January 23, 2008

FINAL APPROVED REPORT

Total Maximum Daily Loads for Selected Streams in the Potomac Direct Drains Watershed, West Virginia

Prepared for:

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Division of Water and Waste Management
Watershed Branch, TMDL Section

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TMDL WATERSHED APPENDICES

The TMDL watersheds within the Potomac Direct Drains watershed are as follows:

1. Opequon Creek
2. Sleepy Creek
3. Harlan Run and Jordan Run
4. Elks Run and UNT/Potomac River RM 12.8 (Teague's Run)

ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

7Q10	7-day, 10-year low flow
BMP	best management practice
BOD	biochemical oxygen demand
CFR	Code of Federal Regulations
CSO	combined sewer overflow
CSR	Code of State Rules
DEM	Digital Elevation Model
DNR	Department of Natural Resources
DO	dissolved oxygen
DWWM	[WVDEP] Division of Water and Waste Management
ERIS	Environmental Resources Information System
GAP	Gap Analysis Land Cover Project
GIS	geographic information system
gpd	gallons per day
HAU	home aeration unit
HSPF	Hydrologic Simulation Program Fortran
LA	load allocation
MF	membrane filter counts per test
MOS	margin of safety
mg/L	milligrams per liter
MDAS	Mining Data Analysis System
MPN	most probable number
MS4	municipal separate storm sewer system
NED	National Elevation Dataset
NOAA-NCDC	National Oceanic and Atmospheric Administration, National Climatic Data Center
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
OOG	Office of Oil and Gas
POTW	publicly owned treatment works
SRF	State Revolving Fund
SSO	sanitary sewer overflow
STATSGO	State Soil Geographic database
TMDL	Total Maximum Daily Load
TSS	total suspended solids
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
UNT	unnamed tributary
VADEQ	Virginia Department of Environmental Quality
WAP	Watershed Assessment Program

WLA	wasteload allocation
WVDEP	West Virginia Department of Environmental Protection
WVDOT	West Virginia Department of Transportation
WVSCI	West Virginia Stream Condition Index
WVU	West Virginia University

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 (Dictionary.com, 2007).

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 Potomac Direct Drains watershed consists of the West Virginia portion of the mainstem of the Potomac River and the tributary streams that eventually drain to the Potomac River. The term watershed is used to describe the land area that contributes precipitation runoff that drains Potomac Direct Drains watershed.

TMDL watershed

This term is used to describe the major contributing streams draining directly to the Potomac River mainstem for which TMDLs are being developed. For this report, the Potomac Direct Drains watershed has been divided into six TMDL watersheds: Opequon Creek, Elks Run, Teague's Run, Jordan Run, Harlan Run, and Sleepy Creek (Figure 3-2).

Subwatershed

The subwatershed delineation is the most detailed scale of the delineation that breaks each watershed into numerous catchments for modeling purposes. The entire Potomac Direct Drains watershed has been subdivided into a total of 405 subwatersheds. The six TMDL watersheds have been subdivided into a total of 226 subwatersheds. Only these 226 subwatersheds, which contain impairments or contribute to impaired waters) were modeled as part of this effort. Pollutant sources, allocations and reductions are presented at the subwatershed scale to facilitate future permitting actions and TMDL implementation.

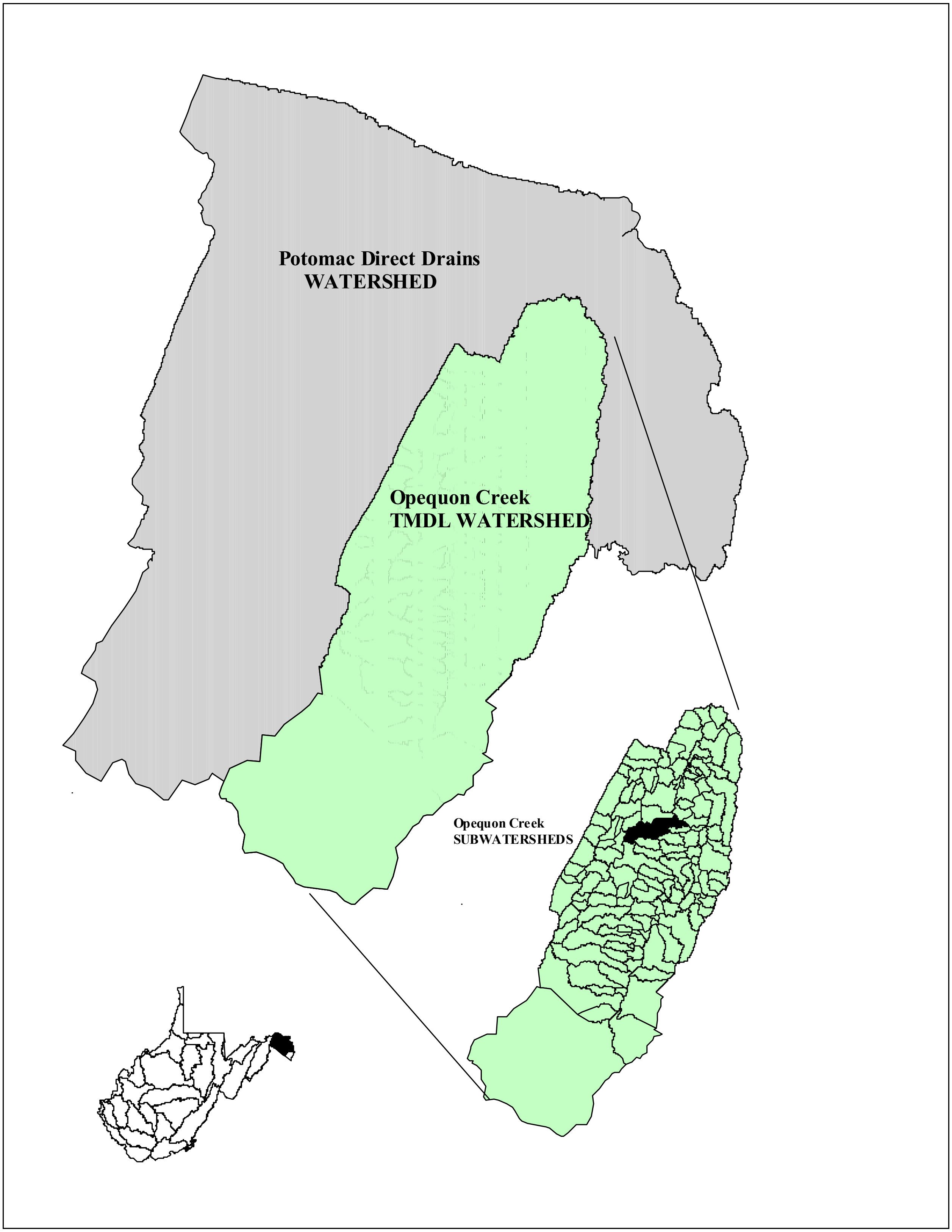


Figure I-1. Examples of a watershed, TMDL watershed, and subwatershed

EXECUTIVE SUMMARY

The Potomac Direct Drains watershed encompasses approximately 927 square miles in the eastern panhandle of West Virginia and adjacent northern Virginia. The majority of the watershed lies within Morgan, Berkeley, and Jefferson counties of West Virginia. The headwaters of some streams extend into portions of Frederick and Clarke counties of Virginia. Major tributaries include Opequon Creek, Back Creek, Sleepy Creek, and Town Run.

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

West Virginia's water quality standards are codified at Title 47 of the *Code of State Rules* (CSR), Series 2, and titled *Legislative Rules, Department of Environmental Protection: Requirements Governing Water Quality Standards*. The standards include designated uses of West Virginia waters and numeric and narrative criteria to protect those uses. The West Virginia Department of Environmental Protection routinely assesses use support by comparing observed water quality data with criteria, and lists and reports impaired waters every two years as required by Section 303(d) of the Clean Water Act. The act requires that TMDLs be developed for listed impaired waters.

West Virginia's draft 2006 Section 303(d) list includes 29 impaired streams in the Potomac Direct Drains watershed. The impairments are related to numeric water quality criteria for fecal coliform bacteria. Many of the listed waters are also biologically impaired based on the narrative water quality criterion of 47 CSR 2–3.2.i, which prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems.

Impaired waters in the Potomac Direct Drains watershed were organized into six TMDL watersheds (Opequon Creek, Sleepy Creek, Harlan Run, Jordan Creek, Elks Run and Teagues Run). For hydrologic modeling purposes, impaired and unimpaired streams in these six watersheds were further subdivided into 226 subwatersheds. The subwatershed delineations provided a basis for geo-referencing source information, monitoring data, and presentation of the TMDLs.

The Mining Data Analysis System (MDAS) was used to represent the source-response linkage for fecal coliform bacteria and sediment. 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. West Virginia's numeric water quality criteria and an explicit margin of safety were used to identify endpoints for TMDL development for fecal coliform bacteria. Sediment TMDLs were developed under a reference watershed approach. The normalized loading from the reference watershed and an explicit margin of safety were used to identify endpoints for sediment.

The MDAS was integrated with a bank erosion model that takes into account stream flow and bank stability. The bank erosion rate per unit area was defined as a function of bank flow volume above a specified threshold and the bank erodible area. Bank full depth was used as the threshold above which streambank erosion occurred. The coefficient of scour for the bank soil was related to the Bank Stability Index (S-value). Streambank erosion was modeled as a unique sediment source independent of other upland-associated erosion sources.

Both point and nonpoint sources contribute to the fecal coliform bacteria impairments in the watershed. The most significant nonpoint sources are those related to the inadequate treatment of sewage. Failing onsite systems and direct discharges of untreated sewage often result in exceedances to the fecal coliform criteria. Precipitation runoff from residential areas is another nonpoint source of fecal coliform bacteria. Agricultural sources of fecal coliform bacteria are present, but less significant. Point sources of fecal coliform bacteria include the effluents of Publicly Owned Treatment Works (POTWs) and private sewage treatment facilities, overflows from POTW collection systems, and stormwater discharges from Municipal Separate Storm Sewer Systems (MS4s).

Point sources of sediment largely consist of stormwater discharges from construction sites greater than one acre and stormwater discharges from MS4s. Nonpoint sources of sediment include roads, agriculture, and urban and residential land disturbance. Bank erosion is a significant sediment source throughout the watershed. The presence of individual nonpoint sources and their relative significance vary by subwatershed.

Biological integrity is based on a rating of the stream's benthic macroinvertebrate community using the multimetric West Virginia Stream Condition Index (WVSCI). Streams are deemed to be biologically impaired if the rating results in a score of less than 60.6. The first step in TMDL development for biologically impaired waters is stressor identification. Section 6 details the WVSCI and the stressor identification process. The causative stressors to the benthic communities identified in this effort are organic enrichment and/or sedimentation.

Stressor identification was followed by stream-specific determinations of the pollutants for which TMDLs must be developed. Where organic enrichment was identified as the biological stressor, the waters also demonstrated violations of the numeric criteria for fecal coliform bacteria. It was determined that implementation of fecal coliform TMDLs would remove untreated sewage and animal wastes and thereby reduce the organic and nutrient loading causing the biological impairment. Sediment TMDLs were developed where the stressor identification process indicated sedimentation as a causative stressor.

The main section of the report describes the TMDL development and modeling processes, identifies impaired streams and existing pollutant sources, discusses future growth, provides assurance that the TMDLs are achievable, and documents the public participation associated with the process. The main report also contains a detailed discussion of the allocation methodologies applied for various impairments. The employed methodologies prescribe allocations that achieve water quality criteria throughout the watershed. Various provisions attempt to achieve equity among categories of sources, and target pollutant reductions from the most problematic sources. Nonpoint source and precipitation-induced point source reductions were not specified beyond natural (background) levels. Similarly, non-precipitation-induced point source reductions were no more stringent than numeric water quality criteria.

Virginia Department of Environmental Quality (VADEQ) has already completed fecal coliform and sediment TMDLs for the Virginia portion of Opequon Creek. The TMDL results (both baseline and TMDL conditions) were incorporated into the TMDL development process for the downstream portions of the Opequon Creek watershed. The TMDL conditions of the fecal coliform and sediment TMDLs developed by the VADEQ for Opequon Creek define the water quality of Opequon Creek at the location where it exits Virginia and enters West Virginia.

The TMDL watershed appendices focus on the impaired waters in the specified watersheds. TMDLs are displayed in Section 4 of each appendix. Accompanying spreadsheets provide TMDLs, wasteload allocations to individual point sources, and example load allocations to categories of nonpoint sources that achieve the total TMDL. Also provided is an interactive ArcExplorer geographic information system (GIS) project that allows for the exploration of spatial relationships among the source assessment data.

1. REPORT FORMAT

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

2. INTRODUCTION

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

2.1 Total Maximum Daily Loads

Section 303(d) of the federal Clean Water Act and the U.S. Environmental Protection Agency's (USEPA) Water Quality Planning and Management Regulations (at Title 40 of the *Code of Federal Regulations* [CFR] Part 130) require states to identify waterbodies 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, load allocations (LAs) for nonpoint sources, and natural background levels. In addition, the TMDL must include a margin of safety (MOS), implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. TMDLs can be expressed in terms of mass per time or other appropriate units. Conceptually, this definition is denoted by the following equation:

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

WVDEP develops 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 2006 TMDLs should be pursued in Hydrologic Group C, which includes the Potomac Direct Drains watershed. Figure 2-1 depicts the hydrologic groupings of West Virginia's watersheds; the legend includes the target year for finalization of each TMDL.

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

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

This document provides TMDLs for the Potomac Direct Drains watershed stream/impairment listings from West Virginia's Draft 2006 Section 303(d) list that have a projected TMDL date of 2006. The remaining streams on the Section 303(d) list in the Potomac Direct Drains watershed will be completed by their projected TMDL dates.

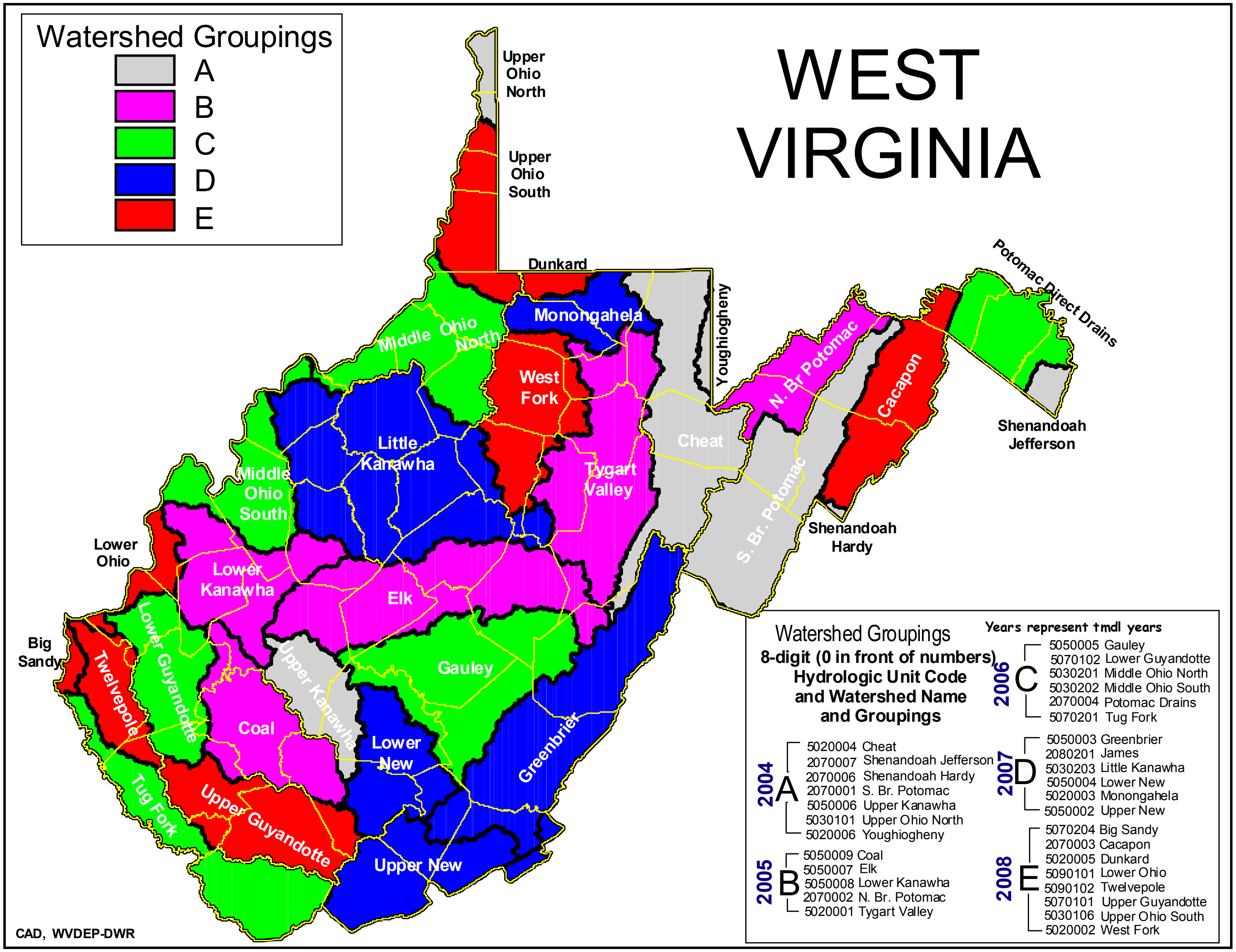


Figure 2-1. Hydrologic groupings of West Virginia's watersheds

2.2 Water Quality Standards

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

Water quality standards consist of three components: designated uses, narrative and/or numeric water quality criteria necessary to support those uses, and an antidegradation policy. Appendix E of the Standards contains the numeric water quality criteria for a wide range of parameters, while Section 3 contains the narrative water quality criteria. Designated uses include: aquatic life protection, water contact recreation, and public water supply. Although the designated use of aquatic life protection is applicable to the streams in the Potomac Direct Drains watershed, violations of numeric aquatic life criteria were not observed through pre-TMDL monitoring. In various waters, the water contact recreation and public water supply uses have been determined to be violated, pursuant to exceedances of the numeric water quality criteria for fecal coliform bacteria. The numeric criteria for fecal coliform bacteria are shown in Table 2-1.

