SRBC Quality Assurance Program Plan (QAPrP): Water Quality Data Collection Supporting General Programmatic Activities

Commission QAPP #QA080

Prepared by
Susquehanna River Basin Commission
4423 North Front Street
Harrisburg, PA 17110

Prepared for
U.S. Environmental Protection Agency, Region 3
1600 John F. Kennedy Blvd
Philadelphia, PA 19103

Approval Signatures:

_____ Date: 7/14/2023
Andrew D. Dehoff (Susquehanna River Basin Commission: Executive Director)

_____ Date: 7/14/2023
Andrew J. Gavin (Susquehanna River Basin Commission: Deputy Executive Director)

_____ Date: 7/14/2023
Jamie Shallenberger (Susquehanna River Basin Commission: Manager, Monitoring and Protection / Quality Assurance Coordinator)

KELLY SOMERS Digitally signed by KELLY SOMERS Date: 2023.07.17 13:44:44 -04'00'
_____ Date: _____
Kelly Somers (USEPA Project Officer)

ELIZABETH GAIGE Digitally signed by ELIZABETH GAIGE Date: 2023.07.17 14:22:14 -04'00'
_____ Date: _____
USEPA-Delegated Approving Official

REVIEWS AND REVISIONS

Date	Revision #	Summary of Changes	Sections	Other Comments
10/5/2022	original	--	--	--
7/7/2023	1	Title changed, Signature page changed, SRBC email address updated, site location reporting information added, fish tagging information added	Title page Signature page Section 1.4 Section 1.7 Section 2.2.7	

TABLE OF CONTENTS

FIGURES

TABLES

ATTACHMENTS

1.0 PROGRAM MANAGEMENT

1.1 Title and Approval Page – See page 1.

1.2 Reviews and Revisions – See page 2.

1.3 Table of Contents – See pages 3-4.

1.4 Distribution List

Susquehanna River Basin Commission (Commission): Andrew Dehoff, Andrew Gavin, James Shallenberger, Ellyn Campbell

U.S. Environmental Protection Agency: Kelly Somers, Jillian Adair, Leah Ettema

Agency	Name	Title	Email
SRBC	Andrew Dehoff	Executive Director	adehoff@srbc.gov
	Andrew Gavin	Deputy Executive Director	agavin@srbc.gov
	James Shallenberger	QA Coordinator	jshallenberger@srbc.gov
	Ellyn Campbell	Project QA Manager	ecampbell@srbc.gov
USEPA	Kelly Somers	Project Officer	Somers.kelly@epa.gov
	Jillian Adair	Quality Assurance Coordinator, Standards and TMDL Section	Adair.jillian@epa.gov
	Leah Ettema	Region 3 Monitoring and Assessment Coordinator	Ettema.leah@epa.gov

1.5 Program Organization

See Figure 1 for the Commission's Program Organization Chart.

Program Manager / Quality Assurance Coordinator: Jamie Shallenberger (SRBC)
The Program Manager will supervise Project Managers and the Project QA Manager. The Program Manager will troubleshoot higher level issues that may arise in regards to sampling, travel, and contractors. The Program Manager also functions as the QA Coordinator and will communicate significant QA concerns to the Deputy Executive Director.

Quality Assurance Manager: Ellyn Campbell (SRBC)
The QA Manager will be responsible for reviewing sampling design and data quality and will troubleshoot with laboratories as required.

Project Managers (SRBC)
The Project Managers will be responsible for planning efforts, sampling of necessary parameters, supervision and management of supporting field crews, submission of samples to contractors, and analysis of data. Project Managers report to the Program Manager.

Field Sampling Leads (SRBC):
These crew members will be responsible for travel to the sites, field sampling, and direct submission of samples to labs. The Field Sampling Leads report to the Project Managers.

Laboratory Services Managers:
The Laboratory Services Managers will be responsible for delivery of properly labeled and packaged sampling bottles (if applicable), custody of received samples at the lab, assigning appropriate laboratory staff to perform analyses, identifying and troubleshooting laboratory issues, and communicating any and all issues as well as results to the Project Managers.

1.6 Problem Definition/Background (EPA QA/R-5 A5)

The Commission conducts stream monitoring projects within the scope of several U.S. Environmental Protection Agency (USEPA)-approved Quality Assurance Project plans (QAPPs) funded by Section 106 monies. The Commission also conducts stream monitoring activities that fall outside the scope of specific and approved QAPPs, but within the scope of a USEPA-approved, Section 106-funded programmatic workplan. The Commission undertakes these activities to fulfill many goals:

- identify potential stream restoration candidates,
- measure the success of past stream restoration activities,
- conduct small pilot efforts to determine the feasibility of larger projects,
- fill information gaps as requested by member state resource agencies, and
- assist in data gathering for watershed groups and stakeholders.

