Final Approved Report

# Total Maximum Daily Loads for Selected Streams in the Lower Kanawha River Watershed, with Dissolved Aluminum Addendum

*Prepared for:*

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


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# Total Maximum Daily Loads for Selected Streams in the Lower Kanawha River Watershed, West Virginia

FINAL APPROVED REPORT

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B — Tupper Creek

C — Twomile Creek

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| 7Q10 | 7-day, 10-year low flow |
| AMD | acid mine drainage |
| AML | abandoned mine land |
| AnnAGNPS | Annualized Agricultural Nonpoint Source model |
| 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 |
| DESC-R | Dynamic Equilibrium In-stream Chemical Reactions model |
| DMR | [WVDEP] Division of Mining and Reclamation |
| DNR | Department of Natural Resources |
| DO | dissolved oxygen |
| DWWM | [WVDEP] Division of Water and Waste Management |
| ERIS | Environmental Resources Information System |
| FCLES | Fecal Coliform Loading Estimation Spreadsheet |
| FS | Forest Service |
| GIS | geographic information system |
| GPS | global positioning system |
| GWLF | Generalized Watershed Loading Functions |
| HAU | home aeration unit |
| LA | load allocation |
| MDAS | Mining Data Analysis System |
| MOS | margin of safety |
| MPN | most probable number |
| MRLC | Multi-Resolution Landuse Characteristic |
| 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 |
| NPS | nonpoint sources |
| NRCS | Natural Resources Conservation Service |
| OOG | Office of Oil and Gas |
| ORSANCO | Ohio River Valley Water Sanitation Commission |
| OWR | Office of Water Resources |
| POTW | publicly owned treatment works |
| PSD | public service district |
| SMCRA | Surface Mining Control and Reclamation Act |
| SRF | State Revolving Fund |
| SSO | sanitary sewer overflow |
| STATSGO | State Soil Geographic database |
| TMDL | Total Maximum Daily Load |

| | |
|---|---|
| TSS | total suspended solids |
| USDA | U.S. Department of Agriculture |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| UT | unnamed tributary |
| WAP | Watershed Assessment Program |
| WLA | wasteload allocation |
| WVDEP | West Virginia Department of Environmental Protection |
| WVSCI | West Virginia Stream Condition Index |
| WVU | West Virginia University |

# EXECUTIVE SUMMARY

The Lower Kanawha River watershed encompasses nearly 923 square miles in western West Virginia. The portion of the watershed covered in this report is north of the City of Charleston in Kanawha and Putnam counties and encompasses approximately 73 square miles. The major tributaries in the study area are Manila Creek, Heizer Creek, Tupper Creek, and Twomile Creek.

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

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

West Virginia's final 2004 Section 303(d) list includes 57 impaired streams in the Lower Kanawha River watershed; TMDLs for 29 of these streams are presented in this report; TMDLs for the remaining streams will be addressed in the future. The impairments are related to numeric water quality criteria for fecal coliform bacteria, dissolved aluminum, total iron and pH. Many of the listed waters are also biologically impaired based on the narrative water quality criterion of 46 CSR 1–3.2.i, which prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems.

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

Since 1997, the U.S. Environmental Protection Agency (USEPA), Region 3, has developed West Virginia TMDLs under the settlement of a 1995 lawsuit, *Ohio Valley Environmental Coalition, Inc., West Virginia Highlands et al.* v. *Browner et al.* The resulting consent decree established a rigorous schedule for TMDL development and required TMDLs for the impaired waters on West Virginia's 1996 Section 303(d) list. TMDL development dates scheduled extend through March 2008. This report accommodates the timely development of the remaining Lower Kanawha River watershed TMDLs as required by the consent decree.

The impaired waters were organized into three TMDL subwatersheds, which were further divided into 73 subwatersheds for modeling purposes. The second subwatershed delineation provided a basis for georeferencing pertinent source information and monitoring data and presenting the TMDLs.

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

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

Metals and pH impairments were present in the Heizer Creek, Tupper Creek, and Twomile Creek watersheds. Abandoned mine lands and land disturbance activities that introduce excess sediment are problematic sources of metals. There are no active mining operations in these watersheds.

Both point and nonpoint sources contribute to the fecal coliform bacteria impairments in the Tupper Creek and Twomile Creek watersheds. Overflows from the collection systems of publicly owned treatment works (POTWs), known as combined sewer system overflows (CSOs), are problematic point sources. The City of Charleston municipal separate storm sewer system (MS4) has discharges in the Twomile Creek watershed, and the city has filed a Notice of Intent for MS4 permit issuance. The area within the corporate limits is a fecal coliform bacteria point source. The significant nonpoint sources are related to inadequate treatment of sewage (failing onsite systems and direct discharges of untreated sewage).

Point sources of sediment include stormwater discharges from construction sites greater than 1 acre. Nonpoint sources of sediment include roads, timbering, and urban and residential land disturbance. The presence of individual nonpoint source categories and the significance of their effects vary by subwatershed.

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

Stressor identification facilitated stream-specific determinations of the pollutants for which TMDLs must be developed. Metals toxicity and pH toxicity biological stressors were identified in waters that also demonstrated violations of the iron, aluminum, or pH numeric water quality criteria for protecting aquatic life. It was determined that implementation of those pollutant-specific TMDLs would address the biological impairment. 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, thereby reducing the organic and nutrient loading causing the biological impairment. Where the stressor identification process indicated sedimentation as a causative stressor, sediment TMDLs were developed.

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

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

This report and those developed simultaneously for the impaired waters of the Coal River and the North Branch Potomac River watersheds are the second major group of West Virginia TMDLs developed by WVDEP. Considerable resources were applied to generate recent and robust water quality and pollutant source information on which the TMDLs are based. The modeling is among the most sophisticated available and incorporates sound scientific principles. TMDL outputs are presented in various formats to make them understandable and easy to use in implementing the TMDLs.

# 1. REPORT FORMAT

This report consists of a main section, appendices, a supporting geographic information system (GIS) application, and spreadsheet data tables. The main section describes the overall Total Maximum Daily Load (TMDL) development process for the Lower Kanawha River watershed, identifies impaired streams, and outlines the source assessment of metals, pH, fecal coliform bacteria, and biological stressors. It also describes the modeling process and TMDL allocations, and lists actions planned to ensure that the TMDLs are met.

The main section is followed by appendices that describe specific conditions in each of the three subwatersheds for which TMDLs were developed. The applicable TMDLs are displayed in section 4 of each appendix.

The data in this report are supported by an interactive ArcExplorer GIS project on CD that provides further details on the data and enables the user to explore the spatial relationships among the source assessment data. Users can zoom in on streams and other features of interest. The CD also includes Microsoft Excel spreadsheets with the data used to develop the TMDLs, 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 available.

# 2. INTRODUCTION

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

## 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 taking the actions needed to restore water quality.

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

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

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

WVDEP is developing TMDLs in concert with the Watershed Management Framework, a geographically based approach to water resource management intended to ensure efficient and systematic TMDL development. The framework orders annual TMDL development for a specific geographic area. In 2005 TMDLs are to be developed for Hydrologic Group B, which includes the Lower Kanawha River watershed. Figure 2-1 depicts the hydrologic groupings of West Virginia's watersheds; the legend includes the year of each TMDL finalization target.

WVDEP is committed to implementing a TMDL process that reflects the requirements of the TMDL regulations, provides for the achievement of water quality standards, and ensures that ample stakeholder participation is achieved in the development and implementation of TMDLs. The 48-month development process enables the agency to collect and analyze extensive data to produce scientifically defensible TMDLs, as well as to develop models and solicit public input in the process.

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

This document provides TMDLs for most of the Heizer Creek, Twomile Creek, and Tupper Creek watershed stream/impairment listings from West Virginia's 2004 Clean Water Act Section 303(d) list. All remaining Lower Kanawha River watershed impairments for which USEPA committed to TMDL development by 2008 are addressed in this effort.

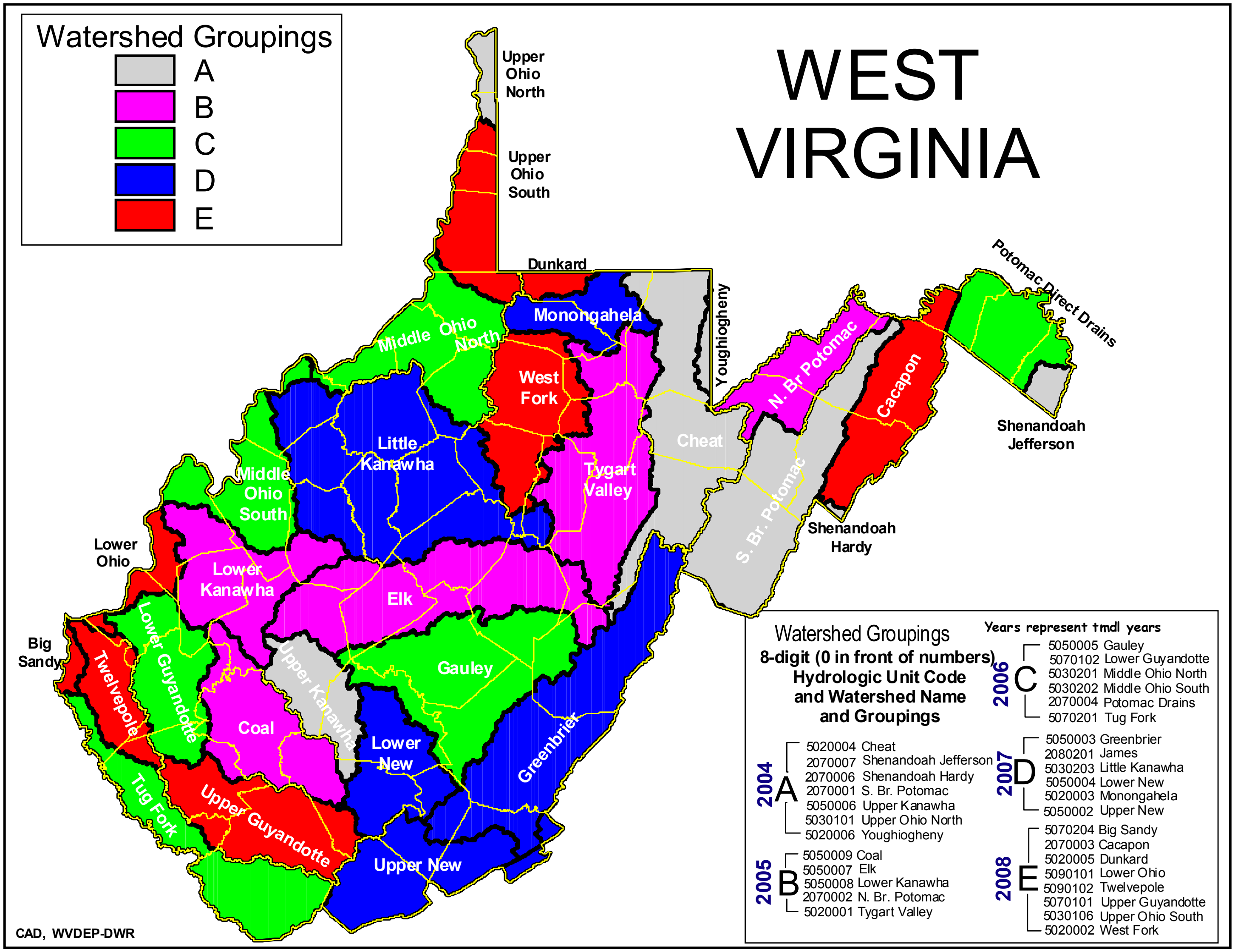



**Figure 2-1.** Hydrologic groupings of West Virginia's watersheds.

## 2.2 Water Quality Standards

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

The West Virginia 2004 Section 303(d) list includes 12 waters in the Heizer Creek, Tupper Creek and Twomile watersheds identified as manganese impaired. On June 29, 2005, EPA approved a revision to the West Virginia Water Quality Standards that altered the zone of applicability of the manganese water quality criterion for the public water supply designated use. The criterion is now applicable only in the five-mile zone upstream of known public or private water supply intakes used for human consumption. The revision necessitated DEP's identification of intakes and revaluation of prior impairment decisions.

