streambank erosion to calculate the iron loads delivered to the streams.

Generation of upland sediment loads depends on the intensity of surface runoff and varies by landuse and the characteristics of the soil. Soil erodibility and sediment washoff coefficients varied among soil types and landuses and were used to simulate sediment erosion by surface runoff. Sediment delivery paths modeled were surface runoff erosion and streambank erosion. Streambank erosion was modeled as a unique sediment source, independent of other upland-associated erosion sources.

The MDAS bank erosion model takes into account stream flow and bank stability using the following methodology. Each stream segment has a flow threshold (Q Threshold) above which streambank erosion occurs. This threshold is estimated as the flow that occurs at bank full depth. The bank erosion rate per unit area is a function of bank flow volume above the specified threshold and the bank erodible area(Q Bank Erosion). The bank scouring process is a power function dependent upon high-flow events exceeding the flow threshold. Bank erosion rates increase when the flow is above the Q Threshold.

The wetted perimeter and reach length represent ground area covered by water (**Figure 7-1**). 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 eroded sediment mass corresponding to the stream segment.

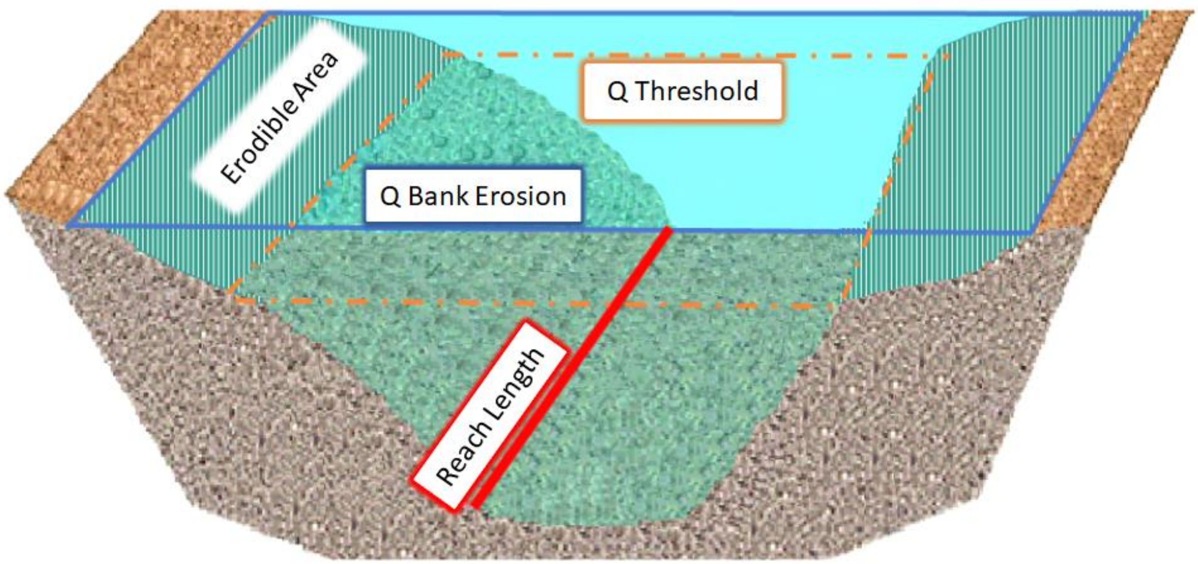


Figure 7-1. Conceptual diagram of stream channel components used in the bank erosion model

Another important variable in the prediction of sediment yield is bank stability as defined by coefficient for scour of the bank matrix soil (referred to as “kber”) for the reach. Both quantitative and qualitative assessments indicated that vegetative cover was the most important factor controlling bank stability. Overall bank stability was initially characterized by assessing and rating bank vegetative cover from aerial photography on a subwatershed basis. The erodibility coefficient from soils data was used to refine this assessment. Using the aerial assessment and the soil erodibility data together, the subwatershed’s bank condition was scored and each level was associated with a kber value. Streambank erosion soil loss results from the model were compared to field data available from previous WVDEP streambank erosion pin studies to verify that the amount of lost sediment generated by the model was within reason.

The Technical Report provides more detailed discussions on the technical approaches used for streambank erosion and sediment modeling.

7.2.3 Selenium Configuration

Modeled landuse categories contributing selenium via precipitation and runoff include background undisturbed land, AML lands, legacy mine areas, and active surface mining permitted lands. Other sources, such as pumped discharges from active mines and legacy mine seeps, were modeled as direct, continuous-flow sources in the model.

Selenium loading rates for background and AML sources were derived through model calibration to replicate in-stream selenium concentrations observed during pre-TMDL monitoring. Legacy mine loading rates were developed from WVDEP source tracking sampling during field investigations. Active mining permits were characterized by their contributing acreage for surface mines, or flow volume for deep mines with continuous flow. For mine outlets with selenium permit limits, modeled selenium concentrations were the same as the permit limit. In Bandmill Hollow (WVOG-68-A), several mining outlets were represented at concentration equal to an effluent limit derived through a fish tissue bioaccumulation study, 0.0079845 mg/L. For mine outlets without selenium limits, an estimate of selenium concentration derived from discharge monitoring report data was used.

7.2.4 Fecal Coliform Configuration

Modeled landuse categories contributing bacteria via precipitation and runoff include pasture, cropland, urban/residential pervious lands, urban/residential impervious lands, grassland, forest, barren land, and wetlands. Other sources, such as failing septic systems 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.

7.3 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. Three USGS gauging stations located in Upper Guyandotte River watershed had adequate recorded data for model hydrology calibration:

- USGS 03203600 Guyandotte River at Logan, WV
- USGS 03202750 Clear Fork at Clear Fork, WV
- USGS 03202400 Guyandotte River near Baileysville, WV

Hydrology calibration compared observed data from the stations and modeled runoff from the landuses present in the watershed. 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, 2007 to December 31, 2016. 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 Upper Guyandotte River watershed. A detailed description of the hydrology calibration and a summary of the results and validation are presented in the Technical Report in **Appendix I**.

7.4 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.

The water quality was calibrated by comparing modeled versus observed pollutant 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. Initial model parameters for the various pollutant parameters were derived from previous West Virginia TMDL studies, storm sampling efforts, and literature values. 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 7-2**.

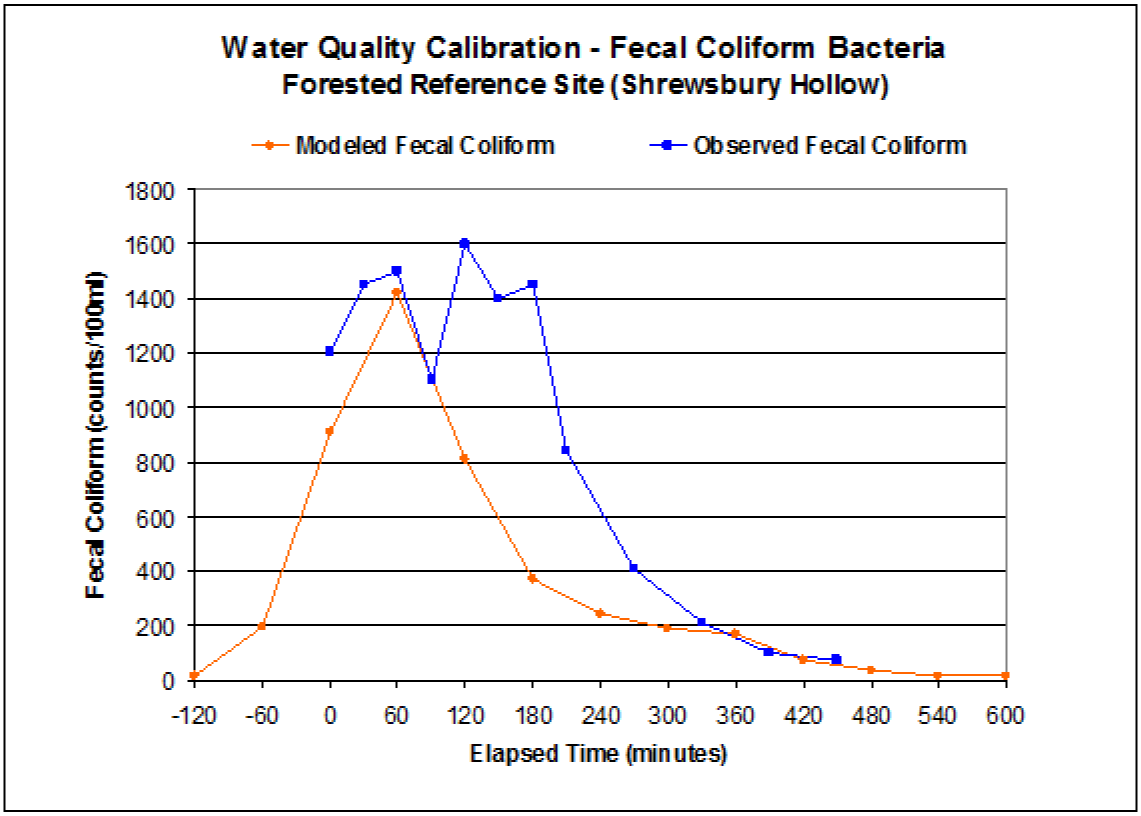


Figure 7-2. Shrewsbury Hollow fecal coliform observed data

Sediment calibration consisted of adjusting the soil erodibility and sediment transport parameters by landuse, and the coefficient of scour for bank-erosion. Initial values for these parameters were based on available landuse-specific storm-sampling monitoring data. Initial values were adjusted so that the model's suspended solids output closely matched observed instream data in watersheds with predominately one type of landuse.

7.5 Modeling Technique for Biological Impacts with Sedimentation Stressors

The SI process discussed in **Section 4** identified sedimentation as a significant biological stressor in some of the streams. Often streams with sedimentation impairments are also impaired pursuant to the total iron criterion for aquatic life protection and WVDEP determined that implementation of the iron TMDLs would require sediment reductions sufficient to resolve the biological impacts. The sediment reduction necessary to attain iron criteria was compared to the sediment reduction necessary to resolve biological stress under a "reference watershed" approach. The approach was based on selecting watersheds with acceptable biological condition that share similar landuse, ecoregion, and geomorphologic characteristics with the watersheds of impacted streams. The normalized loading associated with the reference stream is assumed to represent the conditions needed to resolve sedimentation stress in impacted streams. 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 impacts associated with sediment. As such, the iron TMDLs presented for the subject waters are appropriate surrogates to address impacts related to sediment. Refer to the Technical Report and **Appendix L** for details regarding the iron surrogate approach.

7.6 Allocation Strategy

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:

TMDL = sum of WLAs + sum of LAs + MOS

To develop the TMDLs for each of the impairments 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

7.6.1 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 TMDL endpoints for the various criteria are displayed in **Table 7-1**.

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.