The purpose of this Quality Assurance Program Plan (QAPrP) is to document the methods and techniques used by the Commission on a programmatic level to fulfill the above-listed goals.

1.7 Program Description (EPA QA/R-5 A6)

Monitoring activities that expected to occur on a programmatic level could include one or more levels of effort.

Coordination: Potential coordination activities for the Commission include office and field meetings to discuss scope and site locations, assessments and troubleshooting of supply, equipment, permitting and site accessibility needs, and scheduling and communication of sampling activities during favorable weather and streamflow conditions. Potential work also includes discussions with contractors to ensure proper shipment, labeling, and preservation of sample bottles, receipt of correct data and invoices, and troubleshooting of any data quality issues that might arise.

Sampling: Potential work includes organization of bottles and coolers, sampling at field sites, compliance with Commission health and safety protocols, proper preparation of samples for submission to contractors, and delivery and confirmation of receipt of samples by contractors within the proper timeframe. Potential work also includes the acquisition of secondary data.

Data Analysis: Potential work includes organization and quality review of data into spreadsheets, calculating metrics, and entering data into the Commission database. Potential work also includes a quality review of secondary data and subsequent inclusion or exclusion of the data in analyses.

Deliverables: In lieu of technical reports, potential deliverables include providing a list of monitoring sites and associated parameters sampled under this QAPrP with USEPA funding during the grant cycle. This list would include site name/ID, location coordinates, parameters sampled, sampling method or instrument, and number of sampling events at each site. The Commission will also publish this list on the Commission website and indicate that USEPA funding was used. The Commission will upload data collected under this QAPrP to the WQX database.

1.8 Quality Objectives and Criteria for Measurement Data (EPA QA/R-5 A7)

1.8.1 Objectives and Project Decisions

The purpose of this program is to sample and provide quality data for Commission scientists, other resource agencies, conservation and watershed groups, researchers, civic groups, and government officials. These data will be used for assessment, decision-making, trend evaluation, or other project-specific goals of the Commission and these other organizations. These data can be biological (macroinvertebrate, fish, or algae), chemical (field measurements or samples collected for laboratory analyses), or physical (discharge measurements, ratings of habitat quality, and photographs).

1.8.2 Measurement Performance Criteria/Acceptance Criteria

Please see Table 1 for Quality Control Requirements for Analyses and Field Measurements.

1.9 Special Training Requirements/Certification (EPA QA/R-5 A8)

Program activities require implementation of sampling protocols while wading, from a bridge, or on a boat. None of this sampling requires specialized training or certification. The Commission holds a field training session each year to refresh familiarity with all Commission sampling protocols. This field training session is typically held in May or June each year.

1.10 Documents and Records

Project records and documents will be managed according to the Commission's Records Retention Policy (Policy No. 2018-01) and the Commission's Quality Management Plan (QMP) (SRBC, 2021. The Project Manager is responsible for entering data into the Commission's database and ensuring electronic files are saved to the network drives.

1.10.1 QA Program Plan (QAPrP) Distribution

The QAPrP will be maintained by the Program Manager and Quality Assurance Manager and distributed to Field Sampling Leads during the Coordination portion of the project. The QAPrP will be reviewed annually by both the Program Manager and the Quality Assurance Manager. Any changes to existing data collection protocols or implementation of new data collection protocols that affect the operation of sampling activities shall be documented as a QAPrP amendment and submitted to USEPA for approval. The QAPrP as well as any revisions or addendums will be

retained in the program-designated workspace on the network drive.

1.10.2 Field Documentation and Records

Project records and documents will be managed according to the Commission's Records Retention Policy and the Commission's QMP. Hardcopy documents will be retained in project-designated Monitoring & Protection program file cabinets in the Harrisburg office after data are entered into Excel spreadsheets on the network drive or the Access database. Data are uploaded to the WQX annually in March. The Project Manager will be responsible for ensuring electronic files are saved to the network drives.