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

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

The applicable designated uses for all the waters addressed in this report are aquatic life protection, water contact recreation, and public water supply. All the waters in the study area are designated as warmwater fisheries.

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

**Table 2-1.** Applicable West Virginia water quality criteria

<table>
<tr><th rowspan="4">POLLUTANT</th><th colspan="5">USE DESIGNATION</th></tr>
<tr><th colspan="4">Aquatic Life</th><th>Human Health</th></tr>
<tr><th colspan="2">Warmwater Fisheries</th><th colspan="2">Troutwaters</th><th>Contact Recreation/Public Water Supply</th></tr>
<tr><th>Acute[a]</th><th>Chronic[b]</th><th>Acute[a]</th><th>Chronic[b]</th><th></th></tr>
<tr><td>Aluminum, dissolved (µg/L)</td><td>750</td><td>87</td><td>750</td><td>87</td><td>—</td></tr>
<tr><td>Iron, total (mg/L)</td><td>—</td><td>1.5</td><td>—</td><td>0.5</td><td>1.5</td></tr>
<tr><td>pH</td><td>No values below 6.0 or above 9.0</td><td>No values below 6.0 or above 9.0</td><td>No values below 6.0 or above 9.0</td><td>No values below 6.0 or above 9.0</td><td>No values below 6.0 or above 9.0</td></tr>
<tr><td>Fecal coliform bacteria</td><td colspan="5">Human Health Criteria Maximum allowable level of fecal coliform content for Primary Contact Recreation (either MPN [most probable number] or MF [membrane filter counts/test]) shall not exceed 200/100 mL as a monthly geometric mean based on not less than 5 samples per month; nor to exceed 400/100 mL in more than 10 percent of all samples taken during the month.</td></tr>
</table>

[a] 1-hour average concentration not to be exceeded more than once every 3 years on the average.
[b] 4-day average concentration not to be exceeded more than once every 3 years on the average.
Source: West Virginia Water Quality Standards 2003.

All West Virginia waters are subject to the narrative criteria in Section 3 of the standards, titled *Conditions Not Allowable in State Waters*, which contains various general provisions relative to water quality. The narrative water quality criterion at 46 CSR 1– 3.2.i prohibits the presence of wastes in state waters that cause or contribute to significant adverse impacts on the chemical, physical, hydrologic, and biological components of aquatic ecosystems. This provision is the basis for the determination of “biological impairment,” signifying a stressed aquatic community, which is discussed in section 6.

TMDLs presented herein are based upon the water quality criteria that are currently effective. If the West Virginia Legislature adopts water quality standard revisions that alter the basis upon which the TMDLs are developed, then the TMDLs and allocations may be modified as warranted. Any future Water Quality Standard revision and/or TMDL modification must receive EPA approval prior to implementation.

# 3. WATERSHED DESCRIPTION AND DATA INVENTORY

## 3.1 Watershed Description

The Lower Kanawha River watershed (U.S. Geological Survey [USGS] 8-digit hydrologic unit code 05050008) encompasses nearly 923 square miles in western West Virginia. The portion of the watershed covered in this report (Figure 3-1) covers approximately 73 square miles north of the City of Charleston in Kanawha and Putnam counties. The major tributaries are Manila Creek, Heizer Creek, Tupper Creek, and Twomile Creek. Cities and towns in the vicinity of the area of study are Charleston, Sissonville, and Winfield.

The average elevation in the watershed is 842 feet, the highest point is 1,496 feet within the Kanawha State Forest, and the minimum elevation is 530 feet at the confluence of the Kanawha and Ohio rivers. The average elevation in the area of study is 858 feet, the highest at 1,152 feet in northern Kanawha County, and the lowest at 571 feet at the confluence of Twomile Creek and the Kanawha River.

Land use and land cover estimates were obtained from vegetation data gathered from the West Virginia Gap Analysis Land Cover Project (GAP), produced by the Natural Resource Analysis Center and the West Virginia Cooperative Fish and Wildlife Research Unit of West Virginia University (WVU). The GAP database for West Virginia includes detailed vegetative spatial data derived from satellite imagery taken during the early 1990s. The Technical Report appendices provide additional information on the GAP spatial database.

The GAP categories for vegetation cover were consolidated to create six land use categories, summarized in Table 3-1. The table shows that forest, which constitutes 82.7 percent of the area of study, is the dominant land use type in the watershed. Other important land use types are pasture and grassland (9.7 percent), urban/residential (7.1 percent), and barren/mining (0.1 percent). Individually, all other land cover types constitute less than 1 percent of the total watershed area.

The total population for the Heizer, Twomile, and Tupper watersheds, derived from the 2000 U.S. Census data, is approximately 13,000 people.

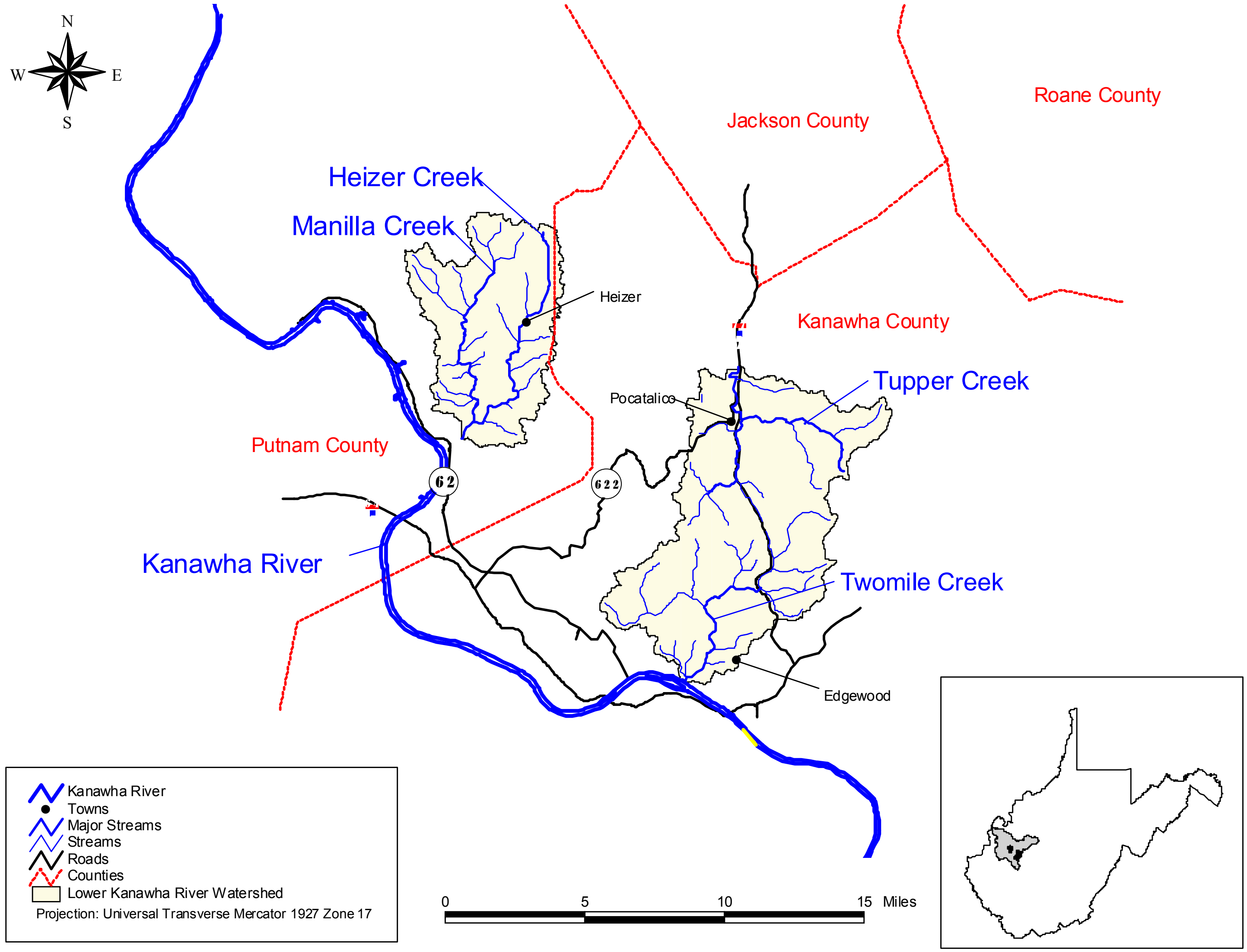



**Figure 3-1.** Location of the Lower Kanawha River watershed.

**Table 3-1.** Land use and land cover in Heizer, Twomile, and Tupper Creek watersheds

| Land Use Type | Area of Watershed | | Percentage |
|---|---|---|---|
| | Acres | Square Miles | |
| Agriculture | 19.6 | 0.03 | 0.04 |
| Barren/Mining | 63.8 | 0.10 | 0.14 |
| Forest | 38,720.3 | 60.50 | 82.72 |
| Pasture | 4567.8 | 7.14 | 9.76 |
| Urban/Residential | 3355.9 | 5.24 | 7.17 |
| Water | 80.1 | 0.13 | 0.17 |
| **Total** | **46,807.5** | **73.14** | **100.00** |

## 3.2 Data Inventory

Various sources of data were used in the TMDL development process. The data were used to identify and characterize sources of pollution and to establish the water quality response to those sources. Review of the data included a preliminary assessment of the watershed's physical and socioeconomic characteristics and current monitoring data. Table 3-2 identifies the data used to support the TMDL assessment and modeling effort for the Lower Kanawha River watershed. These data describe the physical conditions of the watershed, the potential pollutant sources and their contributions, and the impaired waterbodies for which TMDLs need to be developed. A summary of the data obtained for the Lower Kanawha River watershed during the pre-TMDL monitoring effort is provided in the Technical Report. The geographic information is provided in the ArcExplorer GIS project included in 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) |
| | Land use | Multi-Resolution Land Characterization (MRLC) Database |
| | Counties | U.S. Census Bureau |
| | Cities/populated places | U.S. Census Bureau |
| | Soils | State Soil Geographic Database (STATSGO)<br>U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NCRS) soil surveys |
| | Cataloging Unit boundaries | U.S. Geological Survey (USGS) |
| | Topographic and digital elevation models (DEMs) | National Elevation Dataset (NED) |
| | Dam locations | USGS |
| | Roads | U.S. Census Bureau TIGER, WVU WV Roads |
| | Water quality monitoring station locations | WVDEP, USEPA STORET |
| | Meteorological station locations | National Oceanic and Atmospheric Administration, National Climatic Data Center (NOAA-NCDC) |

| Type of Information | | Data Sources |
|---|---|---|
| | Permitted facility information | WVDEP Division of Water and Waste Management (DWWM) , WVDEP Division of Mining and Reclamation (DMR) |
| | Timber harvest data | USDA Forest Service (FS) |
| | Oil and gas operations coverage | WVDEP, Office of Oil and Gas (OOG) |
| | Abandoned mining coverage | WVDEP DMR |
| | Wastewater disposal methods | WVDEP |
| | Livestock counts | USDA Agricultural Census |
| Monitoring data | Physical data | WVDEP DNR |
| | Historical flow record (daily averages) | USGS |
| | Rainfall | NOAA-NCDC |
| | Temperature | NOAA-NCDC |
| | Wind speed | NOAA-NCDC |
| | Dew point | NOAA-NCDC |
| | Humidity | NOAA-NCDC |
| | Cloud cover | NOAA-NCDC |
| | 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 2002 through June 2003 in the Lower Kanawha River watershed. The results of that effort were used to confirm the impairments of waterbodies identified on previous 303(d) lists and to identify other impaired waterbodies that were not previously listed as such.

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

TMDLs were developed for impaired waters in three subwatersheds (Figure 3-2): Heizer Creek, Tupper Creek, and Twomile Creek. The waterbody/impairment combinations for which TMDLs are developed are presented in Table 3-3, including the stream code, subwatershed, stream name, and impairments for each stream.

