Department of Environmental Protection

Division of Water and Waste Management

Quality Assurance Project Plan

for

Watershed Assessment Branch Monitoring Activities

Revised May 14, 2019

west virginia department of environmental protection

Approval Sheet

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Mindy Neil, TMDL Project Manager — Date

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Chapter A – Project Management

Section A1 Distribution List

This document and all supporting materials will be submitted to the following individuals. Distribution format will be electronic and/or paper copies.

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Margaret Cadmus, Environmental Resources Specialist 1

Karen Maes, Environmental Resources Specialist 1

Sara Miller, Environmental Resources Specialist 1

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Nick Murray, Environmental Resources Specialist Supervisor

Mike Ong, Environmental Resources Specialist 2

Nick Snider, Environmental Resources Specialist 3

Wade Alexander, Environmental Resources Specialist 1

Danielle Nathanson, Environmental Resources Specialist 3

Carissa Turley, Environmental Resources Specialist 1

Mike McDaniel, Technical Analyst Associate

Steve Stutler, Environmental Resources Specialist 3

Chris Daugherty, Environmental Resources Analyst

James Summers, Environmental Resources Analyst

Section A2 Project/Task Organization

The Watershed Assessment Branch consists of the following personnel. An organization chart depicting the relationships of these individuals is presented in Figures 1 and 2.

John Wirts, Environmental Resources Program Manager 3: Supervises the Watershed Assessment Branch; responsible for program operations including budget, goals development and interagency coordination.

Lindsey Leonard, Secretary 2: Assists in preparing budget; prepares invoices for payment; prepares monthly reports on expenditures; scans data for electronic filing; assists staff in various projects.

Wetlands Monitoring & Assessment

Elizabeth Byers, Senior Level 1 wetland scientist – part-time. Leads DEP's work related to the development of functional indices for improving the state's ability to properly value the primary functions that wetlands provide and to improve the state's ability to mitigate impacts based on those functions. Also, will lead efforts to develop a wetlands monitoring component within the Watershed Assessment Branch.

Jack Hopkins, Environmental Resources Specialist 2: Junior Level 1 wetland scientist. Assists the senior level wetlands scientist and with other Watershed Assessment Branch field work and technical support as needed.

Watershed Assessment Section

Jeff Bailey, Environmental Resources Program Manager: Supervises Watershed Assessment Section (WAS); oversees data collection for all water quality assessment programs involving streams, rivers, and lakes; performs data analysis to interpret chemical, physical, and biological information; performs required procedures to purchase equipment and services necessary for maintaining and enhancing the WAS; performs administrative duties involving staff; plans and oversees annual Standard Operating Procedures training for WAS field staff; conducts field assessments and monitoring.

Janice Smithson, Environmental Resources Specialist Supervisor: Is responsible for overall quality assurance/quality control. Supervises daily activities of full-time & temporary field and office staff; trains personnel and oversees data entry/data review; manages data flow & verifies incoming field data and prepares weekly quality reports; merges field data and chemistry data into WABbase; prepares assignments and assists in scheduling for field crews; macroinvertebrate taxonomist; coordinates with macroinvertebrate identification laboratory; prepares and maintains scientific collecting permits.

Nick Murray, Environmental Resources Specialist Supervisor: Supervises daily activities of full-time & temporary field and office staff; performs waterbody assessment training for field personnel; performs field audits on WAS staff; trains personnel and oversees data entry/data review; analyzes data from continuous water quality monitoring devices; performs waterbody assessments; performs maintenance, diagnostic, repairs to deployable dataloggers and other field equipment; maintains inventory of field equipment; purchases field equipment and coordinates factory repairs; participates in public outreach activities.

Michael Whitman, Environmental Resources Analyst: Oversees security, design, maintenance, training, and QA/QC databases (Primary Data Manager); oversees development of data flow among shared databases; performs statistical analyses for probabilistic sampling; oversees scanning of paper forms into electronic filing system; QA/QC of GIS data; assists in WAB planning activities; maintains and updates field forms and SOPs; macroinvertebrate collection curator; proctor for the Society of Freshwater Science's taxonomic certification program; participates in various waterbody assessments.

Jason Morgan, Environmental Resources Specialist 3: Fish collection crew leader; participates in development of fish assessment index; fish taxonomist; coordinates fish identification QA/QC with third party taxonomists; performs trout stream evaluations; collects and prepares fish tissue for consumption advisories; performs waterbody assessments.

Nick Snider, Environmental Resources Specialist 3: Field lead for continuous water quality monitoring network of streams and rivers; performs monthly data retrieval, deployment/redeployment/retrieval & field maintenance for deployable dataloggers; tracks and maintains activity log for deployable dataloggers; collects field data for watershed assessments; performs source tracking for TMDL development.

Philip Ryan Pack, Environmental Resources Specialist 3: Fish collection crew leader; fish taxonomist; performs trout stream evaluations; collects and prepares fish tissue for consumption advisories; maintains boats/trailers; conducts general waterbody assessments; performs data analysis to interpret chemical, physical, and biological information.

Danielle Nathanson, Environmental Resources Specialist 3: Lead researcher for lakes assessments; selects lakes for annual assessments and conducts related field work; responds to reports of harmful algal blooms (HABs), identifies HAB taxa and prepares toxin samples for analysis; communicates all HABs findings to appropriate personnel in several state agencies; performs data entry for lakes and HABs and evaluates data; field crew leader for National River and Stream Assessments (NRSA) and National Lakes Assessment (NLA); assures all sampling is compliant with EPA's protocols and serves as "single point of contact"; participates in stream assessments.

Mike Ong, Environmental Resources Specialist 2: Performs waterbody assessments; responsible for monthly water quality sampling for TMDL development & Ambient Network; oversees maintenance and repair of WAB vehicles.

Horace Reid Downer, Environmental Resources Specialist 2: Responsible for monthly water quality sampling for Ambient Network; analyzes data from continuous water quality monitoring devices; performs data entry/data review; participates in special surveys as requested (National Aquatic Resource Surveys or NARS); participates in public outreach activities. Field leader for salamander population studies; salamander taxonomist.

Karen Maes, Environmental Resources Specialist 1: Performs data entry/review; manages and orders field supplies; assists in maintenance of benthic macroinvertebrate voucher and reference collections.

Carissa Turley, Environmental Resources Specialist 1: Participates in waterbody assessments; responsible for monthly water quality sampling for TMDL development; coordinates & participates in public outreach and educational activities; performs data entry/data review; assists in maintenance of benthic macroinvertebrate voucher and reference collections.

Vacant, Environmental Resources Specialist 1: Collects field data for waterbody assessments and TMDL development; participates in special surveys as requested (NARS); performs data entry and data review.

Sara Miller, Environmental Resources Specialist 1: Participates in waterbody assessments; responsible for monthly water quality sampling for TMDL development; participates in special surveys as requested (NARS); performs data entry/data review.

Wade Alexander, Environmental Resources Specialist 1: Collects field data for waterbody assessments and TMDL development; participates in special surveys as requested (NARS); performs data entry and data review; collects data for storm runoff studies.

Margaret Cadmus, Environmental Resources Specialist 1: Collects field data for waterbody assessments and TMDL development; performs data entry and data review.

Vacant, Environmental Resources Specialist 1: Collects field data for waterbody assessments and TMDL development; performs data entry and data review.

Vacant, Environmental Resources Specialist 1: Collects field data for waterbody assessments and TMDL development; performs data entry and data review.

TMDL Section

Mindy Neil, Environmental Resource Program Manager 1: Supervises Total Maximum Daily Load Section; communicates plans & accomplishments of TMDL program to stakeholders & public; facilitates stakeholder input to the TMDL development process; ensures compilation of technical information for TMDL development and submits to contractors; oversees preparation of 303(d) List & Integrated Report and finalizes these documents for submission to EPA; participates in Chesapeake Bay TMDL development and implementation.

Mike McDaniel, Technical Analyst 1: Solicits and secures consultants for TMDL modeling and report development; oversees and manages TDML development contracts; reviews the interim products of TDML contractors and prepares agency's comments; assists with public outreach and technical support activities of the TDML program. Participates in the QA/QC of TMDL monitoring data in WABbase.

Vacant, Environmental Resources Specialist Supervisor: Supervises staff performing listing assessments; oversees the public outreach activities of the TMDL program; Oversees technical support activities of the TMDL program; oversees data management systems and comprehensive office files related to TMDL and Integrated report development; coordinates development of Integrated Reports. Participates in the QA/QC of TMDL monitoring data in WABbase.

Chris Daugherty, Environmental Resources Analyst: (Assessment Data Manager) Lead for the compilation, review, entry and assessment of data for the biennial 303(d) List and Integrated Report; lead for maintenance and refinement of databases specific to the TMDL and 303(d) assessments; prepares and transfers data to support TMDL development; standardizes data sources for stream codes and stream names, including NHD database and GIS coverages; supports maintenance and updates of workgroup's databases; provides informal technical support for GIS.

James Summers, Environmental Resource Analyst: Participates in the process to identify pollutants and biological stressors causing water quality impairments; identifies and investigates pollution sources; validates existing data on known pollution sources using GPS & GIS; developments and refines formats for tracking and reporting information to TMDL contractors; performs field investigations and prepares reports relating to water quality criteria.

Steve Stutler, Environmental Resources Specialist 3: Assists in compiling, formatting and transferring water quality source assessment data to TMDL contractors; assists in compiling and assessing data for the Integrated Report; assists in coding for 24K NHD coverages; assesses WAB computer needs and recommends purchases; compiles data on land application of sludge for Chesapeake Bay TMDL implementation.

Vacant, Environmental Resources Specialist 2: Assists with the input, QA/QC and proofing of third party data in WABbase; assists in compiling, formatting and transferring water quality and pollution source data to TMDL contractors; compiles, assesses, and inputs data into database for the Integrated Report; reviews water quality duplicate and field blank samples and reports significant anomalies to management for investigation.

Vacant, Environmental Resources Specialist 2: Assists in the process to identify pollutants causing water quality impairments; identifies and investigates pollution sources; provides support to the TMDL and 303(d)/Integrated Reports through data analysis in GIS, field studies, document reviews, proper document/file management, and 303(d) assessments.

Figure 1. Watershed Assessment Branch Organization Chart - Watershed Assessment Section

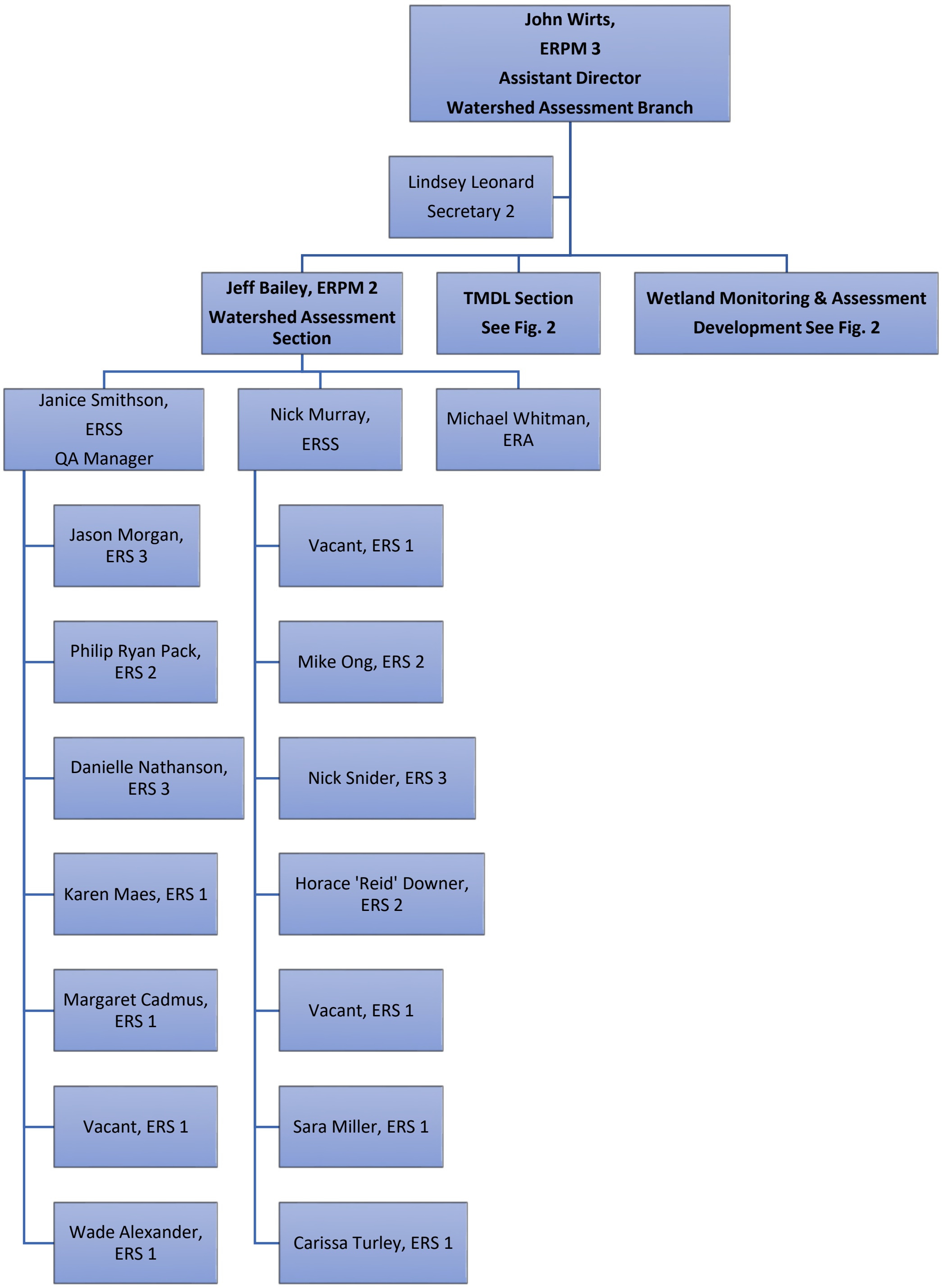
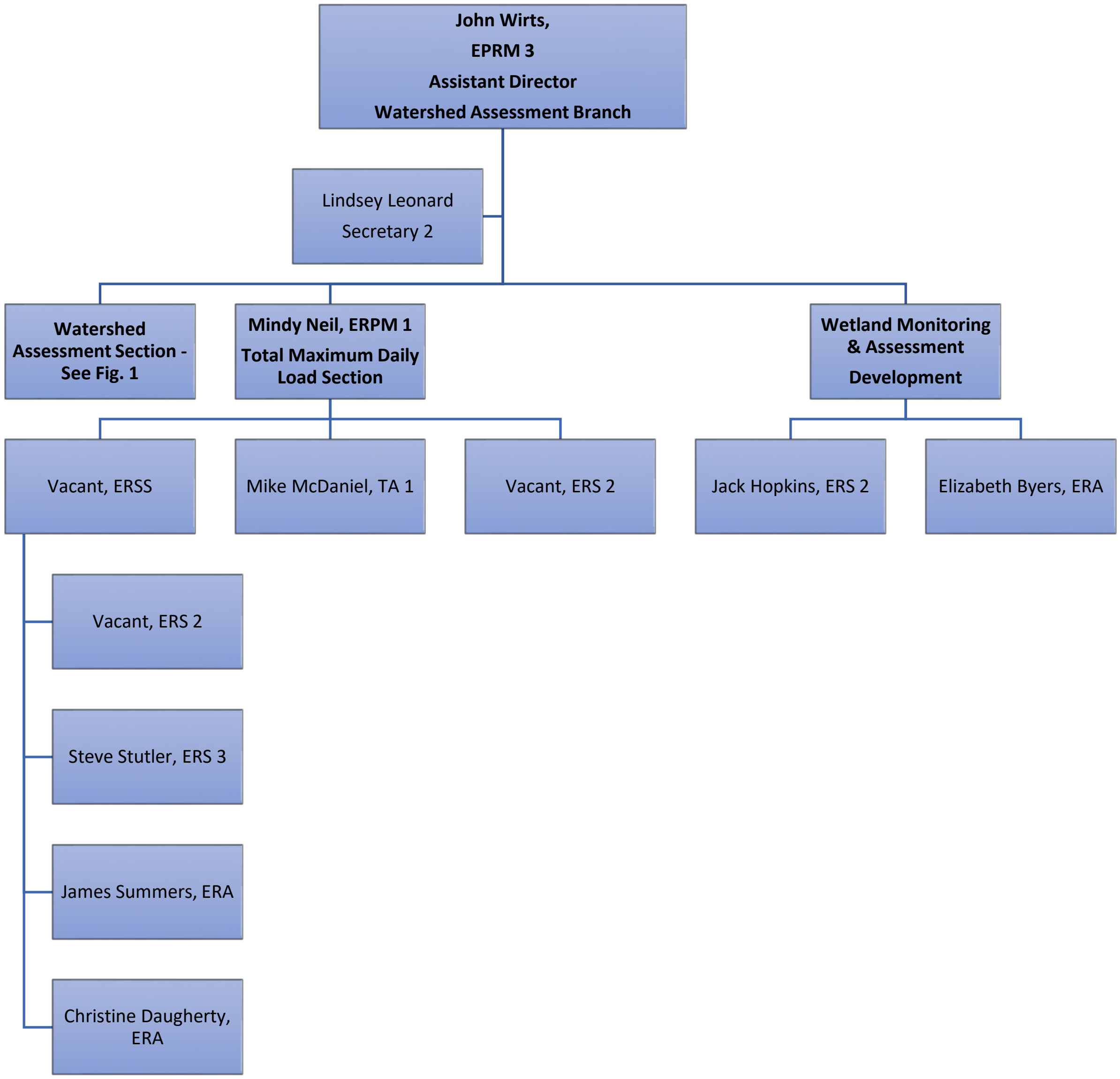


Figure 2. Watershed Assessment Branch Organizational Chart – Wetland Monitoring & Assessment and Total Maximum Daily Load Section.