These records include but are not limited to:

- Field forms
- Chains of custody
- Calibration, maintenance, and sample logs
- Photos
- Water quality, macroinvertebrate, fish, and crayfish data (electronic or hardcopy)
- Data analyses
- Corrective actions and results
- Technical reports

1.10.3 Laboratory Documentation and Records

Upon receipt of water samples, Pace Analytical Services (Pace Analytical) will email the Project Manager a Sample Acknowledgement Form that documents information collected from the chain of custody (COC) for the samples received. These emails will be retained in the project-designated workspace on the network drive. Pace Analytical will email an Excel file containing the water sample results as well as a PDF file containing a report of the results, analytical methods used, and all internal documentation pertaining to the processing of the sample at their lab. These electronic files will be retained in the project-designated workspace on the network drive. The data will also be uploaded to the Access database. All emails between Pace Analytical and the Commission pertaining to sample integrity or troubleshooting will be saved in the project-designated workspace.

Upon receipt of macroinvertebrate samples, the taxonomist will email the Project manager a signed copy of the COC acknowledging receipt. The taxonomist will email an Excel file containing the macroinvertebrate results as well as internal documentation pertaining to the processing and identification of the macroinvertebrate sample at their lab. These electronic files will be retained in the project-designated workspace on the network drive. The macroinvertebrate data will be uploaded to the Access database. All emails between the taxonomist and the Commission pertaining to sample integrity or results will be saved in the project-designated workspace.

1.10.4 Quarterly and/or Final Reports

Program activity will be documented as part of the Section 106 mid-year report and end-of-year report, both of which are retained in the Section 106 workspace on the network drive. All analyses

and any generated technical reports are retained in the project-designed workspace on the network drive. Any technical reports will be published in the Reports Library section of the Commission website.

2.0 DATA GENERATION AND ACQUISITION

2.1 Sampling Design

Data generation activities may include collecting macroinvertebrate and water quality samples, collecting environmental DNA, sampling of fish populations, PIT tagging of fish for mark-recapture studies, operating and maintaining continuous instream monitoring (CIM) equipment, measuring stream discharge, and rating and surveying instream and riparian habitat features.

See Table 2 for a summary of the sampling parameters to be collected as well as the QC sampling expected. Where appropriate, duplicate samples will be taken throughout the sampling period (10 percent of the sites; one duplicate every 10 samples). Where appropriate, blank samples will be taken during the sampling period (one blank every 10 samples) to check for bottle contamination, preservative contamination, sterility of the lab's deionized water, and integrity of the lab's analytical processes.

All sampling will be done upstream of any road crossings if possible. If access into the stream is allowed, field crews will wade into the stream and set up a transect across the stream at least 50 feet above the bridge. If access into the stream is not allowed, field crews will sample from the bridge, using the bridge span as the stream transect. Sampling will be limited after storm events, and no sampling will occur within three days of a severe weather event.

The research question determines what parameters will be sampled for three different project categories:

1. Identify restoration candidates and assess restoration effects,
2. Conduct pilot research projects, and
3. Assist member state resource agencies and stakeholders.

2.1.1 Identify Restoration Candidates and Assess Restoration Efforts

The Commission collects chemical, biological, and physical data to identify potential streams for possible restoration, verify identified impaired reaches, and re-establish baseline data prior to the implementation of restoration activities.

These data help the Commission's Coordinator for mine drainage projects prepare concept-level site restoration plans and design site and watershed monitoring approaches. The Commission's Coordinator for mine drainage projects has long collaborated on inter-agency and other stakeholder organization partnerships to restore water quality and related ecosystem functions as the result of legacy mining impacts.

Likewise, the Commission collects chemical, biological, and physical data to document the effects of restored water quality on aquatic life. These data are reported to member resource agencies for

use in regulatory decisions, including potential delisting stream segments or upgrading to special protection status.

2.1.2 Conduct Pilot Research Projects

The Commission has the flexibility to identify and launch pilot research projects to investigate novel hypotheses, increase knowledge about previously understudied aquatic resources in the Basin, and incorporate new technology into monitoring activities. Depending upon the research goal, the Commission collects chemical, biological, and/or physical parameters. Past pilot research projects have led to successful and ongoing funding of the Eel Restoration Study, the Roller Mill Dam Removal Study, and the Harmful Algal Bloom Study.

2.1.3 Assist Member State Resource Agencies and Stakeholders

Commission scientists support member agencies with supplemental sampling upon request, largely focused on fisheries-related priorities associated with regional issues. These priorities focus on successful migration of fish into and out of the Basin, protection of threatened species, and controlling and preventing the spread of aquatic nuisance species. At times, Commission scientists may also be called upon to help identify streams and watersheds that are in need of increased protection.