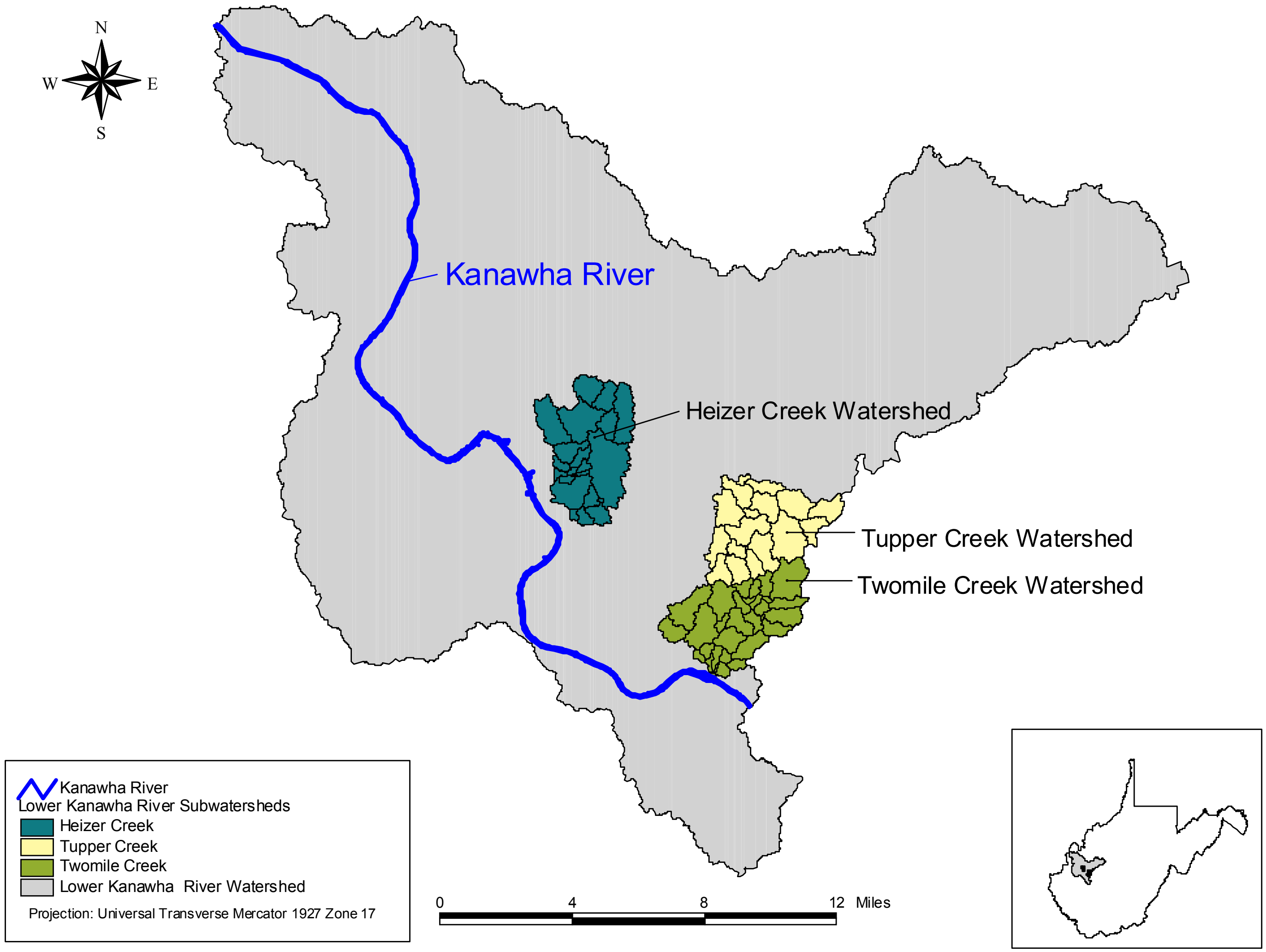



**Figure 3-2.** Impaired waterbodies in the three subwatersheds of the Lower Kanawha River watershed.

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

| Subwatershed | Stream Code | Stream Name | Dis Al | Fe | pH | Bio | FC |
|---|---|---|---|---|---|---|---|
| Heizer Creek | WVKP-1 | Heizer Creek | X | X | | | |
| | WVKP-1-A | Manila Creek | X | X | X | X | |
| | WVKP-1-A.3 | Coal Hollow | X | X | X | | |
| | WVKP-1-A.6 | UNT/Heizer Creek RM 2.3 | X | X | X | | |
| | WVKP-1-A-0.4 | Sulphur Hollow | X | X | X | | |
| | WVKP-1-A-0.48 | UNT/Manila Creek RM 2.3 (#4 Hollow) | X | X | X | | |
| | WVKP-1-A-0.5 | Washington Hollow | | X | | | |
| | WVKP-1-A-0.6 | Alcocks Hollow | X | X | X | | |
| | WVKP-1-A-0.8 | UNT/Manila Creek RM 3.2 | | X | | | |
| Tupper Creek | WVKP-13 | Tupper Creek | X | X | X | X | X |
| | WVKP-13-A | Legg Fork | | | | | X |
| | WVKP-13-A-1 | Sigman Fork | | | | | X |
| | WVKP-13-C.5 | Union Fork | X | X | X | | X |
| | WVKP-13-C.5-1 | UNT/Union Fork RM 0.2 | X | X | X | | X |
| Twomile Creek | WVK-41 | Twomile Creek | X | X | | X | X |
| | WVK-41-A | Woodward Branch | | | | | X |
| | WVK-41-A-1 | Pfieffer Branch | | | | | X |
| | WVK-41-A-2 | UNT/Woodward Branch RM 0.9 | | | | | X |
| | WVK-41-B | Chandler Branch | | | | | X |
| | WVK-41-C | Sugar Creek | | | | | X |
| | WVK-41-D | Left Fork/Twomile Creek | | | | | X |
| | WVK-41-D.5 | Rich Fork | X | X | X | X | X |
| | WVK-41-D.5-2 | Craig Branch | | | | X | |
| | WVK-41-D-1 | UNT/Left Fork RM 0.5/Twomile Creek | | | | X | X |
| | WVK-41-E | Right Fork/Twomile Creek | | | | | X |
| | WVK-41-E-1 | Edens Fork | | | | X | X |
| | WVK-41-E-1-A | Sheldon Rock Branch | | | | | X |
| | WVK-41-E-2 | Holmes Branch | | | | X | X |
| | WVK-41-E-2.5 | Trace Fork | | | | | X |

Note: UNT = unnamed tributary; Dis Al = dissolved aluminum; Fe = iron; Bio = biological impairment; FC = fecal coliform bacteria.

# 4. METALS, pH, AND SEDIMENT SOURCE ASSESSMENT

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

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

For purposes of these TMDLs only, wasteload allocations are given to NPDES-permitted discharge points, and load allocations are given to discharges from activities that do not have an associated NPDES permit, such as mine forfeiture sites and abandoned mine lands (including tunnel discharges, seeps, and surface runoff). The decision to assign load allocations to abandoned and reclaimed mine lands does not reflect any determination by WVDEP or USEPA as to whether there are, in fact, unpermitted point source discharges within these land uses. In addition, by establishing these TMDLs with mine drainage discharges treated as load allocations, WVDEP and USEPA are not determining that these discharges are exempt from NPDES permitting requirements.

The physiographic data discussed in Section 3 enabled WVDEP to characterize pollutant sources. As part of the TMDL development process, the agency performed additional field-based source-tracking to obtain information to supplement the other available source characterization data. WVDEP staff recorded physical descriptions of pollutant sources and the general condition of the stream in their vicinity, as well as collecting global positioning system (GPS) data and water quality samples for laboratory analysis as necessary to characterize the sources and their impacts. Source-tracking information was compiled and electronically plotted on maps using geographic information system (GIS) software. Detailed information, including the locations of pollutant sources, is provided in the subwatershed appendices, the Technical Report, and the ArcExplorer project on the CD version of this TMDL report.

## 4.1 Metals, pH, and Sediment Point Sources

Metals, pH, and sediment point sources are classified by the mining and non-mining permits issued by WVDEP. No active coal mining operations or industrial manufacturing operations discharge into the impaired waters addressed in this report.

WVDEP issued a general NPDES permit (permit WV0115924) to regulate stormwater flowing into streams from discharges associated with construction activities. Registration under the permit is required for construction activities with a land disturbance greater than 1 acre. Both the land disturbance and the permitting process associated with construction activities are transient; 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 1 year. These permits require that the site have properly installed best management practices (BMPs), such as silt fences, sediment traps, seeding and mulching, riprap, to prevent or reduce erosion and sediment runoff. At the time the TMDL were developed, three active construction sites were registered under the general permit.

Individual and General NPDES permits for sewage treatment facilities contain 30 mg/l monthly average effluent limitations for Total Suspended Solids. Such facilities are given wasteload allocations in sediment TMDLs developed in response to biological impairment. Compliant sewage treatment facilities are not considered significant sediment sources and are assigned wasteload allocations which authorize continued discharge under existing permit conditions.

## 4.2 Metals, pH, and Sediment Nonpoint Sources

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

### *4.2.1 Abandoned Mine Lands*

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

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

Abandoned mine lands were modeled in the Lower Kanawha River TMDLs. In total, 397 acres of AML area, 50 AML sources, and 25.6 miles of highwall were identified in the TMDL watersheds and incorporated into the TMDL model.

### *4.2.2 Bond Forfeiture*

Mining permittees are required to post a performance bond to ensure the completion of reclamation requirements. When a bond is forfeited, WVDEP assumes the responsibility for the reclamation requirements. The Office of Special Reclamation in WVDEP's Division of Land Restoration made information and data associated with bond forfeiture sites available. There are no bond forfeiture sites in the Heizer, Twomile, and Tupper Creek watersheds.

### *4.2.3 Sediment Sources*

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

In the Twomile and Tupper Creek watersheds, sediment was identified as a primary stressor for biological impairment where forestry, roads, and other land-disturbing activities are present.

*Forestry*

The West Virginia Bureau of Commerce's Division of Forestry provided information on forest industry sites (registered logging sites) in the watershed. This information included the harvested area and the subset of land disturbed by roads and landings for seven registered logging sites in the Heizer, Twomile, and Tupper watersheds.

West Virginia recognizes the water quality issues posed by sediment from logging sites. In 1992 the West Virginia Legislature passed the Logging Sediment Control Act. This act requires that 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 roads to serve logging sites can increase sediment loading to streams.

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

*Oil and Gas*

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

Oil and gas data incorporated into the TMDL model were obtained from the WVDEP OOG GIS coverage. The watersheds in this study contain 81 active oil and gas wells. Runoff from unpaved access roads to these wells and the disturbed areas around the wells might contribute sediment to adjacent streams.

*Roads*

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

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

*Agriculture*

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

*Other Land Disturbance Activities*

As stated previously, WVDEP issues general NPDES permits to regulate sediment contributions to streams from discharges associated with construction activities that have surface disturbances greater than 1 acre. Construction activities disturbing less than 1 acre are uncontrolled sources of sediment and are not subject to construction stormwater permitting. There are three construction stormwater permits in the watersheds.

# 5. FECAL COLIFORM SOURCE ASSESSMENT

## 5.1 Fecal Coliform Point Sources

Publicly and privately owned sewage treatment facilities and home aeration units are point sources of fecal coliform. These sources are regulated by WV/NPDES permits that require effluent disinfection and compliance with strict fecal coliform effluent limitations (200 counts/100 milliliters [average monthly] and 400 counts/100 mL [maximum daily]). Combined Sewer Overflows (CSOs), Sanitary Sewer Overflows (SSOs) and discharges from Municipal Separate Storm Sewer Systems (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 Twomile Creek and Tupper Creek watersheds.

### *5.1.1 Individual NPDES Permits*

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

No POTWs discharge treated effluent to any of the fecal coliform-impaired waters. However, the City of Charleston operates a sludge composting facility in the Twomile Creek watershed. Stormwater runoff from this facility is discharged to Woodward Branch under NPDES permit WV0023205 (outlet 078) and has fecal coliform effluent limitations of 200 counts/100 milliliters (average monthly) and 400 counts/100 mL (maximum daily).