Table 7-1. 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	1.0 mg/L (4-day average)	0.95 mg/L (4-day average)
Total Selenium *	Aquatic Life	0.005 mg/L (4-day average)	0.005 mg/L (4-day average)

Water Quality Criterion	Designated Use	Criterion Value	TMDL Endpoint
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)

*Bandmill Hollow (WVOG-68-A) mining permit effluent limits were based on a fish tissue bioaccumulation study.

TMDLs are presented as average daily loads that were developed to meet TMDL endpoints under a range of conditions observed throughout the year. For most pollutants, 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.

7.6.2 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 point source loadings at permit limits and existing nonpoint source loadings. 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, 2011 through December 31, 2016). 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 7-3** presents both the seasonal and annual rainfall totals for the years 2006 through 2016 at the Bluefield Mercer County Airport (WBAN 03859) weather station near Bluefield, West Virginia. The years 2011 to 2016 are highlighted, in red, to indicate the range of precipitation conditions used for TMDL development in the Upper Guyandotte River watershed.

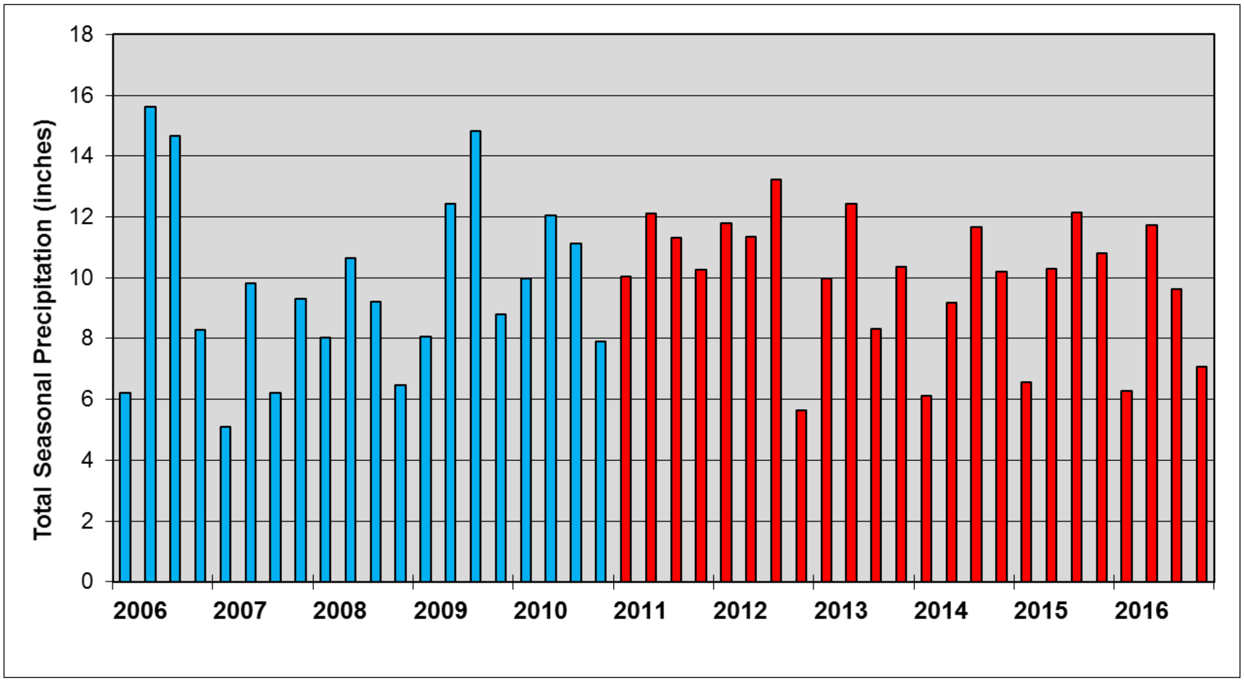


Figure 7-3. Seasonal and annual precipitation totals for the Bluefield Mercer County Airport (WBAN 03859) weather station

NPDES permits contain effluent limitations for iron concentrations. In the baseline condition, discharges that are influenced by precipitation were represented using precipitation and drainage area. Baseline concentrations varied by parameter. For iron, baseline concentrations were generally established at the technology based concentration (3.2 mg/l) or water quality based concentration (1.5 mg/l), as applicable to each permit.

In order to establish allocated load, 2.5 percent of the total subwatershed area was allotted for concurrent construction activity under the CSGP, where possible. Baseline loadings were based upon precipitation and runoff and an assumption that proper installation and maintenance of required BMPs will achieve a Total Suspended Solids (TSS) benchmark value of 100 mg/L.

Sediment-producing nonpoint sources 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 geometric mean fecal coliform effluent limitation of 200 counts/100 mL. Baseline characteristics for non-stormwater industrial wastewater sources were obtained from effluent limitations and other permitting information.

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. Performing 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 sources were individually adjusted and the modeled instream concentrations were then evaluated.

Multiple allocation scenarios were run for the impaired waterbodies. 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 7-4 shows an example of model output for a baseline condition and a successful TMDL scenario.

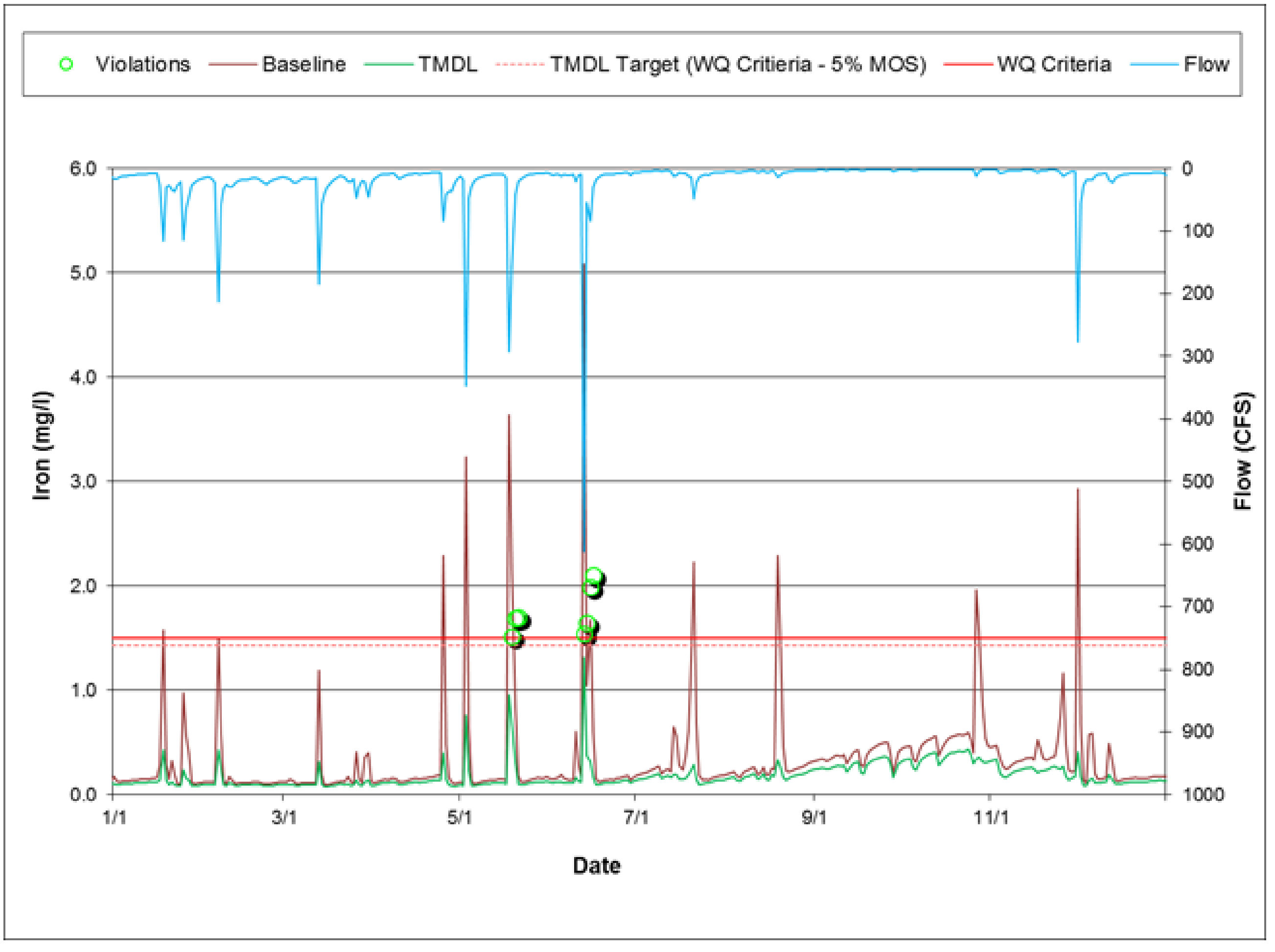


Figure 7-4. Example of baseline and TMDL conditions for total iron

7.7 TMDLs and Source Allocations

7.7.1 Total Iron TMDLs

Source allocations were developed for all modeled subwatersheds contributing to the iron impaired streams of the Upper Guyandotte River watersheds. In order to meet iron criterion and allow for equitable allocations, reductions to existing sources were first assigned using the following general rules:

1. The loading from streambank erosion was first reduced to the loading characteristics of the streams with the best observed streambank conditions.
2. The following land disturbing sources were equitably reduced to the iron loading associated with 100 mg/L TSS.
    - Barren
    - Cropland
    - Pasture
    - Urban Pervious
    - Oil and gas
    - Unpaved Roads
    - Forestry Skid Roads and Landings
3. Harvested Forest was reduced to the sediment and iron loading associated with forest.
4. AMD seeps were reduced to water quality criterion end of pipe (1.5 mg/L iron).
5. Active mining permits and other point sources discharging to warm-water streams were reduced to water quality criterion end of pipe (1.5 mg/L iron) in subwatersheds where the model indicated non-attainment after reductions associated with Steps 1-4. Likewise, active mining permits in trout streams were reduced to 1.0 mg/L iron in subwatersheds where the model indicated non-attainment after reductions associated with Steps 1-4.

In addition to reducing the streambank erosion and source contributions, activity under the CSGP and OGCSGP was considered. Area based WLAs were provided for each subwatershed to accommodate existing and future registrations under the CSGP or OGCSGP. Two and a half (2.5) percent of the subwatershed area was allocated for activity in almost all subwatersheds to account for future growth.

After executing the above provisions, model output was evaluated to determine the criterion attainment status at all subwatershed pour points.

Using this method ensured that contributions from all sources were weighted equitably and that cumulative load endpoints were met at the most downstream subwatershed for each impaired stream. 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. Permitted source reductions did not result in allocated loadings to a permittee that would be more stringent than water quality criteria.

Wasteload Allocations (WLAs)

WLAs were developed for all point sources permitted to discharge iron 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, and facilities registered under the General NPDES permit for construction stormwater. NPDES permits must contain effluent limits and conditions consistent with the assumptions and requirements of the WLAs in the TMDL (40 CFR § 122.44(d)(1)(vii)(B)). WLAs for non-construction stormwater sources should be translated into effective, measurable water quality effluent limits in the form of numeric limits or measurable, objective BMP-based limits projected to achieve the WLAs, with benchmark values and monitoring to determine BMP effectiveness.