The Commission provides support to local watershed initiatives that involve sampling chemical, biological, or physical parameters before and/or after restoration projects. Some stakeholder groups supported and promoted by the Commission include the Susquehanna River Heartland Coalition, Upper Susquehanna Coalition, Upper Susquehanna Conservation Alliance, Trout Unlimited, Pennsylvania County Conservation Districts, and the Chesapeake Bay Foundation.

The Commission also operates and maintains continuous instream monitoring (CIM) equipment throughout the Basin to help protect and manage public water supplies and operations for about 850,000 public water customers. These real-time data are shared among public water suppliers, state and local agencies, and the emergency response community.

2.2 Sampling Methods (EPA QA/R-5 B2)

2.2.1 Water Quality Samples

Water samples are collected across a stream transect using depth-integrating samplers. When wading, samples are collected using a hand sampler. When sampling from the bridge, a bridge sampler is used. The sampler is positioned facing upstream into the current to prevent collection of sediments kicked up by the sampler or field personnel. At each station, vertical samples are collected at equal distances across the stream, composited in a churn splitter, and churned while the sample bottle is filled. The churn is rinsed between each sample collection with deionized water and sample water from the new sample site before a sample is taken.

All samples are logged on the Pace Analytical chain of custody form (Attachment A) with site ID, date and time of collection, number of bottles, and analyses requested.

2.2.2 Field Measurements

A YSI ProDSS multimeter (or YSI EXO2 or EXO3 data sonde for deeper reaches) will be used to measure in-situ temperature, conductivity, pH, turbidity, and dissolved oxygen when water quality samples are collected. Field measurements will be recorded on log book sheets (Attachment B).

Each parameter will be calibrated at the frequency suggested in the user's manual for the YSI multimeter or data sonde. The probes of all meters will be rinsed first with deionized water and then with sample water prior to collection of water quality data. At the end of each sampling day, the field meter will be post-checked against calibration standards to check for drift.

YSI EXO2 or EXO3 data sondes to be used for continuous data collection instruments will be installed and will measure in-situ temperature, conductivity, pH, turbidity, and dissolved oxygen. Installation, frequency of data collection, and data correction are detailed in the Commission's Remote Water Quality Monitoring Network Standard Operating Procedures (SRBC, 2017).

For some research projects, chlorophyll will also be measured on YSI EXO2 or EXO3 data sondes that are outfitted with the EXO Total Algae PC Smart Sensor.

2.2.3 Stream Discharge

Discharge will be measured manually at most sites using a SonTek FlowTracker2 handheld Acoustic Doppler Velocimeter (ADV) (SonTek, 2019) and USGS methods (Buchanan and Somers, 1969) when possible. Discharge at sites adjacent to USGS gaging stations will be obtained from USGS National Water Information System (NWIS).

2.2.4 Environmental DNA

Field crews will collect a 2L grab sample using the Field Collection of Environmental DNA (eDNA) Water Samples from Streams protocol (USFWS, 2018). Samples will be logged on eDNA Sample Collection sheets (Attachment C). Samples will be kept on wet ice following collection and filtered within 12 hours of collection.

Water samples will be filtered through a 47-mm diameter, 1.5uM pore size glass fiber filter through use of a vacuum pump. The target volume for a single filter will be between 1L and 2L. In the event a single filter clogs before the entire 2L water sample can be filtered, filtration will be stopped and the filtered volume will be recorded. All filtering information will be recorded on eDNA Sample Filtration sheets (Attachment D).

Field controls (2L deionized water) will be filtered before and after each sample set to ensure proper decontamination protocols were followed during sampling and filtration. Filters will be frozen, placed inside 5ml plastic vials, placed in plastic transport bags, and transported to the USFWS Northeast Fishery Center (NEFC) for DNA extraction and analysis. Filters will be stored at -80^{o}C at NEFC until DNA is extracted.

DNA extraction and processing will follow USFWS procedures outlined in the Quality Assurance Plan for bighead and silver carps (USFWS, 2019).

2.2.5 Benthic Macroinvertebrate Community

Macroinvertebrate samples are collected using the protocol outlined in the Pennsylvania Department of Environmental Protection's (PADEP's) Index of Biotic Integrity for Benthic Macroinvertebrate Communities in Pennsylvania's Wadeable, Freestone, Riffle-Run Streams in Pennsylvania (PADEP, 2013). This method has been adopted by the Commission for the standardized collection of macroinvertebrates throughout the Basin. The sample will be a composite of six kick samples collected using a D-frame in riffle run habitat. The total area sampled using this method is $6m^2$. One duplicate D-frame sample will be collected at a randomly determined site.