Section A3 Background and Problem Definition

The United States Environmental Protection Agency (EPA) promotes a watershed approach to monitoring, assessment and implementation of water quality protection activities. This approach provides an environmental management program that places a greater focus on ecosystems and utilizes decreasing resources more effectively in threatened watersheds. The West Virginia Department of Environmental Protection (DEP), Division of Water and Waste Management's (DWWM), Watershed Assessment Branch provides current water quality to support this initiative. The Watershed Assessment Branch (WAB) consists of three major components, the Watershed Assessment Section (WAS), the Total Maximum Daily Load (TMDL) Section and Wetland Monitoring & Assessment.

The mission of the Watershed Assessment Branch is to collect and interpret water quality information from West Virginia's 32 hydrological units on a five-year rotation. The data collected provide direction to stakeholders who regulate water quality and implement protective measures. As the five-year cycles repeat, the Watershed Assessment Branch will be able to measure the stakeholders' effectiveness in the management and protection of the water resources of the state.

The specific objectives of the Watershed Assessment Branch are:

- to obtain current, accurate water quality and habitat relative to the water resources of the state;
- to maintain West Virginia's 303(d) list and prepare the state's Integrated Report;
- to prepare water quality improvement plans (Total Maximum Daily Loads, TMDLs);
- to provide information in support of the state's antidegradation policy;
- to support stakeholders in the implementation of management and control measures for priority waterbodies.

The WAB also cooperates with and provides leadership to other DEP entities who are collecting water quality information. These entities (e.g., Watershed Improvement Branch, Division of Mining and Reclamation, etc.) often use WAB QA/QC principles in their work. Qualifying information is incorporated into the WAB's assessment and decision-making processes.

Section A4 Task Description

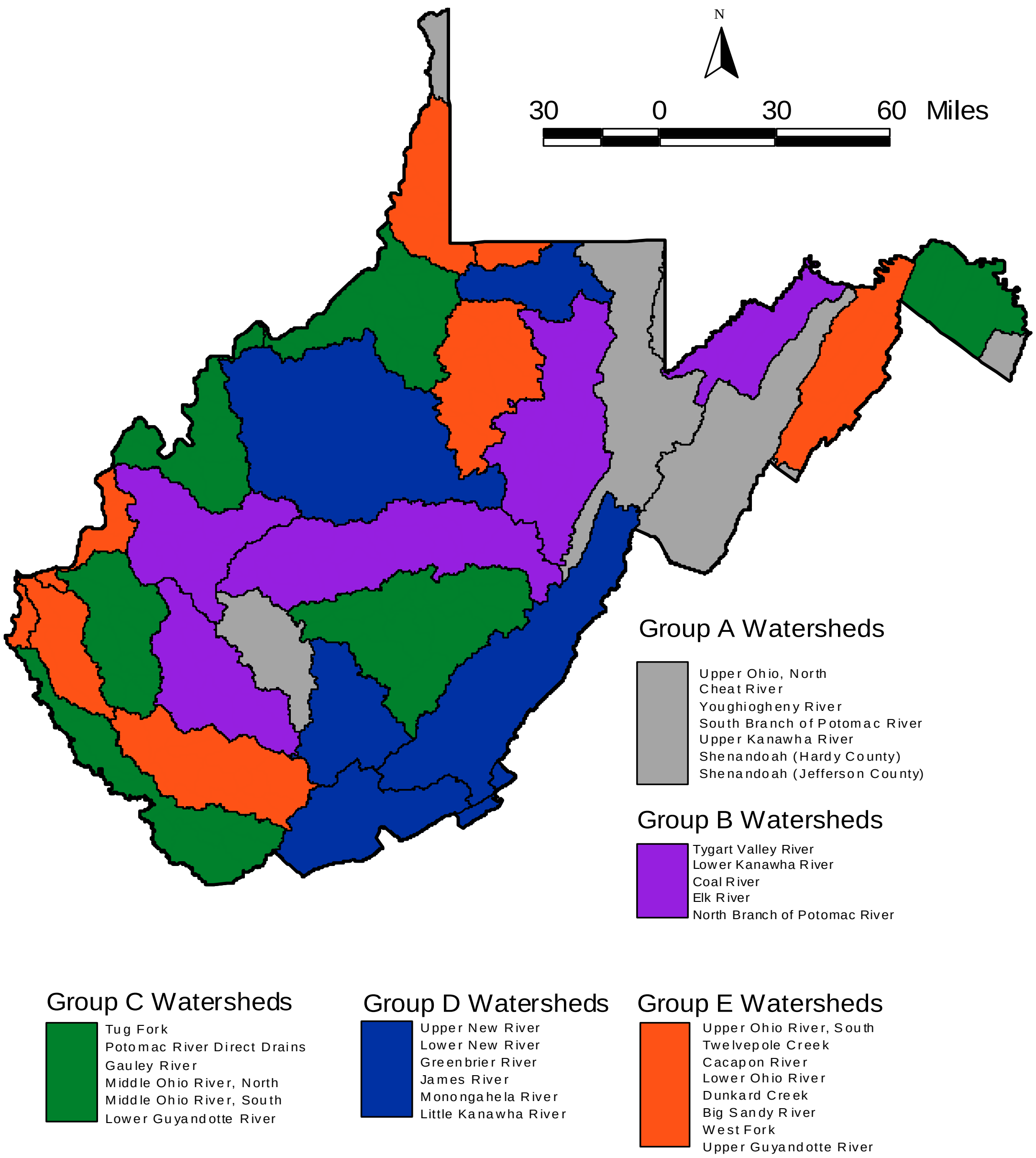
West Virginia has been divided in 32 waterbodies using the United States Geologic Survey's eight-digit (HUC8) cataloguing unit method. The 32 watersheds have been assigned to 5 hydrologic groups (A-E). Each year, the Watershed Assessment Branch's data collection efforts will focus on one of the hydrologic groups. In general, upon the completion of a five-year cycle, each hydrologic group had been studied and the cycle would be repeated. The cataloging units are as follows:

Hydrologic Group	Watershed Name	HUC Code
A	South Branch of Potomac River	02070001
B	North Branch of Potomac River	02070002
E	Cacapon River	02070003
C	Potomac River Direct Drains	02070004
A	Shenandoah River (Hardy County)	02070006

Hydrologic Group	Watershed Name	HUC Code
A	Shenandoah River (Jefferson Co.)	02070007
D	James River	02080201
B	Tygart Valley River	05020001
E	West Fork	05020002
D	Monongahela River Direct Drains	05020003
A	Cheat River	05020004
E	Dunkard Creek	05020005
A	Youghiogheny River	05020006
A	Upper Ohio River, North	05030101
E	Upper Ohio River, South	05030106
C	Middle Ohio River, North	05030201
C	Middle Ohio River, South	05030202
D	Little Kanawha River	05030203
D	Upper New River	05050002
D	Greenbrier River	05050003
D	Lower New River	05050004
C	Gauley River	05050005
A	Upper Kanawha River	05050006
B	Elk River	05050007
B	Lower Kanawha River	05050008
B	Coal River	05050009
E	Upper Guyandotte River	05070101
C	Lower Guyandotte River	05070102
C	Tug Fork	05070201
E	Big Sandy River	05070204
E	Lower Ohio River	05090101
E	Twelvepole Creek	05090102

The watershed sequence is illustrated in Figure 4. When needed, assessments for hydrologic groups may be scheduled out of the cycle to study known impairment in watersheds (see italicized watersheds). Boldface watersheds are tentatively planned.

Figure 3. Watershed Grouping for Assessment within the Five-Year Cycle.



The work performed by the Watershed Assessment Branch falls into several major categories: Wadeable stream assessments, Long Term Monitoring Stations (LTMS), probabilistic sampling, TMDL development sampling, the Ambient Water Quality Network (large river monitoring), lake assessments, and continuous (time-series) water quality monitoring. These components are discussed in detail in the following paragraphs. A new component – Wetland Monitoring & Assessment – is currently under development and will be discussed in as much detail as possible. Table 1 summarizes the physical and chemical interests for each of these activities. Figure 5 presents the timeline for various components.

Table 1. Summary of Watershed Assessment Branch Parameters.

Parameter	Wadeable Streams	Probabilistic & LTMS	TMDL Development	Ambient Network	Lakes	CIM	Wetlands
Habitat Evaluation	S	S	V	V	S		S
Physical Evaluation	S	S	S	S	S	S	S
Stream Velocity	V		V	V			
Field pH	S	S	S	S	S	S	
Field Temp	S	S	S	S	S	S	
Field Conductivity	S	S	S	S	S	S	
Field Dissolved Oxygen	S	S	S	S	S	S	
Hot Acidity	V	S	V	S			
Cold Acidity			V				
Alkalinity	V	S	V	S		S	
Hardness			V				
Sulfate	V	S	V	S			
Chloride	V	S	V				
Bromide	V	S	V	S			
Fecal Coli.	V	S	V	S		S	
Chlorophyll-a						S	
Total Suspended. Solids	V	S	V	S		S	
Total Dissolved Solids	V	S	V	S		S	
Total Phosphorus-P	V	S	V	S		S	
Total Ortho-Phosphate			V				
Diss. Ortho-Phosphate			V				
TKN	V	S	V	S		S	
Ammonia-N			V	S			
Nitrate-Nitrite-N	V	S	V	S		S	
Total Aluminum	V	S	V	S			
Total Arsenic			V	S			
Total Barium	V	S	V	S			
Total Beryllium	V	S	V	S			
Total Boron			V	S			
Total Calcium	V	S	V	S			
Total Iron	V	S	V	S			
Total Magnesium	V	S	V	S			
Total Manganese	V	S	V	S			
Total Mercury			V				

Parameter	Wadeable Streams	Probabilistic & LTMS	TMDL Development	Ambient Network	Lakes	CIM	Wetlands
Total Potassium			V	S			
Total Selenium	V	S	V	S			
Total Sodium	V	S	V	S			
Total Strontium			V				
Dissolved Aluminum	V	S	V	S			
Dissolved Cadmium			V	S			
Dissolved Copper	V	S	V	S			
Dissolved Iron	V	S	V	S			
Dissolved Lead			V	S			
Dissolved Nickel			V	S			
Dissolved Selenium			V				
Dissolved Silver			V	S			
Dissolved Zinc	V	S	V	S			
Volatile Organics			V				
Semi-volatile Organics			V				

CIM = Continuous Instream Monitoring
S=Standard Parameter - collected each sampling event
V=Variable - collected only when specified.

Wadeable stream assessments are usually synchronized with the five-year watershed cycle. Assessment sites are selected to address specific issues:

- Reference sites: These are unimpaired sites that must meet a specified set of criteria. A subset of previously identified reference sites is revisited in subsequent years and potential new reference sites will be considered for each watershed.
- Impaired Streams: Streams that are 303(d) listed will be revisited and examined in greater detail.
- Unassessed streams: Significant tributaries that have not been assessed during previous cycles.
- Flood or Drought Impaired Streams: This subset contains streams that were not in their normal state during previous assessment cycles. Scour from floods and extremely low flows temporarily depress the biological communities. These sites are revisited to evaluate their condition during normal flow conditions.
- Significant Tributaries: The watershed mainstem and significant sub-watersheds are sampled at multiple locations to examine the overall condition of the aquatic system and to determine spatial trends.
- Stakeholder Requests: Specific requests from watershed associations and state and federal agencies are included during the site selection process.

Long-Term Monitoring Stations (LTMS) are used to develop trends at targeted wadeable stream throughout the state. This network does not follow the hydrologic watershed cycle. The stations represent a wide array of impairments, such as acid mine drainage, acid deposition, sediment, and nutrient enrichment. The network also includes streams that represent reference or best attainable conditions. Some sites are sampled annually, while others are sampled every 2-3 years. A small subset of the LTMS sites is sampled twice a year to evaluate seasonal trends. Sampling occurs March through October, inclusive.

Probabilistic sampling produces unbiased data that can be subjected to statistical analysis with a high degree of confidence. These studies can be used to address state-wide issues, such as differences among ecoregions or the number of stream miles impaired by a specific condition. Sites are selected at random using a program that weighs the site selection based on specified criteria, such as stream size, specific waterbody type, or ecoregion. The number of sites will vary depending on the objective of the study, but sampling efforts will be sufficient to assure the data will stand up to statistical analysis. Probabilistic studies have a five-year duration. However, unlike the wadeable streams assessments, probabilistic studies do not adhere to the five-year watershed cycle; instead, sampling occurs statewide annually. This process will help to mitigate problems that arise if a short-term environmental event, such as drought, occurs during the study.

TMDL development sampling is an intensive approach to obtaining a large amount of water quality information under a variety of environmental conditions. Conforming to the five-year cycle, sites are established on 303(d) listed streams and other streams that may provide additional supportive information. Water quality sampling is performed monthly, July through June. Data are submitted to modelers for development of TMDLs.

Ambient water quality monitoring is performed to capture data from the state's larger rivers and streams. West Virginia's ambient monitoring network has been in existence since the mid 1940's, although the number of sites and sampling frequency has varied over the years. The current network consists of 26 fixed stations (Figure 6). Most sites are sampled bi-monthly (i.e., six events per year); the exception being sites in the Monongahela basin, which are sampled monthly. Each event includes a brief documentation of prevailing conditions and a large suite of water quality parameters.

Lake assessments are performed in accordance with the 5-year watershed cycle. Lakes are sampled four times between May and September. The number of stations per lake varies and is generally proportional to the size of the impoundment. The components of sampling include a vertical water chemistry profile (includes physiochemical properties, nutrients, and turbidity measurements), chlorophyll-a and fecal coliform sampling, Secchi depth, and limited habitat and disturbance observation.

Continuous (time-series) water quality monitoring uses deployable sondes to provide more detailed and more frequent water quality data in support of other sampling programs. Sondes are usually deployed to support other projects, such as TMDL sampling. Sondes are checked periodically (approximately once per month) to download data and to perform maintenance. These visits may also include discrete water sampling to aid in calibration of the final sonde dataset.

Wetlands Monitoring & Assessment is currently under development. When fully implemented, wetlands monitoring will likely follow the 5-year watershed cycle. There will be three levels of assessment.

- Level 1: Landscape Assessments. Utilizes Geographic Information System (GIS) data to describe the condition, distribution, and abundance of West Virginia's wetlands. A GIS-based tool has been developed to define the wetland polygons, and to assess functions (flood attenuation, water quality, ecological integrity and wildlife habitat, and education/recreation/aesthetics) of the wetland based on land-use, water retention time, nearby water bodies, etc.
- Level 2: Rapid Wetland Assessments. The West Virginia Wetland Rapid Assessment Procedure (WVWRAP) will be revised and will likely be a major component of future field

assessment. These protocols are designed so that an assessment can be completed by a crew of two within ½ day. The team will ground-verify the wetland polygon, evaluate vegetative, hydrologic and anthropomorphic stressors, and assess habitat and water regimes. Pilot studies will be performed prior to full implementation of this project.

- Level 3: Intensive, Site-Specific Evaluations. Level 3 wetland assessments will likely not be included in future Wetland Monitoring and Assessment protocols except for specific projects.

Figure 4. Annualized Timeline for Watershed Assessment Branch Activities.