Discharges regulated by the Multi Sector Stormwater Permit

Certain registrations under the general permit for stormwater associated with industrial activity 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, whether those requirements are expressed in effluent limits or benchmark values. BMP based limits constitute acceptable implementation of the wasteload allocations for stormwater discharges.

Construction Stormwater

Specific WLAs for activity under the CSGP are provided at the subwatershed scale and are described in **Section 5.1.2**. With several exceptions, an allocation of 2.5 percent of undeveloped subwatershed area was provided with loadings based upon precipitation and runoff and an assumption that required BMPs, if properly installed and maintained, will achieve a TSS benchmark value of 100 mg/L. In certain areas, the existing level of activity under the CSGP does not conform to the subwatershed allocations. In these instances the WVDEP DWWM permitting program will require stabilization and permit termination in the shortest time possible. Thereafter the program will maintain concurrently disturbed areas as allocated or otherwise control future activity through provisions described in **Section 10**.

Other Non-mining Point Sources

Non-stormwater municipal and industrial sources for which existing NPDES permits did not contain iron were not considered to be substantive sources and were not explicitly represented in the modeling. A list of such negligible sources appears in **Appendix F** of the Technical Report. Existing discharges from negligible sources do not require wasteload allocations pursuant to the iron TMDLs. Any metals loading associated with such sources is contained in the background loading and accounted for in model calibration.

Load Allocations (LAs)

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

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

7.7.2 Total Selenium TMDLs

Source allocations were developed for all modeled subwatersheds contributing to the selenium impaired streams of the Upper Guyandotte River watershed. In order to meet water quality criterion and allow for equitable allocations, reductions to existing sources were first assigned using the following general rules:

- Reduced legacy mines to water quality end-of-pipe (5 ug/L selenium).
- The loading from instream ponds was reduced to water quality criterion end-of-pipe.
- The loading from continuous discharges was reduced to water quality criterion end-of-pipe.
- The loading from on-bench structures was reduced to water quality criterion end-of-pipe using a top-down approach in subwatersheds where the model indicated non-attainment.

Using this method ensured that contributions from all sources were weighted equitably and that cumulative load endpoints were met at the most downstream subwatershed for each impaired stream. 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. Permitted source reductions did not result in allocated loadings to a permittee that would be more stringent than water quality criteria.

The presented Selenium TMDLs are based solely upon the water column concentration component of the aquatic life protection criteria of the currently effective West Virginia Water Quality Standards (47 CSR 2-8.27.1). The operable wasteload allocations for point sources are also presented in concentration terms with expected implementation in accordance with the TSD.

It is important to note that the water quality standards include selenium criteria in terms of fish whole-body/muscle and egg/ovary concentrations. The water quality standards provide implementation protocols where whole-body/muscle criterion assessment results override those based upon the water column concentration criterion, and where egg/ovary criterion assessment results override those based upon whole-body/muscle and/or water column concentration criteria. As such, the water quality standards recognize that site specific conditions in waters of the State may allow attainment and protection of aquatic life designated uses in the presence of selenium concentrations greater than those prescribed by the water column concentration criterion component. (*See 47 CSR-2-8.27.1, 47 CSR-2-8.27.2, 47 CSR-2-8.27.3 and footnotes f and g*)

The Selenium TMDLs do not preclude the pursuit of use attainment evaluations through fish tissue studies envisioned by the water quality standards. If site-specific fish whole-body/muscle and/or egg/ovary concentrations are measured and subsequent analysis demonstrates aquatic life use protection at water column selenium concentrations greater than 5 ug/l, then point source controls alternative to the TMDL wasteload allocations may be implemented to the extent demonstrated by the assessment to be protective of the immediate receiving stream and all downstream waters for which Selenium TMDLs have been developed.

Wasteload Allocations (WLAs)

WLAs were developed for all mining related point source discharges. WLAs for active mining operations considered the functional characteristics of the permitted outlets (i.e., precipitation driven, pumped continuous flow, or commingled) and their respective impacts at high and low flow conditions.

Load Allocations (LAs)

LAs were developed for background sources, and other nonpoint sources. LAs were divided into several landuse categories: undisturbed forest and grasslands, abandoned mine lands, and legacy mine areas. Legacy mine areas that contributed significantly to selenium impairment in streams with no other sources were reduced to the water quality criterion.

By establishing these TMDLs with legacy mine discharges treated as LAs, WVDEP and USEPA are not determining that these discharges are exempt from NPDES permitting requirements. **Table 7-2** provides a list of streams and subwatershed in which legacy mine discharges were represented. Most often the model representation was a precipitation landuse based on the delineated area for valley fills directly upstream of discharges. In one instance (Lefthand Fork/Gilbert Creek), a deep mine was represented as a continuous flow discharge. Loadings associated with background and other nonpoint sources were represented but not reduced.

Table 7-2. Legacy Mine sources

NHD Code	Stream Name	WV Code	SWS	Area
WV-OGU-1-B-3-E	UNT/Whitman Creek RM 3.83 (Skifus Branch)	WVOG-65-B-2-C	1022	33.20
WV-OGU-10-B	Right Hand Fork/Rum Creek	WVOG-70-A	2029	29.70
WV-OGU-10-D	Slab Fork	WVOG-70-B	2033	71.80
WV-OGU-27-E-1	Perry Branch	WVOG-75-A-1	2063	83.00
WV-OGU-47-B	Horsepen Creek	WVOG-89-B	2168	25.50
WV-OGU-47	Gilbert Creek	WVOG-89	2173	44.60
WV-OGU-47-K	Lefthand Fork/Gilbert Creek	WVOG-89-F	2174	0.00
WV-OGU-62-O	Toler Hollow	WVOG-96-F	2312	47.79
WV-OGU-119	Joe Branch	WVOG-128	5014	79.00
WV-OGU-128-E	Hickory Branch	WVOG-131-B	5022	56.20

7.7.3 Fecal Coliform Bacteria TMDLs

TMDLs and source allocations were developed for impaired streams and their tributaries on a subwatershed basis throughout the watershed. 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 geometric mean)
- Because West Virginia Bureau for Public Health regulations prohibit the discharge of raw sewage into surface waters, all illicit discharges of human waste (i.e., from failing septic systems and straight pipes) were reduced by 100 percent in the model
- If further reduction was necessary, 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 WLAs equal to existing monthly fecal coliform effluent limitations of 200 counts/100 mL. When there are permitted stormwater outlets at sewage treatment plants, BMP based limits constitute acceptable implementation of the wasteload allocations for stormwater discharges.

Load Allocations (LAs)

Fecal coliform LAs are assigned 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)

7.7.4 Seasonal Variation

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 pollutant 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.

7.7.5 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).

7.7.6 TMDL Presentation

The TMDLs for all impairments are shown in **Section 8** of this report. The TMDLs for iron and selenium are presented as average daily loads, in pounds per day. The TMDLs for fecal coliform bacteria are presented in average number of colonies per day. All TMDLs were developed to meet TMDL endpoints under a range of conditions observed over the modeling period. 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 of the TMDL to restore the waterbody.

The iron WLAs for future CSGP 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-construction sectors registered under the Multi Sector Stormwater Permit are also 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 fecal coliform bacteria WLAs for sewage treatment plant effluents 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.

This TMDL does not mandate change to the existing NPDES permits that regulate stormwater discharges under the BMP basis and include benchmark values and monitoring to assess BMP effectiveness is measured that are less than or equal to specified concentration-based wasteload allocations.

8.0 TMDL RESULTS

Table 8-1. Iron TMDLs

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Island Creek	OGU-1	Island Creek	WVOG-65	339.70	328.55	35.17	703.42
Island Creek	OGU-1-A	Coal Branch	WVOG-65-A	2.41	0.35	0.15	2.90
Island Creek	OGU-1-B	Copperas Mine Fork	WVOG-65-B	136.77	74.37	11.11	222.26
Island Creek	OGU-1-B-1	Mud Fork	WVOG-65-B-1	40.15	4.73	2.36	47.24
Island Creek	OGU-1-B-1-C	Lower Dempsey Branch	WVOG-65-B-1-A	3.22	0.47	0.19	3.89
Island Creek	OGU-1-B-1-D	Ellis Branch	WVOG-65-B-1-B	2.37	0.32	0.14	2.83
Island Creek	OGU-1-B-1-G	Upper Dempsey Branch	WVOG-65-B-1-E	2.16	0.21	0.12	2.49
Island Creek	OGU-1-B-1-H	Rockhouse Branch	WVOG-65-B-1-F	3.86	0.59	0.23	4.68
Island Creek	OGU-1-B-1-L	UNT/Mud Fork RM 6.12		1.65	0.22	0.10	1.97
Island Creek	OGU-1-B-3	Whitman Creek	WVOG-65-B-2	26.65	21.96	2.56	51.17
Island Creek	OGU-1-B-3-B	Left Fork/Whitman Creek	WVOG-65-B-2-A	8.43	1.25	0.51	10.19
Island Creek	OGU-1-B-3-B-2	Poleroad Fork	WVOG-65-B-2-A-1	2.41	0.39	0.15	2.95
Island Creek	OGU-1-B-3-G	Pine Gap Branch	WVOG-65-B-2-D	2.47	1.84	0.23	4.54
Island Creek	OGU-1-B-4	Aldrich Branch	WVOG-65-B-3	3.23	0.46	0.19	3.89
Island Creek	OGU-1-B-6	Trace Fork	WVOG-65-B-4	9.88	17.24	1.43	28.55
Island Creek	OGU-1-B-6-E	UNT/Trace Fork RM 2.95	WVOG-65-B-4-G	1.30	1.13	0.13	2.56
Island Creek	OGU-1-B-8	Curry Branch	WVOG-65-B-5	1.84	0.31	0.11	2.26
Island Creek	OGU-1-B-15	Dingess Fork	WVOG-65-B-8	0.82	19.55	1.07	21.44
Island Creek	OGU-1-N	Steele Branch	WVOG-65-E	2.34	0.38	0.14	2.87
Island Creek	OGU-1-Q	Middle Fork/Island Creek	WVOG-65-G	6.03	24.11	1.59	31.73
Island Creek	OGU-1-T	Pine Creek	WVOG-65-H	29.02	75.80	5.52	110.34
Island Creek	OGU-1-T-6	Right Fork/Pine Creek	WVOG-65-H-1	9.91	41.87	2.73	54.50
Island Creek	OGU-1-T-6-A	Little Right Fork	WVOG-65-H-1-A	2.36	5.03	0.39	7.78