Table 2-1. Applicable West Virginia water quality criteria

POLLUTANT	USE DESIGNATION
	Human Health
	Contact Recreation/Public Water Supply
Fecal coliform bacteria	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.

Source: West Virginia Water Quality Standards, 2005.

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 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 on the chemical, physical, hydrologic, and biological components of aquatic ecosystems. This provision is the basis for biological impairment determinations. Biological impairment signifies a stressed aquatic community, and is discussed in Section 6.

3. WATERSHED DESCRIPTION AND DATA INVENTORY

3.1 Watershed Description

The Potomac Direct Drains watershed, U.S. Geological Survey (USGS) 8-digit hydrologic unit code (02070004), lies mostly within Morgan, Berkeley, and Jefferson counties in the eastern panhandle of West Virginia, and also in portions of Frederick and Clarke counties in Virginia, as shown in Figure 3-1. A component of the Potomac River drainage, the Potomac Direct Drains watershed TMDL study area encompasses nearly 927 square miles. There are 592.6 square miles (64 percent) of the study area located in West Virginia, with the remainder in Virginia. The Potomac River mainstem flows along the northern edge of the TMDL study area. Major tributaries include Opequon Creek, Back Creek, Sleepy Creek, and Town Run. The average elevation in the watershed is 646 feet. The highest point is at 2,615 feet on High Point, which is in the western edge of the watershed near the Morgan County - Frederick County line. The minimum elevation is 300 feet at the confluence of the Potomac and Shenandoah rivers at Harpers Ferry.

Landuse and land cover estimates were originally obtained from vegetation data gathered from the West Virginia Gap Analysis Land Cover Project (GAP). The Natural Resource Analysis Center and the West Virginia Cooperative Fish and Wildlife Research Unit of West Virginia University (WVU) produced the GAP coverage. The GAP database for West Virginia was derived from satellite imagery taken during the early 1990s, and it includes detailed vegetative spatial data. Enhancements and updates to the GAP coverage were made to create a modeled landuse by custom edits derived from 911 emergency response addressable structures, 911 roads data, and 2003 aerial photography with 1-meter resolution. Additional information regarding the GAP spatial database is provided in the appendices of the Technical Report. The categories for vegetation cover were consolidated to create 16 landuse categories, summarized in Table 3-1.

A “new residential” landuse was created and incorporated into the model using GIS techniques. Exact locations of homes in the watershed were known from emergency response address data for Berkeley, Jefferson, and Morgan Counties, WV, and Frederick County, VA. These locations were used to create a polygon theme with the approximate area associated with housing development in the modeled subwatersheds. These address polygons were added to the GAP shapefile to account for homes built after the year 2000, as well as older homes not captured by GAP. The resulting shapefile showed where forest, grassland, or cropland had been replaced with new residential landuse. Where address polygons overlapped areas already counted as urban or residential in GAP 2000, the areas retained their original GAP 2000 designation. The improved resolution achieved by using emergency response address data increased the percentage of the residential landuse accounted for in the model from 4.4 percent to 9.3 percent, and addition of approximately 29,000 acres. A detailed analysis of roads was also completed using the 911 roads shapefiles and 2003 aerial photography with 1-meter resolution. A detailed description of the landuse modification process can be found in the Technical Report.

As shown in Table 3-1, the dominant modeled landuse type after modification in the Potomac Direct Drains watershed is forest, which constitutes 49.9 percent of the total landuse area. Other important modeled landuse types after modification are grassland (25.7 percent), urban/residential (9.3 percent), pasture (4.5 percent), and cropland (4.2 percent). All other land cover types compose less than six percent of the total watershed area.

The total population for the entire Potomac Direct Drains watershed TMDL study area, derived from the 2000 U.S. Census data, is approximately 195,000 people.

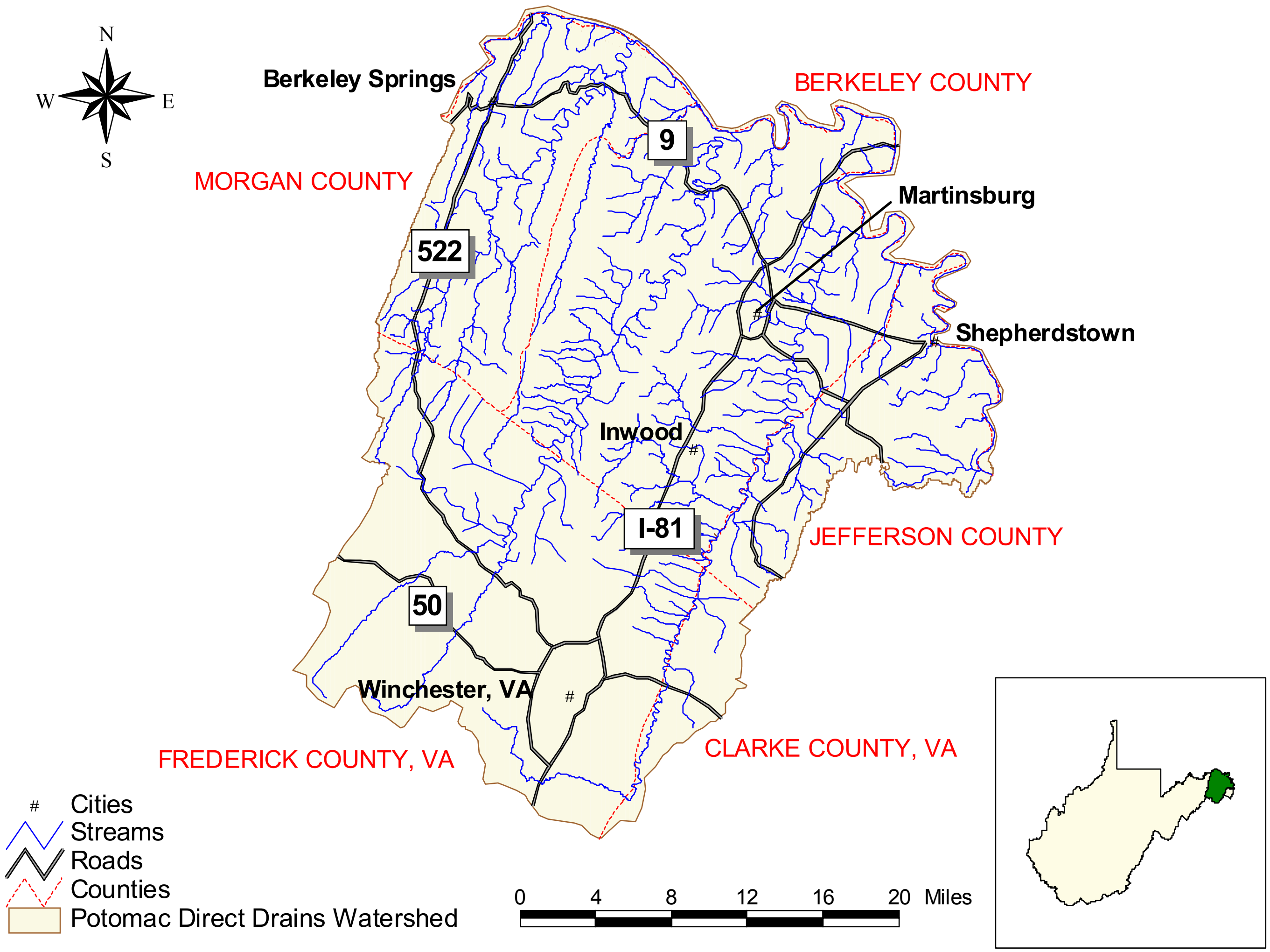


Figure 3-1. Location of the Potomac Direct Drains watershed

Table 3-1. Modified modeled landuse for the Potomac Direct Drains watershed

Landuse Type	Area of Watershed		
	Acres	Square Miles	Percentage
Barren	1,284.74	2.01	0.22
Cropland	24,995.93	39.06	4.22
Forest	295,993.45	462.49	49.91
Grassland	152,468.55	238.23	25.71
Harvested Forest	1,058.21	1.65	0.18
Orchards and Golf Courses	5,932.25	9.27	1.00
Pasture	26,438.10	41.31	4.46
Quarries	788.08	1.23	0.13
Roads Paved	5,012.14	7.83	0.85
Roads Unpaved	3,666.97	5.73	0.62
Skid Roads	81.97	0.13	0.01
Construction Stormwater Permitted Area	9,453.55	14.77	1.59
Urban Impervious	8,218.09	12.84	1.39
Urban Pervious	46,627.14	72.85	7.86
Water	9,574.34	14.96	1.61
Wetland	1,408.19	2.20	0.24
Total	**593,001.71**	**926.57**	**100**

3.2 Data Inventory

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

Table 3-2. Datasets used in TMDL development

Type of Information		Data Sources
Watershed physiographic data	Stream network	West Virginia Division of Natural Resources (DNR)
	Landuse	WV Gap Analysis Project (GAP)
	911 Structures	Berkeley, Jefferson, and Morgan Counties, WV, and Frederick County, VA Enhanced 911 Shapefiles
	911 Roads	Berkeley and Jefferson Counties Enhanced 911 Shapefiles
	2003 Aerial Photography (1-meter resolution)	WVDEP
	Counties	U.S. Census Bureau
	Cities/populated places	U.S. Census Bureau
	Soils	State Soil Geographic Database (STATSGO) U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) soil surveys
	Cataloging Unit boundaries	U.S. Geological Survey (USGS)
	Topographic and digital elevation models (DEMs)	National Elevation Dataset (NED)
	Dam locations	USGS
	Roads	U.S. Census Bureau TIGER, WVU WV Roads
	Water quality monitoring station locations	U.S. Census Bureau, WVDEP, USEPA STORET
	Meteorological station locations	National Oceanic and Atmospheric Administration, National Climatic Data Center (NOAA-NCDC)
	Permitted facility information	WVDEP Division of Water and Waste Management (DWWM), WVDEP Division of Mining and Reclamation (DMR)
	Timber harvest data	USDA, Forest Service
	Oil and gas operations coverage	WVDEP Office of Oil and Gas (OOG)
	Abandoned mining coverage	WVDEP DMR
Monitoring data	Historical Flow Record (daily averages)	USGS
	Rainfall	NOAA-NCDC
	Temperature	NOAA-NCDC
	Wind speed	NOAA-NCDC
	Dew point	NOAA-NCDC
	Humidity	NOAA-NCDC
	Cloud cover	NOAA-NCDC
	Water quality monitoring data	USEPA STORET, WVDEP
	National Pollutant Discharge Elimination System (NPDES) data	WVDEP DMR, WVDEP DWMM
	Discharge Monitoring Report data	WVDEP DMR, Mining Companies
	Abandoned mine land data	WVDEP DMR, WVDEP DWMM
Regulatory or policy information	Applicable water quality standards	WVDEP
	Section 303(d) list of impaired waterbodies	WVDEP, USEPA
	Nonpoint Source Management Plans	WVDEP

3.3 Impaired Waterbodies

WVDEP conducted extensive water quality monitoring from July 2003 through June 2004 in the Potomac Direct Drains watershed. The results of that effort were used to confirm the impairments of waterbodies identified on previous 303(d) lists and to identify other impaired waterbodies that were not previously listed.

TMDLs were developed for impaired waters in six TMDL watersheds (Figure 3-2): Opequon Creek, Elks Run, Teague's Run, Jordan Run, Harlan Run, and Sleepy Creek. The impaired waters for which TMDLs have been developed are presented in Table 3-3. The table includes the stream code, subwatershed, stream name, and impairments for each stream.

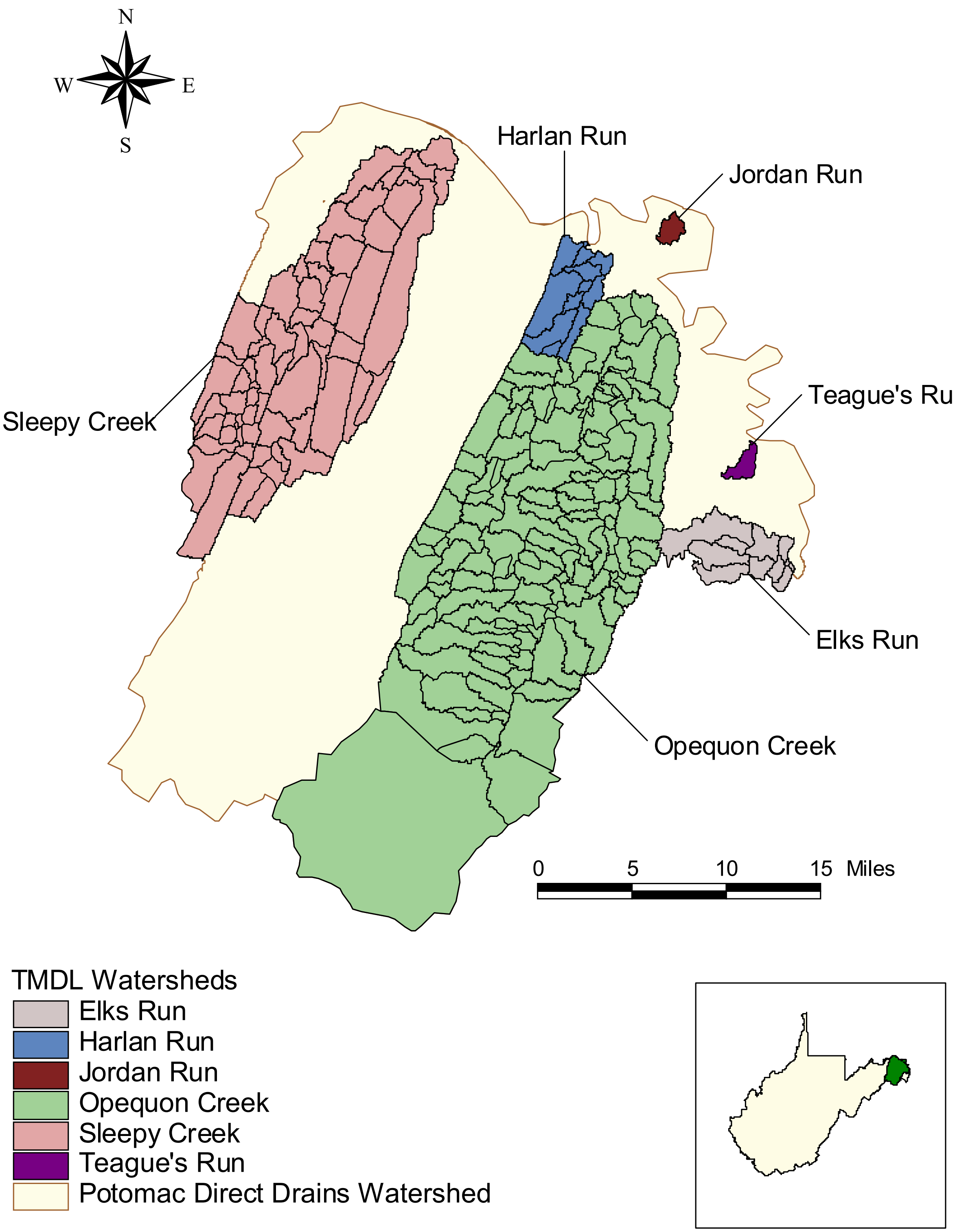


Figure 3-2. Potomac Direct Drains TMDL watershed

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

TMDL watershed	Code	Stream Name	FC	BIO
Elks Run	WVP-1	Elks Run	x	x
	WVP-1-A	Elk Branch	x	x
Teague's Run (UNT/Potomac River RM 12.8)	WVP-2.2	Teague's Run (UNT/Potomac River RM 12.8)	x	x
Opequon Creek	WVP-4	Opequon Creek	x	x
	WVP-4-A	Hoke Run	x	x
	WVP-4-B	Eagle Run	x	x
	WVP-4-C	Tuscarora Creek	x	x
	WVP-4-C-1	Dry Run	x	x
	WVP-4-D	Evans Run		x
	WVP-4-F	Shaw Run	x	x
	WVP-4-H	Buzzard Run	x	
	WVP-4-I	Hopewell Run	x	x
	WVP-4-I-2	UNT/Hopewell Run RM 1.7	x	x
	WVP-4-J	Middle Creek	x	x
	WVP-4-J-1	Goose Creek	x	
	WVP-4-L	Three Run	x	
	WVP-4-M	Mill Creek	x	x
	WVP-4-M-1	Sylvan Run		x
	WVP-4-M-2	Torytown Run	x	x
	WVP-4-N	Turkey Run	x	x
	WVP-4-P	Silver Spring Run	x	x
Jordan Run	WVP-4.5	Jordan Run	x	
Harlan Run	WVP-5	Harlan Run	x	x
	WVP-5-A	Tullis Branch (Tulisus Branch)	x	x
Sleepy Creek	WVP-9	Sleepy Creek	x	
	WVP-9-G	Indian Run	x	

Note:
UNT = unnamed tributary.
FC indicates Fecal Coliform bacteria impairment
BIO indicates a Biological impairment

4. FECAL COLIFORM SOURCE ASSESSMENT

4.1 Fecal Coliform Point Sources

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

4.1.1 Sewage Treatment Plant Effluents Regulated by Individual NPDES Permits

WVDEP issues individual NPDES (National Pollutant Discharge Elimination System) permits to both publicly owned and privately owned sewage treatment facilities. POTWs are generally large facilities with extensive wastewater collection systems, whereas private facilities are usually used in smaller applications such as those serving subdivisions and shopping centers.