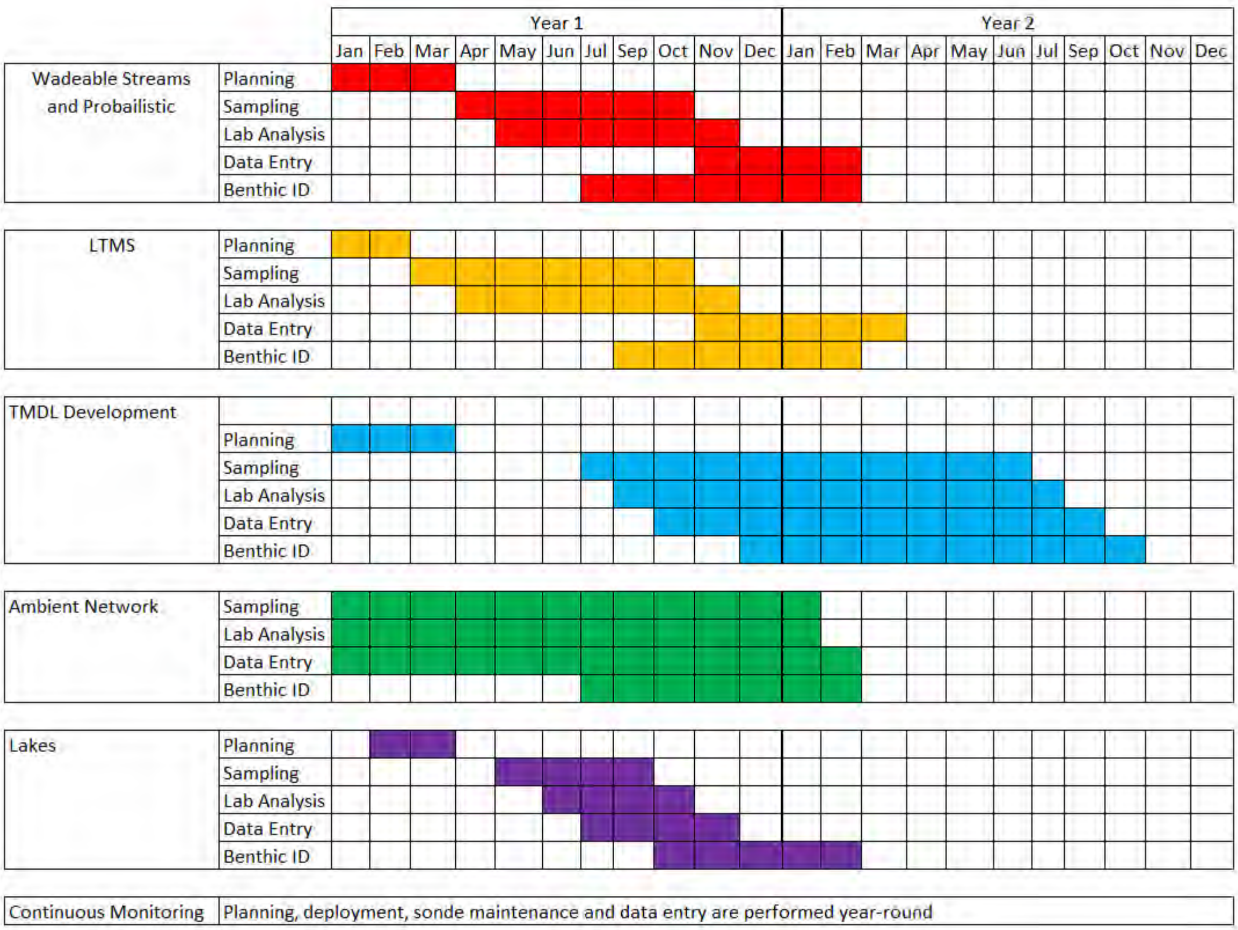
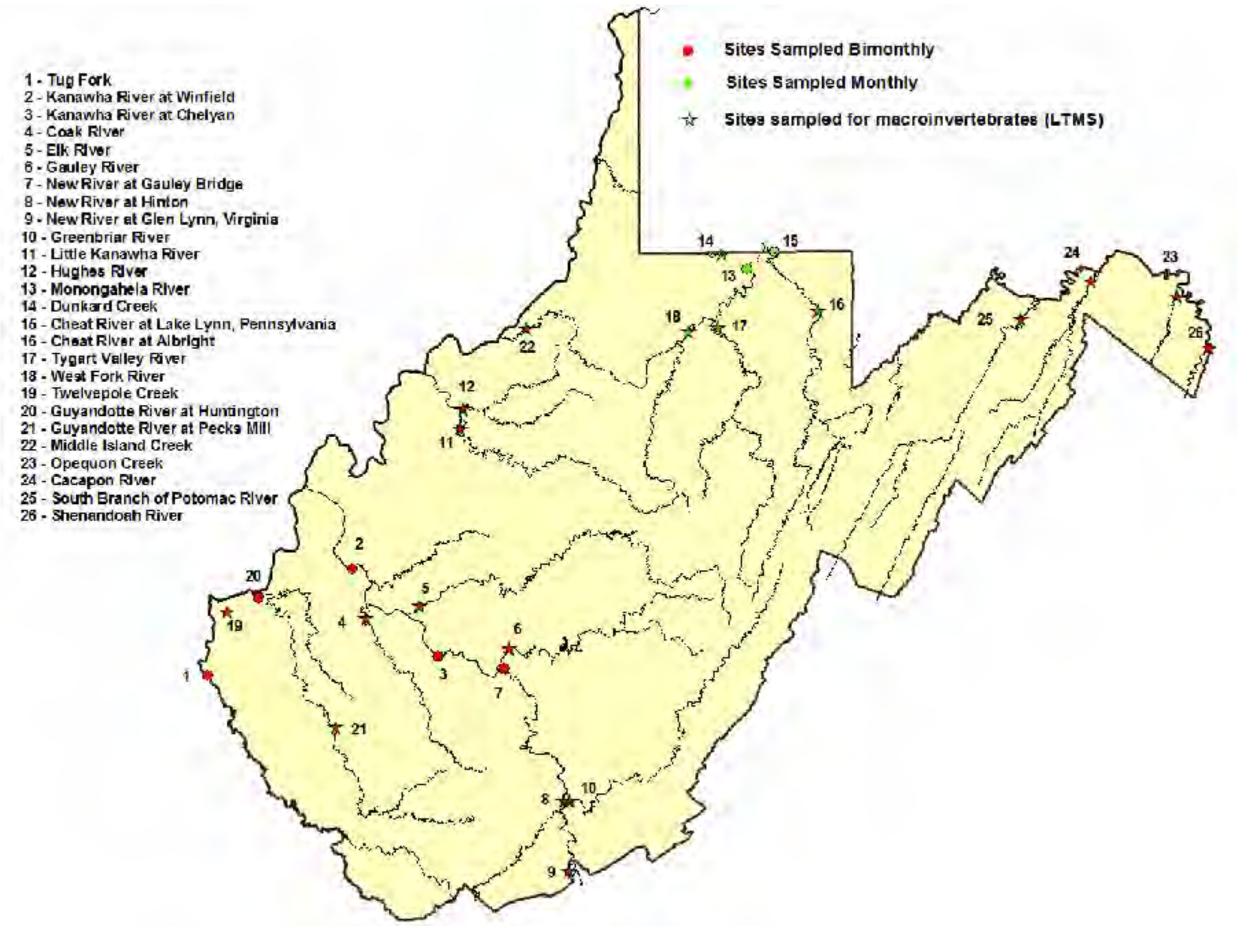


Figure 5. Map of Ambient Water Quality Network.



Section A5 Quality Objectives and Criteria for Measurement Data

Introduction

In 1996, the WV Office of Water Resources (now the Division of Water and Waste Management) initiated a new approach to address water quality issues by developing a statewide Watershed Management Framework. The objective of the watershed management scheme was to coordinate the operations of existing water quality programs and activities in West Virginia to achieve shared water resource management goals. On May 29, 1997, eleven agency and program directors from state and federal water quality agencies signed a resolution of mutual intent to form a partnership for statewide watershed management. The partners included: West Virginia Division of Environmental Protection, West Virginia Soil Conservation Agency, West Virginia Division of Forestry, West Virginia Bureau for Public Health, West Virginia Bureau of Commerce, U. S. Environmental Protection Agency, U. S. Geological Survey,

U. S. Office of Surface Mining, U. S. Forest Service, Monongahela National Forest, Natural Resource Conservation Service, U. S. Army Corps of Engineers. The goals of the watershed management partners were to:

- Improve public awareness, understanding, and involvement
- Improve program efficiency
- Improve program effectiveness and cost effectiveness
- Improve information and data management

The five phases of the Watershed Management Framework are as follows:

1. Scoping and Screening – compile existing data and conduct public outreach to identify problems and issues within watersheds.
2. Strategic Monitoring and Assessment – develop and implement a monitoring plan and conduct monitoring assessments.
3. Management Strategy Development – develop and assess integrated management strategies, including the development of TMDLs.
4. Priority Watershed Management Plan – develop and finalize management plans.
5. Implementation – implement point and non-point management strategies.

Data Quality Objectives

The West Virginia Department of Environmental Protection created the Watershed Assessment Program (currently known as the Watershed Assessment Branch) to help address the needs of these stakeholders by implementing Phases 2 and 3 of the framework. The Watershed Assessment Branch uses a 7-step data quality objective process.

Step 1. Identify the Problem

The West Virginia Department of Environmental Protection (DEP) established its Watershed Assessment Section in 1996. This section, currently known as the Watershed Assessment Branch, consists of managers, engineers, geologists, and biologists. The experience these individuals bring into the program includes laboratory analysis, taxonomy, quality assurance, statistical analysis, and field research. The skills of every individual are considered and utilized during the planning and decision-making processes.

The overall goal of the Watershed Branch is to monitor and assess streams, rivers, and lakes throughout the state to assure these waterbodies are meeting their designated uses. The basic problem that needs to be addressed can be summarized into the following question:

Is this waterbody meeting its uses?

The Watershed Branch's goal and strategy for data collection are addressed in Sections A3 and A4.

Budgetary constraints place limits on the amount of work that can be accomplished within a given year. The Watershed Branch seeks funding from state and federal sources annually. State budgets are first assembled in August, evaluated by the legislature each spring, and made available to the program in July. Section 106 federal monies are applied for by July and received in October. All Watershed Branch activities are carefully monitored to operate efficiently and within budgetary constraints. A crew of 14 scientists is dedicated to performing the field work. This team is further supplemented during the summer months via temporary employment of college students. Contractual work, such as chemical analyses, organism identification, and TMDL modeling are subjected to a qualifying and bidding process.

Step 2. Identify the Decision

The principal study question for the Watershed Branch is:

Is this waterbody meeting its uses?

When this question is answered, the following actions may be taken.
Depending on the severity of impairment, one or more of these options may apply.

- Notify Environmental Enforcement or other regulatory entity for immediate resolution. This option is chosen if active violations of state regulations are observed by field crews.
- Add the waterbody to the 303(d) list of impaired streams
- Schedule TMDL development
- Capture assessment data for future action and/or reporting (e.g. Category 1-meeting all uses)

The purpose of the decision statement is to determine if a waterbody is supporting its designated uses. If the waterbody is non-supporting **and** if the cause of impairment is active, acute, and in violation of state laws, DEP’s Environmental Enforcement is notified. If the waterbody is impaired, but the source of impairment is chronic, it is added to the 303(d) list and prioritized according to the established scheduling methodology.

If the waterbody is supporting its designated uses and is considered to be high-quality, it will be protected at a Tier 2 or higher level of detection.

Step 3. Identify the Inputs to the Decision

In order to address the decision statement, the Watershed Branch requires substantial amounts of chemical, physical, and biological information from a large number of waterbodies. These data need to be obtained in a consistent manner so that comparisons could be made. Existing data were spatially sporadic, outdated, and many were obtained with varying methods; therefore, a fresh dataset was required.

An intense assessment protocol has been developed for use at each site. These assessments include documentation of sampling location, instream and riparian habitat evaluations, and the collection of water samples for chemical analysis. Water chemistry is either measured on-site using calibrated instruments or samples are preserved and analyzed by state-certified laboratories in accordance with 40 CFR 136 or SW-846. All information generated by the Watershed Branch is maintained in databases, which are used to expedite decision-making.

The initial round of field assessments (from 1996 through 2000), which focused on wadeable streams, adequately addressed the issues identified by the stakeholders; however, as these data were analyzed, further questions arose. As a result, the Watershed Branch reviews and improves its assessment protocols annually. Examples of such changes include expansions to the on-site observations, new habitat measurement techniques, new aquatic communities, and the inclusion of additional waterbody types (non-wadeable streams, lakes).

Action Levels are values that provide the basis for choosing among the alternative actions (i.e., degree of impairment). Action Levels for water analyses are embodied in the state's water quality criteria.

All field personnel must adhere to a set of standard operating procedures (SOPs) to reduce variability and bias during site assessments. These SOPs cover every aspect of on-site assessment including equipment calibration and maintenance, sample collection and preservation, and guidelines for completing habitat assessment forms. Off-site chemical analyses are performed by state-certified laboratories and are handled and analyzed in compliance with 40 CFR 136 and SW-846.

Step 4. Define the Boundaries of the Study

The target population includes any or all of the State's water resources. Spatial boundaries for most studies are defined in the five-year watershed cycle presented in earlier sections.

Pre-TMDL development samples are collected each month from July through June. This procedure assures that data will be obtained during a variety of environmental conditions. While the actual sampling dates are not randomly determined, care is taken to collect information during high, low, and normal flow conditions. Probabilistic and Watershed Assessments are performed seasonally. The Ambient Water Quality Monitoring Network, which emphasizes larger streams and rivers, does not comply with the watershed cycle. All samples in this network have been sampled quarterly; and, beginning in 2006, these sites will be visited 6 times per year (bi-monthly).

Data are reviewed periodically to assure the results are providing the information required by the specific projects. Pre-TMDL development sampling networks are examined mid-cycle (January). Sites may be added to or dropped from the network at this point. Probabilistic sampling is evaluated annually, and field protocols are adjusted as deemed necessary. Watershed Assessment samples are critically evaluated in conjunction with 303(d) list preparation.

Step 5. Develop a Decision Rule

Data collected for the Watershed Assessment and Probabilistic programs are one-time events, therefore any initial decisions made from this information assumes that the results are the "true" value. Water quality is currently used in the decision-making process. Analytical values for water are examined for violation of the state's water quality criteria. The focus of pre-TMDL development is on streams that have already been subjected to a decision-making process. Unimpaired or unassessed streams within the study are may also be included to provide additional information for TMDL development. At the conclusion of the Pre-TMDL sampling process, these data are submitted to contracted TMDL modelers for further analysis. The final TMDL will determine what action is to be taken.

The Ambient Water Quality Monitoring Network is used to evaluate temporal and/or spatial long-term trends. These data are subject to periodic review and evaluation. When violations are observed the waterbody is considered for 303(d) listing.

Step 6. Specify Tolerable Limits on Decision Errors

Every research effort has an element of uncertainty. Natural variability and limitations of measuring instruments will prevent the collection of “true values” for a given set of parameters. The selection of an appropriate sampling design and compliance with specific field and laboratory protocols will help to reduce the degree of error that may occur. The allowable degree of error and the consequences of these errors must be addressed. This effort is accomplished by the development of a baseline hypothesis, a definition of the areas of uncertainty, and tolerable limits for decision errors.

The baseline hypothesis for Watershed Branch projects is:

Measured water quality values are below state water quality criteria

The burden of proof is in *rejecting* this hypothesis; that is, it must be proven that a waterbody has violations. For the needs of the Watershed Branch, a relatively small amount of data can result in rejection of this hypothesis.

Two types of decision errors can result from this hypothesis. These errors are most likely to occur when study results approach the Action Levels: The closer the data are to water quality criteria the more likely it would be to take improper action.

The first kind of error is a *false acceptance* of the baseline (also known as a Type II error). This type of error occurs when one assumes the baseline is true, when in reality it is false. False acceptance occurs when a waterbody is determined to be unimpaired, when in actuality it *is* impaired. The consequences of making a false acceptance error would be to take no action on a waterbody that needed to be subjected to pollution abatement/control procedures. If a false acceptance occurs, a stream that is only slightly impaired would not be subjected to further investigation.

The second type of error is a *false rejection* of the baseline (also known as a Type I error). False rejection errors occur when one assumes the baseline is false when it is actually true. A false rejection occurs when a waterbody is flagged as impaired, when it is actually unimpaired. If a false rejection occurs, an unimpaired stream would be subjected to additional sampling, which will provide evidence that an error had been made.

The two main components of the Total Study area are Sampling Error and Measurement Error. Sampling Error is influenced by the inherent variability of the study population (streams) over space and time, the sample collection design, and number of samples taken. Measurement Error (or Physical Sampling Error) is influenced by imperfections in the measurement and analysis system (e.g., sample collection, handling, equipment or preservative contamination, laboratory preparation, analysis, transmission, and storage errors).