### *5.1.2 Overflows*

Combined sewer overflows (CSOs) are outfalls from POTW sewer systems that carry untreated domestic waste and surface runoff. CSOs contain fecal coliform bacteria and are permitted to discharge only during precipitation events. Two CSO outfalls associated with the City of Charleston wastewater treatment plant (WV0023205, outlets 053 and 055) discharge in the

Twomile Creek watershed. Outlet 053 discharges to Twomile Creek and Outlet 055 discharges to Woodward Branch.

### *5.1.3 Municipal Separate Storm Sewer Systems*

USEPA's stormwater permitting regulations require municipalities to obtain permit coverage for all stormwater discharges from municipal separate storm sewer systems (MS4s). A portion of one designated MS4 municipality, the City of Charleston, is located in the Twomile Creek watershed. The City of Charleston has filed a Notice of Intent for MS4 permit issuance. The area within the corporate limits located in the Twomile Creek watershed is assumed to be subject to MS4 stormwater permitting.

### *5.1.4 General Sewage Permits*

General sewage permits are designed to cover similar 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), 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 Twomile and Tupper Creek watersheds, three facilities are registered under the "package plant" general permit and 40 are registered under the HAU general permits.

## 5.2 Fecal Coliform Nonpoint Sources

### *5.2.1 On-site Treatment Systems*

Overall, failing septic systems and straight pipes represent the most significant non-permitted, nonpoint source of fecal coliform bacteria in the Lower Kanawha River watershed. According to the West Virginia Department of Health, the failure rate for septic systems in the watershed is estimated to be 70 percent during the first 10 years after installation. Information collected during source-tracking efforts by WVDEP yielded an estimate of 1,007 homes in the Twomile and Tupper Creek watersheds that are not served by centralized sewage collection and treatment systems.

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 there are, in fact, nonpermitted point source discharges. In addition, by establishing these TMDLs with failing septic systems and straight pipes treated as load allocations, WVDEP and USEPA are not determining that such discharges are exempt from NPDES permitting requirements.

### *5.2.2 Stormwater Runoff*

Stormwater runoff represents another nonpoint source of fecal coliform bacteria in residential and urbanized areas. Runoff from residential and urbanized areas during storm events can be a significant source, delivering bacteria from the waste of pets and wildlife to the waterbody. GAP2000 land use data were used to determine the number of acres of residential and urbanized areas.

#### *5.2.3 Agriculture*

Agricultural activities can contribute fecal coliform bacteria to receiving streams through surface runoff or direct deposition. Grazing livestock and application of manure to fields result in the deposition and accumulation of bacteria on land surfaces, from which they are washed into the streams when it rains. In addition, livestock with unrestricted access can deposit feces directly into streams.

The GAP 2000 land use data showed that agriculture is not prevalent in the impaired portions of the Twomile and Tupper Creek watershed. Although there is little agriculture, source tracking efforts identified isolated instances of pastures and feedlots near impaired segments that could have significant localized effects on in-stream bacteria levels. Livestock counts from the 1997 Census of Agriculture (USDA 1997) were used to develop accumulation rates for agricultural sources of fecal coliform bacteria.

#### *5.2.4 Natural Background (Wildlife)*

A certain “natural background” contribution of fecal coliform bacteria can be attributed to 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 the West Virginia Division of Natural Resources. On the basis of the low fecal accumulation rates for forested areas, wildlife is not considered to be a significant nonpoint source of fecal coliform bacteria in the Twomile and Tupper Creek watersheds.

# 6. BIOLOGICAL IMPAIRMENT AND STRESSOR IDENTIFICATION

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

## 6.1 Introduction

Assessment of the biological integrity of a stream is based on a survey of the stream’s benthic macroinvertebrate community using a multimetric index developed for the wadeable streams in West Virginia. The West Virginia Stream Condition Index (WVSCI; Gerritsen et al. 2000) comprises six metrics 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 might not clearly identify the causes of impairment, which must be determined before TMDL development can proceed.

USEPA developed *Stressor Identification: Technical Guidance Document* (Cormier et al. 2000) to help water resource managers identify stressors that cause biological impairment. WVDEP used elements of the stressor identification process to evaluate and identify the biological stressors to the impaired benthic communities. WVDEP staff also performed custom analyses of biological data to supplement the framework recommended by the guidance document.

Identifying stressors involves reviewing available information, forming and analyzing possible stressor scenarios, and implicating causative stressors. The stressor identification method provided a consistent process for evaluating the information on which the TMDLs for responsible pollutants could be based. As a result, the TMDL process established a link between the impairment and the 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, GAP2000 land use 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
- Altered hydrology causes higher water temperature, resulting in direct impacts
- Altered hydrology, nutrient enrichment, and increased biochemical oxygen demand (BOD) cause reduced dissolved oxygen (DO)
- Algal growth causes food supply shift
- High levels of ammonia cause toxicity (including increased toxicity due to algal growth)
- Chemical spills cause toxicity

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

## 6.4 Stressor Identification Results

The results of the stressor identification process determined the primary causes of biological impairment. biological impairment was linked to a single or multiple stressors in different cases.

The stressor identification process identified the following stressors for the biologically impaired waters of the Heizer, Twomile, and Tupper Creek watersheds:

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

After stressors were identified, WVDEP determined the pollutants for which TMDLs were required to address the impairment.

The stressor identification process identified metals toxicity and pH toxicity as biological stressors in Manila Creek, Tupper Creek, Twomile Creek, and Rich Fork whose waters also demonstrated violations of the iron, aluminum, or pH numeric water quality criteria for protection of aquatic life. WVDEP determined that implementing those pollutant-specific TMDLs would address the biological impairment.

Where organic enrichment was identified as the biological stressor, the waters also demonstrated violations of the numeric criteria for fecal coliform bacteria. The predominant source of fecal coliform bacteria in the watershed is inadequately treated sewage. WVDEP determined that implementing fecal coliform TMDLs would remove untreated sewage and limit the introduction of livestock wastes, 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.

Sedimentation was identified as a problem in the Tupper Creek and Twomile Creek watersheds. Craig Branch and Edens Fork, tributaries of the Twomile Creek watershed, were also determined to be impaired by sedimentation. WVDEP developed sediment TMDLs for those streams.

Table 6-1 summarizes the primary stressors' contributions to biological impairments in the Lower Kanawha River watershed.

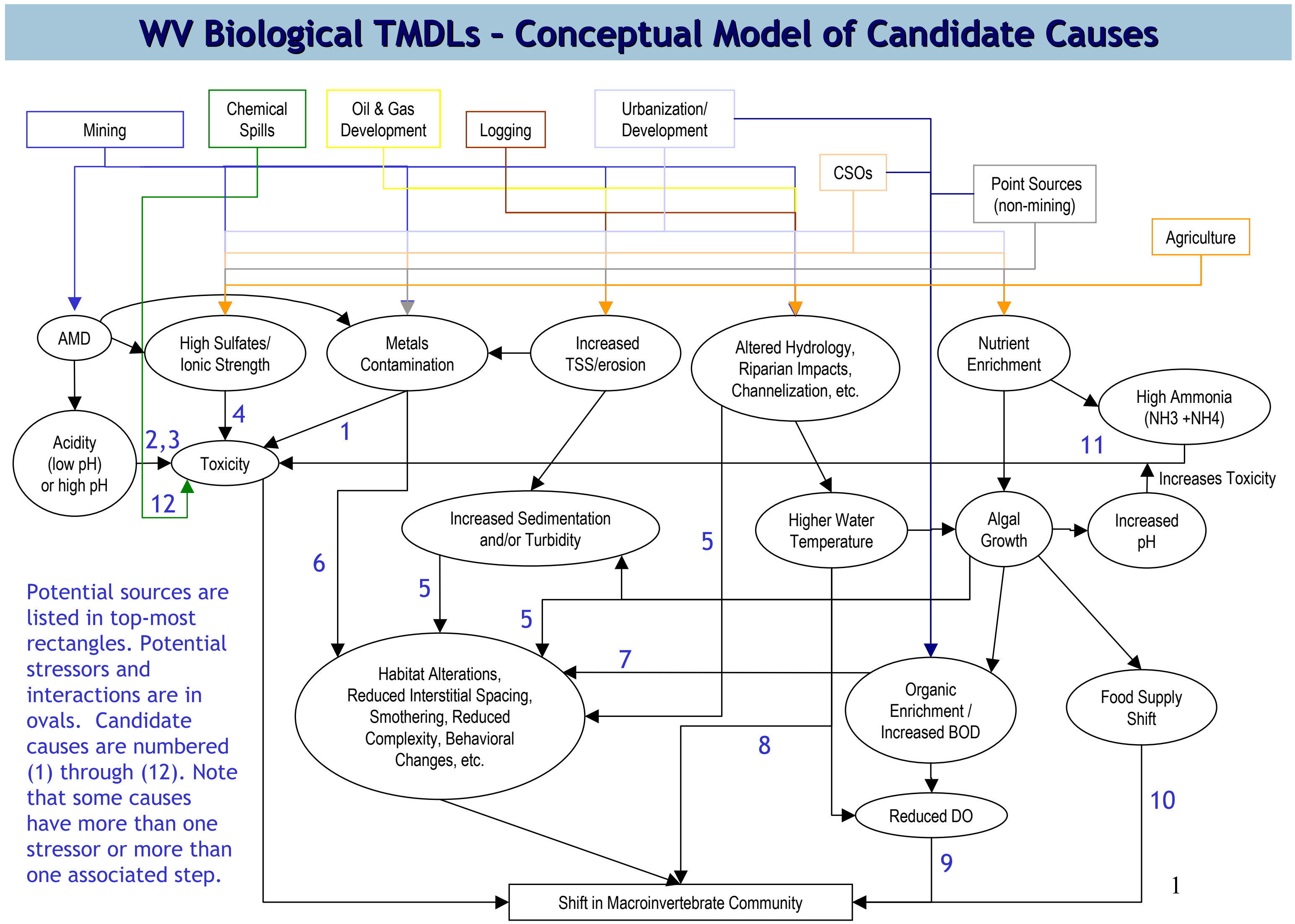



**Figure 6-1.** Conceptual model of candidate causes and potential biological effects for the Lower Kanawha River watershed.

**Table 6-1.** Primary stressors of biologically impaired streams in the Lower Kanawha River watershed

| Major Watershed | Stream | Biological Stressors | TMDL Required |
|---|---|---|---|
| Heizer Creek | Manila Creek | Metals toxicity (aluminum, iron) | Aluminum<br>Iron |
| | | pH toxicity (acidity) | pH |
| Tupper Creek | Tupper Creek | Metals toxicity (aluminum, iron) | Aluminum<br>Iron |
| | | pH toxicity (acidity) | pH |
| | | Organic enrichment | Fecal coliform |
| | | Sedimentation | Sediment |
| Twomile Creek | Twomile Creek | Metals toxicity (iron) | Iron |
| | | Organic enrichment | Fecal coliform |
| | | Sedimentation | Sediment |
| | Rich Fork | Metals toxicity (aluminum) | Aluminum |
| | | pH toxicity (acidity) | pH |
| | | Organic enrichment | Fecal coliform |
| | Craig Branch | Sedimentation | Sediment |
| | UNT/Left Fork RM 0.5/Twomile Creek | Organic enrichment | Fecal coliform |
| | Edens Fork | Organic enrichment | Fecal coliform |
| | | Sedimentation | Sediment |
| | Holmes Branch | Organic enrichment | Fecal coliform |

# 7. MODELING PROCESS

A critical component of TMDL development is establishing the relationship between the in-stream water quality targets and source loadings, which allows for evaluation of management options to achieve the desired source load reductions. A number of techniques can be used to establish the link, ranging from qualitative assumptions based on sound scientific principles to sophisticated modeling techniques. Ideally, the linkage will be supported by monitoring data that allow the TMDL developer to associate certain waterbody responses with flow and loading conditions. This section presents the approach taken to develop the linkage between sources and in-stream response for TMDL development in the Heizer, Twomile, and Tupper Creek watersheds.

## 7.1 Modeling Technique for Metals, pH, and Fecal Coliform Bacteria

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

- Scale of analysis is important.