Berkeley County Public Service Sewer District (BCPSSD) operates four large wastewater treatment facilities that discharge treated effluent to fecal coliform impaired waters. Three of these facilities discharge to Opequon Creek and one discharges to an unnamed tributary of Eagle Run. BCPSSD has also taken over the operation of several additional smaller wastewater treatment plants that were previously operated by private entities. The City of Martinsburg operates a wastewater treatment facility that discharges treated effluent to Tuscarora Creek. Additional private sewage treatment plants operating under individual NPDES permits discharge treated effluent to various fecal coliform impaired waters. These sources are regulated by NPDES permits that require effluent disinfection and compliance with strict fecal coliform effluent limitations (200 counts/100 mL [average monthly] and 400 counts/100 mL [maximum daily]).

4.1.2 Combined Sewer Overflows

CSOs are outfalls from POTW collection systems that carry untreated domestic waste and surface runoff. CSO discharges contain fecal coliform bacteria and are permitted only during precipitation events. There is one CSO, associated with permit number WV0023167, which discharges into Tuscarora Creek in subwatershed 4021.

Sanitary sewer overflows (SSOs) are unpermitted overflows that occur as a result of excess inflow and/or infiltration to POTW separate sanitary collection systems. None have been identified in the watersheds of the impaired waters that are the subject of this TMDL effort.

4.1.3 General Sewage Permits

General sewage permits are designed to cover like discharges from numerous individual owners and facilities throughout the state. General Permit WV0103110 regulates small, privately owned sewage treatment plants (“package plants”) that have a design flow of less than 50,000 gallons per day (gpd). General Permit WV0107000 regulates 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. Within the watersheds addressed by this report, 27 facilities are registered under the "package plant" general permit and none are registered under the "HAU" general permit.

4.1.4 Municipal Separate Storm Sewer Systems (MS4s)

Runoff from residential and urbanized areas during storm events can be a significant fecal coliform source, delivering bacteria from the waste of pets and wildlife to the waterbody. USEPA's stormwater permitting regulations require public entities to obtain NPDES permit coverage for stormwater discharges from MS4s in specified urbanized areas. The City of Martinsburg, Berkeley County and the West Virginia Department of Transportation (WVDOT) are designated MS4 entities. As such, their stormwater discharges are considered point sources and are prescribed wasteload allocations. MS4 source representation was based upon precipitation and runoff from landuses determined from the modified GAP 2000 landuse data, the jurisdictional boundaries of the City and County, and the associated drainage area for the WVDOT MS4s.

4.2 Fecal Coliform Nonpoint Sources

4.2.1 On-site Treatment Systems

Overall, failing septic systems and straight pipes represent the most significant nonpoint source of fecal coliform bacteria in the Potomac Direct Drains watershed. An analysis of 911 emergency response addressable structure data combined with WVDEP source tracking information yielded an estimate of 40,960 homes in the watershed that are not served by centralized sewage collection and treatment systems.

A customized Microsoft Excel spreadsheet tool was created to estimate the fecal coliform bacteria contribution from failing on-site septic systems. Fecal coliform loads from failing septic systems were modeled as point sources in the MDAS. To calculate point source loads, values for both wastewater flow and fecal coliform concentration are needed. Literature values for failing septic system flows and fecal concentrations vary over several orders of magnitude. Therefore, it was necessary to perform original analysis using West Virginia pre-TMDL monitoring and source tracking data.

To calculate failing septic wastewater flows, the study area was divided into four septic failure zones. During the WVDEP source tracking process, septic failure zones were delineated by geology, and defined by rates of septic system failure. Two types of failure were considered: complete failure and seasonal failure. Complete failure varied from five percent to 28 percent across the septic zones and seasonal failure from three percent to 19 percent. For the purposes of this analysis, complete failure was represented as 50 gallons per house per day of untreated sewage escaping a septic system and seasonal failure was defined as 25 gallons per house per day. During the model calibration process, adjustments were made to best represent the pollutant load reaching receiving waters as driven by seasonal hydrologic conditions.

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 load allocations to those sources does not reflect a determination by WVDEP or USEPA as to whether they are, in fact, non-permitted point source discharges. In addition, 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.

4.2.2 Stormwater Runoff

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

4.2.3 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.

Based on modified modeled landuse data, approximately 8.6 percent of the Potomac Direct Drains watershed is used for livestock pasture and crop production. Agricultural landuse has declined over the past fifteen years due to residential development. Although agriculture is not widespread in the impaired portions of the watershed, source tracking efforts identified instances of pastures and feedlots near impaired segments that potentially have significant localized impacts on instream bacteria levels. Source tracking information regarding number of livestock, proximity and access to stream, and overall runoff potential were used to develop accumulation rates for agricultural sources of fecal coliform bacteria that were subsequently adjusted during model calibration.

4.2.4 Natural Background (Wildlife)

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

5. SEDIMENT SOURCE ASSESSMENT

For many waters in the Potomac Direct Drains watershed, excess sediment has been identified as a significant stressor in relation to biological impairment. The Stressor Identification process is detailed in Section 6, with additional information provided in the Technical Report. This section discusses point and nonpoint sources of sediment that are present in the watershed.

5.1 Sediment Point Sources

Point sources of sediment include permitted loadings from traditional NPDES permits and the precipitation-induced loadings associated with stormwater NPDES permits.

5.1.1 Construction Stormwater General Permit

WVDEP issues a General NPDES Permit (Permit WV0115924) to regulate stormwater discharges associated with construction activities. Registration under the permit is required for construction activities with a land disturbance greater than one acre. Both the land disturbance and the permitting process associated with construction activities are transient; that is, the water quality impacts are minimal after construction is completed and the sites are stabilized. Individual registrations under the general permit are usually limited to less than one year. These permits require that the site have properly installed best management practices (BMPs), such as silt fences, sediment traps, seeding and mulching, and riprap, to prevent or reduce erosion and sediment runoff. At the time the TMDLs were developed, 297 construction sites encompassing 8,470 acres were registered, or had registrations pending, under the general permit.

5.1.2 Municipal Separate Storm Sewer System (MS4) General Permit

Runoff from residential and urbanized areas during storm events can be a significant sediment source. USEPA's stormwater permitting regulations require public entities to obtain NPDES permit coverage for stormwater discharges from MS4s in specified urbanized areas. The City of Martinsburg, Berkeley County and WVDOT are designated MS4 entities. As such, their stormwater discharges are considered point sources and are prescribed wasteload allocations. MS4 source representation is based upon precipitation and runoff from landuses determined from the modified GAP 2000 landuse data, the jurisdictional boundaries of the City and County, and the associated drainage area for the WVDOT MS4s.

5.1.3 Other Individual and General NPDES Permits

Individual and general NPDES permits for sewage treatment facilities, industrial process wastewater, and stormwater associated with industrial activity contain technology-based total suspended solids (TSS) effluent limitations. Facilities that are compliant with such limitations are not considered significant sediment sources. Example permits include:

- Individual and general NPDES permits for sewage treatment facilities (POTWs, private sewage treatment plants, package plants and home aeration units) with monthly average effluent limits of 30 mg/L for TSS

- The Multi-Sector Stormwater General Permit with TSS benchmark values equal to 100 mg/L
- Individual NPDES permits for industrial process wastewater with 60-100 mg/L maximum daily TSS effluent limitations
- Individual and general permits for quarries with 35 mg/L average monthly and 70 mg/L maximum daily effluent limitations for TSS

All such facilities are recognized in the sediment modeling process and are assigned wasteload allocations that allow for continued discharge under existing permit conditions.

5.2 Sediment Nonpoint Sources

Land disturbance can increase sediment loading to impaired waters. Potential sediment-related nonpoint sources are forestry operations, barren lands, pasture, cropland, stormwater from construction sites less than one acre, and stormwater from urban and residential land and roads in non-MS4 areas. Additionally, streambank erosion is a significant sediment source throughout the watershed.

5.2.1 Forestry

The West Virginia Bureau of Commerce's Division of Forestry provided information on forest industry sites (registered logging sites) in the watershed. This information included the harvested area and the subset of land disturbed by haul roads and landings for 52 registered logging sites in the watershed. 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. This act requires that Best Management Practices (BMPs) be used to reduce sediment loads to nearby waterbodies. Without properly installed BMPs, logging and the land disturbance associated with the creation and use of haul roads to serve logging sites can increase sediment loading to streams.

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

5.2.2 Residential and Urban Land

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

5.2.3 Roads

Runoff from paved and unpaved roadways can contribute significant sediment loads to nearby streams. Runoff from roads that are outside MS4 areas are considered nonpoint sources. Heightened stormwater runoff from paved roads (impervious surface) can increase erosion potential. Unpaved roads can contribute sediment through precipitation-driven runoff. Roads that traverse stream paths elevate the potential for direct deposition of sediment. Road construction and repair can further increase sediment loads if BMPs are not properly employed. Information on roads was obtained from various sources, including the 2000 TIGER/Line GIS shapefiles from the US Census Bureau, the WV Roads GIS coverage prepared by WVU, 911 roads GIS shapefiles and manually delineated roads from the 2003 aerial photography.

5.2.4 Agriculture

Agricultural land can be a significant source of sediment. Agricultural runoff can contribute excess sediment loads when farming practices allow soils to be washed into the stream. The erosion potential of cropland and overgrazed pasture is particularly high because of the lack of year round vegetative cover. Livestock traffic, especially along streambanks, disturbs the riparian buffer and reduces vegetative cover, causing an increase in erosion from these areas.

Based on modified modeled landuse data, approximately 8.6 percent of the Potomac Direct Drains watershed is used for livestock pasture and crop production. Agricultural landuse has declined over the past fifteen years, due to residential development. Although agriculture is not widespread in the impaired portions of the watershed, source tracking efforts identified instances of pastures and feedlots in the subwatersheds of biologically impaired waters for which sediment has been identified as a significant stressor.

5.2.5 Streambank Erosion

Streambank erosion has been determined to be a significant sediment source throughout the watershed. As discussed in Section 7, the base and allocated loads associated with bank erosion are generally included in the MS4 wasteload allocations in subwatersheds where MS4 entities have areas of responsibility. In non-MS4 subwatersheds, the sediment loading from bank erosion is considered a nonpoint source and load allocations are assigned. In a limited number of MS4 subwatersheds, where WVDEP source tracking determined moderate and high water quality impact from agricultural landuses, the bank erosion components are prescribed as nonpoint source load allocations.

5.2.6 Other Land Disturbance Activities

As stated previously, WVDEP issues general NPDES permits to regulate sediment contributions to streams from discharges associated with construction activities that disturb more than one acre. Construction activities that disturb less than one acre are not subject to construction stormwater permitting and are uncontrolled sources of sediment.

6. BIOLOGICAL IMPAIRMENT AND STRESSOR IDENTIFICATION

Initially, TMDL development in biologically impaired waters requires identification of the pollutants that cause the stress to the biological community. This section discusses the basis for determining biological impairment and the stressor identification process. Additional detail is provided in the Technical Report.

6.1 Introduction

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

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

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

6.2 Data Review

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

6.3 Candidate Causes/Pathways

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

- Metals contamination (including metals contributed through soil erosion) causes toxicity
- Acidity (low pH) causes toxicity
- High sulfates and increased ionic strength cause toxicity
- Increased total suspended solids (TSS)/erosion and altered hydrology cause sedimentation and other habitat alterations
- Organic enrichment and increased biochemical oxygen demand (BOD) cause reduced dissolved oxygen (DO)
- Algal growth causes food supply shift
- High levels of ammonia cause toxicity (including increased toxicity due to algal growth)
- Chemical spills cause toxicity

A conceptual model was developed to examine the relationship between candidate causes and potential biological effects. The conceptual model (Figure 6-1) depicts the sources, stressors, and pathways that affect the biological community.

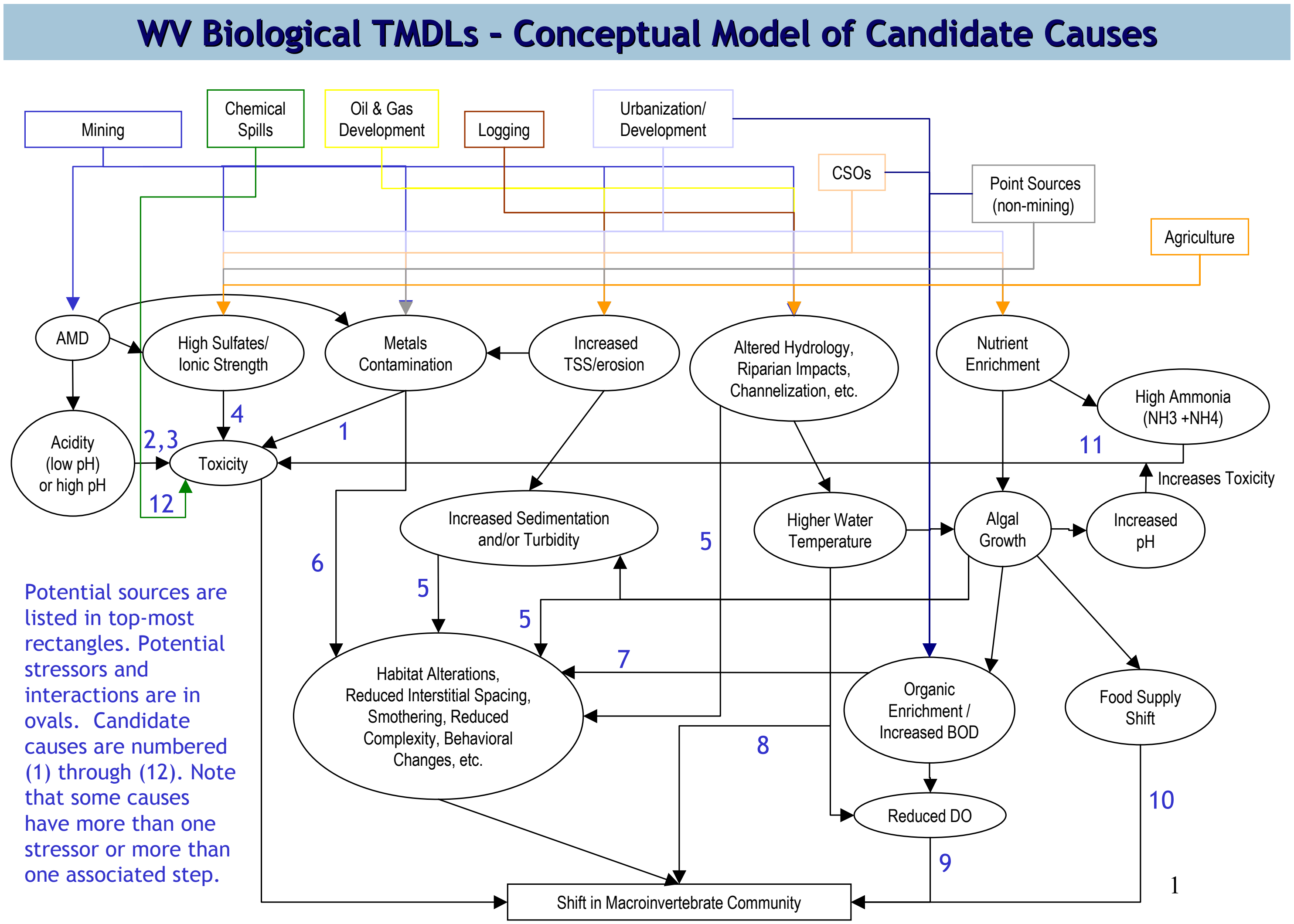


Figure 6-1. Conceptual model of candidate causes and potential biological effects

6.4 Stressor Identification Results

The stressor identification process determined significant causes of biological impairment. After stressors were identified, WVDEP determined the pollutants for which TMDLs were required to address the impairment. In some instances, biological impairment was determined to be caused by a single stressor; whereas, multiple stressors were indicated in other cases. In the Potomac Direct Drains watershed, the causes of biological impairment were determined to be sedimentation and/or organic enrichment (the combined effects of oxygen demanding carbon based pollutants and nutrients, and the resultant eutrophication). The sources of those pollutants are described in Sections 4 and 5.