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Island Creek	OGU-1-T-6-I	Laurel Fork	WVOG-65-H-1-B	1.86	3.22	0.27	5.34
Island Creek	OGU-1-T-6-J	Tin Branch	WVOG-65-H-1-C	1.31	1.27	0.14	2.72
Island Creek	OGU-1-T-8	Twin Branch	WVOG-65-H-2	0.93	3.86	0.25	5.04
Island Creek	OGU-1-T-10	Left Fork/Pine Creek	WVOG-65-H-3	3.61	0.42	0.21	4.24
Island Creek	OGU-1-U	Rockhouse Branch	WVOG-65-I	1.34	23.34	1.30	25.98
Island Creek	OGU-1-V	Cow Creek	WVOG-65-J	14.92	9.10	1.26	25.28
Island Creek	OGU-1-V-4	Left Fork/Cow Creek	WVOG-65-J-3	3.54	0.82	0.23	4.59
Island Creek	OGU-1-V-8	UNT/Cow Creek RM 5.35		0.77	0.12	0.05	0.95
Island Creek	OGU-1-X	Littles Creek	WVOG-65-K	5.42	21.67	1.43	28.52
Island Creek	OGU-1-Y	Conley Branch	WVOG-65-L	3.90	2.95	0.36	7.21
Island Creek	OGU-1-AA	Left Fork/Island Creek	WVOG-65-M	4.24	0.65	0.26	5.15
Island Creek	OGU-1-AC	Upper Dempsey Branch	WVOG-65-O	1.35	13.70	0.79	15.84
Guyandotte River (Upper)	OGU	Guyandotte River (upper)	WVOG-up	3380.20	1497.29	256.71	5134.21
Dingess Run	OGU-4	Dingess Run	WVOG-68	52.13	453.89	26.63	532.66
Dingess Run	OGU-4-A	Bandmill Hollow (Righthand Fork)	WVOG-68-A	6.60	156.39	8.58	171.56
Dingess Run	OGU-4-B	Fort Branch	WVOG-68-B	2.55	0.41	0.16	3.12
Dingess Run	OGU-4-E	Ethel Hollow	WVOG-68-E	7.04	149.61	8.24	164.89
Dingess Run	OGU-4-E-3	Big Dark Hollow		2.18	0.97	0.17	3.32
Dingess Run	OGU-4-E-4	Little Dark Hollow		1.57	0.46	0.11	2.14
Dingess Run	OGU-4-G	Freeze Fork	WVOG-68-G	1.99	21.76	1.25	25.00
Dingess Run	OGU-4-G-1	UNT/Freeze Fork RM 1.05	WVOG-68-G-1	0.50	11.45	0.63	12.58
Dingess Run	OGU-4-J	Georges Creek	WVOG-68-H	2.47	24.86	1.44	28.78
Dingess Run	OGU-4-J-1	UNT/Georges Creek RM 1.07	WVOG-68-H-1	0.20	9.57	0.51	10.28
Dingess Run	OGU-4-J-2	UNT/Georges Creek RM 1.50	WVOG-68-H-2	0.10	4.75	0.26	5.11
Guyandotte River (Upper)	OGU-8	Beech Branch	WVOG-69	2.53	0.34	0.15	3.03
Rum Creek	OGU-10	Rum Creek	WVOG-70	45.47	265.91	16.39	327.77

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Rum Creek	OGU-10-B	Right Hand Fork/Rum Creek	WVOG-70-A	10.73	42.68	2.81	56.23
Rum Creek	OGU-10-B-2	Burgess Branch	WVOG-70-A-1	2.60	0.00	0.14	2.74
Rum Creek	OGU-10-C	UNT/Rum Creek RM 1.83	WVOG-70-A.2	2.11	6.04	0.43	8.58
Rum Creek	OGU-10-D	Slab Fork	WVOG-70-B	8.79	37.61	2.44	48.84
Rum Creek	OGU-10-I	Cub Branch	WVOG-70-D	0.39	14.39	0.78	15.56
Rum Creek	OGU-10-J	Big Lick Branch	WVOG-70-E	1.25	21.44	1.19	23.88
Guyandotte River (Upper)	OGU-16	Camp Branch	WVOG-71.5	2.60	0.70	0.17	3.47
Madison Branch	OGU-17	Madison Branch	WVOG-72	2.27	12.04	0.75	15.07
Madison Branch	OGU-17-A	UNT/Madison Branch RM 0.68	WVOG-72-A	0.66	6.89	0.40	7.95
Rich Creek	OGU-18	Rich Creek	WVOG-73	28.13	28.38	2.97	59.49
Rich Creek	OGU-18-A	Left Fork/Rich Creek	WVOG-73-A	2.27	2.93	0.27	5.47
Rich Creek	OGU-18-A-1	UNT/Left Fork RM 1.02/Rich Creek	WVOG-73-A-1	0.41	0.60	0.05	1.07
Rich Creek	OGU-18-G	Laurel Branch	WVOG-73-D	0.69	1.99	0.14	2.83
Guyandotte River (Upper)	OGU-21	Pine Branch	WVOG-73.5	1.14	0.18	0.07	1.39
Guyandotte River (Upper)	OGU-24	Henry Hollow	WVOG-74	1.60	20.69	1.17	23.47
Buffalo Creek	OGU-27	Buffalo Creek	WVOG-75	118.05	188.04	16.11	322.19
Buffalo Creek	OGU-27-B	Bingo Hollow		1.32	8.22	0.50	10.04
Buffalo Creek	OGU-27-E	Right Fork/Buffalo Creek	WVOG-75-A	19.76	14.22	1.79	35.78
Buffalo Creek	OGU-27-I	Proctor Hollow (Mudlick Branch)	WVOG-75-C.5	2.89	16.40	1.02	20.31
Buffalo Creek	OGU-27-I-1	UNT/Proctor Hollow RM 0.54	WVOG-75-C.5-1	0.80	4.07	0.26	5.12
Buffalo Creek	OGU-27-J	Robinette Branch	WVOG-75-D	2.30	0.35	0.14	2.79
Buffalo Creek	OGU-27-R	Dingess Branch	WVOG-75-H	4.15	16.78	1.10	22.03
Buffalo Creek	OGU-27-T	Davy Branch	WVOG-75-I	3.04	11.97	0.79	15.80
Buffalo Creek	OGU-27-U	Toney Fork	WVOG-75-J	6.89	20.90	1.46	29.25
Buffalo Creek	OGU-27-W	Elklick Branch	WVOG-75-K	3.57	18.50	1.16	23.23

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Buffalo Creek	OGU-27-W-1	UNT/Elklick Branch RM 0.89	WVOG-75-K-1	1.32	2.24	0.19	3.75
Buffalo Creek	OGU-27-Y	Lee Fork	WVOG-75-L	3.47	6.59	0.53	10.59
Buffalo Creek	OGU-27-Y-1	Middle Fork/Buffalo Creek	WVOG-75-L-1	2.43	6.41	0.47	9.31
Huff Creek	OGU-28	Huff Creek	WVOG-76	129.11	174.10	15.96	319.17
Huff Creek	OGU-28-C	Big Springs Branch	WVOG-76-C	5.24	0.88	0.32	6.45
Huff Creek	OGU-28-G	Sandlick Branch	WVOG-76-F	3.20	8.61	0.62	12.43
Huff Creek	OGU-28-N	Beech Branch	WVOG-76-K	1.06	23.35	1.28	25.69
Huff Creek	OGU-28-Q	Toney Fork	WVOG-76-L	7.83	10.49	0.96	19.28
Huff Creek	OGU-28-S	Paynter Branch	WVOG-76-M	7.51	14.30	1.15	22.96
Huff Creek	OGU-28-S-1	Elk Trace Branch	WVOG-76-M-1	3.09	0.51	0.19	3.79
Huff Creek	OGU-28-S-3	Cub Trace Branch	WVOG-76-M-2	0.06	6.91	0.37	7.33
Huff Creek	OGU-28-S-4	UNT/Paynter Branch RM 1.86	WVOG-76-M-3	0.57	1.48	0.11	2.16
Huff Creek	OGU-28-W	Road Branch	WVOG-76-O	4.26	11.34	0.82	16.42
Huff Creek	OGU-28-W-4	UNT/Road Branch RM 1.79	WVOG-76-O-3	0.81	0.12	0.05	0.98
Huff Creek	OGU-28-Z	Sycamore Creek	WVOG-76-P	2.89	11.00	0.73	14.62
Huff Creek	OGU-28-AE	Straight Fork	WVOG-76-U	7.36	1.21	0.45	9.02
Huff Creek	OGU-28-AG	Brushy Fork	WVOG-76-W	3.12	0.52	0.19	3.83
Rockhouse Creek	OGU-29	Rockhouse Creek	WVOG-77	14.83	38.57	2.81	56.21
Rockhouse Creek	OGU-29-A	Spring Branch	WVOG-77-A	1.30	2.39	0.19	3.88
Rockhouse Creek	OGU-29-A-1	UNT/Spring Branch RM 0.56		0.17	0.44	0.03	0.64
Rockhouse Creek	OGU-29-B	Oldhouse Branch	WVOG-77-A.5	1.94	0.69	0.14	2.77
Rockhouse Creek	OGU-29-C	Lefthand Fork/Rockhouse Creek	WVOG-77-D	5.01	4.87	0.52	10.41
Sandlick Creek	OGU-31	Sandlick Creek	WVOG-78	8.98	1.44	0.55	10.97
Sandlick Creek	OGU-31-A	Right Fork/Sandlick Creek	WVOG-78-A	2.22	0.35	0.14	2.70
Elk Creek	OGU-34	Elk Creek	WVOG-80	26.68	58.56	4.49	89.73
Elk Creek	OGU-34-F	Right Hand Fork/Elk Creek	WVOG-80-E	5.06	4.76	0.52	10.34
Elk Creek	OGU-34-M	Stonecoal Branch	WVOG-80-I	0.46	18.86	1.02	20.34
Spice Creek	OGU-36	Spice Creek	WVOG-82	4.17	0.64	0.25	5.06
Sylvia Branch	OGU-38	Sylvia Branch	WVOG-84	1.32	3.13	0.23	4.69