The Sampling Error component is addressed by a robust sampling design where not only streams with known impacts are sampled, but a gradient of impacted streams (from highly impacted to control or reference conditions) are sampled throughout the targeted watershed. While the sample locations are targeted, attempts are made to spatially distribute sites throughout the watershed to be able to not only cover the gradient of disturbance, but isolate known specific sources of pollution and capture information from streams where no previous data is available. Additionally, the sampling design attempts to account for temporal variation by not only spreading sampling out over the course of a year to capture seasonal (intra-annual) variability, but also high and low flow regimes are targeted to capture the variability caused by shifts in the flow regime caused by precipitation events.

Measurement Error is addressed by the use of both same-day duplicate (replicate) samples and Field Blanks. Same-day duplicates are collected at one sampling site per field crew per week (resulting in a minimum of 5% of the sampling events throughout the course of the study). These duplicate sample pairs are an attempt to document and measure the cumulative measurement error from the physical sample collection, sample handling and preservation, and laboratory analysis steps. The same-day duplicate samples are collected simultaneously (minimizing temporal variation) and side-by-side (minimizing spatial variation) in a vector of flowing water. Samples are collected by a pair of field personnel (or if working alone, both by the one sampler) one matching container at a time (e.g., Total Metals container, Nutrients container, etc.). Each sampler handles their own samples independently (i.e., filtration & preservation) and when delivered to the lab, the identity of the sample pair as being a same-day duplicate is censored. Differences between the analytical results of same-day duplicate pairs are compared to each other and significantly different results are further scrutinized to determine the potential source of the variation (e.g., sampler collection/handling error vs. laboratory error).

Field Blanks are an attempt to evaluate possible sampling equipment contamination and laboratory measurement error/variability. Field Blanks are created at one sampling site per field crew per week (resulting in a minimum of 5% of the sampling events throughout the course of the study). Instead of using stream water as a sample, Deionized or Distilled Water is used. The samples are handled in the same manner as a normal sample would be handled and in the same environment (i.e., outside in the back of a vehicle vs. inside a controlled laboratory space). Like same-day duplicates, the identity of samples as field blanks are censored when delivered to the laboratory. Any samples returning values greater than the minimum detection limit (MDL) or practical quantification limit (PQL) are further scrutinized the potential source of the variation (e.g., sampler collection/handling error vs. laboratory error).

Sampling conditions are documented during sample collection and anything that could potentially impact the sample result is noted (e.g., turbidity, number of filters used, precipitation status and history, etc.).

All data from the laboratory is delivered as paper hardcopy and electronic data deliverables (EDDs; e.g., pdf and xls files) exported directly form the laboratory's LIM (Laboratory Information Management) system so that transcription errors are minimized and attributed primarily to the laboratory. The laboratory is contacted to verify if suspect results are the result of a transcription error or if the reported value is correct. If possible, the analysis is rerun to verify its accuracy.

Further evaluation and review of the water quality data comes in the form of an analysis of each site x parameter statistical distribution. Outliers are identified and investigated as potential errors (e.g., transcription or analytical errors).

Step 7. Optimize the Design for Obtaining Data.

The Watershed Branch has developed four projects to meet the various needs of the agency. The sampling design and key assumptions supporting these designs are presented in the following paragraphs.

Watershed Assessments

The goal of watershed assessment is to obtain current data throughout a given watershed, in accordance with the five-year cycle. The sampling design was developed to obtain a large amount of data from as many streams as possible. Existing data are used to select sample locations, but unassessed waterbodies are also considered for inclusion. Measurements include habitat evaluations, periphyton, fecal coliform bacteria. Grab samples for other parameters may be taken at the discretion of the field personnel. Sampling frequency is one visit per site per year. A site may or may not be reevaluated in subsequent cycles.

Ideally, all waterbodies within a given watershed would be sampled; however, the costs and personnel required to perform this level of effort would be prohibitive. Therefore, the number of sites selected is driven by a “sampling budget”, which considers the number of individuals and time available to assess a watershed. To further expedite sampling, most sites are selected in areas with easy access.

The key assumption is that the habitat and water quality components of each assessment will present an overall snapshot of the health of the stream at the specified location.

Probabilistic Sampling

Probabilistic sampling is designed to address some of the shortfalls of general watershed assessments by employing a statistical method of site selection into the sampling design. A model is used to randomly choose sites based on a predetermined set of criteria. Probabilistic sampling may be designed to address a specific set of issues, such as the number of stream miles impaired by water quality violations or the differences between ecoregions. Measurements are the same as for general watershed assessments, but also include additional habitat evaluation components (such as the riffle stability index). A standard set of water quality parameters is also obtained at each site.

Probabilistic sampling is performed state-wide within a designated time frame. Six samples are collected from each watershed annually. At the completion of the five-year cycle, thirty or more sites will have been sampled from each watershed[3]. Statisticians indicate that thirty samples are sufficient for accurate analysis of environmental data.

The key assumption is that the thirty sites visited will represent the overall conditions of the watershed under investigation.

Pre-TMDL Sampling

Results of pre-TMDL sampling are applied to models for TMDL development. The accuracy of these models is dependent on the amount of data available. Sampling frequency is once per month for twelve months. This plan allows the Watershed Branch to capture data under a variety of flow regimes and weather conditions. The data collected from each sampling site will vary, depending on the suspected cause of impairment. These data may include mine drainage, acid rain, and/or nutrient loading parameters; fecal coliform bacteria; and flow. Data generated by watershed assessments, probabilistic sampling, and external sources are considered in the site selection process. The sample design may also include pollution sources such as mine discharges.

The key assumption is that twelve sampling events, occurring over the course of a year and under various conditions, will accurately represent the natural conditions of the waterbodies under investigation.

Ambient Water Quality Monitoring

The Ambient Network was established on the state's larger streams and rivers to identify long-term temporal and/or spatial trends. This project was established in the 1940's and the number of stations and sampling frequency have gone through numerous, undocumented changes throughout the years. The current sampling design consists of 25 fixed stations. In recent years, sampling frequency has been quarterly. However, beginning in 2006 these sites will be visited bi-monthly (6 times per year). Sampling protocols include a standard set of water quality analyses, field observations, and flow measurements (direct measurement or via gages). Grab water samples are collected at the surface. Annual aquatic organism collections have recently been reinstated for the Ambient Network[4]. Sites having wadeable, riffle habitat are subjected to standard Watershed Assessment protocols.

The key assumption for the Ambient Network is that the selected sampling frequency and parameters will provide sufficient information for periodic trend assessments.

Criteria for Measurement Data

All water quality samples are tested at West Virginia certified laboratories. Certification assures that Data Quality Indicators[1] (DQIs) are in compliance with quality assurance/quality control protocols. Analytical methods are specified in 40 CFR 136. Lab blanks, field blanks, spiked samples and duplicates must be performed at specified intervals. Detection limits must fall below the action level.

Standardized methods are used for habitat evaluations and the collection of water samples. A series of Standard Operating Procedure (SOP) manuals detail field protocols. All new personnel are subjected to intensive training with seasoned biologists.

[1] Data quality indicators are performance and acceptance criteria. Examples of DQIs are precision, bias, accuracy, comparability, and sensitivity.

Section A6 Special Training and Certification

Once a year, all field participants in the WAB attend mandatory training sessions. The purpose of these sessions is to ensure that all field personnel are familiar with sampling protocols presented in this SOP document and calibrated to sampling standards. These sessions occur at a field location to provide real examples and situations. Any persons unable to attend the annual training session will be instructed and evaluated on the job in the following month by one of the WAB training instructors.

Topics include all aspects of data collection; however, greater emphasis is placed on newly implemented procedures and components that can be influenced by personal bias, such as habitat evaluations.

Individuals who are more experienced in using these sampling protocols will be teamed up with the less experienced to ensure reinforcement of training and accurate results before they can work solo or lead a sampling team. Trainers are also part of the field crew and, as such, can provide ongoing evaluations of teammates throughout the field season.
Several staff meetings occur throughout the year to update field personnel (those collecting the data) and office personnel (those using, analyzing, and distributing the data) with any running changes to protocol and address reoccurring problems and issues in front of the two groups. These staff meetings also serve as communication forums between field and office personnel to help each group better understand where and how the data is collected, how the data is used in fulfilling WVDEP's Clean Water Act requirements, and the specific needs of each group.

Specialized training sessions (e.g., WVDNR Boating Safety, Red Cross First Aid & CPR/AED training) as well as thematic training seminars (e.g., AMD/Acid Rain Training, Fish Taxonomy) are also scheduled as needed.

In supplement, WAB personnel may undergo additional education in the form of Workshops, Seminars, and Societal Meetings (e.g., Association of Mid-Atlantic Aquatic Biologists, American Fisheries Society, or Society for Freshwater Science) and often trained and participate in other projects with similar methodologies to those in this document (e.g., USEPA's National Aquatic Resource Surveys for Streams and Rivers, Lakes, and Wetlands).

Section A7 Documents and Records

Signatory personnel will receive electronic copies of this Quality Assurance Project Plan via email. A copy of this document will also be available on a shared hard-drive and the file pathway will be provided to other recipients identified in the Distribution List (Section A3).

Standard Operation Procedures (SOPs) are made available to all Watershed Assessment Branch personnel. In addition, all field personnel receive copies for reference during sampling events. SOPs are reviewed annually and are updated or supplemented as necessary. SOPs can be accessed at https://dep.wv.gov/WWE/watershed/Pages/WBSOPs.aspx

Documentation of instrument calibration and repair is maintained in binders in the Watershed Assessment Branch laboratory at the DEP headquarters. In addition, calibration for field multimeter probes and continuous monitoring devices are entered into WABbase. Field forms, chain-of-custody forms, and analytical results are organized, scanned, and filed. .

All documents and records are maintained for a minimum of five years. Paper files are stored at the DEP headquarters. Anyone removing a file is required to sign it out so that it can be easily located. Older versions of Quality Assurance Project Plans and SOPs are retained as electronic files. All electronic data are backed up daily by DEP's Information and Technology Office.

Chapter B: Data Generation and Acquisition

Section B1 Sampling Process Design

This Quality Assurance Project Plan embodies the eight primary monitoring components of the Watershed Assessment Branch: Wadeable stream assessments, Long Term Monitoring Stations (LTMS), Probabilistic sampling, TMDL development sampling, the Ambient Water Quality Network, lake assessments, continuous water quality monitoring, and wetland monitoring & assessments. The sampling design process for each of these components is described in the following paragraphs. Specific elements of these projects are presented in Table 1.

Wadeable Stream Assessments

The objectives of targeted watershed assessments are to identify areas of impairment and to document recovery in areas where pollution abatement activities have been implemented. A directed sampling approach is employed for targeted assessments. Sites are selected to confirm and update existing data, or to address questions arising from previous assessments. Unassessed waterbodies may also be targeted. The study area is selected in accordance with the five-year cycle described in Section A6.

All sites are selected in advance, but field personnel have the freedom to move a site to obtain the best representative sample or if the designated site is inaccessible. The number of sites per year will vary, depending on the size of the watershed. Critical elements are habitat evaluations, macroinvertebrate assemblages, on-site measurements (pH, dissolved oxygen, water temperature, and conductivity), and fecal coliform bacteria. Additional water quality parameters may be obtained at the discretion of the collectors. A set of reference sites serves a background population. Reference sites have minimal anthropogenic influence and must comply with a specific set of water quality, habitat, and landuse criteria.

These are single-sample events; however, a site may be revisited on subsequent assessment cycles. Water samples are mid-stream grabs; they are preserved according to regulation and retained by the sampler until laboratory pick-up. Replicates and field blanks are prepared at 8% of the sites. Replicate sampling is a complete duplication of effort; that is, each teammate performs a complete assessment and collects all samples.

Long Term Monitoring Stations (LTMS)

Data from LTMS sites are used to monitor water quality and habitat trends at targeted wadeable streams throughout the state. The stations represent a wide array of impairments (acid mine drainage, acid deposition, sediment, nutrient enrichment, etc.). The network also includes streams that represent reference or best-attainable conditions.

Sampling frequency is variable. Some sites are sampled annually, while others are sampled every two to three years. Critical elements include habitat evaluations, macroinvertebrate assemblages, on-site measurements (pH, dissolved oxygen, water temperature, and conductivity), and water quality sampling (Refer to Table 1 for details).

The sampling events take place between March and October, inclusive. Most sites are sampled once per year; however, a subset of the LTMS sites is sampled in the twice per year to document seasonal differences.

Water samples are obtained and handled according to the same protocols applied to targeted assessments. Replicate sampling is conducted at 10% of the sites and field blanks are prepared and analyzed at a minimum of once per week per sampling person or crew.

Probabilistic Assessments

The objective of probability sampling is to obtain data that can provide strong statistical conclusions. Depending on the specific objective of the probabilistic research, sampling may occur state-wide or be restricted to specific watersheds. Sites are randomly selected using the general protocols employed in EPA's R-EMAP Program[2] described in *R-EMAP: Regional Environmental Monitoring and Assessment Program* (EPA, 1993). This randomization process assures that no particular portion of the group of streams is favored; the chance of selecting a degraded site is proportional to the number of streams having degraded conditions. Results of probabilistic study designs can be used to characterize watersheds, ecoregions, or the entire state.

The prime objective for the probabilistic sampling is to obtain sufficient data for statewide, watershed-specific and ecoregional applications. This on-going study was initiated in 2002 and entails annual statewide sampling. The initial round was designed to evaluate the state's 32 watersheds. Six samples were collected from each watershed[3] annually to meet statistical requirements at the conclusion of the five-year cycle. This process provided 30 samples per watershed. The five-year design minimized the effects of short term events, such as droughts, that may periodically impact an area.

Sampling design for subsequent probabilistic cycles has been based on ecoregions rather than watersheds. West Virginia has three major ecoregions: Western Allegheny Plateau, Central Appalachians, and Ridge and Valley. Twenty-six sites are sampled in each ecoregion annually; 13 sites are newly-selected, the remaining are revisits from previous probabilistic sampling events.

Probabilistic sites are selected in advance and cannot be moved. If a site is inaccessible or cannot be sampled due to lack of habitat, it is replaced by a new randomly-selected site. Critical elements include habitat evaluations, macroinvertebrate, on-site measurements (pH, dissolved oxygen, water temperature, and conductivity), and water quality sampling (Refer to Table 1 for details).

[2] R-EMAP: Regional Environmental Monitoring and Assessment Program. 1993. United States Environmental Protection Agency. EPA/625/R-93/012.
[3] Small watersheds (<30 streams) were combined with larger watersheds having similar characteristics.

The one-time sampling events take place between April and October, inclusive. Water samples are obtained and handled according to the same protocols applied to targeted assessments. Replicate sampling is conducted at 4% of the sites and field blanks are prepared and analyzed at a minimum of once per week per sampling person or crew.

TMDL Development Sampling

Large amounts of data from impaired streams are needed to develop accurate TMDL models. Therefore, a targeted sampling plan is used to develop pre-TMDL sampling networks. The objective of this sampling scheme is to obtain as much information on a watershed or sub-watershed as budget and personnel restrictions allow. Sites are selected in advance with these limitations in mind.
TMDL planners consider all existing data in designing the network. Sites are selected based on known or suspected impairments. Additional sites are established upstream of known impacts and/or on nearby non-degraded streams to provide information on background conditions.

The TMDL network for any given year may consist of hundreds of sites, which will be sampled 10-12 time at roughly one-month intervals. To manage field activities, the network is broken down into smaller groups of ~50 sites, based on travel logistics. Each “mini-network” is permanently assigned to an individual, who is responsible for monthly data collection for the duration of the study.

Although sites are designated in advance, field personnel are permitted to move sites during the initial round with the approval of the TMDL decision-makers. Critical elements are water quality samples (specific parameters will vary), on-site measurements, and documentation of field observations. Some sites may require one-time macroinvertebrate and fish collections as well.

Sampling is conducted July through June (to obtain 10-12 “rounds” of sampling). Grab water samples are preserved in accordance with established protocols and held until laboratory pick-up is arranged. Individuals assigned to the network are required to perform replicate sampling during each round and to prepare field blanks weekly. Sampling is conducted regardless of weather conditions; however, field crews are not required to work in unsafe conditions

Ambient Water Quality Network

The Ambient Water Quality Network was established to evaluate long-term spatial and temporal trends in the state’s larger streams and rivers. This network of sites was established in the 1940’s, but the number of sites and sampling frequency has varied over the years.

The current network consists of 26 sites. Most sites are sampled bi-monthly (i.e., six events per year); the exception being sites in the Monongahela basin, which are sampled monthly. Critical elements include on-site measurements, field observations, and water quality parameters (Refer to Table 1). Stations that have wadeable habitat during the low-flow season are sampled for macroinvertebrate communities as part of the LTMS network.

Water samples are mid-stream or streambank surface grabs. Samples are appropriately preserved and held until laboratory pick-up can be arranged. One or two replicate samples are collected each month (rate of 8%) and field blanks are prepared weekly. Trip blanks for organic samples are prepared daily.