Where identified as the biological stressor, organic enrichment was linked to violations of the numeric criteria for fecal coliform bacteria. WVDEP determined that implementation of fecal coliform TMDLs would remove untreated sewage and animal waste, thereby reducing the organic and nutrient loading causing the biological impairment. Therefore, fecal coliform TMDLs will serve as a surrogate where organic enrichment was identified as a stressor.

Where the stressor identification process indicated sedimentation as a causative stressor, WVDEP developed sediment TMDLs. Table 6-1 summarizes the significant stressors for biological impairment in the Potomac Direct Drains watershed.

Table 6-1. Significant stressors of biologically impaired streams in the Potomac Direct Drains watershed

Major Watershed	Stream	Biological Stressors	TMDLs Developed
Elks Run	Elks Run	Organic enrichment Sedimentation	Fecal coliform Sediment
	Elk Branch	Organic enrichment Sedimentation	Fecal coliform Sediment
UNT/Potomac	UNT/Potomac River RM 12.8 (Teague's Run)	Organic enrichment Sedimentation	Fecal coliform Sediment
Opequon Creek	Opequon Creek	Organic enrichment Sedimentation	Fecal coliform Sediment
	Hoke Run	Organic enrichment Sedimentation	Fecal coliform Sediment
	Eagle Run	Organic enrichment Sedimentation	Fecal coliform Sediment

Table 6-1. (Continued) Significant stressors of biologically impaired streams in the Potomac Direct Drains watershed

Major Watershed	Stream	Biological Stressors	TMDLs Developed
Opequon Creek	Tuscarora Creek	Organic enrichment Sedimentation	Fecal coliform Sediment
	Dry Run	Organic enrichment Sedimentation	Fecal coliform Sediment
	Evans Run	Sedimentation	Sediment
	Shaw Run	Organic enrichment Sedimentation	Fecal coliform Sediment
	Hopewell Run	Organic enrichment Sedimentation	Fecal coliform Sediment
	UNT/Hopewell Run RM 1.7	Organic enrichment	Fecal coliform
	Middle Creek	Organic enrichment Sedimentation	Fecal coliform Sediment
	Mill Creek	Organic enrichment Sedimentation	Fecal coliform Sediment
	Sylvan Run	Sedimentation	Sediment
	Torytown Run	Organic enrichment Sedimentation	Fecal coliform Sediment
	Turkey Run	Organic enrichment Sedimentation	Fecal coliform Sediment
	Silver Spring Run	Organic enrichment Sedimentation	Fecal coliform Sediment
Harlan Run	Harlan Run	Organic enrichment Sedimentation	Fecal coliform Sediment
	Tullis Branch (Tulisus Branch)	Sedimentation Organic enrichment	Sediment Fecal coliform

7. 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 Potomac Direct Drains watershed.

7.1 Modeling Technique for Fecal Coliform Bacteria

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

- Scale of analysis.
- Point and nonpoint sources and their mechanisms for bacteria delivery.
- Temporal variability of fecal coliform bacteria concentrations and critical flow conditions.
- Temporal variability of land practices and their effect on fecal coliform water quality.
- Bacteria transport mechanisms and their dependency on weather.

The primary regulatory factor that initiated the selection process was West Virginia's water quality criteria. According to 40 CFR Part 130, TMDLs must be designed to implement applicable water quality standards. The applicable water quality standards for fecal coliform bacteria in West Virginia are presented in Section 2.2, Table 2-1. West Virginia water quality criteria are applicable at all stream flows greater than the 7-day, 10-year low flow (7Q10). The approach or modeling technique must permit representation of instream concentrations under a variety of flow conditions to evaluate critical flow.

The TMDL development approach must also consider the dominant processes affecting pollutant loadings and instream fate. For the Potomac Direct Drains watershed, primary sources contributing to fecal coliform impairments include an array of point and nonpoint sources. Nonpoint sources are typically rainfall-driven with pollutant loadings primarily related to surface runoff. Point source discharges might or might not be induced by rainfall.

A variety of modeling tools were used to develop the 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 4.2.1 describes the process in assigning flow and fecal coliform concentrations to failing septics. The failing septic analysis provides initial values for model input; however, these values are further refined during the model calibration process.

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. Fecal coliform bacteria were modeled using the MDAS. The model selection process, modeling methodologies, and technical approaches are discussed further in the Technical Report.

7.1.1 MDAS Setup

Configuration of the MDAS model involved subdivision of the Potomac Direct Drains watershed into modeling units. Flow and water quality for those units were continuously simulated using meteorological, landuse, point source loading, and stream data.

The watershed was broken into six separate TMDL watersheds. These watersheds were further subdivided 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. The 226 total subwatershed delineations across all of the six TMDL watersheds are shown in Figure 7-1.

Modeled landuses contributing to fecal coliform loads include forest, grassland, cropland, pasture, urban/ residential pervious lands, urban/residential impervious lands, barren areas, roads, and harvested forest. Several additional landuse categories were created to account for recent land disturbance activities (e.g., harvested forest, new residential, and paved and unpaved roads) that are not represented in the GAP 2000 landuse coverage. The process of consolidating and updating the modeled landuses is explained in further detail in the Technical Report.

Other sources, such as failing septic systems, straight pipes, and discharges from sewage treatment facilities, were modeled as direct, continuous-flow sources in the model. The basis for the initial loading rates for landuses and direct sources are described in the Technical Report. The initial estimates were further refined during the model testing (calibration).

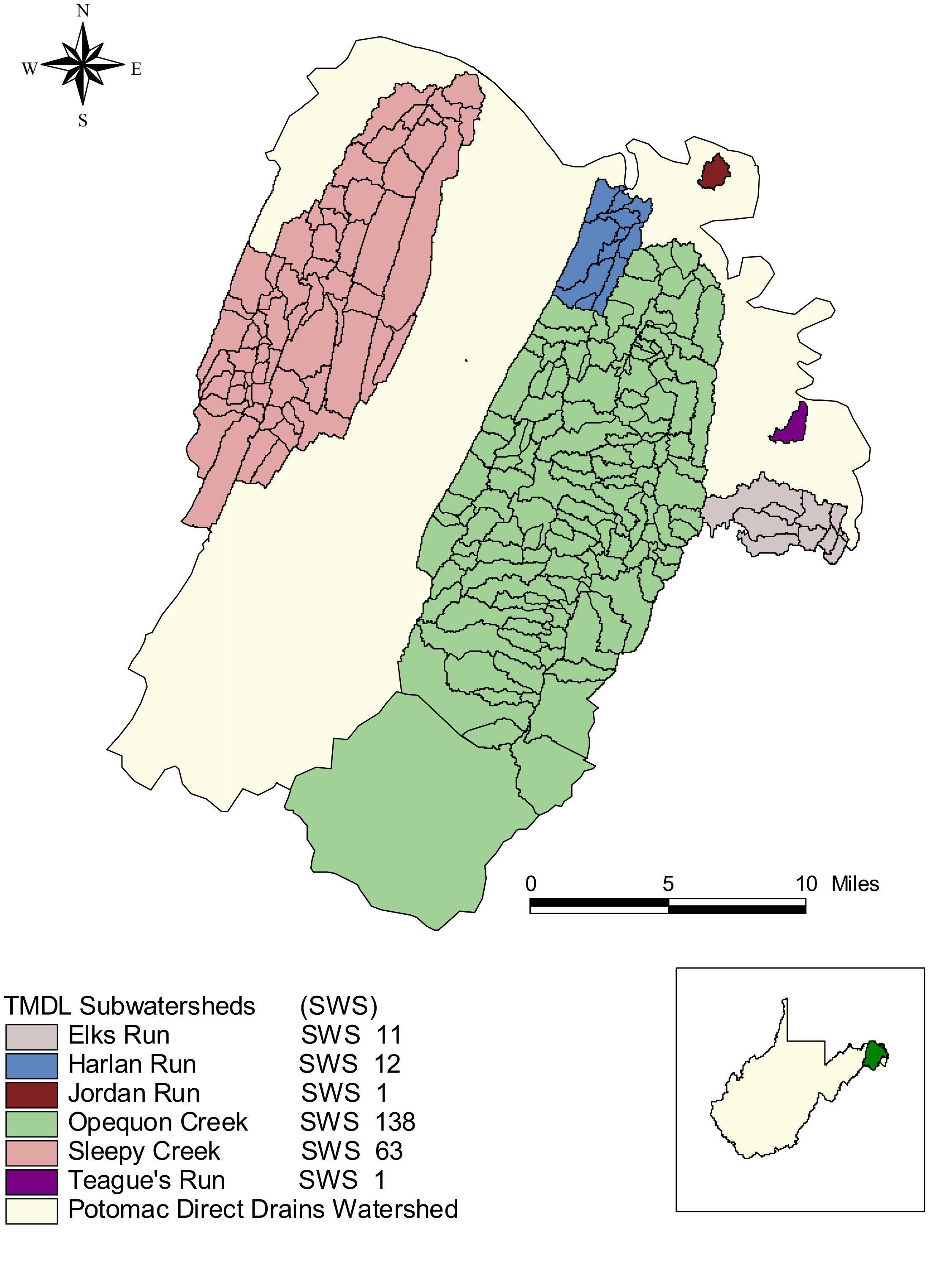


Figure 7-1. Potomac Direct Drains subwatershed delineation

7.1.2 Hydrology Calibration

Hydrology and water quality calibration were performed in sequence because water quality modeling is dependent on an accurate hydrology simulation. Typically, hydrology calibration involves a comparison of model results to instream flow observations from USGS flow gauging stations throughout the watershed. There is one USGS flow gauging station in the Potomac Direct Drains watershed with adequate data records for hydrology calibration. This USGS gauging station (01616500) operated on Opequon Creek near Martinsburg from 1947 to 2004. Hydrology calibration was based on observed data from that station and the landuses present in the watershed at that time. Key considerations for hydrology calibration included the overall water balance, the high-flow/low-flow distribution, storm flows, and seasonal variation. As a starting point, many of the hydrology calibration parameters originated from the USGS *Scientific Investigations Report 2005-5099* (Atkins, 2005). The hydrology was validated for the time period of January 1, 1991 to September 30, 2004. Final adjustments to model hydrology were based on flow measurements obtained during WVDEP's pre-TMDL monitoring in the Potomac Direct Drains watershed. Further description and a summary of the results of the hydrology calibration and validation are presented in the Technical Report.

7.1.3 Water Quality Calibration

Following hydrology calibration, the water quality was calibrated by comparing modeled versus observed instream fecal coliform bacteria concentrations. The water quality calibration consisted of executing the MDAS model, comparing the model results with available observations, and adjusting water quality parameters within reasonable ranges. The model was calibrated to the observed data recorded in the Opequon Creek watershed from July 1, 2003, to June 30, 2004. WVDEP conducted storm monitoring on Shrewsbury Hollow in Kanawha State Forest, Kanawha County, West Virginia. The data gathered during this sampling episode was also used in the calibration of fecal coliform and total suspended solids. The results of the storm sampling calibration are shown in Figure 7-2.

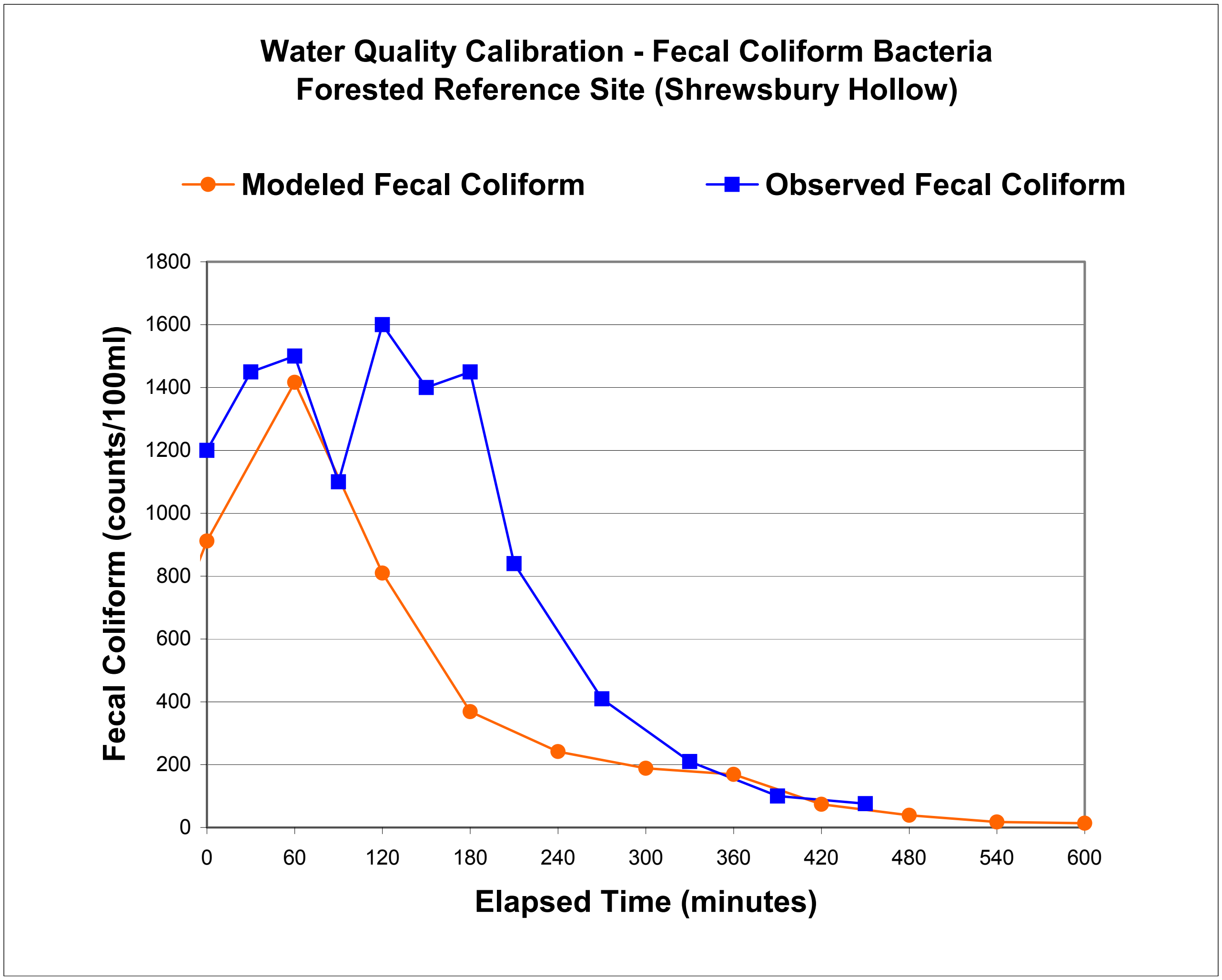


Figure 7-2. Shrewsbury Hollow fecal coliform observed data

7.2 Modeling Technique for Sediment

The stressor identification process discussed in Section 6 indicated a need to reduce the contribution of excess sediment to certain biologically impaired streams in the Potomac Direct Drains watershed. Based on experience in addressing these considerations in West Virginia's watersheds, the Mining Data Analysis System (MDAS) was chosen for sediment modeling.

Selection of this modeling system for the development of sediment TMDLs was based on the evaluation of available technical and regulatory criteria. Adequately representing erosion processes and nonpoint source loads in the watershed was a primary concern in selecting the appropriate modeling system.