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Guyandotte River (Upper)	OGU-42	Canebrake Branch	WVOG-86	1.19	19.10	1.07	21.35
Harrys Branch	OGU-45	Harrys Branch	WVOG-87	4.91	1.37	0.33	6.61
Stafford Branch	OGU-46	Stafford Branch	WVOG-88	1.60	0.24	0.10	1.93
Gilbert Creek	OGU-47	Gilbert Creek	WVOG-89	59.09	165.49	11.82	236.40
Gilbert Creek	OGU-47-A	Skillet Creek	WVOG-89-A	3.62	2.69	0.33	6.64
Gilbert Creek	OGU-47-B	Horsepen Creek	WVOG-89-B	25.65	127.12	8.04	160.81
Gilbert Creek	OGU-47-B-1	Lower Pete Branch	WVOG-89-B-0.3	0.37	5.18	0.29	5.84
Gilbert Creek	OGU-47-B-3	Browning Fork	WVOG-89-B-1	10.39	38.69	2.58	51.67
Gilbert Creek	OGU-47-B-3-E	Right Fork/Browning Fork	WVOG-89-B-1-B	2.26	3.94	0.33	6.53
Gilbert Creek	OGU-47-B-12	Donaldson Branch	WVOG-89-B-6	0.17	22.54	1.20	23.90
Gilbert Creek	OGU-47-F	Adams Fork	WVOG-89-C.3	0.88	7.94	0.46	9.28
Gilbert Creek	OGU-47-K	Lefthand Fork/Gilbert Creek	WVOG-89-F	5.01	2.85	0.41	8.28
Neds Branch	OGU-48	Neds Branch	WVOG-90	3.44	0.53	0.21	4.18
Little Huff Creek	OGU-54	Little Huff Creek	WVOG-92	109.43	17.65	6.69	133.77
Little Huff Creek	OGU-54-C	Little Cub Creek	WVOG-92-B	9.30	1.24	0.55	11.09
Little Huff Creek	OGU-54-C-5	Trace Fork	WVOG-92-B-1	2.28	0.33	0.14	2.75
Little Huff Creek	OGU-54-D	Lizard Creek	WVOG-92-C	1.76	0.27	0.11	2.14
Little Huff Creek	OGU-54-I	Nelson Branch	WVOG-92-G	1.94	0.28	0.12	2.33
Little Huff Creek	OGU-54-K	Muzzle Creek	WVOG-92-I	10.55	3.78	0.75	15.09
Little Huff Creek	OGU-54-K-1	Right Fork/Muzzle Creek	WVOG-92-I-1	2.61	0.37	0.16	3.14
Little Huff Creek	OGU-54-M	Buffalo Creek	WVOG-92-K	5.29	1.98	0.38	7.65
Little Huff Creek	OGU-54-M-3	Kezee Fork	WVOG-92-K-1	1.16	0.18	0.07	1.41
Little Huff Creek	OGU-54-O	Suke Creek	WVOG-92-M	7.26	1.19	0.44	8.90
Little Huff Creek	OGU-54-T	Pad Fork	WVOG-92-Q	11.44	3.35	0.78	15.56
Little Huff Creek	OGU-54-T-5	Righthand Fork/Pad Fork	WVOG-92-Q-1	2.92	0.45	0.18	3.54
Big Cub Creek	OGU-62	Big Cub Creek	WVOG-96	36.15	55.49	4.82	96.46
Big Cub Creek	OGU-62-C	Sturgeon Branch	WVOG-96-A	1.84	0.30	0.11	2.25
Big Cub Creek	OGU-62-G	Road Branch	WVOG-96-B	1.16	9.06	0.54	10.75

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Big Cub Creek	OGU-62-G-2	UNT/Road Branch RM 1.13	WVOG-96-B-2	0.12	3.35	0.18	3.65
Big Cub Creek	OGU-62-H	Elk Trace Branch	WVOG-96-C	3.03	0.47	0.18	3.69
Big Cub Creek	OGU-62-O	Toler Hollow	WVOG-96-F	0.41	10.56	0.58	11.55
Big Cub Creek	OGU-62-S	McDonald Fork	WVOG-96-H	1.01	16.33	0.91	18.25
Long Branch	OGU-65	Long Branch	WVOG-97	3.90	9.64	0.71	14.25
Reedy Branch	OGU-68	Reedy Branch	WVOG-99	5.64	18.57	1.27	25.48
Clear Fork	OGU-70	Clear Fork	WVOGC	323.37	128.63	23.79	475.79
Clear Fork	OGU-70-E	Cedar Creek	WVOGC-4	2.01	4.48	0.34	6.83
Clear Fork	OGU-70-F	Laurel Branch	WVOGC-5	6.35	0.75	0.37	7.47
Reedy Branch	OGU-70-L	Reedy Branch	WVOGC-8	6.24	0.81	0.37	7.41
Clear Fork	OGU-70-N	McDonald Mill Creek	WVOGC-10	7.22	1.03	0.43	8.69
Lower Road Branch	OGU-70-S	Lower Road Branch	WVOGC-12	5.81	2.80	0.45	9.06
Clear Fork	OGU-70-W	Dry Branch	WVOGC-15	3.19	0.46	0.19	3.84
Laurel Fork	OGU-70-X	Laurel Fork	WVOGC-16	113.46	35.57	7.84	156.88
Laurel Fork	OGU-70-X-6	Coon Branch	WVOGC-16-B	4.64	0.82	0.29	5.76
Laurel Fork	OGU-70-X-6-C	Chestnut Flats Branch	WVOGC-16-B-1	1.01	0.19	0.06	1.26
Laurel Fork	OGU-70-X-10	Cabin Branch	WVOGC-16-C	2.17	0.36	0.13	2.66
Laurel Fork	OGU-70-X-13	Acord Branch	WVOGC-16-E	3.44	0.53	0.21	4.18
Laurel Fork	OGU-70-X-19-A	Tom Bailey Branch	WVOGC-16-J-1	2.21	0.37	0.14	2.71
Laurel Fork	OGU-70-X-23	Laurel Branch	WVOGC-16-K	3.42	0.56	0.21	4.20
Laurel Fork	OGU-70-X-27	Milam Fork	WVOGC-16-M	11.64	3.44	0.79	15.87
Laurel Fork	OGU-70-X-32	White Oak Branch	WVOGC-16-N	1.32	0.21	0.08	1.61
Laurel Fork	OGU-70-X-36	Trough Fork	WVOGC-16-P	7.73	5.02	0.67	13.43
Laurel Fork	OGU-70-X-47	Franks Fork	WVOGC-16-U	2.28	10.28	0.66	13.22
Toney Fork	OGU-70-AC	Toney Fork	WVOGC-19	12.50	19.44	1.68	33.62
Crane Fork	OGU-70-AM	Crane Fork	WVOGC-26	5.85	9.32	0.80	15.97
Clear Fork	OGU-70-AW	Knob Fork	WVOGC-28	1.39	14.48	0.84	16.71
Guyandotte River (Upper)	OGU-73	Brickle Branch	WVOG-102	1.38	0.21	0.08	1.67

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Horse Creek	OGU-77	Horse Creek	WVOG-105	9.43	1.95	0.60	11.98
Horse Creek	OGU-77-B	Hound Fork	WVOG-105-B	1.77	0.25	0.11	2.12
Little Cub Creek	OGU-81	Little Cub Creek	WVOG-108	4.79	0.71	0.29	5.79
Indian Creek	OGU-84	Indian Creek	WVOG-110	100.66	169.91	14.24	284.82
Indian Creek	OGU-84-D	Brier Creek	WVOG-110-A	16.01	4.08	1.06	21.14
Indian Creek	OGU-84-D-2	Trace Fork	WVOG-110-A-1	3.06	0.46	0.19	3.71
Indian Creek	OGU-84-D-6	Marsh Fork	WVOG-110-A-2	2.84	0.94	0.20	3.98
Indian Creek	OGU-84-F	Shop Branch	WVOG-110-B	2.68	18.40	1.11	22.19
Indian Creek	OGU-84-P	Wolf Pen Branch	WVOG-110-G	4.36	11.37	0.83	16.56
Indian Creek	OGU-84-Q	Lick Branch	WVOG-110-H	2.75	9.25	0.63	12.63
Indian Creek	OGU-84-R	Turkeywallow Branch	WVOG-110-I	1.70	0.24	0.10	2.04
Indian Creek	OGU-84-U	Nancy Fork	WVOG-110-J	6.19	9.11	0.81	16.11
Indian Creek	OGU-84-U-7	Stanley Fork	WVOG-110-J-1	1.37	4.55	0.31	6.23
Indian Creek	OGU-84-X	UNT/Indian Creek RM 11.15	WVOG-110-K.3	2.35	0.40	0.14	2.89
Indian Creek	OGU-84-AC	White Oak Branch	WVOG-110-M	0.89	20.80	1.14	22.84
Indian Creek	OGU-84-AI	Fort Branch	WVOG-110-O	2.44	0.37	0.15	2.96
Guyandotte River (Upper)	OGU-88	Doublecamp Branch	WVOG-113	1.92	0.66	0.14	2.72
Guyandotte River (Upper)	OGU-93	Shannon Mill Creek	WVOG-116	4.58	2.15	0.35	7.09
Turkey Creek	OGU-94	Turkey Creek	WVOG-118	13.81	6.13	1.05	20.99
Turkey Creek	OGU-94-B	Right Fork/Turkey Creek	WVOG-118-A	3.86	4.58	0.44	8.89
Skin Fork	OGU-95	Skin Fork	WVOG-119	8.59	1.29	0.52	10.40
Skin Fork	OGU-95-A	Left Fork/Skin Fork	WVOG-119-A	2.33	0.36	0.14	2.83
Big Branch	OGU-97	Big Branch	WVOG-120	3.05	7.83	0.57	11.45
Big Branch	OGU-97-C	UNT/Big Branch RM 1.54	WVOG-120-C	0.27	1.92	0.11	2.30
Rockcastle Creek	OGU-107	Rockcastle Creek	WVOG-123	31.42	5.08	1.92	38.43
Rockcastle Creek	OGU-107-A	Bearhole Fork	WVOG-123-A	9.89	2.35	0.64	12.88

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Rockcastle Creek	OGU-107-A-1	Bird Branch	WVOG-123-A-1	0.52	0.07	0.03	0.62
Pinnacle Creek	OGU-108	Pinnacle Creek	WVOG-124	79.44	190.58	14.21	284.23
Pinnacle Creek	OGU-108-B	Baldwin Branch	WVOG-124-A	1.96	16.63	0.98	19.57
Pinnacle Creek	OGU-108-C	Lambert Branch	WVOG-124-B	0.86	11.84	0.67	13.38
Pinnacle Creek	OGU-108-K	Smith Branch	WVOG-124-D	0.31	11.68	0.63	12.62
Pinnacle Creek	OGU-108-M	Little White Oak Creek	WVOG-124-E	4.44	37.20	2.19	43.83
Pinnacle Creek	OGU-108-M-3	Sulphur Branch	WVOG-124-E-0.5	0.76	21.23	1.16	23.14
Pinnacle Creek	OGU-108-M-4	Jenny Branch	WVOG-124-E-1	0.88	7.46	0.44	8.78
Pinnacle Creek	OGU-108-M-4-A	UNT/Jenny Branch RM 0.67	WVOG-124-E-1-A	0.12	6.32	0.34	6.79
Pinnacle Creek	OGU-108-T	Laurel Branch/Pinnacle Creek	WVOG-124-H	1.11	2.95	0.21	4.28
Pinnacle Creek	OGU-108-U	Spider Creek	WVOG-124-I	5.58	1.09	0.35	7.03
Pinnacle Creek	OGU-108-Z	White Oak Branch	WVOG-124-J	3.78	42.34	2.43	48.55
Pinnacle Creek	OGU-108-Z-1	Payne Branch	WVOG-124-J-1	1.37	8.80	0.54	10.71
Pinnacle Creek	OGU-108-Z-1-C	UNT/Payne Branch RM 1.37	WVOG-124-J-1-C	0.21	0.68	0.05	0.93
Pinnacle Creek	OGU-108-AD	Beartown Fork	WVOG-124-N	6.76	1.08	0.41	8.25
Pinnacle Creek	OGU-108-AJ	Little Pinnacle Creek	WVOG-124-P	0.73	10.05	0.57	11.35
Sugar Run	OGU-111	Sugar Run	WVOG-125	1.18	1.06	0.12	2.36
Cabin Creek	OGU-118	Cabin Creek	WVOG-127	14.44	3.43	0.94	18.82
Cabin Creek	OGU-118-C	Meadow Fork	WVOG-127-B	1.58	0.32	0.10	2.00
Cabin Creek	OGU-118-G	Marsh Fork	WVOG-127-D	4.74	0.89	0.30	5.92
Cabin Creek	OGU-118-H	Black Fork	WVOG-127-E	2.56	0.42	0.16	3.14
Joe Branch	OGU-119	Joe Branch	WVOG-128	1.33	0.22	0.08	1.63
Long Branch	OGU-120	Long Branch	WVOG-129	1.06	0.22	0.07	1.35
Guyandotte River (Upper)	OGU-124	Still Run	WVOG-130	7.27	15.54	1.20	24.01
Long Branch	OGU-124-D	UNT/Still Run RM 1.00	WVOG-130-A.2	0.84	5.89	0.35	7.08
Barkers Creek	OGU-128	Barkers Creek	WVOG-131	47.03	22.93	3.68	73.64
Barkers Creek	OGU-128-E	Hickory Branch	WVOG-131-B	1.21	0.23	0.08	1.51