Lakes Assessments

As with stream assessments, the objectives of lake assessments are to identify areas of impairment and to document recovery were abatement plans have been implemented. Sites are selected to update existing data or to address sites with little or no information. Lakes are sampled in accordance with the five-year watershed cycle.

The number of sites per lake is proportional to the size of the impoundment. One site is established at the deepest part of the impoundment and additional sites may be added to evaluate different arms of the lake or to provide longitudinal information. Each lake is sampled four times during the summer months (May-September). Critical elements are vertical chemistry profiles for temperature, pH, dissolved oxygen, and conductivity (on-site measurements); nutrients, fecal coliform bacteria, and chlorophyll-a sampling; and Secchi depth. Protocols are based on the National Lake Assessment methods.

All samples are preserved in accordance with standard procedures and retained by the sampler until laboratory pick-up. A minimum of one replicate water quality sample is collected during each round (~10% of the sites). Field blanks are prepared weekly.

Continuous Monitoring

Deployable sondes are used for a variety of applications to provide more detailed information on a stream. These devices can capture conditions that may not be captured with grab samples; such as diurnal changes and surge events. These devices are used to support existing studies, such as TMDL development and trout stream determinations. As these units are frequently moved to meet the agency's needs, the number of sites is variable.

Typically, the sondes are set up to record parameters hourly. However, if frequent fluctuations in water quality are suspected, parameters may be recorded at 30-minute or 15-minute intervals. Deployed sondes are visited a minimum of once per month to download data, perform maintenance, and to retrieve or replace the sonde. A critical element is conducting discrete checks, wherein a second recently-calibrated multi-probe meter is used to record field readings (temperature, pH, dissolved oxygen, and/or conductivity) immediately adjacent to with the deployed unit. The discrete check provides a fresh baseline and aids in compensating for drift in the deployed unit's recordings.

Occasionally, additional water quality samples are collected to support a continuous monitoring unit. When taken, these samples are preserved in accordance with established procedures and retained by the sampler until sample pick-up. Replicate sampling is not performed as part of the continuous monitoring network. However, if water samples are obtained for the lab, a field blank will be prepared as well. Additional information about site establishment; field forms; sonde programming; sonde deployment; collection of discrete samples used for QA/QC; downloading of data; and data analysis can be found in the Continuous Water Quality Monitoring chapter of our SOP

Wetland Monitoring & Assessments

The objectives of wetland monitoring and assessments vary depending on the three assessment levels.

- Landscape Assessments (Level 1) rely on existing GIS data to describe wetland condition, distribution, and abundance. Level 1 assessments can indicate likely stressors, ecological integrity, and function. This level will also establish a framework for ground-based evaluations. Site selection is based on the current WV Wetland Inventory, an updated version of the National Wetland Inventory that was recently updated by WVDEP and the WV Division of Natural Resources. Static functional values for NWI-mapped wetlands have been calculated statewide. There are no seasonal restrictions and no samples are collected.
- Rapid Assessments (Level 2) will ground-verify data gathered following Level 1 assessments by providing more accurate delineation of the area, verify stressors and document habitat, vegetation, and water regimes. The West Virginia Wetland Rapid Assessment Method (WVWRAM) manual is in the process of being updated based on input from researchers that tested the previous methodology during field surveys during the summers of 2017 and 2018. The updated manual will be completed in early 2019 prior to several training sessions currently being scheduled. Sites will be selected in advance and the number of sites will vary annually. Critical elements will include a buffer segment analysis, buffer zone and assessment area stressor rating, determination of hydrology and soil characteristics, and documenting vegetation.
- Intensive, Site-Specific Assessment (Level 3) will likely evaluate the performance of wetland mitigation, enhancement, and restoration.

Section B2 Sampling Methods

Detailed descriptions of sampling protocols, instruments, sampling devices, sample containers, forms, and guidance for all current field activities are contained in the Watershed Assessment Branch SOPs. All activities covered in this quality assurance project plan are addressed in these documents. Annual training sessions and adherence to these SOPs assures that the data generated by the Watershed Assessment Branch are comparable and defensible.

Sampling methods for Level 2 wetland monitoring have not been finalized. A draft training manual is in production. Pilot studies have been conducted to refine the methods and to assist in the development of an SOP.

In any endeavor things can – and will – go wrong. Fortunately, field crews rarely work in isolation. If one team experiences an equipment failure or supply shortage, a team working in an adjacent area can offer support or advice on possible solutions. Replacement supplies, such as sample containers, can be provided by the lab during sample pick-up. In some cases, arrangements can be made with field offices or headquarters for supply or equipment replacement. If a sample is lost or destroyed after collection, the site may be revisited and fully re-sampled. Replacement samples must be clearly identified.

Section B3 Sample Handling and Custody

Sample handling and preservation for all samples, except fecal coliform bacteria, conforms to methods specified in 40 CFR136. These methods are detailed in the specific SOPs and are summarized in Table 2. All samples are collected in sufficient quantities to perform analyses with enough excess for the laboratory to perform spiked and duplicate analyses.

Holding times for fecal coliform bacteria samples have been expanded to 24 hours. Sampling can occur in remote areas and the 6-hour holding time was impractical or impossible to attain. The Watershed Assessment Branch conducted literature searches and performed internal testing to discern the differences in fecal colony counts based on 6-hour and 24-hour holding times. It was determined that decision errors based on 24-hour fecal samples would be insignificant.

Table 2. Sample Collection and Preservation Methods.

Parameter	Sampling Container	Preservation Method	Holding Time	Analytical Method	MDL
Hot Acidity	1-L Cubitainer	Cool, 4° C	14 Days	SM2310B	5 mg/L
Cold Acidity	1-L Cubitainer	Cool, 4° C	14 Days	SM2310B	5 mg/L
Alkalinity	1-L Cubitainer	Cool, 4° C	14 Days	SM2320B	5 mg/L
Turbidity	1-L Cubitainer	Cool, 4° C	48 Hours	EPA180.1	0.5 NTU
Hardness	1-L Cubitainer	HNO_3 to pH<2	6 Months	SM2340B	1.3 mg/L
Sulfate	1-L Cubitainer	Cool, 4° C	28 Days	EPA300.0	2 mg/L
Chloride	1-L Cubitainer	None	28 Days	EPA300.0	0.625 mg/L
Bromide	1-L Cubitainer	None	28 Days	EPA300.0	0.05 mg/L
Fecal Coliform Bacteria	100 mL sterile bottle	Cool, 4° C, +sodium Thiosulfate	24 Hours*	SM9222D	2 col/100mL
Chlorophyll-a	Filter immediately	Frozen	4 Weeks	EPA446.0	0.1 mg/m³
Total Suspended Solids	1-L Cubitainer	Cool, 4° C	7 Days	USGS I-3765-85	2 mg/L
Total Dissolved Solids	1-L Cubitainer	Cool, 4° C	7 Days	USGS I-1750-85	5 mg/L
Phosphorus-P	1-L Cubitainer	H_2SO_4 to pH<2, Cool, 4°C	28 Days	LACHAT 10-115-01-1-F	0.0016 mg/L
Ortho-Phosphate	1-L Cubitainer	Cool, 4° C	48 Hours	SM4500P-E	0.012 mg/L
TKN	1-L Cubitainer	H_2SO_4 to pH<2, Cool, 4°C	28 Days	LACHAT 10-107-06-2-E	0.075 mg/L
Ammonia-N	1-L Cubitainer	H_2SO_4 to pH<2, Cool, 4°C	28 Days	LACHAT 10-107-06-5-J	0.02 mg/L
Nitrate-Nitrite-N	1-L Cubitainer	H_2SO_4 to pH<2, Cool, 4°C	28 Days	LACHAT 10-107-04-1-C	0.01 mg/L
Organic Carbon	250 mL Plastic Bottle	H_2SO_4 to pH<2, Cool, 4°C, Dark	28 Days	SM5310C	1 mg/L
Aluminum	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.005 mg/L
Arsenic	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.8	0.0016 mg/L
Barium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.002 mg/L
Beryllium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.8	0.00012 mg/L
Boron	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.003 mg/L
Cadmium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.001 mg/L
Calcium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.2 mg/L
Copper	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.002 mg/L
Iron	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.01 mg/L
Lead	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.8	0.00054 mg/L
Magnesium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.2 mg/L
Manganese	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.003 mg/L
Mercury	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA245.1	0.0001 mg/L
Nickel	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.005 mg/L
Potassium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.2 mg/L
Selenium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.8	0.001 mg/L
Silver	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.8	0.00005 mg/L
Sodium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.5 mg/L
Strontium	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.001 mg/L
Zinc	1-L Cubitainer	HNO_3 to pH<2	6 Months	EPA200.7	0.002 mg/L
Volatile Organics	40-mL Glass Vial	HCl to pH<2, Cool, 4°C	14 Days	SW8260B	Variable
Semivolatile Organics	1-L Amber Glass Jar	Cool, 4°C	7 Days	SW8270D	Variable
* This holding time is not in compliance with Standard Methods.					

All samples are labeled to indicate the station code, waterbody name, date/time of collection, and type of preservative. An "Analysis Request Form" is used to indicate the desired analyses. The bottom of the form contains a section to track sample chain-of-custody. Examples of sample labels and forms are included in the SOPs.

Labs are required to document sample receipt and assign tracking numbers. After the holding time has expired, the receiving lab properly disposes the samples.

Section B4 Analytical Methods

All water samples submitted to laboratories are analyzed in accordance with 40 CFR 136 or SW-846. Protocols for field measurements are defined in the SOPs.

Section B5 Quality Control

Multiprobe instruments are used to determine pH, dissolved oxygen, conductivity, and temperature on-site. These units are fully calibrated weekly, prior to use in the field. Calibration, adjustments, and maintenance are recorded for each instrument. Any instrument failing to meet calibration requirements is repaired on-site or returned to the manufacturer. All repairs are documented in the calibration books. The identification number for each unit is recorded each time the meter is used. This process allows minimum loss of data if the meter fails in the field or upon recalibration.

All sampling efforts are broken down into smaller, more manageable components or "lists", which are then assigned to an individual or crew for completion. Field crews are required to conduct replicate sampling for each "list" of samples collected. Estimated rates for the various projects are: Wadeable Stream Assessments – 8%, LTMS – 10%, Probabilistic – 4%, TMDL development – 3%, Ambient Water Quality Network – 8%, Lake Assessments – 12%. In addition to replicate sampling, field blanks are prepared and analyzed at a minimum of once per week per sampling person or crew. WAB recognizes that in some circumstances that this results in fewer than the recommended number of field blanks analyzed and is comfortable with our level of effort and accepts the associated risk.

The intensity of replication is dependent upon the specific project. Wadeable stream assessments, LTMS, and probabilistic sampling are typically performed by two-person crews. Field crews are instructed to perform replicate sampling at a designated location. At a replicate site, each crew member conducts a full assessment as though he/she is the only one present.

TMDL development, lakes assessments and Ambient Network replicate sites are determined by the list assignee. Only water quality sampling is replicated as replicate habitat observations would be redundant. When semi-volatile and volatile organics are collected for the Ambient Network, trip blanks are prepared daily. Field blanks are prepared weekly.

Various steps may be taken if a field blank exceeds an analyte detection limit. If the analyte detected is near the analytical limits, it is considered an outlier and no additional action is taken. If a field blank is significantly higher than the minimum detection limit, steps are taken to verify that the field blank was not misidentified. The lab is notified of the situation and asked to verify the results. If it is clear that an error has been made and is correctable, the data are revised, and the reasons fully documented. Further investigation may be required if a persistent contamination trend is noted in a series of field blanks. Step by step evaluations will determine whether sample handling, preservatives, field blank water, or laboratory error is the source of contamination.

All water analyses are performed by firms that have been awarded contracts by the state. The specifications for this contract include quality control requirements. Quality control requirements are described in detail in the contract (Appendix A). Stated briefly, all labs are required to use standard analytical procedures. Duplicates and spikes must be performed every tenth sample and reference samples must be tested every six months. In addition, DEP may submit blind samples of known composition.

Quality control for wetland assessments will be developed after pilot studies have been conducted and an SOP has been prepared.

Section B6 Instrument/Equipment Testing, Inspection, and Maintenance

Hydrolab and YSI brand multiprobe instruments are used to measure pH, dissolved oxygen, temperature, and conductivity in the field for general assessment purposes. Deployable units are manufactured by YSI, Hydrolab, and Onset. Each instrument is individually numbered so that its history may be traced. Before use, the probes are examined for fractures, punctured membranes, biofouling and other problems. Probes are cleaned, repaired, or replaced as needed. Spare probes are available as replacement parts.

Flow measurement equipment is zero-adjusted annually. The probes are cleaned if readings become erratic. However, erratic readings may also occur in waterbodies with high conductivity or near-freezing temperatures.

Any instrument that cannot be repaired on-site is shipped to the manufacturer for repair. All repair and maintenance activities are recorded in the instrument’s calibration manual.

Results of instrument/equipment testing are recorded in Excel file saved to the Watershed Assessment Branch network server and retained indefinitely.

One person is assigned responsibility for ordering and maintaining supplies. This person monitors usage of sample bottles, batteries, preservatives, etc., and reorders these items as required. Field personnel are provided with checklists to assure that vehicles are fully stocked prior to departure.

Section B7 Instrument/Equipment Calibration and Frequency

Instructions for calibrating all instruments are detailed in the SOPs. Hydrolab and YSI brand multiprobe instruments (non-deployable) are calibrated weekly prior to use. Additionally, dissolved oxygen is calibrated daily as this parameter tends to drift with changes in elevation and barometric pressure. Deployable units are calibrated prior to use and a minimum of once/month during deployment. All calibration activities, including maintenance and repairs are recorded in the calibration manuals. Flow measurement probes are zeroed annually. Paper data records of calibration logs have been maintained for more than fives years. Watershed Assessment Branch intends to scan these logs and keep indefinitely in a document management system (Application Xtender). Log data are also entered into the Watershed Assessment Branch's database: WABbase.

Section B8 Inspection/Acceptance of Supplies and Consumables

Critical supplies include Cubitainer brand bottles (for general water samples), sterile fecal coliform bottles, macroinvertebrate and fish sample jars, field and chain-of-custody forms, preservatives (ice, acids, formalin, alcohol), batteries, deionized water for rinsing and field blank preparation, and calibration standards.

The supply officer monitors the levels of these consumables and orders new supplies from the current state laboratory-supply contract. The supply officer examines these items when they are received and documents the receipt and expiration date for preservatives and standards to inform when to reorder supplies. Consumables are most often used prior to expiration. Records are kept for any existing consumable to track when supplies need to be reorder. Records for used consumables are not retained. All consumables that exceed the expiration date are discarded.

Section B9 Non-direct Measurements

The Watershed Assessment Branch relies on internally-collected data for most of its decision-making processes. However, data provided from outside sources – watershed associations, mining and permitting surveys, etc. – are also taken into consideration. These data are considered supportive; that is, they are used to help prove the assumptions made from the Watershed Assessment Branch's data. Greater weight is given to outside data that are known to be collected using Watershed Assessment Branch protocols. Any data that meet the strict requirements of the Watershed Assessment Branch and are known to be obtained using the Branch's protocols are entered into the Decision Database.

Section B10 Data Management

All paper data – field forms, chain-of-custody forms and assignment lists – are submitted to the Field Data Manager. These documents are compared to the original assignment list and reviewed for completeness and reporting errors. Laboratory results, which are submitted in both electronic and paper formats, are collated with the respective field documents. The electronic version of the collated materials is then transferred to the Watershed Assessment Branch's database: WABbase. Field forms (including chain-of-custodys, analytical results) are scanned into an electronic format (pdf) and stored in a Document Management System (Application Xtender) indefinitely.

WABbase is housed on an ORACLE platform and utilizes Microsoft Access as a front-end. WABbase readily imports data from other databases and/or spreadsheets. The database is stored on DEP's mainframe, which is backed-up daily.

After the electronic data have been merged into WABbase, the paper versions are submitted to one of the Data Entry Managers or other WAB personnel to key in additional information that could not be transferred electronically. The Data Entry Managers are responsible for assuring that all data have been entered and reviewed for transcription errors. The data entry and review processes are documented within the database. Errors that are noticed after the final review process are also documented within the database. The Data Entry Managers are also responsible for proper filing of paper copies in the central file room at DEP's headquarters.

Data is submitted from WABbase to EPA's STORET database through the use of exchange nodes. Selected data is exported from WABbase into an intermediary database that maps the data to match STORET's table and field formats. The resulting XML data packets are submitted via DEP's Central Data Exchange node to EPA's Water Quality Exchange. A processing report is generated for each data packet submitted.