Narrative criteria are included in West Virginia's water quality standards (Title 47 CSR 2–3.2.i), as discussed in Section 2 of this report. The narrative water quality criterion prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems. This provision is the basis for "biological impairment" determinations. WVDEP assesses compliance with the narrative criteria by monitoring the benthic macroinvertebrate community. Sediment reductions are required to restore water quality and habitat conditions in many of the biologically impaired streams in the Potomac Direct Drains watershed.

A reference watershed approach was used to establish the acceptable level of sediment loading for each impaired stream on a watershed-specific basis. This approach was based on selecting a non-impaired watershed that shares similar landuse, ecoregion, and geomorphologic characteristics with the impaired watershed. Stream conditions in the reference watershed are assumed to be representative of the conditions needed for the impaired stream to attain its designated uses. Given these parameters and a non-impaired WVSCI score, the Buzzard Run (WVP-4-H) watershed was selected as the reference watershed. The location of the Buzzard Run watershed is shown in Figure 7-3.

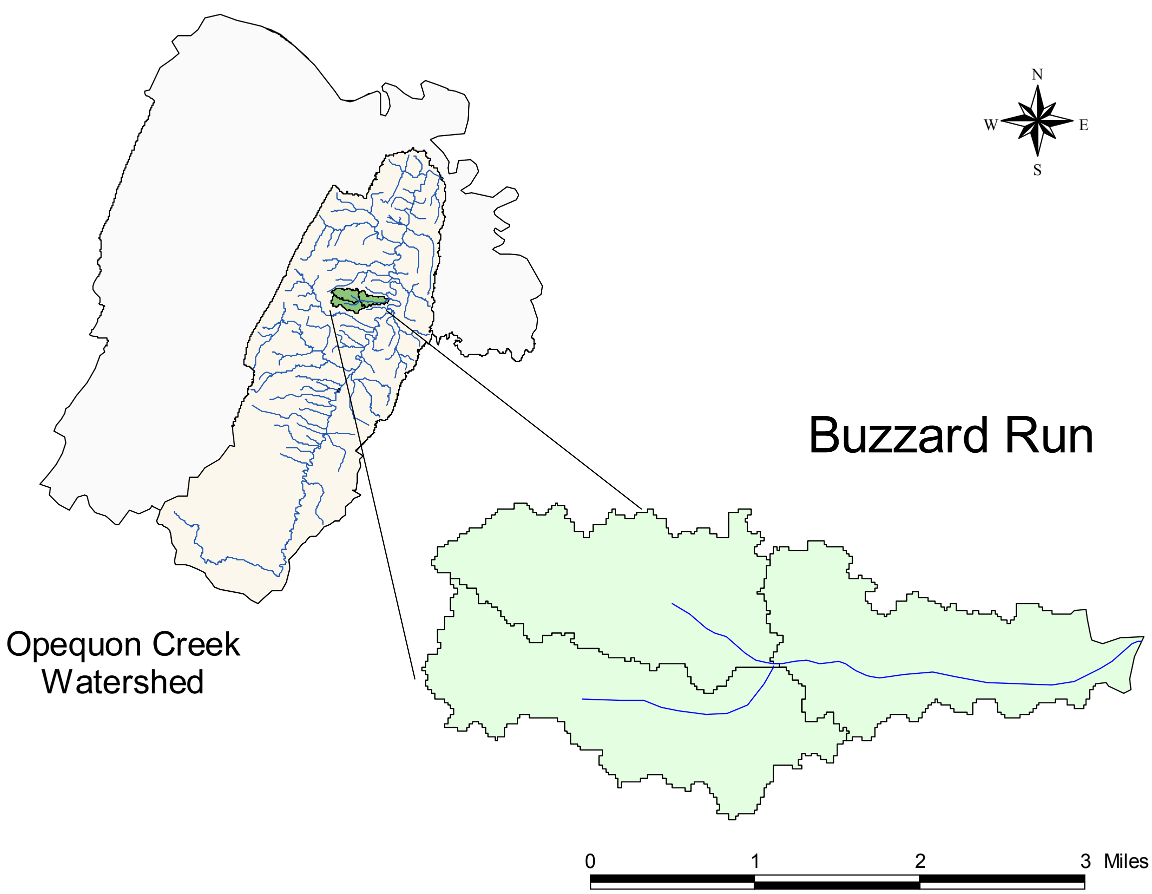


Figure 7-3. Location of the sediment reference stream, Buzzard Run

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

The wetted perimeter and reach length represent the ground area covered by water (Figure 7-4). 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 the estimate of sediment mass eroded for each stream segment. The Technical Report provides more detailed discussions on the technical approaches used for sediment modeling.

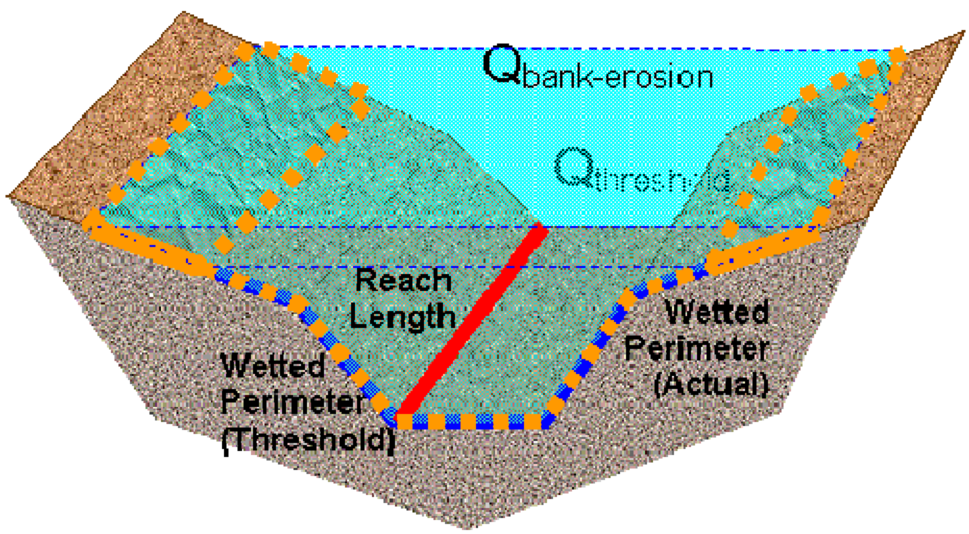


Figure 7-4. Conceptual diagram of stream channel as represented in the bank erosion model

7.2.1 Model Hydrology Calibration

The MDAS hydrology calibration is discussed in Section 7.1.2 and in the Technical Report.

7.2.2 Model Water Quality Calibration

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

Besides land-based sources of sediment, streambank erosion was also modeled. The relevant parameters in the bank erosion algorithms are the threshold flow at which bank erosion starts to occur, and a coefficient for scour of the bank matrix soil for the reach. The threshold flow at which bank erosion starts to occur was estimated as the flow that occurs at bank full depth. The coefficients for scour of the bank matrix soil were a direct function of the reaches' stability factors (S-values).

Sediment calibration consisted of adjusting the sed-suro, sed-ifwo, and sed-agwo concentrations by landuse, and the coefficient of scour for bank erosion. Initial values were adjusted so that the modeled output matched unit area loading values obtained from literature.

7.3 Allocation Analysis

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

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

To develop fecal coliform bacteria and sediment TMDLs for each of the waterbodies listed in Table 3-3 of this report, the following approach was taken:

- Define TMDL endpoints.
- Simulate baseline conditions.
- Assess source loading alternatives.
- Determine the TMDL and source allocations.

7.3.1 TMDL Endpoints

TMDL endpoints represent the water quality targets used to quantify TMDLs and their individual components. West Virginia's numeric water quality criteria for fecal coliform bacteria (identified in Section 2) and an explicit MOS were used to identify endpoints for TMDL development. The normalized loading from the reference watershed and an explicit margin of safety were used to identify endpoints for sediment. 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.

Fecal Coliform Bacteria
The endpoint for fecal coliform bacteria was selected as the instantaneous endpoint of 380 counts/100 mL (based on the 400 counts/100 mL criterion for human health minus a five percent MOS) and the geometric mean endpoint of 190 counts/100 mL (based on the 200 counts/100 mL geometric mean criterion minus a five percent MOS). The instantaneous criterion is more stringent and more difficult to obtain; however, both criteria are satisfied in this TMDL.

Sediment
The endpoints for the sediment TMDLs were based on the simulated reference watershed sediment loading from the Buzzard Run watershed. A five percent MOS was applied to the normalized reference sediment load, and the sediment load reductions necessary to meet those endpoints were then determined.

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

7.3.2 Baseline Conditions and Source Loading Alternatives

The calibrated model provides the basis for performing the allocation analysis. The first step is to simulate baseline conditions, which represent existing nonpoint source loadings and point source loadings at permit limits. Baseline conditions allow for an evaluation of instream water quality under the highest expected loading conditions.

Baseline Conditions for Fecal Coliform Bacteria
The MDAS model was run for baseline conditions using hourly precipitation data for a representative seven-year simulation period (January 1, 1991 through December 31, 1997). 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.

Effluents from sewage treatment plants were represented under baseline conditions as continuous discharges, using the design flow for each facility and the monthly average effluent limitation of 200 counts/100 mL. Nonpoint sources and precipitation-induced point sources were represented based upon drainage area, design precipitation and runoff, as appropriate for each landuse.

Figure 7-5 presents the annual rainfall totals for the years 1980 through 2003 at the Cacapon State Park weather station in West Virginia. The years 1991 to 1997 are highlighted to indicate the range of precipitation conditions used for TMDL development in the Potomac Direct Drains watershed. Figure 7-6 shows examples of model output for a fecal coliform baseline condition and a successful TMDL scenario for both instantaneous output and the 30 day geometric mean of the output.

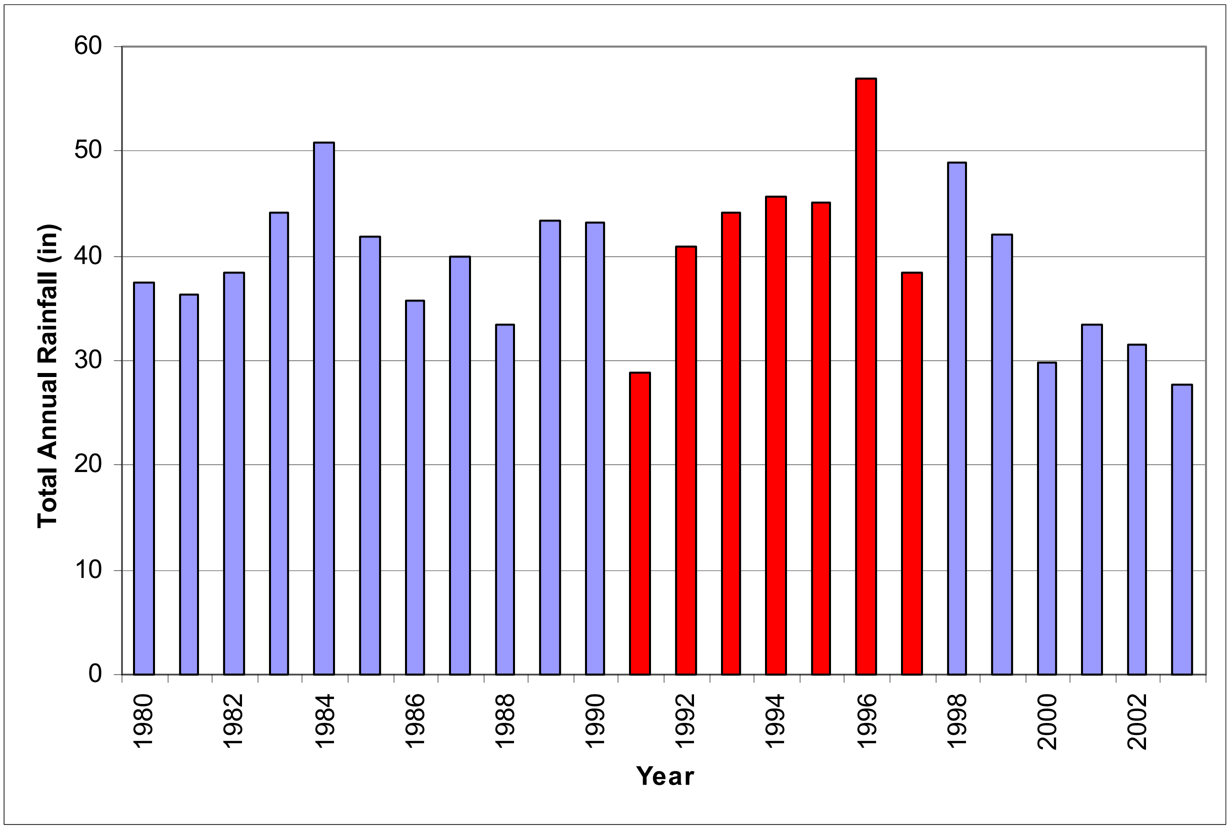
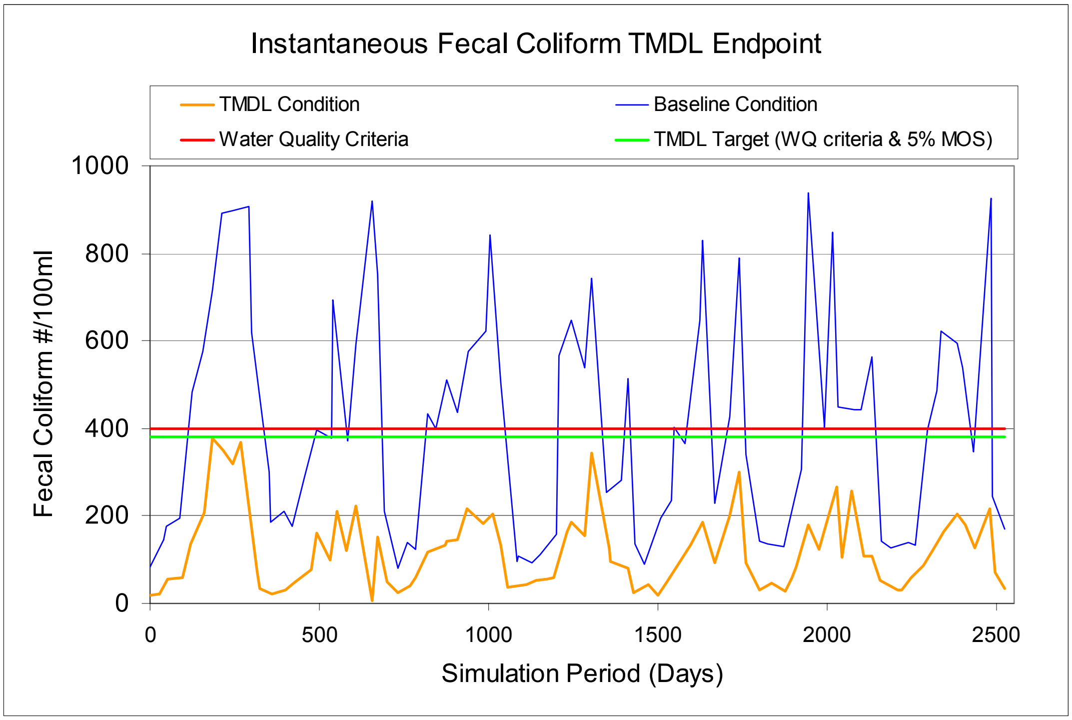


Figure 7-5. Annual precipitation totals and percentile ranks for the Cacapon State Park in West Virginia



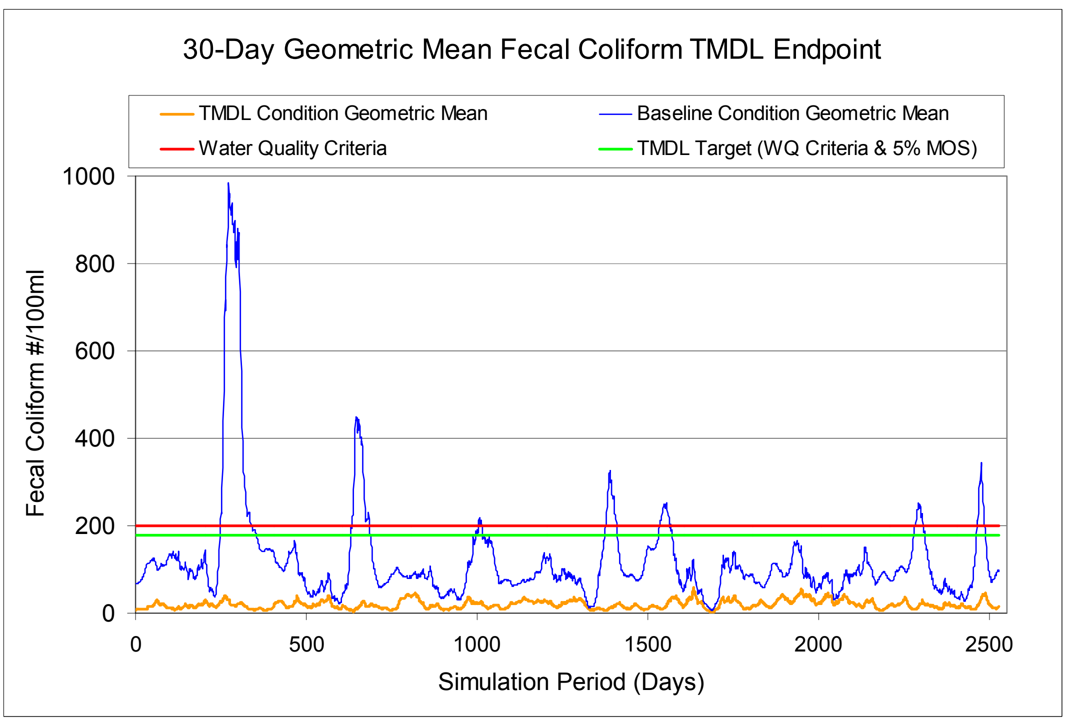


Figure 7-6. Examples of baseline and TMDL conditions (instantaneous and geometric mean) for fecal coliform

Baseline Conditions for Sediment

The calibrated MDAS model provided the basis for performing the allocation analysis. The first step was to simulate baseline conditions, which allowed for an evaluation of instream water quality under the highest expected loading conditions. The pollutant loadings from precipitation-induced point sources and nonpoint sources were represented based upon drainage area, and design precipitation and runoff, as appropriate for each landuse. The effluents from sewage treatment facilities and industrial process wastewater treatment facilities were represented at design flow and TSS effluent limits. The S-values in the MDAS bank erosion model were set at the observed or determined conditions for each subwatershed. The model was run for baseline conditions using daily precipitation data for the representative period discussed earlier. The precipitation data were applied to the landuses and pollutant sources that existed at the time of TMDL development. The resultant predicted watershed loadings were then compared directly with the TMDL endpoint. This comparison allowed evaluation of sediment loadings under a range of hydrologic and environmental conditions, including dry, wet, and average periods.