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

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

The TMDL development approach must also consider the dominant processes affecting pollutant loadings and in-stream fate. For the Heizer, Twomile, and Tupper Creek watersheds, an array of point and nonpoint sources contribute to metals, pH, and fecal coliform impairments. Nonpoint sources are typically rainfall-driven, with pollutant loadings primarily related to surface runoff. Point source discharges might or might not be induced by rainfall.

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

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

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

FCLES (Fecal Tool) is a Microsoft Excel spreadsheet tool used to quantify nonpoint source bacteria accumulation rates based on watershed-specific information by estimating the fecal coliform bacteria contributions from multiple sources. Inputs to FCLES may be generated manually or by using various functions of the Watershed Characterization System. Output from FCLES is input to MDAS. The Fecal Tool estimates the monthly accumulation rate of fecal coliform bacteria on four land uses (cropland, forest, built-up, and pastureland), as well as the asymptotic limit for that accumulation if no wash-off occurs. The tool also estimates the direct input of fecal coliform bacteria to streams from grazing agricultural animals and failing septic systems. It provides starting values for model input; however, a thorough calibration of the model is still necessary.

### *7.1.1 MDAS Setup*

Configuration of the MDAS model involved subdivision of the Heizer, Twomile, and Tupper Creek watersheds into modeling units. Continuous simulation of flow and water quality for those units was accomplished by using meteorological, land use, point source loading, and stream data.

The three watersheds were broken into 73 separate watershed units based on the watershed groupings of impaired streams shown in Table 3-1. These subwatersheds were further subdivided to allow evaluation of water quality and flow at pre-TMDL monitoring stations. This division process also ensured a proper stream network configuration within the basin. The subwatershed delineation for each of the 73 watersheds is shown in Figure 7-1.

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

Modeled land uses contributing bacteria loads include pasture, urban/residential pervious lands, urban/residential impervious lands, and forest (including barren and wetlands). Other sources, such as failing septic systems, straight pipes, and permitted sources, were modeled as direct, continuous-flow sources. The basis for the initial loading rates for land uses and direct sources is described in the Technical Report. The initial estimates were further refined during the model testing (calibration).

### ***7.1.2 Hydrology Calibration***

Hydrology and water quality calibration were performed in sequence because water quality modeling depends on an accurate hydrology simulation. Hydrology calibration typically involves a comparison of model results to in-stream flow observations from USGS flow gauging stations throughout the watershed. The Lower Kanawha River watershed lacked a long-term time series of flow data useful for calibration and validation. For this reason, the calibrated hydrology parameters from the Coal River watershed were applied to the Lower Kanawha River model, and the simulated flows were compared with the limited flow data from USGS 03201000 on the Pocatalico, River at Sissonville, WV. Key considerations for hydrology calibration included the overall water balance, the high-flow and low-flow distribution, storm flows, and seasonal

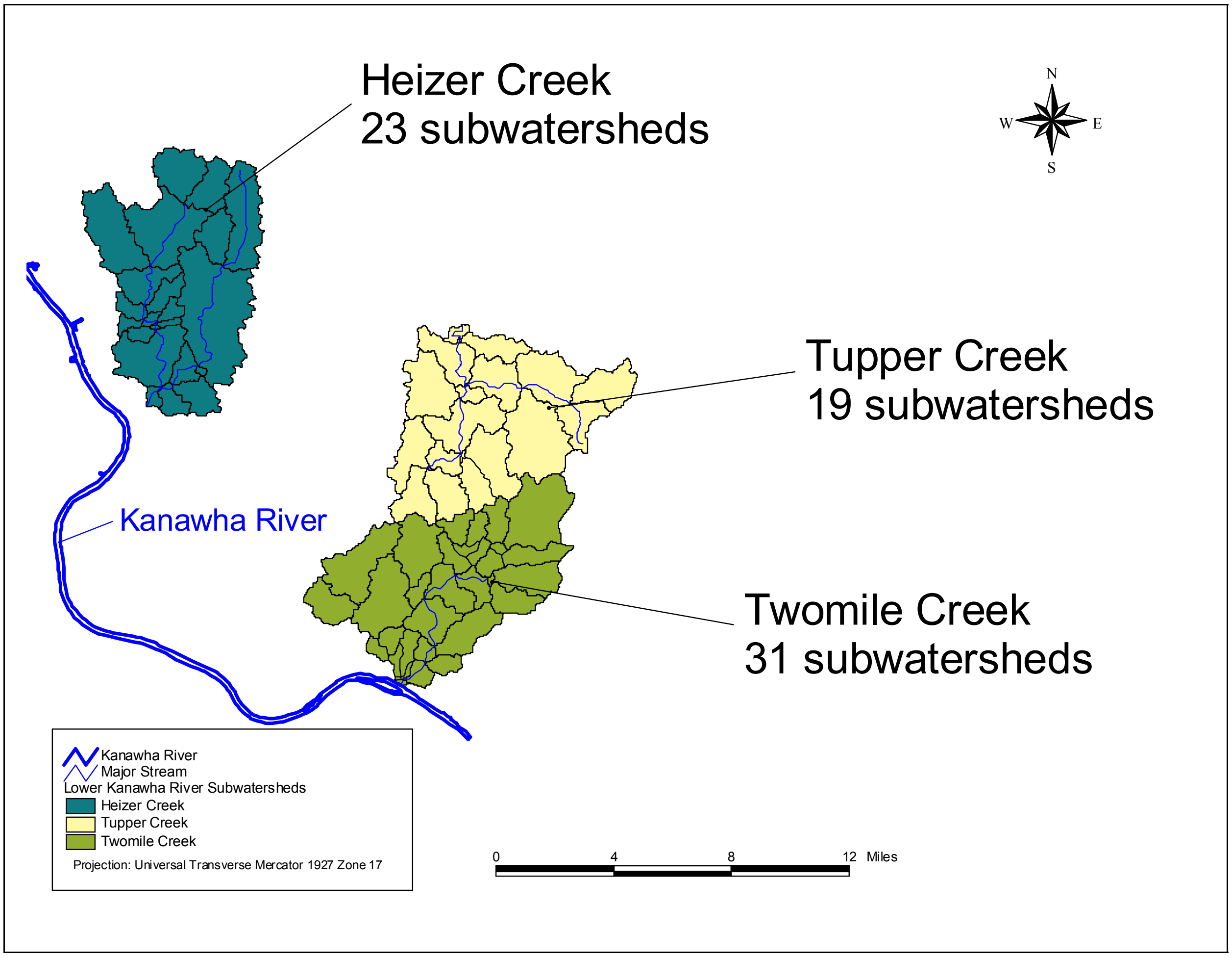



**Figure 7-1.** Lower Kanawha River subwatershed delineation.

variation. Hydrology calibration was based on observed data from this station and land uses present in the watershed at that time. Final adjustments to model hydrology were based on flow measurements obtained during WVDEP's pre-TMDL monitoring in the Lower Kanawha River 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 in-stream metals and fecal coliform bacteria concentrations. The water quality calibration consisted of executing MDAS, comparing the model results to available observations, and adjusting water quality parameters within a reasonable range. Ranges were based on previous watershed modeling experience in West Virginia (e.g., *Metals and pH TMDLs for the Elk River Watershed* [USEPA 2001] and *Metals, pH, and Fecal Coliform TMDLs for the Upper*

*Kanawha River Watershed, West Virginia* [WVDEP 2005]). Parameters for background conditions were established using observations from undisturbed areas.

As stated in Section 7.1, it was necessary to link MDAS with DESC-R to appropriately address dissolved aluminum TMDLs. DESC-R was calibrated by adjusting water quality parameters to match the observed in-stream water quality data. Further description and a summary of the results of the DESC-R water quality calibration and validation are presented in the Technical Report.

## 7.2 Modeling Technique for Sediment

Stressor identification results indicated a need to reduce the contribution of excess sediment to certain biologically impaired streams in the Lower Kanawha River watershed, as discussed in Section 6. As a result, sediment TMDLs were developed by integrating a watershed loading model that quantified land-based loads and a stream routing model that examined stream bank erosion and deposition processes.

Selection of this modeling system for the development of sediment TMDLs was based on the evaluation of available technical and regulatory criteria. The key technical factors listed in Section 7.1 were also considerations in the model selection process for sediment TMDL development. The adequate representation of erosion processes and nonpoint source loads in the watershed were of primary concern in selecting the appropriate modeling system.

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

A reference watershed approach was used to establish the acceptable level of sediment loading for each impaired stream on a watershed-specific basis. This approach was based on selecting a non-impaired watershed that shares similar land use, ecoregion, and geomorphologic characteristics with the impaired watershed. Stream conditions in the reference watershed are assumed to represent the conditions needed for the impaired stream to attain its designated uses. Given these parameters and a non-impaired West Virginia Stream Conditions Index (WVSCI) score, there were no candidate reference watersheds in the Lower Kanawha River watershed. Therefore, Spicelick Fork of the Joes Creek watershed in the nearby Coal River watershed was selected as the reference. The location of the Spicelick Fork watershed is shown in Figure 7-2.

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

As mentioned in Section 5.1, non-mining point source permits may also contain permit limits for TSS that must be considered in sediment modeling. These permits are assigned technology-based TSS effluent limitations that would not cause biological impairment. For example, NPDES permits for sewage treatment and industrial manufacturing facilities contain monthly average TSS effluent limitations between 30 and 60 mg/L. Therefore, reductions to existing non-mining TSS permits limits are not required in the sediment TMDLs. New non-mining point sources may also be permitted in the sediment-impaired watersheds with the implementation of applicable technology-based TSS requirements.

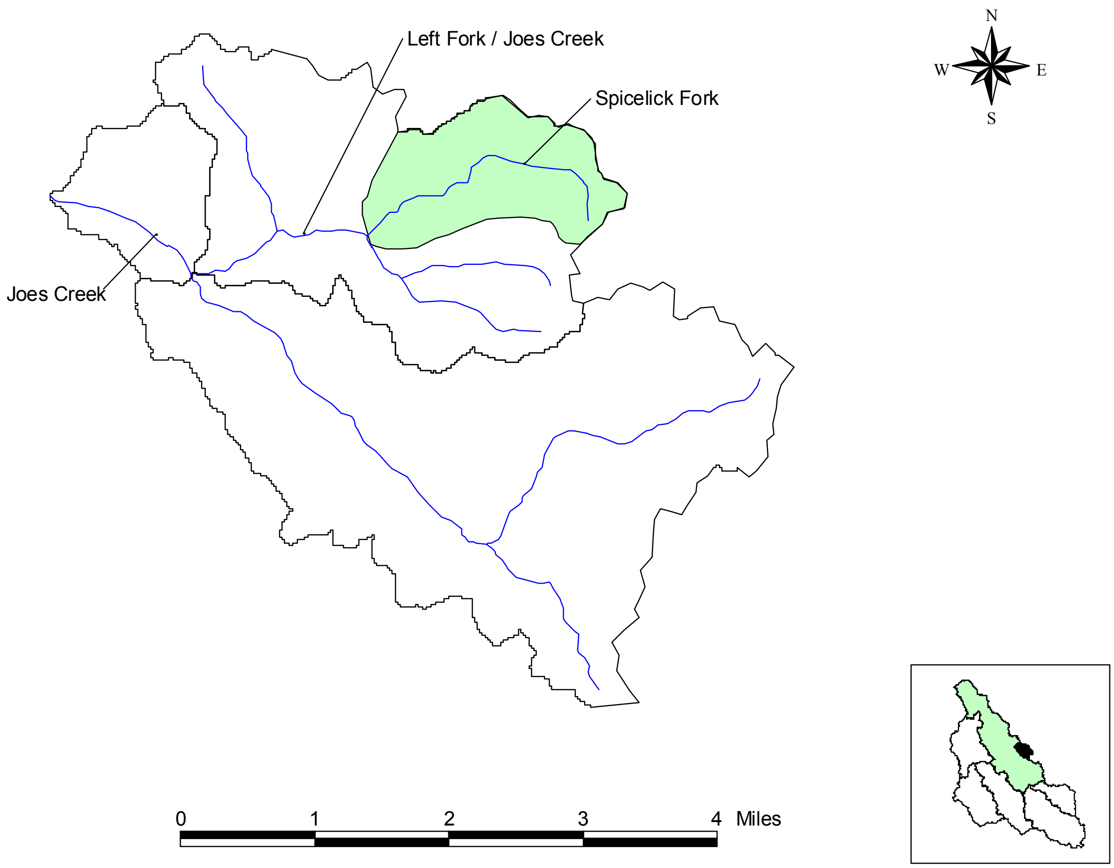



**Figure 7-2.** Location of the Spicelick Fork watershed.

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

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

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

### *7.2.1 GWLF/Stream Module Setup*

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

A continuous simulation period of two years (2002-2003) was used in the hydrologic simulation analysis. An important factor driving model simulations is precipitation data. The pattern and intensity of rainfall affect erosion and the contribution of sediment from the land to the stream. In the GWLF model, the nonpoint source load calculation is affected by terrain conditions, such as the amount of agricultural land and forested land, land slope, soil erosion potential, and land disturbance activities, in each modeled watershed. Various parameters can be adjusted in the model to account for these conditions and practices.