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Barkers Creek	OGU-128-K	Gooney Otter Creek	WVOG-131-F	12.14	2.99	0.80	15.93
Barkers Creek	OGU-128-K-5	Jims Branch	WVOG-131-F-1	0.50	0.08	0.03	0.61
Barkers Creek	OGU-128-K-6	Noseman Branch	WVOG-131-F-2	1.85	0.29	0.11	2.25
Barkers Creek	OGU-128-K-9	UNT/Gooney Otter Creek RM 3.64	WVOG-131-F-5	2.54	0.40	0.15	3.10
Barkers Creek	OGU-128-O	Milam Fork	WVOG-131-I	4.73	0.73	0.29	5.74
Barkers Creek	OGU-128-P	UNT/Barkers Creek RM 8.71	WVOG-131-J	0.65	0.11	0.04	0.80
Barkers Creek	OGU-128-Q	UNT/Barkers Creek RM 9.91		0.81	0.11	0.05	0.96
Barkers Creek	OGU-128-U	UNT/Barkers Creek RM 12.19		0.78	0.12	0.05	0.95
Slab Fork	OGU-132	Slab Fork	WVOG-134	59.32	27.63	4.58	91.52
Slab Fork	OGU-132-E	Cedar Creek	WVOG-134-B	6.24	1.44	0.40	8.09
Slab Fork	OGU-132-E-1	Right Fork/Cedar Creek	WVOG-134-B-1	2.36	0.44	0.15	2.94
Slab Fork	OGU-132-H	Marsh Fork	WVOG-134-C	6.62	1.31	0.42	8.35
Slab Fork	OGU-132-J	Measle Fork	WVOG-134-D	2.70	0.41	0.16	3.28
Slab Fork	OGU-132-L	UNT/Slab Fork RM 7.96	WVOG-134-D.5	0.52	4.04	0.24	4.80
Slab Fork	OGU-132-V	Burnt Fork	WVOG-134-H	5.07	3.25	0.44	8.76
Slab Fork	OGU-132-V-3	Richardson Branch	WVOG-134-H-1	2.69	0.41	0.16	3.26
Slab Fork	OGU-132-Y	Low Gap Branch	WVOG-134-I	2.92	0.45	0.18	3.55
Allen Creek	OGU-136	Allen Creek	WVOG-135	9.44	2.57	0.63	12.65
Allen Creek	OGU-136-D	Left Fork/Allen Creek	WVOG-135-A	1.85	1.32	0.17	3.33
Big Branch	OGU-138	Big Branch	WVOG-136	3.95	0.54	0.24	4.73
Devils Fork	OGU-140	Devils Fork	WVOG-137	31.05	46.33	4.07	81.46
Devils Fork	OGU-140-C	Beetree Branch	WVOG-137-A	3.13	2.81	0.31	6.25
Devils Fork	OGU-140-J	Wiley Spring Branch	WVOG-137-C	8.64	9.04	0.93	18.61
Devils Fork	OGU-140-K-1	UNT/Bluff Fork RM 0.17	WVOG-137-B-0.1	0.69	0.14	0.04	0.87
Stonecoal Creek	OGU-141	Stonecoal Creek	WVOG-139	55.11	150.67	10.83	216.61
Stonecoal Creek	OGU-141-B	Tommy Creek	WVOG-139-A	19.11	57.32	4.02	80.45
Stonecoal Creek	OGU-141-B-4	Bragg Branch	WVOG-139-A-1	1.39	14.02	0.81	16.22

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Iron TMDL (lbs/day)
Stonecoal Creek	OGU-141-B-8	Lefthand Fork/Tommy Creek	WVOG-139-A-3	3.09	11.21	0.75	15.05
Stonecoal Creek	OGU-141-G	Riffe Branch	WVOG-139-B	2.59	8.33	0.57	11.49
Stonecoal Creek	OGU-141-H	Farley Branch	WVOG-139-C	2.05	2.13	0.22	4.40
Stonecoal Creek	OGU-141-L	Pines Creek	WVOG-139-D	3.98	2.87	0.36	7.21
Winding Gulf	OGU-142	Winding Gulf	WVOG-138	35.87	37.55	3.86	77.28
Winding Gulf	OGU-142-E	Berry Branch	WVOG-138-A	1.57	8.68	0.54	10.79
Winding Gulf	OGU-142-I	Alderson Branch	WVOG-138-D	1.31	0.20	0.08	1.59
Winding Gulf	OGU-142-K	Mullens Branch	WVOG-138-E	0.69	2.14	0.15	2.99
Winding Gulf	OGU-142-V	West Fork/Winding Gulf	WVOG-138-G	2.48	6.43	0.47	9.38

UNT = unnamed tributary; RM = river mile

Table 8-2. Selenium TMDLs

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Se TMDL (lbs/day)
Island Creek	WV-OGU-1-B-3-E	UNT/Whitman Creek RM 3.83 (Skifus Branch)	WVOG-65-B-2-C	0.0032	0.0018	0.0003	0.0052
Island Creek	WV-OGU-1-T	Pine Creek	WVOG-65-H	0.0557	0.2376	0.0154	0.3087
Island Creek	WV-OGU-1-T-6	Right Fork/Pine Creek	WVOG-65-H-1	0.0188	0.1203	0.0073	0.1463
Island Creek	WV-OGU-1-T-8	Twin Branch	WVOG-65-H-2	0.0014	0.0166	0.0009	0.0189
Island Creek	WV-OGU-1-T-10	Left Fork/Pine Creek	WVOG-65-H-3	0.0062	0.0196	0.0014	0.0272
Island Creek	WV-OGU-1-U	Rockhouse Branch	WVOG-65-I	0.0032	0.0492	0.0028	0.0552
Island Creek	WV-OGU-1-V	Cow Creek	WVOG-65-J	0.0425	0.0400	0.0043	0.0869
Dingess Run	WV-OGU-4	Dingess Run	WVOG-68	0.1017	1.3534	0.0766	1.5317
Dingess Run	WV-OGU-4-A	Bandmill Hollow	WVOG-68-A	0.0150	0.5149	0.0279	0.5578
Dingess Run	WV-OGU-4-A-4	UNT/Bandmill Hollow RM 1.84	WVOG-68-A-4	0.0000	0.0612	0.0032	0.0645
Dingess Run	WV-OGU-4-G	Freeze Fork	WVOG-68-G	0.0047	0.0458	0.0027	0.0531

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Se TMDL (lbs/day)
Dingess Run	WV-OGU-4-G-1	UNT/Freeze Fork RM 1.05	WVOG-68-G-1	0.0010	0.0241	0.0013	0.0264
Dingess Run	WV-OGU-4-J	Georges Creek	WVOG-68-H	0.0063	0.0592	0.0034	0.0690
Dingess Run	WV-OGU-4-J-1	UNT/Georges Creek RM 1.07	WVOG-68-H-1	0.0003	0.0232	0.0012	0.0248
Dingess Run	WV-OGU-4-J-2	UNT/Georges Creek RM 1.50	WVOG-68-H-2	0.0003	0.0114	0.0006	0.0123
Rum Creek	WV-OGU-10	Rum Creek	WVOG-70	0.0649	0.8425	0.0478	0.9551
Rum Creek	WV-OGU-10-B	Right Hand Fork/Rum Creek	WVOG-70-A	0.0219	0.1828	0.0108	0.2155
Rum Creek	WV-OGU-10-C	UNT/Rum Creek RM 1.83	WVOG-70-A.2	0.0034	0.0167	0.0011	0.0212
Rum Creek	WV-OGU-10-D	Slab Fork	WVOG-70-B	0.0129	0.0971	0.0058	0.1158
Rum Creek	WV-OGU-10-J	Big Lick Branch	WVOG-70-E	0.0014	0.0582	0.0031	0.0627
Madison Branch	WV-OGU-17-A	UNT/Madison Branch RM 0.68	WVOG-72-A	0.0019	0.0152	0.0009	0.0180
Rich Creek	WV-OGU-18-A	Left Fork/Rich Creek	WVOG-73-A	0.0069	0.0346	0.0022	0.0438
Rich Creek	WV-OGU-18-A-1	UNT/Left Fork rm 1.02/Rich Creek	WVOG-73-A-1	0.0014	0.0140	0.0008	0.0162
Rich Creek	WV-OGU-18-G	Laurel Branch	WVOG-73-D	0.0023	0.0045	0.0004	0.0072
Buffalo Creek	WV-OGU-27-E-1	Perry Branch	WVOG-75-A-1	0.0169	0.0000	0.0009	0.0178
Buffalo Creek	WV-OGU-27-F	Ruffner Hollow	WVOG-75-B	0.0000	0.0425	0.0022	0.0447
Buffalo Creek	WV-OGU-27-I-1	UNT/Proctor Hollow RM 0.54	WVOG-75-C.5-1	0.0013	0.0096	0.0006	0.0115
Buffalo Creek	WV-OGU-27-R	Dingess Branch	WVOG-75-H	0.0142	0.0497	0.0034	0.0673
Huff Creek	WV-OGU-28-N	Beech Branch	WVOG-76-K	0.0030	0.0490	0.0027	0.0547
Rockhouse Creek	WV-OGU-29-A	Spring Branch	WVOG-77-A	0.0047	0.0300	0.0018	0.0365
Rockhouse Creek	WV-OGU-29-A-1	UNT/Spring Branch RM 0.56	WVOG-77-A-1	0.0006	0.0127	0.0007	0.0140
Gilbert Creek	WV-OGU-47	Gilbert Creek	WVOG-89	0.1432	0.3725	0.0271	0.5427
Gilbert Creek	WV-OGU-47-B	Horsepen Creek	WVOG-89-B	0.0651	0.2828	0.0183	0.3663
Gilbert Creek	WV-OGU-47-B-1	Lower Pete Branch	WVOG-89-B-0.3	0.0012	0.0119	0.0007	0.0139
Gilbert Creek	WV-OGU-47-F	Adams Fork	WVOG-89-C.3	0.0018	0.0166	0.0010	0.0193
Big Cub Creek	WV-OGU-62-G	Road Branch	WVOG-96-B	0.0038	0.0171	0.0011	0.0220
Big Cub Creek	WV-OGU-62-O	Toler Hollow	WVOG-96-F	0.0030	0.0220	0.0013	0.0263
Reedy Branch	WV-OGU-68	Reedy Branch	WVOG-99	0.0144	0.0273	0.0022	0.0439
Joe Branch	WV-OGU-119	Joe Branch	WVOG-128	0.0277	0.0000	0.0015	0.0292