Source Loading Alternatives

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

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. Successful scenarios were those that achieved the TMDL endpoints under all flow conditions throughout the modeling period.

7.4 TMDLs and Source Allocations

7.4.1 Fecal Coliform Bacteria TMDLs

TMDLs and source allocations were developed for impaired steams and their tributaries on a subwatershed basis throughout the watershed.

A top-down methodology was followed to develop these TMDLs and allocate loads to sources. Headwaters were analyzed first because their loading affects downstream water quality. Loading contributions were reduced from applicable sources in these waterbodies, and TMDLs were developed. The loading contributions of unimpaired headwaters and the reduced loadings for impaired headwaters were then routed through downstream segments. This method allowed contributions from all sources to be weighted equitably.

The following general methodology was used when allocating loads to sources for the fecal coliform bacteria TMDLs. The effluents from all NPDES permitted sewage treatment plants were set at the permit limit (200 counts/100 mL monthly average). Because West Virginia Bureau for Public Health regulations prohibit the discharge of raw sewage into surface waters, all illicit, non-disinfected discharges of human waste (from failing septic systems and straight pipes) were eliminated. If further reduction was necessary, CSOs, MS4s, and nonpoint source loadings from agricultural lands and residential areas were subsequently reduced until instream 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, they were represented by the design flow and the monthly average fecal coliform limit of 200 counts/100 mL and no reductions were applied.

Combined Sewer Overflows
The City of Martinsburg has expended considerable effort to manage overflows from its combined collection system. Currently, only infrequent overflows occur at Outlet C003 of WVNPDES Permit Number WV0023167. In recent years, the City has discharged from this CSO fewer than six times per year. To achieve this level of control, the City has undertaken various collection system upgrade projects that have eliminated CSOs and reduced wet weather flows in the system. A recently completed project in which sewers in the downtown area were retrofitted with cure-in-place pipe is expected to further reduce overflows. The City has also improved operational control at the wastewater treatment plant and collection system pump stations, such that wet weather flow through the wastewater treatment plant is maximized.

The Martinsburg CSO was represented as a discreet point source in the model. The magnitude of its fecal coliform bacteria loading was based upon the maximum observed instream increase indicated by the City's monitoring of Tuscarora Creek immediately upstream and downstream of the CSO. Model representation of occurrence of overflow was based upon storm magnitude and intensity commensurate with the reported precipitation that resulted in CSO overflows in the recent past.

Modeling demonstrates that limited, infrequent overflows from the CSO can continue. The wasteload allocation provides a daily fecal coliform loading that may not be exceeded more than once per calendar month. This level of CSO control, coupled with prescribed reductions for other point and nonpoint sources in the watershed, will result in compliance with fecal coliform water quality criteria in Tuscarora Creek.

Municipal Separate Storm Sewer System (MS4)
USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for stormwater discharges from MS4s. The City of Martinsburg, Berkeley County and WVDOT are designated MS4 entities in the subject watersheds. Each entity will be registered under, and subject to, the requirements of General Permit Number WV0110625. The stormwater discharges from MS4s are point sources for which the TMDLs prescribe wasteload allocations.

Because of the broad definition of an MS4, uncertainty exists regarding the extent of MS4s that are the responsibility of the City of Martinsburg and Berkeley County. Both entities are contemplating the formation of a stormwater utility to comprehensively control stormwater within their jurisdictions and to facilitate implementation of the requirements of the MS4 General Permit. To be consistent with those intentions and to provide the maximum flexibility for local control, the pollutant loadings associated with precipitation and runoff from most land within the corporate boundaries of each entity were aggregated to represent their respective baseline MS4 conditions. Corresponding wasteload allocations were prescribed under the same bases. Only the precipitation-induced loadings from the drainage areas associated with agricultural landuses and the WVDOT MS4s were excluded from the City of Martinsburg's baseline condition and wasteload allocation. The drainage area within the City of Martinsburg corporate boundary, and the drainage areas associated with agricultural landuses and the WVDOT MS4s were excluded from Berkeley County's baseline condition and wasteload allocation. The WVDOT MS4 baseline conditions and wasteload allocations were based upon the drainage areas associated with the roads and MS4s for which WVDOT is responsible, as determined by information provided in their application for registration under General NPDES Permit Number. WV0110625.

The above described methodology for MS4 allocations represents WVDEP's best effort to address the complicated issue of MS4 permitting in a developing area. The watersheds associated with this TMDL effort have experienced significant development in the recent past and this trend is expected to continue. The planned formations of comprehensive stormwater utilities by the Berkeley County Commission and the City of Martinsburg are endorsed and encouraged by WVDEP. The regulatory control that will be available to those utilities is uncertain at this time, but is unlikely to be applicable to private agricultural lands that do not convey stormwater to MS4s. For this reason, the allocations to pasture and croplands are excluded from MS4 wasteload allocations and prescribed as load allocations to nonpoint sources. WVDEP recognizes that the future development of such lands may bring them under local regulatory stormwater control. If that landuse conversion occurs, then the base and allocated nonpoint source loads may be transferred to the wasteload allocation for the appropriate MS4 entity. NPDES permit implementation authority is hereby provided to allow such transfer. The allocation spreadsheet provides the drainage area of pasture and croplands in each subwatershed. Allocation transfer should be proportional to drainage area.

Load Allocations (LAs)

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

- Agricultural landuses — including pasture and croplands
- Onsite Sewage Systems — loading from all illicit, non-disinfected 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 forested land and grasslands in non-MS4 areas. The loadings from wildlife sources were not reduced.

7.4.2 Sediment TMDLs

A unit area loading approach was used to allocate land-based and streambank erosion-based sediment sources. Non-precipitation induced point sources were not considered to be significant sediment sources and were granted wasteload allocations based upon their existing TSS effluent limitations and design flow. For streams with poor riparian habitat and/or unstable streambanks, streambank erosion was first reduced to the loading characteristics of the reference stream, Buzzard Run. If further reductions were needed, significant upland sediment sources were uniformly reduced until the normalized loading to the impaired water was less than or equal to that of the reference stream.

The following landuses were considered to be significant upland sediment sources: barren land, cropland, unpaved roads, pasture lands for which pre-TMDL source tracking determined moderate or high water quality impact, and construction sites subject to the Construction Stormwater General Permit.

Sites subject to the Construction Stormwater General Permit were represented based upon precipitation and runoff from the registered disturbed area and an assumption that proper installation and maintenance of required management practices will achieve an approximate 60 percent reduction of the sediment loading contributed by barren land. All registered sites and sites with registrations pending as of October 2006 were incorporated. To achieve equitable sediment source allocations, the other significant upland sediment sources were reduced to an approximate unit area loading equal to the Construction Stormwater General Permit representation.

This approach resulted in the achievement of TMDL endpoints in the majority of the sediment-impaired streams. Where the allocation resulted in a watershed unit area sediment load less than that of the reference stream, excess loading was translated to area available for registration under the Construction Stormwater General Permit.

Wasteload Allocations (WLAs)
WLAs were developed for all NPDES-permitted facilities with effluent limitations for TSS, for facilities subject to General NPDES Permits related to MS4s, and construction stormwater. Wasteload allocations are also provided for facilities registered under the Multi-sector Stormwater Permit, if the registration includes benchmark values for TSS.

Municipal Separate Storm Sewer System (MS4)
USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for stormwater discharges from MS4s. The City of Martinsburg, Berkeley County and the West Virginia Department of Transportation (WVDOT) are designated MS4 entities in the subject watersheds. Each entity will be registered under, and subject to, the requirements of General Permit Number WV0110625. The stormwater discharges from MS4s are point sources for which the TMDLs prescribe wasteload allocations.

Because of the broad definition of an MS4, uncertainty exists regarding the extent of MS4s that are the responsibility of the City of Martinsburg and Berkeley County. Both entities are contemplating the formation of a stormwater utility to comprehensively control stormwater within their jurisdictions and to facilitate implementation of the requirements of the MS4 General Permit. To be consistent with those intentions and to provide the maximum flexibility for local control, the pollutant loadings associated with precipitation and runoff from most land within the corporate boundaries of each entity were aggregated to represent their respective baseline MS4 conditions. Corresponding wasteload allocations were prescribed under the same bases. Only the precipitation-induced loadings from the drainage areas associated with agricultural landuses and the WVDOT MS4s were excluded from the City of Martinsburg's baseline condition and wasteload allocation. The drainage area within the City of Martinsburg corporate boundary, and the drainage areas associated with agricultural landuses and the WVDOT MS4s were excluded from Berkeley County's baseline condition and wasteload allocation. The WVDOT MS4 baseline conditions and wasteload allocations were based upon the drainage areas associated with the roads and MS4s for which WVDOT is responsible, as determined by information provided in their application for registration under General NPDES Permit Number WV0110625.

As described in Section 7.4.1, allocations to pasture and croplands are excluded from MS4 wasteload allocations and prescribed as load allocations to nonpoint sources. The provisions for allocation transfer described in Section 7.4.1 are also applicable to sediment should private agricultural lands come under MS4 stormwater control.

In the majority of the subwatersheds where MS4 entities have areas of responsibility, the urban, residential and road landuses strongly influence bank erosion. As such, the base and allocated loads associated with bank erosion are generally included in the MS4 wasteload allocations. Only in a limited number of subwatersheds where WVDEP source tracking determined moderate and high water quality impact from agricultural landuses, are the bank erosion component of the load prescribed as nonpoint source load allocations. The subdivision of the bank erosion component between multiple MS4 entities is proportional to their respective drainage areas within each subwatershed.

Model representation of bank erosion is accomplished through consideration of a number of inputs including slope, soils, imperviousness, and the stability of existing streambanks. Bank erosion loadings are most strongly influenced by upland impervious area and bank stability. The decision to include bank erosion in the MS4 wasteload allocations results from the predominance of urban/residential/road landuse and impact in MS4 areas, and the assumption that conversion of other landuses will occur under the regulatory controls of the MS4 permit and local stormwater utilities. However, even if the implementation of stormwater controls on uplands is maximized, and the volume and intensity of stormwater runoff are minimized, the existing degraded stability of streambanks will continue to accelerate erosion. The erosion of unstable streambanks is a nonpoint source of sediment that is included in the MS4 allocations. Natural attenuation of legacy impacts cannot be expected in the short term, but may be accelerated by bank stabilization projects. The inclusion of the bank erosion load component in the wasteload allocations of MS4 entities is not intended to prohibit or discourage cooperative bank stabilization projects between MS4 entities and DEP's Nonpoint Source Program, nor to prohibit the use of Section 319 funding as a component of those projects.

Construction Stormwater WLAs

Initially, 176 sites registered under the Construction Stormwater General Permit and located in the watersheds of sediment impaired streams were represented in the model. The disturbed land associated with those permit registrations totaled approximately 4,201 acres. Because of the rapid rate of development experienced in the Opequon watershed, the WVDEP Environmental Resources Information System (ERIS) database was again queried in October 2006 to determine additional site registrations that occurred after the initial model configuration. Subsequently, the model was reconfigured to add an additional 99 registered sites totaling 3,581 disturbed acres and 22 pending site registrations with 688 disturbed acres. While the existing rate of land disturbance is concerning, the model indicates that a relatively large percentage of a watershed can be disturbed while maintaining the normalized sediment loading of the reference watershed.

Model representation of discharges under the Construction Stormwater General Permit is precipitation-based and couples the design precipitation with the disturbed acreages. The modeled discharge quality is based upon the assumption that proper installation and implementation of the BMPs associated with the permit will achieve a 65 percent reduction of barren land sediment loadings. The water quality impacts of construction activities registered under the permit are transient, and upland sediment loadings are minimized after construction is completed and the sites are stabilized. In the determination of wasteload allocations, the sediment loading associated with the total area registered under the permit was evaluated with respect to the location at which biological impairment was observed, i.e. the mouth of the sediment-impaired stream.

All active registered sites and pending site registrations as of October 2006 are provided individual wasteload allocations. In most watersheds, the existing registered and pending acreage is accommodated, with additional acreage available for future growth. In two watersheds (Elks Run and Elk Branch), the existing registered acreage exceeds that which may be accommodated and the wasteload allocations for those watersheds prescribe pollutant reductions.

It is important to note that the model representation of Construction Stormwater General Permit registrations addresses only the upland loading of sediment contributed from active registered sites. The potential post-construction impacts from increased stormwater volume/velocity must be addressed through implementation of bank erosion allocations.

Other Individual and General NPDES permits

Individual and General NPDES Permits for sewage treatment facilities, industrial process wastewater, and stormwater associated with industrial activity (Multi-sector Stormwater Permit) contain technology-based TSS effluent limitations or benchmark values. Facilities that are compliant with such limitations are not considered significant sediment sources. Example permits include:

- Individual and general NPDES permits for sewage treatment facilities (POTWs, private sewage treatment plants, package plants and home aeration units) with 30 mg/L monthly average effluent limitations for TSS

- The Multi-Sector Stormwater General Permit with TSS benchmark values equal to 100 mg/L

- Individual NPDES permits for industrial process wastewater with 60 mg/L maximum daily TSS effluent limitations
- Individual and general permits for quarries with 35 mg/L average monthly and 70 mg/L maximum daily effluent limitations for TSS

All such facilities are recognized in the sediment modeling process and are assigned wasteload allocations that allow for continued discharge under existing permit conditions.

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

- Agricultural landuses — including pasture and croplands
- Barren land areas — including barren and burned forest areas
- Residential — sediment loading associated with urban/residential runoff from non-MS4 areas
- Roads — including paved and unpaved roads in non-MS4 areas
- Instream processes — bank erosion and deposition
- Other nonpoint sources — forested areas and grassland in non-MS4 areas (the background loadings from other nonpoint sources were not reduced)

7.4.3 Seasonal Variation

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

7.4.4 Critical Conditions

TMDL developers must select the environmental conditions that will be used for defining allowable loads. Many TMDLs are designed around the concept of a critical condition. The critical condition is the set of environmental conditions, under which, if the objectives are met, the attainment of objectives for all other conditions will be ensured. Nonpoint source loading is typically precipitation-driven. Instream impacts tend to occur during wet weather and storm events that cause surface runoff to carry pollutants to waterbodies. During dry periods little or no land-based runoff occurs, and elevated instream pollutant levels may be due to point sources (Novotny and Olem, 1994). The wet weather critical condition is applicable for the sediment related biological impairments. Analysis of fecal coliform water quality data shows that high pollutant concentrations can occur during both high and low flow. In some segments, the adverse impact from failing or non-existent on-site sewage treatment systems causes criteria exceedances during low-flow periods. In those streams and others, stormwater bacteria loadings also cause exceedances during wet weather. Both high-flow and low-flow periods were taken into account during TMDL development by using a long period of weather data that represented wet, dry, and average flow periods.