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

### *7.2.2 Hydrology Calibration*

Hydrology and water quality calibration were performed in sequence because water quality modeling depends on an accurate hydrology simulation. The modeling period was determined on the basis of the availability of weather and flow data collected during the same time period. There were no USGS flow gauging stations in the Heizer, Twomile, and Tupper Creek watersheds with adequate data records for hydrology calibration. Therefore, the GWLF hydrology calibration was performed on the Pocatalico River, and the model parameters were then applied to the other watersheds. The model was calibrated to the observed data recorded on the Pocatalico River at Sissonville (USGS stream flow gage 03201000) from 1996 to 1997. Further description and a summary of the results of the hydrology calibration and validation are presented in the Technical Report.

### *7.2.3 Water Quality Calibration*

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

## 7.3 Allocation Analysis

As explained in Section 2, a TMDL is derived from 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 an implicit or explicit margin of safety (MOS) that accounts for the uncertainty in the relationship between pollutant loads and the quality of the receiving waterbody. TMDLs can be expressed in terms of mass per time or other appropriate measures. Conceptually, this definition is denoted by the equation:

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

To develop aluminum, iron, pH, 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. Where applicable, TMDLs are presented as average annual loads because they were developed to meet TMDL endpoints under a range of conditions observed throughout the year. Analysis of available data indicated that critical conditions occur during both high- and low-flow events. To appropriately address the low- and high-flow critical conditions, the TMDLs were developed using continuous simulation (modeling over several years to capture precipitation extremes), which inherently considers seasonal hydrologic and source loading variability. This variability exists throughout the Lower Kanawha River watershed; therefore, the TMDLs are presented as average annual loads. Different TMDL endpoints are necessary for dissolved aluminum, total iron, pH, fecal coliform bacteria, and sediment. West Virginia's numeric water quality criteria for the subject pollutants (identified in Section 2) and an explicit MOS were used to identify endpoints for TMDL development.

*Dissolved Aluminum and Total Iron*

The TMDL endpoints for dissolved aluminum were selected as 712.5 micrograms per liter (µg/L; based on the 750 µg/L acute criterion for aquatic life minus a 5 percent MOS) and 82.7 µg/L (based on the 87 µg/L chronic criterion for aquatic life minus a 5 percent MOS). The endpoint for total iron was selected as 1.425 mg/L (based on the 1.5 mg/L criterion for aquatic life minus a 5 percent MOS).

Components of the TMDLs for aluminum and iron are presented as average annuals loads in pollutant pounds per year.

*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 5 percent MOS) and the geometric mean endpoint of 190 counts/100 mL (based on the 200 counts/100 mL geometric mean criterion minus a 5 percent MOS). The instantaneous criterion is more stringent and more difficult to obtain; however, both criteria are satisfied in this TMDL. Components of the TMDLs for fecal coliform bacteria are presented as average annuals loads in terms of total counts (fecal coliform colonies) pollutant per year.

*pH*

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

*Sediment*

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

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

*Margin of Safety*

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

### *7.3.2 Baseline Conditions and Source Loading Alternatives*

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

*Baseline Conditions for MDAS*

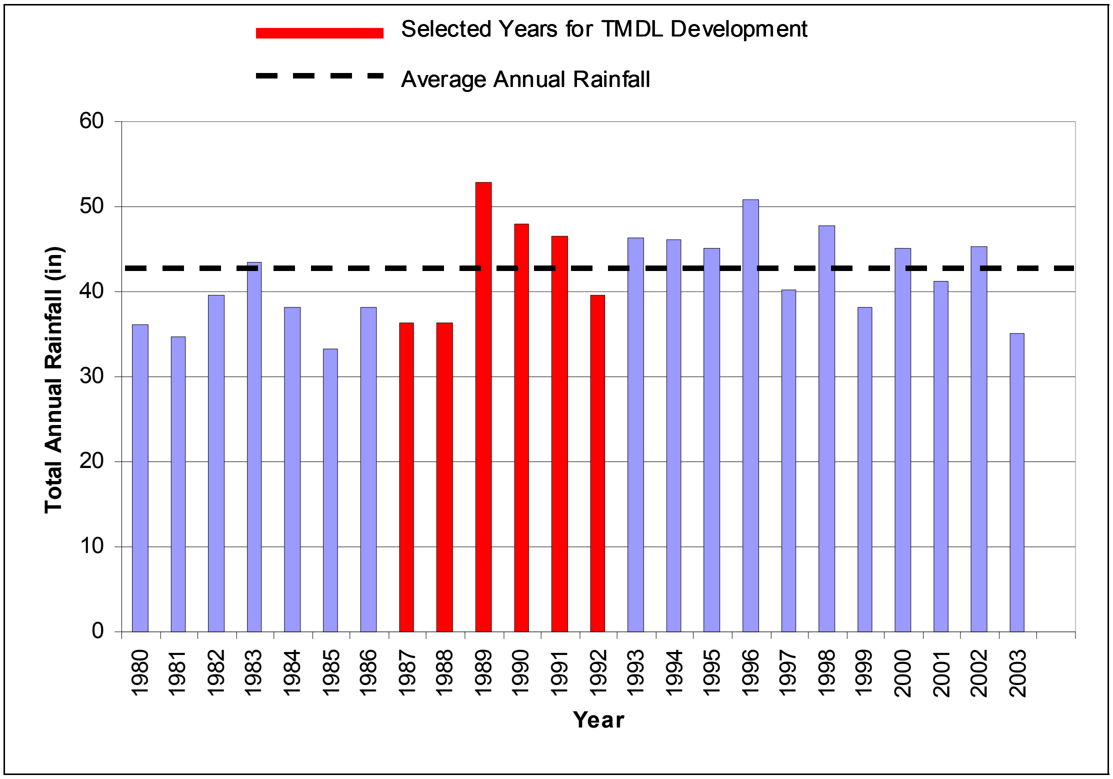
The MDAS model was run for baseline conditions using hourly precipitation data for a representative 6-year period (1987–1992). The precipitation experienced in this period was applied to the land uses and pollutant sources at the time of TMDL development. Predicted in-stream concentrations were compared directly to the TMDL endpoints. Using the model linkage described in Section 7.1, total aluminum was simulated using MDAS, and DESC-R was used to compare predicted dissolved aluminum concentrations to the TMDL endpoint. This comparison allowed for the evaluation of the magnitude and frequency of exceedances under a range of hydrologic and environmental conditions, including dry, wet, and average periods.

Figure 7-3 presents the annual rainfall totals for the years 1980 through 2003 at the Charleston Yeager Airport weather station in Charleston, West Virginia. The years from 1987 to 1992 are highlighted to indicate that a range of precipitation conditions was used for TMDL development.

Permitted conditions for fecal coliform bacteria point sources were represented during baseline conditions using the design flow for each facility and the monthly average effluent limitation of 200 counts/100 mL.

*Baseline Conditions for GWLF*

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




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

**Figure 7-3.** Annual precipitation totals and percentile ranks for the Charleston Yeager Airport weather station in Charleston, West Virginia.

*Source Loading Alternatives*

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

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

An example of model output for a baseline condition and a successful TMDL scenario is shown in Figure 7-4.

## 7.4 TMDLs and Source Allocations

### *7.4.1 Dissolved Aluminum, Total Iron, and pH TMDLs*

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

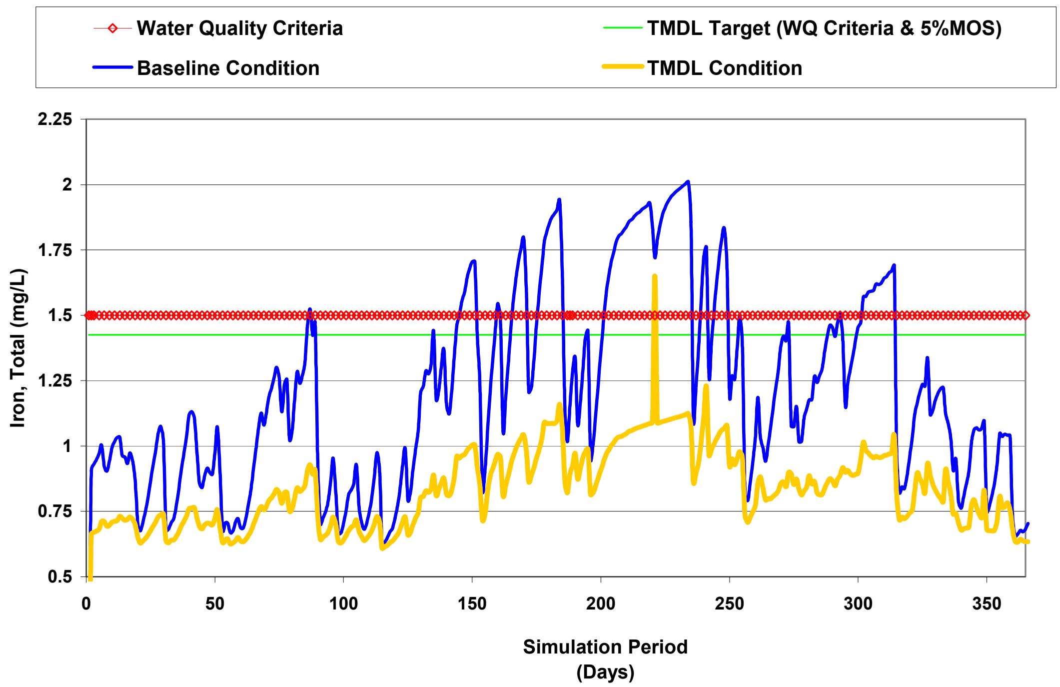



**Figure 7-4.** Example of baseline and TMDL conditions for iron.

The following general methodology was used to allocate loads to sources for the Heizer, Twomile, and Tupper Creek watershed TMDLs:

- For watersheds with AMLs and sediment sources, AML loads were reduced first. This was continued until in-stream water quality criteria were met, or until conditions were equal to those of undisturbed forest. If further reductions were required, the sediment sources were reduced until water quality criteria were met.
- For watersheds where dissolved aluminum TMDLs were developed, source allocations for total iron were developed first because their total in-stream concentrations significantly reduce pH and consequently increase dissolved aluminum concentrations. If the dissolved aluminum TMDL endpoint was not attained after source reductions to iron the total aluminum source loadings were reduced based on the methodology described above.

*Wasteload Allocations (WLAs)*
There are no point sources in the three selected subwatersheds specifically permitted to discharge metals. The sediment-related metals loading from the construction stormwater permits located in these watersheds was incorporated into the model as a background component. The small area associated with those permits was insignificant in relation to the iron impairments. The TMDL does not prescribe pollutant reduction from the existing construction stormwater sources.

*Load Allocations (LAs)*
Load Allocations (LAs) were assigned for the dominant source categories in the following order:

- AMLs—including abandoned mines (surface and deep) and highwalls
- Revoked permits—loading from revoked-permit facilities/bond forfeiture sites
- Sediment sources—metals loading associated with sediment contributions from harvested forest, burned forest, oil and gas well operations, and roads
- Other nonpoint sources—urban/residential, agricultural, and forested land contributions (loadings from other nonpoint sources were not reduced)

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

The iron and aluminum TMDLs are presented in the subwatershed appendices for Heizer Creek, Tupper Creek, and Twomile Creek.