TMDL Watershed	NHD Code	Stream Name	WV Code	Load Allocation (lbs/day)	Wasteload Allocation (lbs/day)	Margin of Safety (lbs/day)	Se TMDL (lbs/day)
Barkers Creek	WV-OGU-128-E	Hickory Branch	WVOG-131-B	0.0214	0.0000	0.0011	0.0225

Table 8-3. Fecal Coliform Bacteria TMDLs

TMDL Watershed	Stream Code	Stream Name	WV Code	Load Allocations (counts /day)*	Wasteload Allocation (counts /day)*	Margin of Safety (counts /day)*	TMDL (counts /day)*
Guyandotte River (Upper)	WV-OGU	Guyandotte River (Upper) Below Lake	WVOG-up	1.79E+12	1.01E+10	9.49E+10	1.90E+12
Island Creek	WV-OGU-1	Island Creek	WVOG-65	2.39E+11	1.18E+09	1.27E+10	2.53E+11
Island Creek	WV-OGU-1-A	Coal Branch	WVOG-65-A	2.89E+09		1.52E+08	3.04E+09
Island Creek	WV-OGU-1-B	Copperas Mine Fork	WVOG-65-B	1.06E+11	6.63E+08	5.63E+09	1.13E+11
Island Creek	WV-OGU-1-B-1	Mud Fork	WVOG-65-B-1	4.04E+10	3.41E+07	2.13E+09	4.26E+10
Island Creek	WV-OGU-1-B-1-C	Lower Dempsey Branch	WVOG-65-B-1-A	3.79E+09		2.00E+08	3.99E+09
Island Creek	WV-OGU-1-B-1-D	Ellis Branch	WVOG-65-B-1-B	3.39E+09		1.79E+08	3.57E+09
Island Creek	WV-OGU-1-B-1-G	Upper Dempsey Branch	WVOG-65-B-1-E	1.73E+09		9.12E+07	1.82E+09
Island Creek	WV-OGU-1-B-1-H	Rockhouse Branch	WVOG-65-B-1-F	3.84E+09		2.02E+08	4.04E+09
Island Creek	WV-OGU-1-B-3	Whitman Creek	WVOG-65-B-2	2.54E+10	5.30E+07	1.34E+09	2.68E+10
Island Creek	WV-OGU-1-B-3-B	Left Fork/Whitman Creek	WVOG-65-B-2-A	7.51E+09	3.79E+07	3.97E+08	7.94E+09
Island Creek	WV-OGU-1-B-6	Trace Fork	WVOG-65-B-4	4.77E+09	4.77E+08	2.76E+08	5.53E+09
Island Creek	WV-OGU-1-B-8	Curry Branch	WVOG-65-B-5	1.18E+09		6.22E+07	1.24E+09
Island Creek	WV-OGU-1-H	Mill Creek	WVOG-65-C	2.90E+09		1.53E+08	3.05E+09
Island Creek	WV-OGU-1-N	Steele Branch	WVOG-65-E	3.15E+09		1.66E+08	3.31E+09
Island Creek	WV-OGU-1-Q	Middle Fork/Island Creek	WVOG-65-G	8.33E+09		4.38E+08	8.76E+09
Island Creek	WV-OGU-1-T	Pine Creek	WVOG-65-H	2.43E+10	3.43E+06	1.28E+09	2.56E+10
Island Creek	WV-OGU-1-V	Cow Creek	WVOG-65-J	1.56E+10		8.21E+08	1.64E+10

TMDL Watershed	Stream Code	Stream Name	WV Code	Load Allocations (counts /day)*	Wasteload Allocation (counts /day)*	Margin of Safety (counts /day)*	TMDL (counts /day)*
Island Creek	WV-OGU-1-V-4	Left Fork/Cow Creek	WVOG-65-J-3	2.63E+09		1.39E+08	2.77E+09
Dingess Run	WV-OGU-4	Dingess Run	WVOG-68	5.81E+10	3.01E+08	3.07E+09	6.15E+10
Dingess Run	WV-OGU-4-G	Freeze Fork	WVOG-68-G	4.14E+09		2.18E+08	4.36E+09
Rum Creek	WV-OGU-10	Rum Creek	WVOG-70	3.87E+10	7.42E+08	2.08E+09	4.16E+10
Madison Branch	WV-OGU-17	Madison Branch	WVOG-72	3.32E+09		1.75E+08	3.49E+09
Madison Branch	WV-OGU-17-A	UNT/Madison Branch RM 0.68	WVOG-72-A	6.66E+08		3.50E+07	7.01E+08
Buffalo Creek	WV-OGU-27	Buffalo Creek	WVOG-75	1.29E+11	7.34E+06	6.78E+09	1.36E+11
Buffalo Creek	WV-OGU-27-E	Right Fork/Buffalo Creek	WVOG-75-A	1.83E+10	7.34E+06	9.61E+08	1.92E+10
Buffalo Creek	WV-OGU-27-J	Robinette Branch	WVOG-75-D	3.12E+09		1.64E+08	3.28E+09
Buffalo Creek	WV-OGU-27-U	Toney Fork	WVOG-75-J	8.92E+09		4.69E+08	9.39E+09
Huff Creek	WV-OGU-28	Huff Creek	WVOG-76	1.28E+11	5.09E+08	6.77E+09	1.35E+11
Huff Creek	WV-OGU-28-N	Beech Branch	WVOG-76-K	3.59E+09		1.89E+08	3.78E+09
Huff Creek	WV-OGU-28-S	Paynter Branch	WVOG-76-M	9.50E+09		5.00E+08	1.00E+10
Huff Creek	WV-OGU-28-W	Road Branch	WVOG-76-O	7.82E+09		4.12E+08	8.23E+09
Sandlick Creek	WV-OGU-31	Sandlick Creek	WVOG-78	8.62E+09		4.54E+08	9.08E+09
Spice Creek	WV-OGU-36	Spice Creek	WVOG-82	3.64E+09		1.92E+08	3.83E+09
Sylvia Branch	WV-OGU-38	Sylvia Branch	WVOG-84	1.19E+09		6.25E+07	1.25E+09
Stafford Branch	WV-OGU-46	Stafford Branch	WVOG-88	2.97E+09		1.56E+08	3.12E+09
Gilbert Creek	WV-OGU-47-A	Skillet Creek	WVOG-89-A	2.99E+09		1.58E+08	3.15E+09
Gilbert Creek	WV-OGU-47-B	Horsepen Creek	WVOG-89-B	3.41E+10	1.63E+08	1.80E+09	3.61E+10
Gilbert Creek	WV-OGU-47-B-3	Browning Fork	WVOG-89-B-1	1.29E+10		6.76E+08	1.35E+10
Neds Branch	WV-OGU-48	Neds Branch	WVOG-90	3.53E+09		1.86E+08	3.72E+09
Little Huff Creek	WV-OGU-54	Little Huff Creek	WVOG-92	7.90E+10	1.36E+08	4.17E+09	8.33E+10
Little Huff Creek	WV-OGU-54-C	Little Cub Creek	WVOG-92-B	8.92E+09		4.69E+08	9.39E+09
Little Huff Creek	WV-OGU-54-D	Lizard Creek	WVOG-92-C	1.35E+09	6.82E+07	7.49E+07	1.50E+09
Little Huff Creek	WV-OGU-54-K	Muzzle Creek	WVOG-92-I	1.16E+10	4.55E+06	6.12E+08	1.22E+10

TMDL Watershed	Stream Code	Stream Name	WV Code	Load Allocations (counts /day)*	Wasteload Allocation (counts /day)*	Margin of Safety (counts /day)*	TMDL (counts /day)*
Little Huff Creek	WV-OGU-54-M	Buffalo Creek	WVOG-92-K	4.42E+09		2.33E+08	4.65E+09
Little Huff Creek	WV-OGU-54-O	Suke Creek	WVOG-92-M	5.07E+09		2.67E+08	5.34E+09
Little Huff Creek	WV-OGU-54-T	Pad Fork	WVOG-92-Q	9.18E+09		4.83E+08	9.67E+09
Big Cub Creek	WV-OGU-62	Big Cub Creek	WVOG-96	3.52E+10		1.85E+09	3.70E+10
Big Cub Creek	WV-OGU-62-G	Road Branch	WVOG-96-B	2.66E+09		1.40E+08	2.80E+09
Big Cub Creek	WV-OGU-62-G-2	UNT/Road Branch RM 1.13	WVOG-96-B-2	7.18E+08		3.78E+07	7.56E+08
Big Cub Creek	WV-OGU-62-O	Toler Hollow	WVOG-96-F	2.44E+09		1.28E+08	2.57E+09
Long Branch	WV-OGU-65	Long Branch	WVOG-97	6.26E+09		3.29E+08	6.59E+09
Guyandotte River (Upper)	WV-OGU	Guyandotte River (Upper) Above Lake	WVOG-up	1.01E+12	1.19E+10	5.39E+10	1.08E+12
Reedy Branch	WV-OGU-68	Reedy Branch	WVOG-99	5.18E+09		2.73E+08	5.46E+09
Clear Fork	WV-OGU-70	Clear Fork	WVOGC	2.49E+11	4.52E+09	1.33E+10	2.66E+11
Laurel Fork	WV-OGU-70-X	Laurel Fork	WVOGC-16	1.03E+11	7.35E+08	5.47E+09	1.09E+11
Laurel Fork	WV-OGU-70-X-6	Coon Branch	WVOGC-16-B	4.99E+09	7.58E+06	2.63E+08	5.26E+09
Laurel Fork	WV-OGU-70-X-6-C	Chestnut Flats Branch	WVOGC-16-B-1	1.22E+09		6.44E+07	1.29E+09
Laurel Fork	WV-OGU-70-X-10	Cabin Branch	WVOGC-16-C	2.83E+09		1.49E+08	2.98E+09
Laurel Fork	WV-OGU-70-X-19	Glen Fork	WVOGC-16-J	9.32E+09	5.30E+07	4.94E+08	9.87E+09
Laurel Fork	WV-OGU-70-X-19-A	Tom Bailey Branch	WVOGC-16-J-1	3.13E+09		1.65E+08	3.30E+09
Laurel Fork	WV-OGU-70-X-23	Laurel Branch	WVOGC-16-K	4.82E+09		2.53E+08	5.07E+09
Laurel Fork	WV-OGU-70-X-27	Milam Fork	WVOGC-16-M	1.28E+10		6.76E+08	1.35E+10
Laurel Fork	WV-OGU-70-X-47	Franks Fork	WVOGC-16-U	3.50E+09		1.84E+08	3.69E+09
Toney Fork	WV-OGU-70-AC	Toney Fork	WVOGC-19	1.74E+10		9.15E+08	1.83E+10
Little Cub Creek	WV-OGU-81	Little Cub Creek	WVOG-108	7.44E+09		3.92E+08	7.83E+09
Indian Creek	WV-OGU-84	Indian Creek	WVOG-110	8.78E+10	2.23E+08	4.63E+09	9.26E+10
Indian Creek	WV-OGU-84-D	Brier Creek	WVOG-110-A	1.48E+10		7.77E+08	1.55E+10
Indian Creek	WV-OGU-84-D-6	Marsh Fork	WVOG-110-A-2	2.45E+09		1.29E+08	2.58E+09
Indian Creek	WV-OGU-84-P	Wolf Pen Branch	WVOG-110-G	3.91E+09		2.06E+08	4.11E+09