The Primary Data Manager is responsible for overall maintenance of the database containing information collected in the field. This individual is responsible for WABbase setup, design, security, maintenance, data transformation and reduction, system backup and data submission to STORET. The Primary Data Manager also reviews data for consistent format and site-location errors. WABbase is backed-up daily by the state's Information and Technology Office. The database is also backed-up before and after major revisions. The WABbase Primary Data Manager also maintains supportive databases: Taxonomic lists, a master stream list, and GIS supportive coverages.

The Assessment Data Manager oversees databases regarding the decision-making and assessment processes. The Decision Database (DDB) imports data from WABbase. The DDB contains information required for 303(d) List preparation and records information for making critical decisions, such as the number of water quality violations. The DDB also houses information on specific impairments and TMDL development. Final decisions are then reported in ATTAINS and to EPA. ATTAINS is used to document impaired streams and to indicate whether they are fully supporting or non-supporting their designated uses. ATTAINS also indicates circumstances where data are insufficient to make fully vs non-supporting decisions. If a stream is designated as non-supporting ATTAINS will list the causes and sources of impairment. The Assessment Data Manager also oversees GIS-related databases and the National Hydrology Dataset.

Certain members of the Watershed Assessment Branch have read/write capabilities for WABbase. Others within WAB and other parts of DEP have access to WABbase as read-only status. This system allows many users to simultaneously query WABbase for information.

Chapter C Assessment and Oversight

Section C1 Assessments and Response Actions

The Watershed Assessment Branch conducts assessments of its field activities to assure the requirements of the Quality Assurance Project Plan are being implemented. These assessments are discussed below and summarized in Table 3.

Readiness reviews are conducted prior to the start of a new activity or at major milestones, such as beginning a new TMDL Monitoring effort or Watershed Assessment Cycle. These reviews are typically conducted during the annual training event and staff meetings. The ability to conduct entirely new activities is tested through the implementation of pilot studies.

Surveillance is a continuous process of verification; it assures that all activities are being performed to specification. For Watershed Assessment Branch purposes, surveillance may be broken down into three categories: Field, lab, and data management activities. The Field Operations Manager and/or supervisors in the Watershed Assessment Section spend time in the field with each team member to assure work is being performed in accordance with the SOPs. Surveillance of laboratory activities includes assuring that all data are received and meet minimum detection requirements. A team of data managers assures the accuracy of electronic information.

To evaluate the proficiency of water testing laboratories, samples having known quantities are submitted to the testing facility as a blind sample. Results of proficiency testing must fall within specified acceptance criteria. This aspect of assessment is managed by DEP's Quality Assurance Program.

System audits are thorough systematic on-site assessments. Laboratory audits are a component of the Quality Assurance Program. In order to be contracted for testing DEP samples, a laboratory must have successfully passed a system audit and must be certified by the state. The activities of the Watershed Assessment Branch are audited periodically by EPA biologists stationed in the Wheeling Field Office.

Table 3. Assessments and Response Actions

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person, Title, Organizaiton Affiliation Responsible for:			
				Performing Assessment	Responding to Assessment Findings	Identifying and Implementing Corrective Actions	Monitoring Effectiveness of Corrective Actions
Readiness Review TMDL	Annually	Internal	WAB/TMDL	Mindy Neil, ERPM1 James Laine, ERSS Michael McDaniel, TA	WAB- field personnel	Mindy Neil, ERPM1 James Laine, ERSS Michael McDaniel, TA	Mindy Neil, ERPM1 James Laine, ERSS Michael McDaniel, TA
Readiness Review WAB	Annually	Internal	WAB/WAS	Jeffrey Bailey, ERPM2 Janice Smithson, ERSS Nick Murray, ERSS Michael Whitman, ERA	WAB- field personnel	Jeffrey Bailey, ERPM2 Janice Smithson, ERSS Nick Murray, ERSS Michael Whitman, ERA	Jeffrey Bailey, ERPM2 Janice Smithson, ERSS Nick Murray, ERSS Michael Whitman, ERA
Surveillance Field	Continuous	Internal	WAB/WAS	Jeffrey Bailey, ERPM2 Nick Murray, ERSS Janice Smithson, ERSS Michael Whitman, ERA	WAB- field personnel	Jeffrey Bailey, ERPM2 Nick Murray, ERSS Janice Smithson, ERSS Michael Whitman, ERA	Jeffrey Bailey, ERPM2 Nick Murray, ERSS Janice Smithson, ERSS Michael Whitman, ERA
Surveillance Lab	Continuous	External	WAB/WAS/ LQAP	Janice Smithson, ERSS Michael Whitman, ERA Karen Maes, ERS1 Charle Gentry, ERS2	Contracted laboratories	Contracted laboratories	Linda Keller Jeffrey Bailey, ERPM2 Janice Smithson, ERSS Michael Whitman, ERA
Surveillance Data Management	Continuous	Internal	WAB/TMDL	Michael Whitman, ERA Janice Smithson, ERSS Karen Maes, ERS1 Chris Daugherty, ERA	Michael Whitman, ERA Janice Smithson, ERSS Karen Maes, ERS1 Chris Daugherty, ERA	Michael Whitman, ERA Janice Smithson, ERSS Karen Maes, ERS1 Chris Daugherty, ERA	Michael Whitman, ERA Janice Smithson, ERSS Karen Maes, ERS1 Chris Daugherty, ERA
Proficiency Testing	Periodic	External	LQAP	Linda Keller, QAP, QAO	Linda Keller, QAP, QAO	Linda Keller, QAP, QAO	Linda Keller, QAP, QAO
System Audit	Periodic	External	EPA	EPA Wheeling Biologists	WAB-personnel	EPA Wheeling Biologists Jeffrey Bailey, ERPM2 Nick Murray, ERSS Janice Smithson, ERSS Michael Whitman, ERA	John Wirts, ERPM Jeffrey Bailey, ERPM2 Nick Murray, ERSS Janice Smithson, ERSS Michael Whitman, ERA

WAB= Watershed Assessment Branch
WAS=Watershed Assessment Section of WAB
TMDL=TMDL Section of WAB
QAP=DEP's Quality Assurance Program
ERPM=Environmental Resource Program Manager
ERSS=Environmental Resource Specialist Supervisor
TA=Technical Analyst
ERA=Environmental Resources Analyst
ERS=Environmental Resource Specialist
QAO=Quality Assurance Officer

*WAP activities include wadeable streams assessments, LTMS, Probability sampling, ambient network, lakes and deployables. Wetlands will be added when Level 2 field activities are intiated

Section C2 Reports to Management

West Virginia's Integrated Report, State of the Environment Report and completed TMDLs are the primary vehicles for summarizing the methodologies and information collected on the state's waters. These important documents summarize and describe large volumes of data representing assessment and TMDL development efforts.

Management of the activities necessary to produce these reports is an active and ongoing process. Monthly detailed intra-branch management reviews provide the systematic approach necessary to ensure that quality control, scheduling commitments, staffing and budgetary concerns are addressed.

Table 4. Quality Assurance Management Reports

Type of Report	Frequency	Projected Delivery Dates	Person Responsible for Report Preparation	Report Recipients
Integrated Report	Biennial	April	Mindy Ramsey	DEP Leadership EPA General Public
TMDL Reports	Annual	December	Mindy Ramsey	DEP Leadership EPA General Public

Chapter D Data Validation and Usability

Section D1 Data Review, Verification, and Validation

Data review and verification is performed in-house to ensure that the data are obtained according to protocol and have been received, recorded, and processed correctly.
The data management team (see Section B10) works with other Watershed Assessment Branch employees to assure that the process is complete.

All water samples are sent to contract laboratories that are certified by WVDEP's Lab Quality Assurance Program. (https://dep.wv.gov/WWE/Programs/lab/Pages/default.aspx) This group is responsible for certifying environmental laboratories to ensure that the DEP receives accurate and reliable analytical data. West Virginia's laboratory certification is the first such state program within U.S. EPA Region III. This program operates under 47CSR32 - *Regulations Governing Environmental Laboratories Certification and Standards of Performance*. Quality Assurance personnel provide laboratory certification services to all divisions of DEP and is open to any U.S. laboratory seeking to provide data to the DEP. In states with reciprocity agreements with West Virginia, laboratories can be granted certification without an on-site inspection by a West Virginia certification officer.

Data are reviewed to determine if they meet the needs of these end users. To aid in the review of analytical results, the distribution of previous results is summarized for both least disturbed reference samples (Table 5) as well as for all samples (Table 6). Table 6 also indicates approximate water quality criterion levels for each parameter for which criteria apply. If the data are found to be deficient in an area, efforts are taken to correct these errors through revisions of field protocols or data evaluation methods.

Table 5. Distribution of water quality values from reference samples (Level I and II)

All Ref Samples L1 & L2	5th	10th	25th	med	75th	90th	95th
Temperature (Deg C)	3.69	6.18	10.77	14.30	17.50	19.81	20.69
D.O. (mg/L)	7.50	7.89	8.58	9.41	10.53	11.84	12.91
pH (S.U.)	6.14	6.30	6.67	7.04	7.44	7.78	7.95
Specific Conductance (umhos/cm)	22	26	37	57	110	192	241
TSS	2	2	2	3	5	7	10.26
Fecal coliform (col/100 ml)	1	2	4	12	45.75	160	303
Acidity (Hot)	1	1	5	5	5	5	5
Alkalinity	5.00	5.00	7.00	13.65	33.00	58.93	84.46
Al-Dis	0.02	0.02	0.02	0.02	0.05	0.1	0.1
Al-Tot	0.0204	0.03	0.05	0.09	0.13	0.2612	0.3816
B	0.00345	0.0039	0.004	0.006	0.016	0.0205	0.0273
Ba	0.014	0.0169	0.02	0.025	0.031	0.038	0.0431
Be	0.00001	0.00001	0.00005	0.00005	0.001	0.001	0.001
Bromide	0.025	0.025	0.025	0.025	0.1	0.1	0.2
Ca	1.763	1.938	2.98	4.9	13.7	23.88	31.088
Chloride	0.99545	1	1	1.6	2.8333	5	9
Cu-Dis	0.001	0.001	0.003	0.003	0.003	0.005	0.01
Fe-Dis	0.01	0.02	0.02	0.02	0.05	0.0825	0.15
Fe-Tot	0.02	0.03	0.05	0.11	0.21	0.42	0.56
Hardness	8.2075	9.81	14.045	21.865	47.008	82.69	104.7
Hg-Tot	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0005
K-Tot	0.5	0.5	0.55	0.8	1.1	1.4	1.7
Mg-Tot	0.8	0.9	1.3	2.1	3.5	5.858	7.82
Mn-Tot	0.003	0.003	0.006	0.01	0.02	0.029	0.044
N-Tot	0.45	0.61	0.75	1.1	1.31	1.6	1.86
Na-Tot	0.5	0.6	0.9	1.4	2.6	5.3	8.62
NO2-NO3-N	0.05	0.0796	0.1205	0.26	0.4243	0.6107	0.78
Phos-Tot	0.01	0.01	0.01	0.02	0.02	0.0497	0.129
Se-Tot	0.001	0.001	0.001	0.001	0.001	0.001	0.005
Sr-Tot	0.01135	0.0127	0.017	0.026	0.0575	0.0703	0.1122
Sulfate	3.9115	5	5	8.74	14	27	41.193
TDS	13	20	27	41.5	69	115	158.15
TKN	0.1	0.292	0.5	0.9	1	1	1.018
Zn-Dis	0.002	0.005	0.005	0.005	0.005	0.01	0.019
n > 700 for most parameters							

Table 6. Distribution of water quality values from all samples

Parameter (units)	5th %	25th %	50th %	75th %	95th %
Al Dissolved (mg/L)	0.02	0.02	0.04	0.069	4.98
Al Total (mg/L)	0.02	0.06	0.15	0.48	7.22
Alkalinity (mg/L)	5	12.8	44	99.2	214
Ammonia-N (mg/L)	0.06	0.5	0.5	0.5	0.5
Ca Dissolved (mg/L)	2.4	11	22.7	39.9	100
Ca Total (mg/L)	0.92	9.6	24.9	59	173
Cd Dissolved (mg/L)	0.0001	0.00011	0.00037	0.00037	0.002
Chloride Total (mg/L)	1	3.55	8	19	99
Chlorophyll A (ug/L)	-0.3	0.3	1.8	4.8	18.7
Cu Dissolved (mg/L)	0.001	0.003	0.003	0.003	0.01
Cu Total (mg/L)	0.001	0.003	0.005	0.0069	0.011
Dissolved Oxygen (mg/L)	4.74	8.3	9.87	11.78	14.66
Fe Dissolved (mg/L)	0.02	0.02	0.04	0.1	1.8
Fe Total (mg/L)	0.026	0.12	0.29	0.72	5.7
Fecal Coliform (col)	2	20	100	460	5400
Hardness (mg/L)	9.3	44.3	96.3	ADB 244	766
Hg Total (mg/L)	2.27E-07	0.0001	0.0001	0.0002	0.005
Hot Acidity (mg/L)	1	5	5	5	41
K Total (mg/L)	0.5	1.1	2.1	4.3	13.39
Lab Hardness (mg/L)	22.6	50	83	168	417
Lab pH (STU)	3.32	6.1	7.24	7.74	8.22
Lab SpCond (uS/cm)	22	110	228	510	1610
Mg Total (mg/L)	0.716	3.5	7.6	20.9	79.69
Mn Total (mg/L)	0.004	0.02	0.067	0.256	2.47
N Total (mg/L)	0.46	0.96	1.21	1.62	3.5
Na Total (mg/L)	0.6	4.05	12.2	38.05	366
Ni Dissolved (mg/L)	0.0029	0.005	0.02	0.04	0.04
NO2-NO3-N (mg/L)	0.01	0.1	0.3	0.6	2.08
P total (mg/L)	0.01	0.02	0.02	0.042	0.19
Pb Dissolved (mg/L)	0.0005	0.0005	0.0007	0.00107	0.005
Pb Total (mg/L)	0.0006	0.00071	0.00071	0.002	0.01
PH (STU)	5	6.88	7.41	7.85	8.34
Se Dissolved (mg/L)	0.001	0.001	0.001	0.001	0.0089
Se Total (mg/L)	0.0009	0.001	0.001	0.005 C	0.006
Specific Conductance (uS/cm)	43	121	234	ADB 511	1428
Sulfate (mg/L)	5.47	21	73	ADB 256	829
TDS (mg/L)	42	99	201	576	1530

Parameter (units)	5th %	25th %	50th %	75th %	95th %
Temperature (°C)	1.51	7.74	14	19.5	25.18
TKN (mg/L)	0.219	0.6	1	1	1.39
TSS (mg/L)	2	3	4	8	49
Unionized NH3-N (mg/L)	0.000158	0.00086	0.003	0.012	1.32
Zn Dissolved (mg/L)	0.005	0.005	0.005	0.01	0.034
Al Dissolved (mg/L)	0.005	0.009	0.017	0.021	0.096
WQ Criterion in this range					
Flag Value in this range					

If results fall outside of expected ranges, senior staff are consulted, and results and sampling circumstances are examined to determine validity of results. If no explanation for odd results is identified, the lab that conducted the analysis are contacted and a review of lab QA/QC begins.

Section D2 Verification and Validation Methods

For all our primary monitoring programs, field personnel work from a pre-determined list of sites to be assessed. This list is maintained in an Excel spreadsheet, which is subsequently used for verification and data entry purposes.

At the completion of an assignment, field crews submit field forms and chain-of-custody forms to the Field Data Manager. These forms are compared to the original list and changes are documented. Coordinates are added to the electronic list and plotted to verify that samples were taken from the correct sites and to verify coordinate data entry. As water chemistry information is received, it is examined for completeness and quality. Paper versions are collated with their respective field forms and electronic results are validated and placed into a temporary folder. When all the electronic data components have been received, the data is merged into WABbase and paper files are submitted to the Data Entry Manager or other personnel for additional processing. The Data Entry Managers verify the correctness of merged data and are responsible for assuring that all keyed-in data are reviewed by a second individual and that all changes are documented within the database. Paper documents are queued for scanning and are then filed in the central file room at DEP’s headquarters. A check-out system is maintained to track paper files that have been removed for review.

The Primary Data Manager submits these data into EPA’s STORET database by uploading data packets via the DEP Central Data Exchange node to Water Quality Exchange (WQX). The WQX analyzes these packets for submission errors, which are corrected and then tagged for resubmission.

The WABbase Primary Data Manager reviews WABbase for inconsistencies, verifies sample locations, maintains supportive databases, and performs data reduction and transformation tasks.

The Primary Data Manager is responsible for exporting WABbase data into the Decision Database (DDB). Information in the DDB is then used to populate the Assessment Database (ADB).