After sampling has been completed at a given site, all equipment that has come in contact with the sample will be rinsed thoroughly, examined carefully, and picked free of algae or debris before sampling at the next site. Additional organisms found on examination of the D-frame net will be placed into the sample containers.

All macroinvertebrate samples will be processed using a U.S. Standard No. 35 mesh sieve, and all collected specimens will be preserved in 95-percent ethanol and returned to the Commission office for identification and enumeration by a contractor. Macroinvertebrate bottles will be labeled with the site, date, and method. Macroinvertebrate samples will be logged on Macroinvertebrate Sample Collection sheets (Attachment E).

At the contractor's laboratory, additional information such as dates and details regarding subsampling and identification will be recorded on Macroinvertebrate Sample Processing Bench sheets (Attachment F). Samples will be sorted into 200-organism subsamples (± 20 percent) using a gridded pan and a random numbers table. All organisms contained in the subsamples, including midges and worms, will be identified to genus when possible, and enumerated. Benthic macroinvertebrates are identified by professional biologists, with a minimum of a Master of Science degree in biology, skilled at recognizing most benthos to the family level by sight, and to the genus level with appropriate keys. All macroinvertebrate identification data will be recorded on an Macroinvertebrate Enumeration lists (Attachment G). All macroinvertebrate data will be appended into the Commission's Access database.

2.2.6 Fish Community

Wadeable streams

A single-unit, multiple pass, Commission-developed protocol will be used for wadeable streams (Shank et al., 2016). This protocol yields reliable estimates of relative abundance with a resource-limited field crew and has been used since 2016 with repeated success.

Electrofishing of all available habitats in wadeable streams will be conducted using either a backpack unit or a tote barge unit depending upon stream size. The sampled stream reach will equal ten times the average wetted width, with a minimum length of 100 meters and a maximum

length of 400 meters. Voltage settings on the equipment will be adjusted to accommodate varying stream conductivities according to U.S. Fish and Wildlife Service (USFWS) courses on Electrofishing Safety and Electrofishing Principles and Techniques.

A three-person crew is used for backpack electrofishing, with one person carrying the backpack shocker and using a net, one person with a net, and the third person with a bucket and a net. A four-person crew is used for tote barge electrofishing, with one person on each probe, one person towing the barge, and the fourth person as an extra netter. When shallow riffles are not available as natural barriers, block nets will be used at the top and bottom of the reach to reduce entry into and escape out of the reach. Nets and holding cages will have 0.25-inch mesh netting to prevent escape.

Non-wadeable streams

Boat electrofishing at non-wadeable streams and rivers is adapted from the protocol outlined in the USEPA manual "Concepts and Approaches for Bioassessment of Non-wadeable Streams and Rivers" (Flotemersch et al., 2006). Fish will be collected by boat electrofishing with the river current of the best available habitat along 500-meter reaches of the left and right banks. A Missouri-style trawl will also be used to collect benthic fish. The trawl is dragged in a downstream manner along the river bottom for two minutes at a speed slightly faster than the river current. A complete sample of the site includes a combination of electrofishing of the left and right banks and any trawling.

When safe boat electrofishing cannot be performed, shoreline fishing will be completed using a backpack electrofishing unit. Total electrofishing (button) time across all gear types at a site will range between 2400-3000 seconds (1200-1500 per bank).

Processing

At the end of each electrofishing run and completion of processing, all fish will be returned to the stream. If there is a question regarding identification, the fish will be preserved in a 10-percent formalin solution and returned to the laboratory for identification. Rare, threatened, or endangered species will not be harmed or killed and will be documented only with digital photographs as voucher documentation. Digital photographs will be taken of each species collected and of all unknown specimens. Fish identifications, measurements (mm), weights (g), and deformities or indications of disease will be recorded on Fish Field Data sheets (Attachment H). All data will be entered into the Commission's Access database.

Digital voucher photos taken in the field will be in color, of appropriate lighting, and have a minimum resolution of 1024x768 pixels. A fish board will be used for scale, and information regarding site, date, and station ID will be visible in the picture. Photograph numbers will be recorded on the Fish Field Data forms. Digital photographs will be placed in the Photo Directory on the network drive.