As stated in Section 7.3.1, a surrogate approach was used for the pH TMDLs. It was assumed that reducing in-stream metal (iron and aluminum) concentrations to meet TMDL endpoints would result in attainment of the water quality standard for pH. This assumption was verified by running DESC-R for an extended period (6 years) in which TMDL endpoints for metals were met. A long-term median pH was calculated based on the daily equilibrium pH output from

DESC-R. These results are also shown in the subwatershed appendices. The Technical Report provides a detailed description of the pH modeling approach.

### *7.4.2 Fecal Coliform Bacteria TMDLs*

TMDLs and source allocations were developed for impaired segments of selected steams and their tributaries for each of the three watersheds in the Lower Kanawha River watershed shown in Figure 3-2. As described in Section 7.4.1, a top-down methodology was followed to develop these TMDLs and allocate loads to sources.

The following general methodology was used when allocating loads to sources for the fecal coliform bacteria TMDLs; all permitted wastewater treatment plant discharges were set at the permit limit (200 counts/100 mL monthly average). Because West Virginia Bureau for Public Health regulations prohibit discharge of raw sewage into surface waters, all illicit, non-disinfected discharges of human waste (from failing septic systems, straight pipes) were eliminated. If further reduction was necessary, combined sewer overflows (CSOs), discharges from MS4s, and nonpoint source loadings from agricultural lands and residential areas were subsequently reduced until in-stream water quality criteria were met.

*Wasteload Allocations (WLAs)*

Wasteload allocations (WLAs) were developed for all facilities permitted to discharge fecal coliform bacteria, including MS4s, as described below. For permitted discharges with numeric effluent limitations, the limitations are more stringent than water quality criteria; therefore, all such fecal coliform sources were represented by the monthly average fecal coliform limit of 200 counts/100 mL and no reductions were applied.

*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 Charleston is a designated MS4 municipality and portions of the City are located within the Twomile Creek watershed. The City filed a Notice of Intent for MS4 permit issuance and became registered under General Permit No.WV0110625 on October 15, 2004. The stormwater discharges from Charleston's MS4 are point sources for which the TMDLs prescribe wasteload allocations. The MS4 fecal coliform wasteload allocations are presented in Table 7-1 as annual average loads, in terms of counts per year. They are presented in that way because loadings are precipitation-driven and allocations were developed to meet TMDL endpoints under a range of conditions observed throughout the year.

Unlike traditional NPDES permits that include effluent limitations and self-monitoring requirements, regulation of MS4s will initially be accomplished under a General NPDES permit that is based upon the implementation of Best Management Practices (BMPs). The wasteload allocations prescribed for MS4s should not be construed to immediately mandate the imposition of numeric effluent limitations. Instead, time should be afforded for improvement to occur under the General Permit and the City of Charleston's MS4 authorization, in particular. Future monitoring should be designed to evaluate BMP effectiveness, over time, relative to the TMDL wasteload allocations.

The prescribed MS4 wasteload allocations are necessary to achieve compliance with water quality standards. DEP recognizes the potential for adverse economic and social impact associated with activities necessary to comply with water quality standards, and the various remedies available pursuant to 46CSR6. The wasteload allocations of the TMDL should not be construed to prohibit the pursuit of such future water quality standard revisions. As discussed in Section 2.2, future water quality standard revisions may be cause for TMDL modification.

**Table 7-1.** Individual fecal coliform MS4 WLAs for the City of Charleston, West Virginia

| Municipality | Watershed | Parameter | Baseline WLA (counts/yr) | WLA (counts/yr) | % Reduction |
|---|---|---|---|---|---|
| City of Charleston | Twomile Creek (inclusive of Chandler Branch, Pfieffer Branch, and Woodward Branch) | Fecal coliform bacteria | 1.89E+13 | 4.90E+12 | 74.1 |
| City of Charleston | Chandler Branch | Fecal coliform bacteria | 1.19E+13 | 2.00E+12 | 83.2 |
| City of Charleston | Pfieffer Branch | Fecal coliform bacteria | 6.68E+11 | 1.41E+11 | 78.9 |
| City of Charleston | Woodward Branch (inclusive of Pfieffer Branch) | Fecal coliform bacteria | 2.50E+12 | 8.06E+11 | 67.8 |

*Load Allocations (LAs)*

LAs were assigned as required to the following source categories:

- Pasture/Grassland—including pasture, successional grasslands, and croplands
- Onsite Sewage Systems—loading from all illicit, nondisinfected discharges of human waste (including failing septic systems and straight pipes)
- Residential—loading associated with urban/residential runoff
- Background and Other Nonpoint Sources—loading associated with wildlife sources from forested land (contributions/loadings from wildlife sources were not reduced)

The fecal coliform bacteria LAs are presented as annual loads, in counts per year, in the spreadsheets associated with this report. For the West Virginia portion of the watershed, subwatershed load allocations for a successful TMDL scenario are presented for specific nonpoint source categories. The fecal coliform bacteria TMDLs are presented in the subwatershed appendices for the impaired streams in the Twomile and Tupper Creek watersheds.

### *7.4.3 Sediment TMDLs*

TMDLs and source allocations were developed for each of the sediment-impaired streams identified in Table 6-1. The stressor identification process identified sediment as a primary stressor in the Tupper Creek and Twomile Creek watersheds. As described previously, headwaters were analyzed first because their loading frequently has a profound effect on downstream water quality. Loading contributions were reduced from applicable sources for these waterbodies, and TMDLs were developed. Source reductions never resulted in loading contributions less than those under the natural conditions represented by the undisturbed forest. Model results from the selected successful scenarios were then routed through downstream waterbodies using the Stream Module, which incorporated sediment transport/routing and stream bank erosion/deposition processes. If necessary, reductions were made in sediment contributions from stream bank erosion.

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

- Step 1: Loads from uncontrolled sediment sources (barren areas and unpaved roads) were reduced to the unit area loading of programmatic BMP sources (harvested forest, oil and gas operations, and MS4 point sources).

- Step 2: If further reduction was required, loads from uncontrolled sediment sources and programmatic BMP sources were together reduced to the unit area loading associated with point sources subject to TSS effluent limitations in an NPDES permit.

- Step 3: If even further reduction was required to meet the TMDL endpoint, loads from all sediment sources were reduced to the extent necessary to achieve the reference watershed loading.

In the Twomile and Tupper Creek watersheds, there are no active mining operations and nonmining point sources subject to TSS effluent limitations were shown to exhibit negligible impact to sediment-impaired waters. Consequently, Step 1 and Step 2 were executed until the TMDL endpoints were attained. Because significant implementation activity has yet to occur under the MS4 General Permit, baseline sediment loadings were represented equally inside and outside the MS4 boundary within a modeled subwatershed. After the land use-based sources were reduced, sediment produced from in-stream processes (bank erosion/deposition) were evaluated for each subwatershed. In subwatersheds where bank erosion was significant, sediment reduction was prescribed for in-stream processes, and the land use-based allocations were then adjusted accordingly.

*Wasteload Allocations (WLAs)*

There are no mining-related point sources in the Twomile and Tupper Creek watersheds. Within the sediment-impaired watersheds, there are sources that have industrial stormwater and sewage permits. The industrial stormwater permitting procedures generally incorporate a 100 mg/L TSS benchmark value, and regulated facilities develop Stormwater Pollution Prevention Plans to achieve that goal. WLAs for these sources were based on the benchmark value. WLAs for sewage treatment facilities recognize the 30 mg/L monthly average TSS effluent limitations contained in their permits. Under this TMDL, the wasteload allocations for these sources do not require pollutant reductions and are authorized to continue operation under existing permit conditions.

*Construction Stormwater Permits*

Three sites registered under the Construction Stormwater General Permit are represented in the Tupper Creek watershed. Those registrations are granted wasteload allocations that represent the sediment loading associated with BMP implementation in compliance with the General Permit. Provisions for future growth related to construction activity are also provided and described in Section 8.

*Municipal Separate Storm Sewer System (MS4)*

As stated previously, the City of Charleston is a designated MS4 municipality and portions of the city are located within the Twomile Creek watershed. The MS4 sediment wasteload allocations are presented in Table 7-2 as annual average loads, in terms of tons per year. They are presented in that way because loadings are precipitation-driven and allocations were developed to meet TMDL endpoints under a range of conditions observed throughout the year.

As with fecal coliform, the sediment wasteload allocations prescribed for MS4s should not be construed to immediately mandate the imposition of numeric effluent limitations. Instead, time should be afforded for improvement to occur under the General Permit and the City of Charleston's MS4 authorization, in particular. Future monitoring should be designed to evaluate BMP effectiveness, over time, relative to the TMDL wasteload allocations.

The prescribed MS4 wasteload allocations are necessary to achieve compliance with water quality standards. DEP recognizes the potential for adverse economic and social impact associated with activities necessary to comply with water quality standards, and the various remedies available pursuant to 46CSR6. The wasteload allocations of the TMDL should not be construed to prohibit the pursuit of such future water quality standard revisions. As discussed in Section 2.2, future water quality standard revisions may be cause for TMDL modification.

**Table 7-2.** Individual sediment MS4 WLA for the City of Charleston, West Virginia

| Municipality | Watershed | Parameter | Baseline WLA (tonnes/yr) | WLA (tonnes/yr) | % Reduction |
|---|---|---|---|---|---|
| City of Charleston | Twomile | Sediment | 240.6 | 81.4 | 66.2 |

*Load Allocations (LAs)*

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

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

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

The sediment TMDLs are presented in the Twomile and Tupper Creek subwatershed appendices.

### *7.4.4 Seasonal Variation*

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

### *7.4.5 Critical Conditions*

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

# 8. FUTURE GROWTH AND WATER QUALITY TRADING

## 8.1 Metals and pH

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

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

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

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

## 8.2 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 areas without it. 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 can be permitted anywhere in the watershed, provided that the permit includes monthly average and maximum daily fecal coliform limitations of 200 counts/100 mL and 400 counts/100 mL, respectively. Furthermore, WVDEP will not authorize construction of combined collection systems or permit overflows from newly constructed collection systems.

## 8.3 Sediment

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

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

In addition to the three construction stormwater permits in the sediment-impaired watersheds, specific future growth allowances are provided. The successful TMDL allocation scenarios allow for 0.5 percent of the area in the Twomile and Tupper Creek watersheds to be disturbed subject to the terms and conditions of the Construction Stormwater General Permit. A minimum of 10 acres is reserved in all subwatersheds for future growth. In subwatersheds where 0.5 percent of the area is less than 10 acres, the minimum of 10 acres is automatically designated for future growth. The reserved acreage is expected to accommodate future development in the subject watersheds. If development projects are proposed in excess of the acreage provided, they may be permitted by implementing controls beyond those afforded by the general permit. Larger areas may be permitted if it can be demonstrated that tighter controls will result in a loading condition commensurate with the general permit area allocations provided in Table 8-1.

**Table 8-1.** Future growth for construction stormwater permits

| Watershed | West Virginia Total Watershed Area (acres) | West Virginia Future Growth Area – 0.5% Total Watershed Area (Acres) |
|---|---|---|
| Twomile Creek | 15,477 | 77.5 |
| Edens Fork | 1,454 | 10.0 |
| Craig Branch | 150 | 10.0 |
| Tupper Creek | 15,101 | 75.5 |

## 8.4 Water Quality Trading

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

# 9. PUBLIC PARTICIPATION

## 9.1 Public Meetings

An informational public meeting was held at the Sissonville High School on September 27, 2004 at which detailed information was presented relative to WVDEP's proposed allocation strategies. On August 23, 2005 a final public meeting to present draft TMDLs was held at Nitro Community Center.

## 9.2 Public Notice and Public Comment Period

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

## 9.3 Response Summary

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

- City of Charleston Sanitary Board
- Michael D. Doran, P.E. DEE
- United States Environmental Protection Agency Region 3

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

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

***1) A mistake was identified in Section 5.1.2 of the Draft Report. The report incorrectly states that City of Charleston Combined Sewer Overflows (CSOs) 053 and 055 both discharge to Woodward Branch. CSO 053 discharges to Twomile Creek and CSO 055 discharges to Woodward Branch.***

The identified mistake is limited to the report narrative. The subject CSOs were correctly located in the modeling, as exemplified in the fecal coliform allocation spreadsheet. Section 5.1.2 has been revised to clearly identify the receiving streams of the CSOs.