Data validation for specific programs and projects will be performed by a third-party individual, not directly involved in the data collection or data use for specific monitoring programs. Individuals from within WAB or the DWWM will form a team to review specific programs and project requirements to identify criteria for which data will be validated. An initial step for data validation will be to verify that SOPs for collection and quality assurance verification steps were followed. Requirements for use of pre-TMDL monitoring data are based on the data's usefulness to represent a water body and calibrate hydrology and water quality in the model used to develop TMDLs for specific pollutant parameters. Pre-TMDL monitoring data are collected from specific stations on streams to represent the streams flow and water quality conditions. Pre-TMDL monitoring data are collected in a range of flow regimes in each season to account for critical environmental conditions and seasonal variation. Additional requirements may be considered for specific TMDL projects to validate data. Any data not meeting program and project requirements for use will be discounted. Programmatically, data validation may determine insufficient samplings plans, resulting in revisions to field protocols and data verification procedures.

Section D3 Reconciliation with User Requirements

General watershed assessments, TMDL development sampling, and the Ambient Water Quality Network are not probabilistic sampling designs and, as such, cannot be subjected to rigorous statistical analysis. However, these activities do require QA/QC in the form of duplicate sampling, which is used to evaluate the ability of the individuals to produce similar data. Macroinvertebrate data from duplicate samples are subjected to precision estimates, the results of which may be used to re-adjust the categories in the West Virginia Stream Condition Index.

The Watershed Assessment Branch's Probabilistic sampling effort was designed after EPA's R-EMAP Program and the data generated through the probabilistic project can be subjected to a multitude of statistical evaluations similar to those used by EPA. The objective of the Watershed Assessment Branch's probabilistic project study is to compare the percentage of stream miles affected by a given parameter (i.e. acid mine drainage or sedimentation) with a 90% confidence level. These types of evaluations can be performed at the watershed, ecoregion, or statewide level. Tables and charts will be used to illustrate trends, relationships and anomalies. If information obtained through probabilistic sampling fails to address a specific question, field protocols can be redesigned to incorporate new parameters.

Appendix A

Watershed Assessment Branch
Analytical Contracts

A-1 Water Analysis

Scope of work

Water and Soil Analytical Contract bid sheet

Water and Soil Analysis – Scope of Work

AREA OF WORK

Bids should be submitted by vendors in connection with the costs of pick up and analysis of water and soil samples from all Department of Environmental Protection (DEP) offices as listed herein. Awards will be made to all laboratories possessing a current valid West Virginia DEP Laboratory Quality Assurance certification for the appropriate categories of parameters and meeting the qualifications listed below. Because of the short holding times for certain parameters and the desire to avoid multiple labs analyzing samples from individual sites, work will be distributed based on proximity of lab to sample collection location, overall costs for parameters being requested, and the ability of labs to analyze all requested parameters (i.e., certified for all requested parameters). Costs to pick up samples from DEP personnel and the willingness to pick up samples after established lab hours will also be taken into consideration.

Bidding should be done for each analyte within a specific method. Prices should also be given for liquid and solid samples. Vendor should include method number (identifier), MDL, PQL, and cost for each parameter. If vendor is certified for more than one method per parameter, include method number, MDL, PQL, and cost for any additional method per parameter. Bids must be submitted exactly as per attached bid sheet.

QUALIFICATIONS

The DEP conducts inspections of permitted and non-permitted facilities, investigates complaints, monitors ambient quality of surface water, groundwater and sediments, performs studies, and provides water quality information to the citizens of West Virginia and other government agencies. Legal action based upon analytic results is possible. Therefore, the vendor or vendors selected must have a quality control program in place and meet the following qualifications:

1. The laboratory must be certified by the Water Resources Quality Assurance Program. This includes any laboratories to which analyses are subcontracted.

2. Accessible by telephone **24 hours per day, 7 days per week.**

3. Capable of attending and providing expert testimony in legal proceeding, upon request.

4. **Proof of certification and staff chemist(s) resume(s) must be provided at the time of bid.**

SCOPE

In administering and enforcing most of the pollution control laws of the state, the importance of quality control cannot be overstated. Quality control measures must be strictly adhered to in all phases of sample collection, preservation, transportation, and analysis. The quality control and analytical work, as they relate to the contractor's responsibility, is divided into four (4) major steps:

STEP 1 - Collection of sample from specified office.
STEP 2 - Conduct specified analysis on samples in a timely and professional manner.
STEP 3 - Establishment of continuing program to ensure the reliability of analytical data.

STEP 4 - Legal Testimony.

<u>Step 1 – Pick up of Samples from Specified Office</u>

Sampling for the DEP shall be conducted by Department personnel. The vendor shall be notified of the date sampling occurs or is to occur and from which DEP office or other location the sample can be obtained. The vendor shall be notified when the sample was taken (time/date) for circumstances when holding times for parameters to be analyzed are less than seven (7) days. The vendor shall indicate the time the sample was obtained from the pickup location and its condition and the time the sample was delivered to the laboratory. The vendor shall be responsible for adhering to holding times, checking the adequacy of and maintaining preserved samples, and the internal chain of custody from the time the vendor obtained the sample until the time the analysis is accepted by the Department. The vendor shall also maintain records of the results of analysis for a minimum of five (5) years.

<u>Step 2 - Conduct Specified Analysis on Samples</u>

The methods used by the laboratory for the analysis shall be either; 1) Methods described in 40 CFR-136 or, 2) <u>Test Methods for Evaluating Solid Waste -Physical/Chemical Methods (SW -846) Third Edition with updates</u>. The sampler shall be responsible for specifying either 1 or 2 above. In the event the method is not specified, the laboratory shall contact the sampler for verification of the method to be used.

Vendors must include the analysis method number on the bid sheet. A single analytical method for some parameters is not adequate, for example, a sample of discharge water from a sewage treatment plant need not have the same detection limit as a sample from relatively clean oligotrophic waters. If vendor submits bids for an alternate method, the analysis method number, MDL, and PQL must be included on the bid sheet. If vendors are certified for more than 2 methods for a parameter, the vendor can provide bids and associated information on a separate page if necessary.

Results of analytical tests must be submitted as both an analysis report and as an Electronic Data Deliverable (EDD). Acceptable analysis report formats include either a paper hardcopy or electronic version of the report (e.g., pdf). All EDDs should be submitted in a Microsoft Excel (or compatible) format and conform to the DEP program approved template. Where provided, the vendor must include all appropriate data fields from the original COC that documents the identity of the sample with the data submitted. This electronic data submittal requirement may be waived in some circumstances where the number of samples and/or number of analytical tests requested is low. Waiver must be requested prior to data submittal.

Analysis of samples is not deemed completed until the data has been submitted to and accepted by DEP. Should the DEP not provide notice of acceptance within four weeks of the date results were mailed, the vendor may consider the data to be acceptable by the Division. The vendor shall be responsible for maintaining preservation of the samples until the holding time is exceeded. Any samples with a sheen, discoloration or odor shall be maintained until DEP's notification that the sample can be properly disposed of. DEP will advise the vendor which samples fall into this category. The vendor shall be responsible for the proper disposal of all samples submitted to them by the DEP unless otherwise notified. The vendor shall dispose of the sample no earlier than four weeks after DEP accepts the results. The results of the analysis shall be submitted to the DEP no more than two (2) weeks after receipt of samples.

Step 3 - Quality Control

Three programs are to be utilized to assure reliable laboratory data: (1) the use and documentation of standard analytical methods, (2) analysis of duplicate and spiked (where the concept applies) samples at regular intervals each day to check analytical precision and accuracy, and (3) analysis of reference samples at 6 (six) month intervals. These analyses shall be conducted under the vendor's performance test number through an EPA-approved PT provider. Regardless of which analytical methods are used in a laboratory, the methodology must be carefully documented. Analytical methods which have been modified or entirely replaced because of recent advances in the state of art may only be used when it has been given approval in the Federal Register. Documentation of procedures must be clear, honest, and adequately referenced; and the procedures shall be applied exactly as documented. The responsibility for legally-defensible results obtained from these procedures rests with the analyst and supervisor, both as representatives of the laboratory.

To check the laboratory analytical precision, duplicate analysis of samples shall be performed at regular intervals. Duplicate samples must be carried through the complete analytical process. For all analyses, the interval shall be every tenth (10th) sample. When less than ten (10) samples are tested in an analytical batch, at least one duplicate sample shall be analyzed, and that sample must be a DEP sample. The difference between the replicates for each analysis is to be plotted on Shewhart precision quality control charts. If the Shewhart chart indicates the samples are not in control, the analyses are to be repeated and appropriate steps shall be taken to locate and remedy the error. Quality control limits used by the laboratory to assess method compliance cannot be broader than those specified by the analytical method or 47CSR32 where applicable.

To check the laboratory analytical accuracy, samples containing a known addition of the target analyte (spike) shall be analyzed at regular intervals. Spiked samples must be carried through the complete analytical process. For all analyses, the interval shall be every tenth (10th) sample. Where less than ten samples are tested in an analytical batch, at least one spiked sample shall be analyzed, and that sample must be a DEP sample. The percent recovery must be plotted out on Shewhart accuracy quality control charts. If the Shewhart chart indicates the samples are not in control, the analyses are to be repeated and appropriate steps taken to locate and remedy the source of error. Quality control limits used by the laboratory to assess method compliance cannot be broader than those specified by the analytical method or 47CSR32 where applicable.

If the analyte of interest is detected in the laboratory Method Blank (MB) or Continuing Calibration Blank (CCB) above the Method Detection Limit (MDL), corrective action is to be taken to identify and alleviate the laboratory contamination and sample analysis is to be repeated. If sample analysis cannot be repeated for any reason including but not limited to inadequate remaining sample volume, expired holding time or equipment failure and the laboratory chooses to report the original analytical data, all sample results associated with the contaminated MB and/or CCB must be qualified in the final report.

If the percent recovery of a known laboratory control standard such as a Laboratory Control Sample (LCS) or Continuing Calibration Verification (CCV) is outside of method-defined control limits (or those defined in 47CSR32 where appropriate) corrective action is to be taken to identify and alleviate the issue and sample analysis is to be repeated. If sample analysis cannot be repeated for any reason including inadequate remaining sample volume, expired holding time or equipment failure and the laboratory chooses to report the analytical data; all sample results associated with the failing quality control must be qualified in the final report.

In addition to the above requirements, all applicable requirements of the analytical methods, 40CFR136, 47CSR32 and the West Virginia DEP's Laboratory Certification program must be adhered to. In the event that any of these requirements are not met, all affected data must be appropriately qualified by the laboratory in the final report. It is the responsibility of the laboratory to provide all necessary information so data usability can be determined by the DEP.

All samples submitted to the laboratory are to be handled, prepared and analyzed in the same manner consistent with the method. Corrective action is to be initiated when a QC check exceeds acceptance limits.

The DEP reserves the right to conduct unannounced examinations of the laboratory's records to assure compliance.

Periodic submission of samples with known composition will occur. No notice of this activity will be provided unless results indicate an anomaly.

Step 4 - Legal Testimony

The selected vendor or vendors may be requested by the DEP to testify concerning the validity of the laboratory analysis. The vendor will only be required to testify to the following areas:

1. Time of notification by Department of sampling and by whom.
2. When and where samples were received by the laboratory's courier and/or by the laboratory's facility.
3. Condition of sample upon receipt by the laboratory.
4. How sample preservation was maintained by the laboratory.
5. Date and time(s) of analysis and by whom.
6. Chain of Custody procedures within the laboratory.
7. Methods used.
8. Results of analysis.

At no time will the firm respond to questions concerning interpretation of results. The Department shall reimburse the vendor for the costs of any such testimony. The vendor must provide a detailed invoice of actual costs incurred.

PRIME VENDOR RESPONSIBILITIES

A vendor, who is awarded a contract, when performing work under the terms and conditions of this contract, is solely responsible for the satisfactory completion of the work. The vendor shall be responsible for ensuring that any subcontractors have all the necessary permits, certifications (including WV State Laboratory Certification) and insurance to perform the work. DEP will consider the prime vendor to be the sole point of contact with regard to authorized work under the contract; however, this provision does not prohibit the DEP from directly contacting subcontractors.

SUBCONTRACTORS

The prime vendor shall not be allowed to subcontract any work or services under this contract to any other person, company, corporation, firm, organization or agency without prior written approval of the DEP. The prime contractor is ultimately responsible for assuring that the results are submitted to DEP and must also provide hard copies or electronic copies of any documentation provided by the subcontractor. All work performed by a subcontractor should be appropriately annotated on any submitted documentation (report or EDD).

CONFIDENTIALITY

The vendor agrees that any and all data, analyses, materials, reports or other information, oral or written, prepared by the vendor with respect to this requisition shall, except for information which has been made publicly available, be treated as confidential and shall not be utilized, released, published, or disclosed, by the vendor at any time for any purpose whatsoever other than to provide consultation or other service to DEP.

MISCELLANEOUS PROVISIONS

1. The vendor shall provide necessary, DEP approved sample containers and field preservation supplies to DEP.

2. The DEP may, at their discretion, choose to deliver samples to the vendor's establishment rather than having them picked up by or delivered to the vendor.

3. Any updates to the MDLs or PQLs during the life of this contract shall be provided to the DEP, in writing within one week of the update(s) completion.

4. The vendor shall provide at no additional cost, any requested quality control/calibration information associated with a particular sample. Quality control/calibration information includes but is not limited to: values of standards used in calibration, date of last calibration, correlation coefficients of calibration curves, instrument blank values, check standard values, spike/recovery values, duplicate values, dilution volumes, bench sheets, calculations and Shewhart quality control charts.

5. Notice of any changes to the vendor's certification status with regard to any of the parameters that the vendor is certified to analyze for, must be submitted to DEP, in writing, within ten (10) days of the time of status change.

6. The laboratory will provide DEP approved blank water to the DEP, at no charge, upon request.

PROGRAM SPECIFIC PROVISIONS

Watershed Assessment Branch of DEP - Electronic Data Deliverable Requirements

Field	Data Type	Description	Notes
AnalyticalLab	Text	The name of the lab providing analysis of the given analyte	Any subcontracted analysis would indicate the subcontracting lab name here
LabNumber	Text	Internal Sample Identifier	e.g., From lab's LIM System
WQ ID	Text	WQ Sample ID from COC	
SampleDateTime	Date/Time	The Date/Time of the sampling event from the COC	
ProjectName	Text	Project Name from the COC	
SiteName	Text	Stream Name from COC	
ANCODE	Text	ANCODE from COC	
MilePoint	Text	Mile Point from COC	This number is in brackets { } following the ANCode on the COC
RandomNumber	Text	Random # from COC	This is only populated if project is designated as RANDOM
Fraction	Text	Fraction of the Analyte	e.g., Total or Dissolved
Analyte	Text	Analyte Name	Report the speciation of the analyte if necessary (e.g., Sulfate as SO4 or Nitrate + Nitrite as N)
Qualifier	Text	Flag Code about the analyte results or analysis	e.g., J flag for result that falls between MDL and PQL; < for result below MDL (i.e., Non-Detect); > for results greater than the result value.
Notes	Text	Notes about the analyte results or analysis (e.g., analyzed out of holding time, estimated results, subcontracted analysis)	
Result	Number, Decimal, 18, 6	The result of the analysis	If the result is a non-detect, report the value of the MDL with a Qualifier of "<"
MDL	Number, Decimal, 18, 6	The Method Detection Limit of the analysis	
PQL	Number, Decimal, 18, 6	The Practical Quantification Limit of the analysis	
Units	Text	The units of the result analysis.	All units should be in mg/L except for Organics, which are reported in ug/L
Method	Text	The analysis methodology	Standard Methods or EPA Methods. Include full context of method (e.g., EPA200.7Rev4.4-1994)
AnalysisDateTime	Date/Time	The Date/Time of Analysis	

ANALYSIS OF WATER AND SOIL
DEP
Vendor's Bid Sheet

Vendors Name: ____

The DEP reserves the right to request additional information and supporting documentation regarding unit prices when the unit price appears to be unreasonable.