7.4.5 Incorporation of Virginia TMDLs for Opequon Creek Watershed

In 2003, the Virginia Department of Environmental Quality (VADEQ) completed a TMDL for fecal coliform bacteria for the Virginia portion of Opequon Creek. The Hydrologic Simulation Program - Fortran (HSPF)-based Virginia TMDL model calculated daily average stream flow and fecal coliform bacteria concentration at the point where Opequon Creek crosses the state line into West Virginia. The TMDL model output for the implemented TMDL condition was obtained from VADEQ and incorporated as a point source into the West Virginia TMDL model to account for the instream fecal contribution of Opequon Creek as it enters West Virginia.

VADEQ also completed a sediment TMDL for the Virginia portion of Opequon Creek. The TMDL calculated the annual average sediment load at the point where Opequon Creek crosses the state line into West Virginia. The Virginia average annual sediment load under fully implemented TMDL conditions was 53,908 tons/year. This load was synchronized with modeled daily flow data to produce daily flow and TSS concentration values equal to the annual TMDL sediment load. These daily flow and concentration values were incorporated as a point source into the West Virginia TMDL model to account for the instream sediment contribution of Opequon Creek as it enters West Virginia.

7.4.6 TMDL Presentation

Fecal coliform and sediment TMDLs, load allocations, and wasteload allocations are shown in the allocation spreadsheets associated with this report. TMDLs are also presented in the TMDL watershed appendices for the impaired streams within each of those TMDL watersheds.

TMDLs, and their components, are presented as average annual loads because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. TMDLs are also presented as equivalent average daily loads.

Wasteload allocations for individual and general NPDES permits for sewage treatment facilities, industrial process wastewater, and stormwater associated with industrial activity (Multi-sector Stormwater Permit) 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. Wasteload allocations for MS4 entities are prescribed in multiple formats. Because the sediment TMDLs address biological impairment observed at or near the mouth of impaired waters, the operable MS4 sediment wasteload allocations are those that are presented by MS4 entity and impaired water on the tab entitled “MS4 WLA_Sediment_Stream_Summary”. To assist in implementation, two additional spreadsheets are provided that portray a successful allocation scenario. For this scenario, the “MS4 WLA_Sediment_Summary” tab prescribes consolidated allocations by MS4 entity and model subwatershed, and the “MS4 WLA_Sediment_Detailed” tab prescribes detailed allocations by MS4 entity, model subwatershed and landuse category. In contrast to sediment TMDLs, where allocations are aimed at impairment observed near the mouth of the waterbody, fecal coliform TMDL allocations address impairments at multiple locations, with model prediction of necessary pollutant reductions at the pourpoint of each subwatershed. For this reason, the operable MS4 fecal coliform wasteload allocations are those that are presented by MS4 entity and model subwatershed on the tab entitled "MS4 WLA_Fecal_Summary". To assist in implementation, an additional spreadsheet, entitled "MS4 WLA_Fecal_Detailed", portrays a successful allocation scenario and prescribes detailed allocations by MS4 entity, model subwatershed and landuse category.

The sediment wasteload allocations for Construction Stormwater General Permit registrations are presented as both annual average loads, for comparison with other sources, and equivalent area registered under the permit. The registered area is the operable allocation. Note that the wasteload allocations for existing registrations in Elks Run and Elk Branch, where existing registered area exceeds that which is allocated for those waters, are portrayed as a uniform percentage reduction from all existing sites in the watershed. The primary implementation focus for site registrations under the Permit should be the maintenance of total registered area less than the total area allocated for the sediment-impaired stream. As such, implementation in Elks Run and Elk Branch need not involve area reductions to each and every registered site, provided that actions are taken to reduce the total registered area to the total area allocated for those waters.

Load allocations for nonpoint sources are presented on the "LAs_Fecal" tab of the "PDD_Fecal_TMDL_Allocations_2_8_07.xls" and "PDD_Sediment_TMDL_Allocations_2_8_07.xls" spreadsheets. These spreadsheets display allocations by model subwatershed, jurisdiction, and nonpoint source category and incorporate the following concepts:

- The TMDL conditions of the fecal coliform and sediment TMDLs developed by the VADEQ for Opequon Creek define the water quality of Opequon Creek at the location where it exits Virginia and enters West Virginia. As such, the load allocation spreadsheets display the gross output of the VADEQ TMDLs for subwatershed 4127.

- Certain watersheds or portions of watersheds are located in Virginia and discharge into West Virginia tributaries of Opequon Creek and Sleepy Creek. For such watersheds, gross allocations are provided for the Virginia portion and detailed allocations by nonpoint source category are provided for the West Virginia portion.

- Certain watersheds are entirely subject to MS4 permitting requirements, and MS4 wasteload allocations are exclusively prescribed for the appropriate MS4 entities. Other watersheds have mixed areas of MS4 applicability and nonpoint sources. In those watersheds, the detailed allocations by nonpoint source category are applicable to the non-MS4 areas of the watershed.

8. FUTURE GROWTH AND WATER QUALITY TRADING

8.1 Fecal Coliform Bacteria

This TMDL does not include specific future growth allocations to each subwatershed. However, the absence of specific future growth allocations does not prohibit new development in the subwatersheds for which fecal coliform TMDLs have been developed or preclude 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 average monthly 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 or permit overflows from newly constructed collection systems.

8.2 Sediment

Most point source discharges are assigned technology-based TSS effluent limitations that would not cause biological impairment. For example, NPDES permits for sewage treatment and industrial manufacturing facilities contain monthly average TSS effluent limitations between 30 and 100 mg/L. New point sources may also be permitted in the sediment-impaired watersheds with the implementation of applicable technology-based TSS requirements.

In addition to the existing Construction Stormwater General Permit registrations in the sediment-impaired watersheds, specific future growth allowances are provided. The successful TMDL allocation scenarios allow a total area for each sediment-impaired stream that may be registered under the Construction Stormwater General Permit at any time. The available areas for sediment-impaired waters are displayed in Table 8-1.

For most waters, the existing registered area is less than that which has been allocated. The reserved acreage is expected to accommodate future development in the subject watersheds. If development projects are proposed in excess of the area provided, they may be permitted by implementing controls beyond those afforded by the general permit. Larger areas may be permitted if it can be demonstrated that tighter controls will result in a loading condition commensurate with the general permit area allocations provided in Table 8-1.

Table 8-1. Future growth for construction stormwater permits

Major Watershed	Stream Name	Stream Code	Contributing Subwatershed(s)	Allowable Construction Stormwater Area (Acres)
UNT/Potomac	UNT/Potomac River RM 12.8 (Teague's Run)	WVP-2.2	221	36
Elks Run	Elks Run	WVP-1	1001 through 1011	489
Elks Run	Elk Branch	WVP-1-A	1009, 1010, 1011	354
Opequon Creek	Opequon Creek	WVP-4	4001 through 4126	92,716
Opequon Creek	Hoke Run	WVP-4-A	4003, 4004, 4005, 4006, 4007	1,435
Opequon Creek	Eagle Run	WVP-4-B	4013, 4014, 4015, 4016, 4017	179
Opequon Creek	Tuscarora Creek	WVP-4-C	4021 through 4038	3,110
Opequon Creek	Dry Run	WVP-4-C-1	4025, 4026, 4027, 4028, 4029	957
Opequon Creek	Evans Run	WVP-4-D	4041, 4042, 4043, 4044	852
Opequon Creek	Shaw Run	WVP-4-F	4049, 4050, 4051, 4052	538
Opequon Creek	Hopewell Run	WVP-4-I	4060 through 4071	717
Opequon Creek	Middle Creek/Opequon	WVP-4-J	4074 through 4081	904
Opequon Creek	Mill Creek	WVP-4-M	4092 through 4109	4,683
Opequon Creek	Torytown Run	WVP-4-M-2	4104, 4105, 4106	522
Opequon Creek	Sylvan Run	WVP-4-M-1	4107, 4108, 4109	1,028
Opequon Creek	Turkey Run	WVP-4-N	4111, 4112, 4113, 4114	332
Opequon Creek	Silver Spring Run	WVP-4-P	4118, 4119, 4120	290
Harlan Run	Harlan Run	WVP-5	5001 through 5012	1,047
Harlan Run	Tullis Branch	WVP-5-A	5006	365

8.3 Water Quality Trading

This TMDL neither prohibits nor authorizes trading in the watersheds addressed in this document. WVDEP generally endorses the concept of trading and recognizes that it might become an effective tool for TMDL implementation. However, significant regulatory framework development is necessary before large-scale trading in West Virginia can be realized.

Furthermore, WVDEP supports program development assisted by a consensus-based stakeholder process. Before the development of a formal trading program, it is conceivable that the regulation of specific point source-to-point source trading might be feasible under the framework.

9. PUBLIC PARTICIPATION

9.1 Public Meetings

Informational public meetings were held on May 5, 2003 at the Martinsburg public library and on December 19, 2005 at the James Rumsey Technical Institute in Martinsburg, West Virginia. The May 5, 2003 meeting occurred prior to pre-TMDL stream monitoring and pollutant source tracking and included a general TMDL overview and a presentation of planned monitoring and data gathering activities. The December 19, 2005 meeting occurred prior to allocation of pollutant loads and included information on WVDEP allocation strategies.

A public meeting was held to present the draft TMDLs on February 27, 2007, at James Rumsey Technical Institute. This meeting occurred during the public comment period and was designed to provide information to stakeholders that would facilitate comments on the draft TMDLs.

9.2 Public Notice and Public Comment Period

The availability of draft TMDLs was advertised in local newspapers on February 14, 2007. Interested parties could submit comments during the public comment period, which began on February 14, 2007 and ended March 15, 2007. Documents were available on WVDEP's internet site at http://www.wvdep.org and could also be obtained by contacting WVDEP.

9.3 Response Summary

The following entities provided written comments on the draft TMDLs:

- Elks Run Study Group
- Paul Burke and Wm. Kelly Baty
- Town of Bolivar
- Virginia Department of Environmental Quality
- United States Environmental Protection Agency Region 3

Comments have been compiled and responded to in this response summary. Comments and comment summaries are in boldface. Agency responses appear in plain text. The comments received from the United States Environmental Protection Agency Region 3 included various suggested typographical /editorial revisions. Although not individually detailed in this summary, WVDEP considered all such comments and revised appropriate report components.

Two submissions suggest that the fecal coliform bacteria model should represent bacteria loading associated with leakage from the sewage collection systems. One commenter stated that the TMDL needs to "*commit WVDEP to monitoring and penalizing sewer pipe leaks*" and that "*all central sewer systems need to track and fix all leaks and connections.*"

It was suggested that the design allowance for infiltration in new systems be used in conjunction with a literature value for fecal coliform concentration in sewage to calculate bacteria loadings to surface waters from leaking collection systems. WVDEP believes the suggested approach would grossly overestimate bacteria loading from this source. In new sewer design, the 200gpd/in/mile allowance is used in conjunction with other criteria to ensure adequate hydraulic capacity and to guard against under-sizing system components. It is not intended as an estimate of the rate of sewage that would escape from the system. Due to the greater exterior pressure on sewers, groundwater infiltration is much more likely in degraded systems. Furthermore, the fecal coliform bacteria load from seepage couldn't be assumed as a direct input to surface water. Any bacteria emitted would have to travel through soils to groundwater and then to surface water and would be subject to biodegradation and dilution along its travel path.

Infiltration and inflow (I&I) of variable magnitude are present in all sewage collection systems, with impacts generally more significant in older collection systems. Present-day pipe materials, jointing practices and materials, and the leak and alignment testing during construction greatly minimize the infiltration into new sewers. Local sewer use regulations and enforcement are also effective in minimizing inflow sources. WV/NPDES permits require proper operation and maintenance of collection system components and prohibit untreated discharges from closed systems. As the adverse impacts of significant I&I commonly result in hydraulic overloading of collection systems (from groundwater and stormwater entering the system), WVDEP often imposes permit conditions and/or initiates enforcement actions requiring the development and implementation of I&I abatement programs. The new sewer construction practices and the execution of I&I abatement plans in degraded systems both serve to mitigate the amount of untreated bacteria that might exit sewage collection systems.

WVDEP recognizes that some amount of sewage may leak from sewage collection systems, but has no information to indicate this to be a significant source of fecal coliform bacteria in the surface waters that are the subject of this TMDL effort. The TMDLs do not authorize bacterial loading from collection system seepage or Sanitary Sewer Overflows and are consistent with the aforementioned NPDES permit requirements that prohibit untreated sewage discharges. When permit noncompliance is identified, WVDEP will continue to pursue enforcement actions that require sewer system rehabilitation.

It was suggested that the TMDL report was overly technical and would be more helpful to non-professionals by *"providing more context for the TMDL process as a whole, more extended definitions and explanations, and a note on scientific notation."*

Many TMDL subjects are complex and some amount of technical discussion is necessary for effective communication. The reports offered for public comment attempt to portray the complex subject matter in the simplest possible terms and highly technical information is contained in a separate Technical Report.

WVDEP also attempts to increase public awareness/understanding of TMDLs through public outreach activities. A large part of the agenda for the initial public meeting associated with the TMDLs (May 5, 2003 – Martinsburg Public Library) was dedicated to the explanation of TMDLs and their relation to water quality standards, and the WVDEP's process for TMDL development. Basic concepts were reiterated during subsequent public meetings and all public meetings included time for WVDEP to answer questions. Further, all public meeting presentations remain posted on the webpage from which the Draft TMDLs may be obtained.

In regard to scientific notation, explanatory notes have been added at multiple locations in the main report and appendices and on the Introduction tab of the Fecal Coliform Allocation Spreadsheet.

One commenter indicated that they became aware of the TMDL process "*very late in the game*" and expressed disappointment with the TMDL public outreach activities.

Multiple public outreach activities were associated with the Potomac Direct Drains TMDL development process, as described in Section 9.1. Public meetings were held at three important steps in the process: prior to the initiation of pre-TMDL monitoring and source tracking, prior to allocating pollutant loads, and after development of the draft TMDLs. All meetings were well attended. Each meeting's agenda included a significant allowance of time for questions and answers. In addition to the public meetings, WVDEP met with the Sleepy Creek Watershed Association, the Opequon Project Team, the City of Martinsburg, and representatives of Berkeley County during the latter stages of draft TMDL development.

The accuracy of the value of the average annual sediment load from the Virginia Opequon Creek Sediment TMDL under fully implemented TMDL conditions was questioned. The commenter stated that the correct value was 53,908 tons/year, whereas a value of 53,335 tons/year is indicated in the draft West Virginia TMDL.

The upstream boundary condition presented in the draft West Virginia Opequon Creek Sediment TMDL was incorrect. The correct loading associated with the Virginia Opequon Creek Sediment TMDL under fully implemented conditions (53,908 tons/year) has been incorporated into the model. The TMDL and components have been recalculated to reflect the revision. This revision has no impact on pollutant allocations for West Virginia sources.

One commenter asked if any "build-out scenarios" are included in the TMDL.

The format of the TMDLs does not include build–out scenarios to address new development. Instead, allocations for stormwater associated with construction include provisions for future growth and fixed stream bank erosion allocations establish the appropriate targets for post-construction stormwater impacts.

One commenter suggests that the load allocations for non-point sources represent unrealistic pollutant reduction expectations. In particular, the commenter suggests that 100 percent bacteria reductions from failing septic systems requires abandoning all houses and 89 percent agricultural bacteria reductions requires killing cows. The commenter also proposed that recognition and reduction of leakage from centralized sewer systems would allow increased loadings from failing septic systems and agricultural activities.

Because failing on-site sewage systems with surface discharges constitute a public health hazard, the prescribed 100 percent reductions of bacteria loadings are consistent with the 64CSR9 (*Legislative Rule, Division of Health: Sewer Systems, Sewage Treatment Systems, and Sewage Tank Cleaners).* Implementation of the allocations involves corrective actions on malfunctioning systems, and not the abandonment of houses. Relaxation of allocations for failing septic systems would be impractical because it would legitimize circumstances that are prohibited by the rule.

Significant bacteria reduction can be expected through implementation of the agricultural Best Management Practices of livestock access restriction and riparian buffer establishment. The prescribed allocations are not more stringent than the background bacteria loadings that include wildlife contributions and reduction of the number of livestock is not an anticipated implementation practice. Better manure management, not fewer animals, can achieve the needed reductions.

As stated previously, WVDEP has no evidence that leakage from centralized sewer systems is a significant bacteria source in the waters that are the subject of this TMDL development effort. Notwithstanding that position, allocations for traditional non-point sources would be unaffected by any prescription of allocations for sewer leakage. Impacts from leakage would occur during low flow periods when precipitation-induced impacts are not active, and conversely, during high flow conditions, the precipitation-induced non-point source loadings would make those associated with leakage insignificant.

One commenter suggested that septic systems could be treated the same as sewer permits and allowed average concentrations equal to the water quality standard.

This would be impractical because a surface discharge from a septic system is evidence of malfunction. Furthermore, it would be unreasonable to assume that the illegal discharges would be effectively disinfected to achieve fecal coliform water quality criteria.