**2) *Commenters expressed concern that the TMDL is inconsistent with the national CSO Control Policy and that the TMDL will undermine CSO control.***

TMDL development requirements conflict with certain aspects of the national CSO Policy, but CSO control under both is not mutually exclusive. The policy allows Long Term Control Plan development under a presumptive or demonstrative approach, with post-construction monitoring to verify compliance with water quality standards. The TMDL may be viewed as a demonstration that compliance with existing water quality criteria in Twomile Creek and Woodward Branch mandates elimination of Charleston CSOs 053 and 055. It does not supersede the timing of corrective action that is ultimately deemed appropriate in the approval of the Charleston Long Term Control Plan. Further, the TMDL may be modified to properly implement future water quality standard revisions (designated use and/or criteria), if enacted and approved by EPA.

Sections 2.2, 5.1, 7.4.2 and 10.1 have been revised to clarify DEP's positions relative to CSO TMDL implementation and control under the national CSO Control Policy and the State CSO Strategy.

**3) *It was suggested that because of its small size, Woodward Branch is an ephemeral stream in which water quality standards are not applicable.***

Ephemeral, or "wet weather" streams are streams that flow only in direct response to precipitation or whose channels are at all times above the water table (46CSR1 § 2.23). Numeric water quality standards do not apply in wet weather streams, provided that existing and designated uses of downstream waters are not adversely affected (46CSR1 § 7.2.c.2). DEP successfully accomplishing the majority of the scheduled sampling events of the pre-TMDL monitoring effort in Woodward Branch and its tributaries (UNT RM 0.9 and Pfeiffer Branch) and monitoring included events at times when flow was not the result of recent precipitation events. Although Woodward Branch is a small stream that may lack flow during seasonal dry periods, it is not a wet weather stream by definition. As such, numeric water quality standards are applicable.

**4) *Arguments were presented that the existing fecal coliform criteria are not appropriate for the protection of bacterial impacts to human health, and that because of its small size, the water contact recreation designated use should not be applicable to Woodward Branch.***

DEP is mandated to develop TMDLs that are based upon currently effective water quality standards. In that regard, the water contact recreation designated use applies to all West Virginia waters (46CSR1 § 6.1) and the fecal coliform TMDLs are based upon the applicable water quality criteria for that use. Redesignations of uses and/or alterations of numeric water quality criteria are water quality standard revisions for future consideration by DEP, the West Virginia Legislature and EPA. In the Section 2.2 discussion, language has been added that clearly states that the TMDLs are based on currently effective water quality standards and that future revisions of standards may be cause for TMDL modification.

**5) *The sufficiency of the fecal coliform dataset used in TMDL development was questioned.***

DEP's pre-TMDL monitoring and source tracking efforts are among the most comprehensive implemented nationally. In the Twomile Creek watershed alone, 21 stations were monitored monthly between July 2002 and June 2003. Monitoring occurred in all seasons and under the range of available flow conditions.

6) ***Contentions were made that the TMDL targets the majority of fecal coliform reduction to CSO and MS4 wet weather sources in the extreme downstream part of the watershed, and the dry weather impacts from absent or inadequate on-site sewage treatment facilities were ignored.***

The contention is inaccurate. The fecal coliform loadings from failing or nonexistent onsite sewage treatment systems were accounted for in the baseline condition and reduced (100%) throughout the watershed. No reductions were specified for home aeration units because those facilities operate under an NPDES permit with effluent limitations that are protective of criteria. Allocation methodology is described in Section 7.4.2 of the main report. Reductions to on-site systems are evidenced in the load allocation tab of the fecal coliform spreadsheet. Fecal coliform modeling indicates that baseline loadings result in criteria exceedances during both low and high flow conditions and the prescribed wasteload and load allocations appropriately target the problematic sources for both conditions.

7) ***It was suggested that fecal coliform and sediment wasteload allocations for MS4 sources are not achievable with available Best Management Practices (BMPs) and should include language that the allocations are to be implemented "to the maximum extent practicable."***

Discharges from MS4 are point sources that require NPDES permits. West Virginia has developed a General NPDES Permit for MS4 discharges (WV0110625) and the City of Charleston became registered under the permit October 15, 2004. The subject permit is based upon national guidance and is non-traditional in that it does not contain numeric effluent limitations, but instead proposes BMPs or "minimum control measures" that must be implemented "to the maximum extent practicable." In addition to BMP implementation requirements, the permit requires compliance with water quality standards.

DEP is mandated to develop TMDLs that are based upon currently effective water quality standards and to prescribe allocations that result in compliance with water quality standards. Compliance with water quality standards is also the expectation of the MS4 general permit. As such, it is inappropriate to include the suggested caveat.

Significant implementation activity under the MS4 general permit has yet to occur and the effectiveness of BMP implementation for small MS4s it not yet known. DEP believes that the MS4 wasteload allocations are technically achievable and that significant fecal coliform and sediment reduction can be accomplished by implementing the minimum control measures. Notwithstanding technical achievability, DEP recognizes that the financial conditions of particular permittees will significantly impact the level of BMP implementation that is practicable for them. In that regard, permittees may seek revisions to water quality standards (designated use reclassification, variances from water quality standards, site-specific numeric criteria) pursuant to 46CSR6. The wasteload allocations of the TMDL should not be construed to prohibit the pursuit of such future water quality standard revisions and future revisions of standards may be cause for TMDL modification.

Time is being afforded to allow General Permit implementation and the assessment of effectiveness in relation to prescribed wasteload allocations, with clarification provided in revised 7.4.2, 7.4.3 and 10.1 of the TMDL.

8) ***DEP was advised that the City of Charleston's combined sewer system and MS4 overlap in certain areas. It was also contended that the model baseline representation of fecal coliform loading from the subject CSOs overestimates their contribution.***

On September 26, 2005, DEP met with Mr. Doran and other representatives of the Charleston Sanitary Board to exchange information and cooperate to resolve their concerns. Following the meeting, Charleston provided additional information regarding the volume of CSO discharges and the overlapping area of CSO and MS4 systems. DEP incorporated the information and adjusted allocations as warranted. The information provided relative to CSO volume indicated that the initial model representation of CSOs underestimated their fecal coliform loading. The CSO/MS4 overlap information shows that modest portions of the watersheds are connected to the CSO system. The new information allowed slight relaxation of the necessary pollutant reductions from MS4 sources, but did not alter the fecal coliform wasteload allocations for the CSOs.

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

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

# 10. REASONABLE ASSURANCE

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

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

### 10.1 Permit Reissuance

WVDEP's Division of Water and Waste Management is responsible for issuing non-mining NPDES permits within the State. The Division of Mining and Reclamation develops NPDES permits for mining activities. As part of the permit review process, permit writers 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 Lower Kanawha River watershed is scheduled to begin in July 2006 for non-mining facilities and in January 2007 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.

West Virginia has developed a General NPDES Permit for MS4 discharges (WV0110625) and the City of Charleston became registered under the permit on October 15, 2004. The permit is based upon national guidance and is non-traditional in that it does not contain numeric effluent limitations, but instead proposes 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.

DWWM also implements a program to control discharges from combined sewer overflows (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 will require significant resources and an extended period of time to accomplish. By December 31, 2005, the City of Charleston will finalize its Long Term Control Plan for more than 50 existing CSOs. Only two of Charleston's CSOs are impacted by this TMDL effort. The Twomile Creek fecal coliform TMDL specifies wasteload allocations for CSO Outlets 053 and 055 that require elimination. While such reductions are necessary to achieve current fecal coliform water quality criteria, mitigation of other CSO impacts may be more important or cost effective to address first. The TMDL should not be construed to supersede the prioritization and scheduling of CSO controls and actions pursuant to the national CSO program.

### 10.2 Watershed Management Framework Process

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

- Bureau for Public Health
- Department of Highways
- Department of Environmental Protection
- State Conservation Agency

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

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

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

The Framework uses the 5-year Watershed Cycle to identify watersheds where restoration efforts will be focused. Each year Framework agencies meet 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 Framework prioritized Hydrologic Group B watersheds in 2005. Although the Lower Kanawha River watershed TMDLs were still in the development phase, preliminary information (gross pollutant reductions predicted by the calibrated models for individual subwatersheds) was provided to the framework to allow their consideration of Lower Kanawha River watershed impaired waters.

Development of "action plans" for priority watersheds is based on the efforts of local project teams. These teams are composed of Framework members and stakeholders having interest in or residing in the watershed. Team formation is based on the type of impairment(s) occurring or protection(s) needed within the watershed. In addition, teams have the ability to use the TMDL recommendations to help plan future activities. The team's goal is to develop a project plan that allows the most efficient use of resources from all involved parties.

### 10.3 Public Sewer Projects

Within WVDEP's Division of Water and Waste Management, the Engineering and Permitting Branch's Engineering Section is responsible for evaluating and providing funding for sewer projects. All municipal wastewater loans issued through the State Revolving Fund (SRF) program are subject to a detailed engineering review of the engineering report, design report, construction plans, specifications, and bidding documents. The staff performs periodic on-site inspections during construction to ascertain the progress of the project and compliance with the plans and specifications. Where the community does not use SRF funds to undertake a project, the staff still performs engineering reviews for the agency on all publicly owned treatment works prior to permit issuance or modification.

In the Twomile Creek and Tupper creek watersheds, the most significant source of fecal coliform contamination is untreated or partially treated residential sewage. The TMDL describes the necessary reductions in fecal coliform required to restore water quality in these streams, however, implementation of these reductions can only occur through proper installation and maintenance of approved sewage treatment systems. Such systems could include properly operated onsite sewage systems, i.e. home aeration units, fully functioning septic systems; or through the extension of public sewer to the affected areas. Although no projects are currently under construction for these watersheds, a list of wastewater projects currently under consideration by the West Virginia Infrastructure Council can be found at: http://www.wvinfrastructure.com/projects/index.html.

### 10.4 AML Projects

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

## 11. MONITORING PLAN

Recommended monitoring activities are described in Sections 11.1–11.3 below.

### 11.1 NPDES Compliance

WVDEP's DWWM is responsible for ensuring that NPDES permits contain effluent limitations as prescribed by the TMDL wasteload allocations and for assessing and compelling 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 predict 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.

# 12. REFERENCES

Bingner, R.L., and F.D. Theurer. 2002. Physics of suspended sediment transport in AnnAGNPS. In *Proceedings of the 2002 Second Federal Interagency Hydrologic Modeling Conference*, Las Vegas, NV, July 28–August 1, 2002. No page numbers; published as CD-ROM.

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

Dai, T., R.L. Wetzel, T.R. Christensen, and E.A. Lewis. 2000. *BasinSim 1.0: A Windows-based Watershed Modeling Package*. Virginia Institute of Marine Science, College of William and Mary, Gloucester Point, VA.

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

Haith, D.A., and L.L. Shoemaker. 1987. Generalized watershed loading functions for stream flow nutrients. *Water Resources Bulletin* 23(3):471–478.

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

PADEP (Pennsylvania Department of Environmental Protection). 2000. *Coal Mine Drainage Prediction and Pollution Prevention in Pennsylvania*. Pennsylvania Department of Environmental Protection, Harrisburg, PA.

Tetra Tech, Inc. 2003. Stream Module.

USDA (U.S. Department of Agriculture). 1997. *Census of Agriculture*. U.S. Department of Agriculture, National Agricultural Statistics Service, Washington, DC.

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

USEPA. 2001. *Metals and pH TMDLs for the Elk River Watershed, West Virginia*. U.S. Environmental Protection Agency, Region 3, Office of Watersheds, Philadelphia, PA.

Watts, K.C., Jr., M.E. Hinkle, and W.R. Griffitts. 1994. *Isopleth Maps of Titanium, Aluminum and Associated Elements in Stream Sediments of West Virginia*. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

WVDEP (West Virginia Department of Environmental Protection). 2005. *Metals, pH, and Fecal Coliform TMDLs for the Upper Kanawha River Watershed, West Virginia*. WVDEP, Charleston, WV.