Liquid Samples & Solids

Item #	Est. Quantity	Description	Method #	Method Detection Limit*	Practical Quantitation Limit	Unit Price	Amount
1	4000	pH		N/A		$	$
1A	10	pH (Solid)				$	$
2	4000	Hot Acidity				$	$
2A	1000	Hot Acidity Alt. Method				$	$
3	4000	Alkalinity				$	$
3A	1000	Alkalinity Alt. Method				$	$
4	500	Hardness				$	$
4A	100	Hardness Alt. Method				$	$
4B	10	Hardness (Solid)				$	$
5	1000	Specific Conductance				$	$
5A	500	Specific Conductance Alt. Method				$	$
6	4000	Sulfate				$	$
6A	1000	Sulfate Alt. Method				$	$
6B	10	Sulfate (Solid)				$	$
7	20	Sulfide				$	$
7A	10	Sulfide Alt. Method				$	$
8	20	Turbidity				$	$
8A	10	Turbidity Alt. Method				$	$
9	25	Bromide				$	$
9A	10	Bromide Alt. Method				$	$
9B	10	Bromide (Solid)				$	$
10	3000	Chloride				$	$
10A	100	Chloride Alt. Method				$	$
10B	10	Chloride (Solid)				$	$
11	25	Fluoride				$	$
11A	10	Fluoride Alt. Method				$	$
11B	10	Fluoride (Solid)				$	$
12	4000	Fecal Coliform (MF)				$	$
12A	1000	Fecal Coliform (MF) Alt. Method				$	$
13	100	Fecal Coliform (MPN)				$	$
13A	50	Fecal Coliform (MPN) Alt. Method				$	$
14	20	Total Coliform				$	$
15	25	Total Solids				$	$
15A	10	Total Solids Alt. Method				$	$
15B	10	Total Solids (Solid)				$	$
16	3000	Dissolved Solids (TDS)				$	$
16A	1000	Dissolved Solids (TDS) Alt. Method				$	$

17	4000	Suspended Solids (TSS)				$	$
17A	1000	Suspended Solids (TSS) Alt. Method				$	$
18	25	Settleable Solids				$	$
18A	10	Settleable Solids Alt. Method				$	$
19	25	Volatile Solids				$	$
19A	10	Volatile Solids Alt. Method				$	$
19B	10	Volatile Solids (Solid)				$	$
20	25	Percent Solids				$	$
20A	10	Percent Solids Alt. Method				$	$
20B	10	Percent Solids (Solid)				$	$
21	400	Kjeldahl Nitrogen				$	$
21A	100	Kjeldahl Nitrogen Alt. Method				$	$
21B	10	Kjeldahl Nitrogen (Solid)				$	$
21C	10	Kjeldahl Nitrogen Alt. Method (Solid)				$	$
22	50	Ammonia Nitrogen				$	$
22A	10	Ammonia Nitrogen Alt. Method				$	$
22B	10	Ammonia Nitrogen (Solid)				$	$
22C	10	Ammonia Nitrogen Alt. Method (Solid)				$	$
23	50	Organic Nitrogen				$	$
23A	10	Organic Nitrogen Alt. Method				$	$
24	50	Nitrate-Nitrogen				$	$
24A	10	Nitrate-Nitrogen Alt. Method				$	$
25	50	Nitrite-Nitrogen				$	$
25A	10	Nitrite-Nitrogen Alt. Method				$	$
25B	10	Nitrite-Nitrogen (Solid)				$	$
25C	10	Nitrite-Nitrogen Alt. Method (Solid)				$	$
26	400	Nitrite-Nitrate				$	$
26A	100	Nitrite-Nitrate Alt. Method				$	$
26B	10	Nitrite-Nitrate (Solid)				$	$
26C	10	Nitrite-Nitrate Alt. Method (Solid)				$	$
27	400	Total Phosphorus				$	$
27A	100	Total Phosphorus Alt. Method				$	$
27B	10	Total Phosphorus (Solid)				$	$
27C	10	Total Phosphorus Alt. Method (Solid)				$	$
28	50	Orthophosphate				$	$
28A	10	Orthophosphate Alt. Method				$	$
29	50	Total Phosphate				$	$
29A	10	Total Phosphate Alt. Method				$	$
29B	10	Total Phosphate (Solid)				$	$
29C	10	Total Phosphate Alt. Method (Solid)				$	$
30	25	BOD				$	$
30A	10	BOD Alt. Method				$	$
31	25	BOD-carbonaceous				$	$
31A	10	BOD-carbonaceous Alt. Method				$	$
32	25	COD				$	$
32A	10	COD Alt. Method				$	$
33	25	TOC				$	$

33A	10	TOC Alt. Method				$	$
34	25	MBAS				$	$
34A	10	MBAS Alt. Method				$	$
35	25	Phenolics				$	$
35A	10	Phenolics Alt. Method				$	$
35B	10	Phenolics (Solid)				$	$
36	25	Total Cyanide				$	$
36A	10	Total Cyanide Alt. Method				$	$
36B	10	Total Cyanide (Solid)				$	$
37	200	Hexavalent Chromium				$	$
37A	10	Hexavalent Chromium Alt. Method				$	$
37B	10	Hexavalent Chromium (Solid)				$	$
38	25	Oil-Grease				$	$
38A	10	Oil-Grease Alt. Method				$	$
38B	10	Oil-Grease (Solid)				$	$
39	100	Chlorophyll A				$	$
39A	20	Chlorophyll A Alt. Method				$	$
40	25	Color (APHA)				$	$
40A	10	Color (APHA) Alt. Method				$	$
41	25	Color (ADMI)				$	$
41A	10	Color Alt. Method				$	$
42	25	Cyanide, Amenable				$	$
42A	10	Cyanide, Amenable Alt. Method				$	$
43	25	Cyanide, Free (ASTM)				$	$
43A	10	Cyanide, Free Alt. Method				$	$
44	25	Mineral Acidity				$	$
44A	10	Mineral Acidity Alt. Method				$	$
45	25	Total Acidity				$	$
45A	10	Total Acidity Alt. Method				$	$
46	25	Tot Petroleum Hydro-carbons GRO/DRO (8015)				$	$
45A	10	Tot Petroleum Hydro-carbons GRO/DRO (8015) Alt. Method				$	$
46B	10	Tot Petroleum Hydrocarbons GRO/DRO (8015) (Solid)				$	$
47	25	Fecal Streptococci				$	$
47A	10	Fecal Streptococci Alt. Method				$	$
47B	10	Fecal Streptococci (Solid)				$	$
48	25	Escherichia Coli (Numeric Result)				$	$
48A	10	E. Coli (Numeric Result) Alt. Method				$	$
49	100	Enterococci				$	$
50	20	Iron Bacteria				$	$
51	20	Sulfate Reducing Bacteria				$	$
52	25	Bicarbonate (Standard Methods)				$	$
52A	10	Bicarbonate Alt. Method				$	$
53	25	Ferrous Iron (Standard Methods)				$	$
53A	10	Ferrous Iron Alt. Method				$	$
54	25	Dissolved Organic Carbon				$	$
54A	10	Dissolved Organic Carbon Alt. Method				$	$
55	4000	Aluminum				$	$

55A	100	Aluminum - Alt. method				$	$
55B	10	Aluminum (Solid)				$	$
56	20	Antimony				$	$
56A	10	Antimony Alt. Method				$	$
56B	10	Antimony (Solid)				$	$
57	20	Arsenic				$	$
57A	10	Arsenic Alt. Method				$	$
57B	10	Arsenic (Solid)				$	$
58	20	Barium				$	$
58A	10	Barium Alt. Method				$	$
58B	10	Barium (Solid)				$	$
59	20	Beryllium				$	$
59A	10	Beryllium Alt. Method				$	$
59B	10	Beryllium (Solid)				$	$
60	20	Boron				$	$
60A	10	Boron Alt. Method				$	$
60B	10	Boron (Solid)				$	$
61	200	Cadmium				$	$
61A	20	Cadmium Alt. Method				$	$
61B	10	Cadmium (Solid)				$	$
62	500	Calcium				$	$
62A	20	Calcium Alt. Method				$	$
62B	10	Calcium (Solid)				$	$
63	20	Chromium				$	$
63A	10	Chromium Alt. Method				$	$
63B	10	Chromium (Solid)				$	$
64	20	Cobalt				$	$
64A	10	Cobalt Alt. Method				$	$
64B	10	Cobalt (Solid)				$	$
65	200	Copper				$	$
65A	20	Copper Alt. Method				$	$
65B	10	Copper (Solid)				$	$
66	3000	Iron				$	$
66A	100	Iron Alt. Method				$	$
66B	10	Iron (Solid)				$	$
67	200	Lead				$	$
67A	10	Lead Alt. Method				$	$
67B	10	Lead (Solid)				$	$
68	500	Magnesium				$	$
68A	20	Magnesium Alt. Method				$	$
68B	10	Magnesium (Solid)				$	$
69	3000	Manganese				$	$
69A	100	Manganese Alt. Method				$	$
69B	10	Manganese (Solid)				$	$
70	200	Mercury				$	$
70A	200	Mercury / Method 1631E				$	$
70B	10	Mercury (Solid)				$	$
71	20	Molybdenum				$	$
71A	10	Molybdenum Alt. Method				$	$
71B	10	Molybdenum (Solid)				$	$
72	200	Nickel				$	$
72A	20	Nickel Alt. Method				$	$
72B	10	Nickel (Solid)				$	$
73	500	Potassium				$	$
73A	20	Potassium Alt. Method				$	$
73B	10	Potassium (Solid)				$	$
74	500	Selenium				$	$

74A	20	Selenium Alt. Method				$	$
74B	10	Selenium (Solid)				$	$
75	200	Silver				$	$
75A	20	Silver Alt. Method				$	$
75B	10	Silver				$	$
76	500	Sodium				$	$
76A	20	Sodium Alt. Method				$	$
76B	10	Sodium (Solid)				$	$
77	200	Strontium				$	$
77A	20	Strontium Alt. Method				$	$
78	20	Thallium				$	$
75A	10	Thallium Alt. Method				$	$
75B	10	Thallium (Solid)				$	$
79	20	Tin				$	$
79A	10	Tin Alt. Method				$	$
79B	10	Tin (Solid)				$	$
80	20	Vanadium				$	$
80A	10	Vanadium Alt. Method				$	$
80B	10	Vanadium (Solid)				$	$
81	200	Zinc				$	$
81A	20	Zinc Alt. Method				$	$
81B	10	Zinc (Solid)				$	$
82	200	Metals Prep Cost				$	$
82A	10	Metals Prep Cost (Solid)				$	$
83	20	Gross Alpha				$	$
83A	10	Gross Alpha (Solid)				$	$
84	20	Gross Beta				$	$
84A	10	Gross Beta (Solid)				$	$
85	20	Ra-226				$	$
85A	10	Ra-226 (Solid)				$	$
86	20	Ra-228				$	$
86A	10	Ra-228 (Solid)				$	$
87	20	Total Uranium				$	$
87A	10	Total Uranium (Solid)				$	$
88	20	Sr-89				$	$
88A	10	Sr-89 (Solid)				$	$
89	20	Sr-90				$	$
89A	10	Sr-90 (Solid)				$	$
90	20	Tritium (H3)				$	$
90A	10	Tritium (H3) (Solid)				$	$
91	20	Gamma (Cs-137)				$	$
91A	10	Gamma (Cs-137) (Solid)				$	$
92	20	Radon				$	$
92A	10	Radon (Solid)				$	$

		Toxicity Testing - Freshwater Organisms			
Item #	Est. Quantity	Description	Method #	Unit Price	Amount
		Acute:			
93	25	Ceriodaphnia		$	$
94	10	Daphnia Pulex / D. magna		$	$
95	25	Pimephales promelas		$	$
		Chronic:			
96	25	Ceroidaphnia		$	$
97	25	Pimephales promelas (Survival & Growth)		$	$

99	10	**Professional staff representation of data in legal/administrative setting per hour**		$	$

		Collection of samples - costs associated with sample pickup form the following locations:		
			Unit Price	Amount
100	24	**Bridgeport Office, 101 Cambridge Place, Bridgeport, WV 26330**	$	$
101	24	**Charleston Office, 601 57th Street S.E., Charleston, WV 25304**	$	$
102	24	**Fairmont Office, 2031 Pleasant Valley Rd., Fairmont, WV 26554**	$	$
103	24	**French Creek Office, P.O. Box 38, French Creek, WV 26218**	$	$
104	24	**Logan Office, 1101 George Kostas Dr., Logan, 25601**	$	$
105	24	**Oak Hill Office, 116 Industrial Dr., Oak Hill, WV 25901**	$	$
106	24	**Parkersburg Office, 2311 Ohio Ave., Parkersburg, WV 26010**	$	$
107	24	**Philippi Office, 105 South Railroad Street, Philippi, WV 26416**	$	$
108	24	**Romney Office, HC 63, Box 2545, Romney, WV 26757**	$	$
109	24	**Teays Office, P.O. Box 662, Teays, WV 25596**	$	$
110	24	**Welch Office, 311 Court St., Welch, 24801**	$	$
111	24	**Wheeling Office, 131A Peninsula St., Wheeling, WV 26003**	$	$
112	5000	**Other locations as Cost Per Mile to pickup site**	$	$
113	10	**24 Hour Turn-Around Rush Orders****	%	
114	10	**48 Hour Turn-Around Rush Orders****	%	
115	10	**72 Hour Turn Around Rush Orders****	%	
		TOTAL	**$**	

All unit pricing quoted should be based on standard (not to exceed two weeks) turn-around time.

* For all test methods , list your current method detection limit for each method /parameter to be bid on. See below for agency desired method detection limits for specific parameters.

**During emergency situations samples may be requested on a quicker turn-around basis. Enter percent increase over standard turn-around time.

Agency desired MDLs

Item #	**Description**	**Method Detection Limit***
1	pH	N/A
2	Hot Acidity	5 mg/l
3	Alkalinity	5 mg/L
4	Hardness	1 mg/L

5	Specific Conductance	3 uS/cm^2
6	Sulfate	5 mg/L
7	Sulfide	1 mg/L
8	Turbidity	1 NTU (higher OK if highly turbid)
9	Bromide	0.05 mg/L
10	Chloride	1 mg/L
11	Fluoride	0.2 mg/L
12	Fecal Coliform (MF)	4 col/100 mL
13	Fecal Coliform (MPN)	4 col/100 mL
15	Total Solids	1 mg/L
16	Dissolved Solids (TDS)	5 mg/L
17	Suspended Solids (TSS)	3 mg/L
19	Volatile Solids	1 mg/L
20	Percent Solids	1%
21	Kjeldahl Nitrogen	0.05 mg/L
22	Ammonia Nitrogen	0.02 mg/L
23	Organic Nitrogen	0.5 mg/L
24	Nitrate-Nitrogen	0.01 mg/L
25	Nitrite-Nitrogen	0.01 mg/L
26	Nitrite-Nitrate	0.01 mg/L
27	Total Phosphorus	0.003 mg/L
28	Orthophosphate	0.01 mg/L
29	Total Phosphate	0.01 mg/L
30	BOD	1 mg/L
31	BOD-carbonaceous	1 mg/L
32	COD	0.5 mg/L
33	TOC	1 mg/L
34	MBAS	0.05 mg/L
35	Phenolics	0.01 mg/L
36	Total Cyanide	0.005 mg/L
37	Hexavalent Chromium	0.005 mg/L
37A	Hexavalent Chromium (Alt)	0.000043 mg/L
37B	Hexavalent Chromium (Solid)	0.017 mg/kg
38	Oil-Grease	2 mg/L
39	Chlorophyll A	0.5 mg/L
40	Color (APHA)	5 color units
41	Color (ADMI)	10 ADMI value
42	Cyanide, Amenable	0.005 mg/L
43	Cyanide, Free (ASTM)	0.005 mg/L
44	Mineral Acidity	1 mg/L
45	Total Acidity	1 mg/L
46	Tot Petroleum Hydrocarbons GRO/DRO (8015)	0.5 mg/L
47	Fecal Streptococci	4 col/100 mL
48	Escherichia Coli (Numeric Result)	1 col/100 mL
52	Bicarbonate (Standard Methods)	1 mg/L
53	Ferrous Iron (Standard Methods)	0.05 mg/L
54	Dissolved Organic Carbon	1 mg/L
55	Aluminum	0.005 mg/L
56	Antimony	0.005 mg/L
Item #	**Description**	**Method Detection Limit***
57	Arsenic	0.005 mg/L
58	Barium	0.005 mg/L
59	Beryllium	0.001 mg/L
60	Boron	0.03 mg/L
61	Cadmium	0.00009 mg/L

62	Calcium	0.2 mg/L
63	Chromium	0.001 mg/L
64	Cobalt	0.001 mg/L
65	Copper	0.001 mg/L
66	Iron	0.01 mg/L
67	Lead	0.00054 mg/L
68	Magnesium	0.2 mg/L
69	Manganese	0.005 mg/L
70	Mercury	0.0001 mg/L
71	Molybdenum	0.005 mg/L
72	Nickel	0.005 mg/L
73	Potassium	0.5 mg/L
74	Selenium	0.001 mg/L
75	Silver	0.0002 mg/L
76	Sodium	0.5 mg/L
77	Strontium	0.001 mg/L
78	Thallium	0.001 mg/L
79	Tin	0.02 mg/L
80	Vanadium	0.005 mg/L
80A	Vanadium (Alt)	0.001 mg/L
81	Zinc	0.002 mg/L
70A	Mercury / Method 1631E	0.5 ng/L
9A	Bromide Alt. Method	0.1 mg/L