One commenter suggests that the TMDL underestimates the dry weather contribution of fecal coliform bacteria from wildlife.

Wildlife contributions to fecal coliform loading were represented as background nonpoint source loadings in the MDAS model. Fecal coliform loadings from wildlife sources were captured in the accumulation rate and wash-off parameters in the watershed model. Wildlife was assumed to be the dominant source of fecal coliform in the following modeled landuses: water, wetland, barren, forest, and non-pasture grassland. Water and wetland landuses were assigned parameter values to reflect direct deposition from wildlife to streams under low flow conditions. Over the past several years, WVDEP has collected instream fecal coliform water quality data throughout West Virginia and the data have shown that fecal coliform water quality criteria are not violated in areas with limited human activity.

Field observations from Meadow Branch (tributary to Sleepy Creek) were used to calibrate background (wildlife) fecal coliform loading. The Meadow Branch watershed is located almost entirely within the boundaries of Sleepy Creek Wildlife Management Area and residential and agricultural landuses represent a very small percentage of watershed area. Simulated daily average fecal coliform concentrations were compared to the observed water quality data collected during pre-TMDL monitoring efforts. The model output follows the observed trend over various flow regimes throughout the year. Parameter values from the Meadow Branch calibration were applied to the aforementioned landuses to represent wildlife bacteria contribution.

It was contended that the rate of failing septic systems is overestimated in the Elks Run watershed and that over-estimated loads from failing septic systems are masking impacts from leaking centralized sewage collection systems.

Model representation of the number of failing septic systems was based upon a number of information sources. First, interviews were conducted with sanitarians from the Berkeley County Health Department. This identified general areas where septic failures were relatively common and areas with relatively low failure rates. These areas with varying septic failure rates were then correlated to the major soil types in the area. Soil characteristics, including depth to bedrock, depth to groundwater, and permeability, were used to classify area soils into four general zones of expected septic failure rates (high, medium, low, and very low) based on the characteristics of individual soil types. USDA county soil survey maps were then used to delineate the four zones of expected septic failure in Berkeley and Jefferson counties.

Infrared photography had been previously obtained in several Berkeley County residential areas. The infrared photographs were analyzed to determine locations of actual failing septic systems; failure rates for each of the four septic failure zones were determined by overlaying the infrared photography with the septic failure zone maps. The actual numerical failure rates corresponded very well with both the anecdotal information provided by the local health department and the expected degree of failure (high, medium, low, very low) based on the broad classifications of the soil characteristics. Although the methodology for determining the number of septic system failures was primarily based upon information from Berkeley County, the similarities in soil types and characteristics made practical its application to the bacteria impaired waters in Jefferson County.

Electronic mapping of “addressable structures” was obtained from the emergency services offices (E-911 centers) for Jefferson and Berkeley counties. These maps provided a GIS shapefile of essentially all houses and businesses located in the counties. Electronic “extent of sewer line” maps were developed for sewered areas by interviewing system operators and reviewing sewer system engineering drawings.

The above-described information was combined to estimate the number of failing septic systems in the unsewered areas of the Potomac Direct Drains on a subwatershed basis.

Calibration of the bacteria loading associated with failing septic systems was accomplished by a detailed assessment of stream bacteria concentrations measured during low precipitation periods in subwatersheds that did not contain permitted sewage discharges. While holding constant the flow rate for two types of failures, an average bacteria concentration (527,179 counts/100 ml) was back calculated from the measured instream loads and the associated number of estimated failures. Application of this concentration provided acceptable calibration during wet periods, but overestimated loading during dry periods, when a significant portion of septic overflows do not reach surface waters. Representation of the reduced loading during dry periods was accomplished by adjusting the concentration associated with failing septic flow, as this methodology provided the best calibration during summer dry periods.

Detailed descriptions of the processes for determining the failure rate and the bacteria loading to surface waters resulting from those failures are provided in the Technical Report. The magnitude of this TMDL development effort necessitates the use of the described assumptions and simplifications. Since other factors such as structure age and the adequacy of homeowner maintenance can influence the performance of septic systems, some variation from the model accounting of failing septic systems is expected at the subwatershed level. The range of calculated septic flow concentrations in the watersheds used for calibration is more indicative of this expected variation than suggestive of an alternative causative source.

One commenter disputed the validity of the future growth provision allowing unrestricted new disinfected sewage discharges and another expressed concern regarding this policy.

The future growth provision is based upon the concept that the discharge of a pollutant at or below the value of a water quality criterion does not cause or contribute to a violation of water quality standards. In regard to fecal coliform bacteria, the applicable technology-based effluent limitations included in WV/NPDES permits for discharges from sewage treatment facilities are more stringent than the current water quality criteria. Limits and criteria both include a 200 counts /100 ml monthly geometric mean provision; however, the daily maximum effluent limitation of 400 counts/100ml is more restrictive than the criteria that allow exceedance of 400 counts/100 ml 10 percent of the time.

One commenter suggested that the TMDLs should control water use because the inter-basin transfer of water may reduce assimilative capacity. The commenter also contended that the bacteria concentration in the groundwater base flow component of surface waters will be increased when it is used and returned to surface waters as disinfected effluent.

Although the lowering of the available assimilative capacity through groundwater use and inter-basin transfer is possible, the prescribed allocations for low-flow critical sources (100 percent reduction of failing septic systems and treated sewage discharges limited to criteria end-of-pipe) protect remaining water quality.

One commenter stated that TMDLs should be developed for Town Run, Rattlesnake Run and Rockymarsh Run.

Evidence of impairment was not available for Rattlesnake Run (WVP-2) and Rockymarsh Run (WVP-3) at the outset of the TMDL development process and those waters were not specifically targeted. When biological impairments were realized, WVDEP lacked the detailed water quality and pollutant source information necessary to develop valid TMDLs. As such, the impairments are included on the West Virginia 2006 Section 303(d) list and TMDLs will be developed at the next opportune time, but not later than 2021. WVDEP has no information regarding use impairment for Town Run (WVP-2.3).

It was contended that the TMDL report contains false statements relative to the non-point source control efforts of the West Virginia Watershed Network that should be revised.

The overview of the West Virginia Watershed Network provided in Section 10 does not contain false statements or misrepresentations. Network activities are aimed at the non-point source pollution control. This is not to say that non-point sources of pollution are subject to ***regulatory*** controls, because most are not. TMDLs must prescribe the pollutant reductions needed to attain water quality standards, but do not provide additional regulatory controls. Where they are causative sources for non-attainment of standards, it is proper for TMDLs to call for significant pollutant reductions from non-point sources, as exemplified by the load allocations in the Potomac Direct Drains TMDLs. Because of the lack of regulatory controls, implementation must be based on voluntary and cooperative activities from local stakeholders, with the assistance of funding that may be available from Network member organizations.

The Section 10.2 discussion of the West Virginia Watershed Management Framework was criticized as too sketchy to provide an adequate background for newcomers to the process. A perceived implication that Watershed Based Plans will not be developed for Elks and Teague Run was also criticized and the omission of implementation plans for Elks Run and Teague Run was portrayed as a serious flaw.

The Draft TMDLs do not include specific implementation plans for any impaired water. The intent of Section 10 is to describe the various point and non-point source control mechanisms that are available and to demonstrate that the TMDLs can be implemented. Section 10.2 provides a general overview of the West Virginia Watershed Network and Watershed Management Framework, and describes activities that are underway in the Potomac Direct Drains watershed. More detailed information regarding the Network and Framework can be obtained from WVDEP's website, on the Nonpoint Source webpage:

http://www.wvdep.org/item.cfm?ssid=11&ss1id=588

Section 10.2 discusses Opequon Creek and Sleepy Creek and their respective project teams because of their prior selection as priority watersheds. This should not be construed as a prohibition to the formation of teams and/or the development of Watershed Based Plans for additional watersheds. Assistance with team formation and Watershed Based Plan development can also be obtained from the Potomac Basin Coordinator (Alana Hartman – ahartman@wvdep.org).

The Elks Run Study Group requested that they be able to participate in future TMDL activities that involve Elks Run. The Town of Bolivar recommended that the Elks Run Study Group be included as a full participant in the West Virginia Watershed Management Framework and expressed concern that Elks Run was not selected as a priority watershed.

Membership in the West Virginia Watershed Network is voluntary and everyone is invited to participate. It is unfortunate that the Elks Run Study Group did not participate in the Hydrologic Group C prioritization that occurred in 2006. The group is welcome to fully participate in future Network activities. Even though Elks Run was not selected as a priority watershed in 2006, the formation of a local project team and the development of a Watershed Based Plan remain possible. The WVDEP point of contact for assistance in this regard is the Potomac Basin Coordinator.

One commenter stated that water quality trading should not be applied to Elks Run because it is the drinking water source for the Town of Bolivar.

The TMDL for Elks Run does not authorize trading and no formal trading framework has been developed for West Virginia. Any trading activity would have to be controlled to ensure that the existing uses of a stream are maintained. The fecal coliform criteria upon which the TMDL is based apply to the public water supply use and water contact recreation uses. Although the report indicates that specific point source-to-point source trading might be feasible in certain situations, fecal coliform trading in West Virginia waters does not appear feasible because it would not be possible to authorize bacteria loadings in excess of the criteria for the water contact recreation use which is universally applicable.

One commenter suggested that increased funding is needed for public education regarding stream buffers and septic tank maintenance.

WVDEP recognizes the value of education and applies all available resources to this effort. Public education regarding non-point source issues and support of citizen-based watershed organizations are important components of WVDEP's Nonpoint Source Program. Programs such as Project Wet West Virginia and West Virginia Save Our Streams are primarily focused on public education. The Nonpoint Source Program's *Streamside Homeowners Packet* is an example publication that contains information on stream buffers and septic system maintenance that can be used as-is or adapted for specific communities. Watershed Associations and all of the Project Teams include educational components in their projects.

Locally, Sleepy Creek Watershed Association in Morgan County used a Stream Partners grant for 2006-2007 to research the subject of stream buffers, and published an instructional brochure entitled "How to Protect and Care for Your Riparian Buffer." The brochures were sent to 410 landowners in the Sleepy Creek watershed and the Association is preparing additional brochures for future mailings. They also hosted a Riparian Buffer Planting workshop on May 5, 2007, and detailed the subject in their April 2007 newsletter. The Association has also proposed to design and distribute a landowner brochure on septic concerns if they receive a Stream Partners grant this fall. They would certainly welcome a request from other communities that wish to use some of their resources for distribution in other areas. The Association's newsletter and brochure may be downloaded at www.sleepycreekwatershedassociation.org.

Closer to Jefferson County, the Opequon Creek Project Team has also made stream buffers a high priority in their efforts to educate the public about nonpoint source pollution. They planted a demonstration buffer along Tuscarora Pike, just west of Martinsburg, in 2006, and planted another buffer on private property this spring, opening the planting days up to new volunteers and contacts from the community. The Opequon Creek Project Team sent information to some Berkeley County landowners along Opequon Creek in 2005 regarding septic system maintenance, and plans to do so again this spring in Jefferson County. Again, the resources gathered for these efforts could be easily shared with other communities.

A booklet called "Protecting Our Water; Berkeley County, West Virginia," was published through the recent efforts of the "Berkeley County Source Water Assessment & Protection (SWAP) Committee." Among other things, it details the connection between caring for a septic system and protecting well water in a karst environment. This document is available for download from:

www.berkeleycountycomm.org/images/swap_final.pdf

A limited number of hard copies are also available from the Potomac Basin Coordinator. More work on public education about septic system maintenance is expected to occur in the coming months, as the watershed groups in the eastern panhandle begin to implement measures to reduce bacterial pollution in response to the Potomac Direct Drains TMDL. Partners and ideas from your community would be most welcome in this effort.

One commenter stated that the TMDL should commit WVDEP to reducing the volume and velocity of runoff from construction stormwater sites.

Many of the sediment TMDLs include bank erosion allocations that represent significant reductions from baseline conditions. The best management practices (BMPs) associated with the Construction Stormwater General Permit are intended to control runoff volume/velocity impacts and upland sediment loading during construction. Post-construction stormwater volume and velocity control will also be needed to achieve bank erosion allocations. Berkeley County and Jefferson County have existing ordinances that contain requirements for post-construction stormwater control and both counties implement local permitting processes to implement the ordinances. Furthermore, Berkeley County and the City of Martinsburg are designated as Municipal Separate Storm Sewer System (MS4) entities and the MS4 permitting program implemented by WVDEP requires local stormwater volume and velocity control by those entities.

10. 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 the protection and/or restoration of water quality.

10.1 NPDES Permitting Program

WVDEP's Division of Water and Waste Management is responsible for issuing non-mining NPDES permits within the State. The Division of Mining and Reclamation develops NPDES permits for mining activities. As part of the permit review process, permit writers have the responsibility to incorporate the required TMDL wasteload allocations into new or reissued permits. Both the permitting and TMDL development processes have been synchronized with the Watershed Management Framework cycle, such that TMDLs are completed just before the permit expiration/reissuance time frames. Existing permit reissuance in the Potomac Direct Drains watershed is scheduled to begin in July 2007 for non-mining facilities and in January 2008 for mining facilities. Therefore, the wasteload allocations for existing activities will be promptly implemented. New facilities will be permitted in accordance with future growth provisions.

Existing sewage treatment facilities already have permit limitations for fecal coliform bacteria that satisfy the wasteload allocations of the TMDLs.

A new MS4 permitting program is being implemented to address stormwater impacts from urbanized areas. West Virginia has developed a General NPDES Permit for MS4 discharges (WV0110625). The City of Martinsburg, Berkeley County Commission, and the West Virginia Department of Transportation are registered under the permit. The permit is based upon national guidance and is non-traditional in that it does not contain numeric effluent limitations, but instead proposes Best Management Practices (BMPs) or "minimum control measures" that must be implemented. Upon implementation of BMPs, their effectiveness will be evaluated in relation to prescribed wasteload allocations, and future permit conditions will be established with a goal of water quality standard compliance.

WVDEP also implements a program to control discharges from CSOs. Specified fecal coliform wasteload allocations for CSOs will be implemented in accordance with the provisions of the national Combined Sewer Overflow Control Policy and the state Combined Sewer Overflow Strategy. Those programs recognize that comprehensive CSO control may require significant resources and an extended period of time to accomplish. The Tuscarora Creek fecal coliform TMDL specifies a wasteload allocation for the Martinsburg CSO. Modeling demonstrates that limited, infrequent overflows from the CSO can continue. The wasteload allocation provides a daily fecal coliform loading that may not be exceeded more than once per calendar month. Based upon the significant CSO controls that have already been implemented by the City of Martinsburg, compliance with the prescribed wasteload allocation is expected. If, however, additional corrective actions are determined to be necessary, the TMDL should not be construed to supersede the scheduling of CSO controls and actions pursuant to the national CSO program or the state Combined Sewer Overflow Strategy.

10.2 West Virginia Watershed Network / Watershed Management Framework

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 the identification and correction of nonpoint source pollution. The combined resources of the partners are used to address the 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 prioritize watersheds within a certain Hydrologic Group. This selection process includes a review and evaluation of TMDL recommendations for the watersheds under consideration. The Network prioritized Hydrologic Group C watersheds in March 2006, and tentatively selected Opequon Creek and Sleepy Creek as priority watersheds. Although the Potomac Direct Drains Watershed TMDLs were still in the development phase, preliminary information was provided to the framework to allow their consideration.

Development of Watershed Based Plans for priority watersheds 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. Project teams have been established for the Opequon Creek and Sleepy Creek watersheds. Watershed Based Plans will be developed after the TMDLs are finalized.

10.3 Public Sewer Projects

Within WVDEP's Division of Water and Waste Management, the State Revolving Fund (SRF) program is charged with the responsibility of evaluating sewer projects and providing funding, where available, for those projects. All municipal wastewater loans issued through the 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 prior to permit issuance or modification.

Berkeley County Public Service Sewer District has plans to replace its Spring Mill sewage treatment plant. The project, when completed, will provide service to some areas of Hoke Run and Harlan Run that are currently unsewered. The request for a proposal for construction is expected to go to bid before the end of 2006. The District is also upgrading its Baker Heights and Inwood wastewater treatment plants. Although the upgrades are primarily intended to provide capacity for future growth, NPDES permit disinfection requirements will ensure that the increased discharges will not cause or contribute to violations of water quality standards.

A list of funded and pending water and wastewater projects in West Virginia can be found at http://www.wvinfrastructure.com/projects/index.html.

11. MONITORING PLAN

The following monitoring activities are recommended:

11.1 NPDES Compliance

WVDEP's Division of Water and Waste Management has the responsibility to ensure that NPDES permits contain effluent limitations as prescribed by the TMDL wasteload allocations and to assess and compel compliance. Permits contain effluent 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 wasteload allocations.

11.2 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 determine expected pollutant reductions from similar future projects.

11.3 TMDL Effectiveness Monitoring

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

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