TMDL Watershed	Stream Code	Stream Name	WV Code	Load Allocations (counts /day)*	Wasteload Allocation (counts /day)*	Margin of Safety (counts /day)*	TMDL (counts /day)*
Turkey Creek	WV-OGU-94	Turkey Creek	WVOG-118	1.55E+10		8.18E+08	1.64E+10
Skin Fork	WV-OGU-95	Skin Fork	WVOG-119	9.95E+09	4.55E+06	5.24E+08	1.05E+10
Rockcastle Creek	WV-OGU-107	Rockcastle Creek	WVOG-123	6.15E+10	1.75E+08	3.24E+09	6.49E+10
Rockcastle Creek	WV-OGU-107-A	Bearhole Fork	WVOG-123-A	1.96E+10		1.03E+09	2.06E+10
Rockcastle Creek	WV-OGU-107-A-1	Bird Branch	WVOG-123-A-1	1.54E+09		8.08E+07	1.62E+09
Pinnacle Creek	WV-OGU-108	Pinnacle Creek	WVOG-124	7.91E+10	3.05E+08	4.18E+09	8.36E+10
Pinnacle Creek	WV-OGU-108-U	Spider Creek	WVOG-124-I	6.29E+09		3.31E+08	6.62E+09
Pinnacle Creek	WV-OGU-108-Z	White Oak Branch	WVOG-124-J	7.87E+09		4.14E+08	8.29E+09
Pinnacle Creek	WV-OGU-108-AD	Beartown Fork	WVOG-124-N	1.37E+10		7.22E+08	1.44E+10
Cabin Creek	WV-OGU-118	Cabin Creek	WVOG-127	2.35E+10	1.90E+08	1.25E+09	2.49E+10
Cabin Creek	WV-OGU-118-C	Meadow Fork	WVOG-127-B	2.44E+09		1.29E+08	2.57E+09
Cabin Creek	WV-OGU-118-G	Marsh Fork	WVOG-127-D	7.96E+09	5.38E+07	4.22E+08	8.43E+09
Barkers Creek	WV-OGU-128	Barkers Creek	WVOG-131	7.27E+10	5.83E+07	3.83E+09	7.65E+10
Barkers Creek	WV-OGU-128-G	Mill Branch	WVOG-131-C	3.33E+09		1.75E+08	3.51E+09
Barkers Creek	WV-OGU-128-K	Gooney Otter Creek	WVOG-131-F	2.73E+10	3.79E+06	1.44E+09	2.88E+10
Barkers Creek	WV-OGU-128-K-5	Jims Branch	WVOG-131-F-1	1.12E+09		5.91E+07	1.18E+09
Barkers Creek	WV-OGU-128-K-9	UNT/Gooney Otter Creek RM 3.64	WVOG-131-F-5	6.40E+09		3.37E+08	6.74E+09
Barkers Creek	WV-OGU-128-O	Milam Fork	WVOG-131-I	1.01E+10		5.32E+08	1.06E+10
Slab Fork	WV-OGU-132	Slab Fork	WVOG-134	7.90E+10	1.80E+08	4.17E+09	8.33E+10
Slab Fork	WV-OGU-132-E	Cedar Creek	WVOG-134-B	7.57E+09		3.99E+08	7.97E+09
Slab Fork	WV-OGU-132-H	Marsh Fork	WVOG-134-C	1.25E+10		6.60E+08	1.32E+10
Slab Fork	WV-OGU-132-J	Measle Fork	WVOG-134-D	4.11E+09		2.16E+08	4.33E+09
Slab Fork	WV-OGU-132-V	Burnt Fork	WVOG-134-H	6.77E+09		3.56E+08	7.13E+09
Slab Fork	WV-OGU-132-Y	Low Gap Branch	WVOG-134-I	3.24E+09		1.70E+08	3.41E+09
Allen Creek	WV-OGU-136	Allen Creek	WVOG-135	1.43E+10		7.51E+08	1.50E+10
Big Branch	WV-OGU-138	Big Branch	WVOG-136	7.63E+09		4.01E+08	8.03E+09

TMDL Watershed	Stream Code	Stream Name	WV Code	Load Allocations (counts /day)*	Wasteload Allocation (counts /day)*	Margin of Safety (counts /day)*	TMDL (counts /day)*
Devils Fork	WV-OGU-140	Devils Fork	WVOG-137	3.97E+10	9.85E+07	2.09E+09	4.18E+10
Stonecoal Creek	WV-OGU-141	Stonecoal Creek	WVOG-139	6.19E+10	1.89E+07	3.26E+09	6.51E+10
Stonecoal Creek	WV-OGU-141-B	Tommy Creek	WVOG-139-A	2.62E+10	3.79E+06	1.38E+09	2.76E+10
Stonecoal Creek	WV-OGU-141-G	Riffe Branch	WVOG-139-B	5.48E+09		2.88E+08	5.76E+09
Stonecoal Creek	WV-OGU-141-L	Pines Creek	WVOG-139-D	5.04E+09		2.65E+08	5.31E+09
Winding Gulf	WV-OGU-142	Winding Gulf	WVOG-138	4.47E+10	1.42E+08	2.36E+09	4.72E+10
Winding Gulf	WV-OGU-142-E	Berry Branch	WVOG-138-A	4.10E+09	4.55E+06	2.16E+08	4.33E+09

NA = not applicable; UNT = unnamed tributary; RM = river mile

* **"Scientific notation"** is a method of writing or displaying numbers in terms of a decimal number between 1 and 10 multiplied by a power of 10. The scientific notation of 10,492, for example, is 1.0492×10^4 or 1.0492E+4.

9.0 FUTURE GROWTH

9.1 Iron

With the exception of allowances provided for CSGP registrations discussed below, this TMDL does not include specific future growth allocations. 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 WLAs 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.

- The alternative precipitation provisions of 40 CFR 434 that suspend applicability of iron and 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, non-mining point source discharges are assigned technology-based TSS effluent limitations. The iron associated with such discharges would not cause or contribute to violations of iron water quality standards. 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 watersheds of iron impaired streams with the implementation of applicable technology based TSS requirements. If iron is identified as a pollutant of concern in a process wastewater discharge from a new, non-mining activity, then the discharge can be permitted if effluent limitations are based on the achievement of water quality standards at end-of-pipe.

- Subwatershed-specific future growth allowances have been provided for site registrations under the CSGP. The successful TMDL allocation provides subwatershed-specific disturbed areas that may be registered under the general permit at any point in time. The iron allocation spreadsheet also provides cumulative area allowances of disturbed area 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, projects with disturbed area larger than allowances may be registered under the general permit under any of the following provisions:

  - A larger total project area can be registered if the construction activity is authorized in phases that adhere to the future growth area allowances.

  - All disturbed areas that will occur on non-background land uses can be registered without regard to the future growth allowances.

  - Registration may be conditioned by implementing controls beyond those afforded by the general permit, if it can be demonstrated that the additional controls will result in a lower unit area loading condition than the 100 mg/l TSS expectation for typical permit BMPs and that the improved performance is proportional to the increased area.

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 geometric mean 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 4, 2015 at Twin Falls State Park near Mullins, WV and on May 5, 2015 at Chief Logan State Park in Logan, WV. The meetings 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.

Due to COVID-19, no travel or public meetings are permitted during the comment period. WVDEP representatives will host a virtual meeting to present an overview of the TMDL development process and answer questions on June 30, 2020 at 6:00PM. Access the meeting via the link below.

Zoom Meeting
link: https://us02web.zoom.us/j/85018287570?pwd=NSt5WW5haTIyRHZiUXZodmxxYzZiUT09

Meeting ID: 850 1828 7570
Password: 451710

To dial in: 646 558 8656
Meeting ID: 850 1828 7570
Password: 451710

10.2 Public Notice and Public Comment Period

The availability of draft TMDLs was advertised via email, social media, and news release. The notice was shared directly with interested stakeholders. A the public comment period began on June 17, 2020 and ended on July 20, 2020. The electronic documents were also posted on the WVDEP's internet site at www.dep.wv.gov/tmdl. An ESRI StoryMap has been created to provide an overview of the TMDL at https://arcg.is/04uiSa.

10.3 Response Summary

WVDEP will review written comments on the Draft TMDLs and respond in this section.

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 10**.

Both the permitting and TMDL development processes have been synchronized with the Watershed Management Framework cycle, intending that the TMDLs are completed just before the permit expiration/reissuance time frames. Reissuances of permits for existing non-mining facilities in the Upper Guyandotte River watershed began in July 2019. Reissuance for existing mining began in January 2020.

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 to 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 Watershed Improvement Branch Southern Basin Coordinator Jennifer Liddle.

There are two active citizen-based watershed association representing the Upper Guyandotte River watershed: the Buffalo Creek Watershed Association and the Friends of Milam Creek. For

additional information concerning the associations, visit:
https://dep.wv.gov/WWE/getinvolved/WSA_Support/Pages/WGs.aspx

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.php.

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. Compliance schedules may be implemented that achieve compliance as soon as possible while providing the time necessary to accomplish corrective actions. The length of time afforded to achieve compliance may vary by discharge type or other factors and is a case-by-case determination in the permitting process. Permits will 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 TMDL WLAs.

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.

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