All fish identifications in the field or laboratory are made by a qualified fish taxonomist. Fish identifications completed in the lab will be documented on the Fish Laboratory Data sheets (Attachment I).

2.2.7 Passive Integrated Transponder (PIT) Tagging

Fish tagging

The Commission will use Passive Integrated Transponder (PIT) tagging to monitor fish movement in streams and watersheds to answer research questions or assess the success of stream restoration projects. In the past, research fish species have included brook trout (*Salvelinus fontinalis*), brown trout (*Salmo trutta*), and American eel (*Anguilla rostrata*). No permits are required to tag fish, but Commission scientists have PFBC scientific collector permits which give permission for fish studies.

Field crews will use different sized half duplex (HDX) PIT tags (Oregon RFID, Portland, OR) depending upon the size of the fish to be studied. Fish that are to be tagged will be anesthetized with 20-30 mg eugenol/L (0.18-0.27 ml Aqui-S 30E/L). A Betadine solution (10 percent Povidone-iodine) will be used to sterilize all instruments and tags prior to use. The Betadine solution will be applied to the ventral surface behind the pelvic fins. A small incision will be made with a scalpel and the tag will be inserted. The incision will be closed with an adhesive. Fish will be returned to a holding area of fresh water for recovery and will be released to the stream once recovered.

Tag reading

Field crews will use the HPR Lite handheld PIT tag reader to read the tag immediately after insertion to make sure the tag is working. During recapture events, the PIT tag reader will be used to determine if the fish is tagged. If the fish contains a tag, the tag number, species name, and weight and length of the fish will be recorded on a log sheet. The tags are placed in areas of the body that are not eaten, but if an angler were to catch a tagged fish, the angler could contact the tag manufacturer to find the agency responsible for placing it (if they desired).

2.2.8 Instream and Riparian Habitat

Field crews will assess instream and riparian habitat at each site using a slightly modified version of the habitat assessment procedure outlined by Barbour and others (1999). Eleven habitat parameters will be field-evaluated at each site and used to calculate a site-specific habitat assessment score. Different habitat assessment forms and criteria will be used to evaluate habitat in riffle/run and glide/pool stream types (Attachments J and K, respectively). Digital photographs of site conditions will be taken during each site visit.

2.3 Sample Handling and Custody (EPA QA/R-5 B3)

2.3.1 Water Quality Samples

All water quality sampling bottles will be provided by Pace Analytical and will be labeled and pretreated with appropriate preservative. It is the responsibility of the Project Manager to inspect all bottles prior to sampling and ensure that the bottles are labelled correctly, are free of any contaminants, and match the COC forms.

Water samples are placed into these bottles at the time of collection. Water sample labels include the station ID, date and time of collection, collector's initials, parameters to be analyzed, and appropriate preservatives, and will be filled out in pencil. This same information is recorded on the laboratory chain of custody form. One COC copy is submitted to the laboratory with the sample, and another is retained as a record. This same information is entered into a logbook, which also includes the name of the sampled waterbody, the flow measurement at the time the sample was collected (if applicable), field meter readings, whether a sample is a duplicate, and any other pertinent information regarding the sample.

No temperature blanks will be submitted. The samples will be chilled on ice to 6ºC and shipped to Pace Analytical by overnight courier service. If samples are received above the 6°C threshold, the laboratory will notify the Project Manager, who will determine whether analysis should continue.

2.3.2 Environmental DNA Samples

All environmental DNA sample bottles will be provided by USFWS. It is the responsibility of the Project Manager to inspect all bottles prior to sampling and ensure that the bottles are free of any contaminants.

Water samples will be placed into these bottles at the time of collection, and bottle caps will be labeled with the site name. Samples will be kept on wet ice following collection and filtered within 12 hours of collection. Environmental DNA sample information will be entered into a logbook.

After the sample is filtered, the filters will be frozen, placed into plastic vials labeled with the site name, date, time, and volume filtered, and transported to the USFWS Northeast Fishery Center (NEFC) for DNA extraction and analysis. The plastic transport bags will also be labeled with the site name in permanent marker. All individually packaged filters, filter vials, and plastic transport bags will be provided by USFWS.

2.3.3 Benthic Macroinvertebrate Samples

Both internal and external labels will be used for macroinvertebrate samples and include site ID, stream name, project name, collection date and time, collection method, initials of the collector, sample jar number, whether the sample is a duplicate, and the preservative used, and will be filled out in pencil. This same information will be recorded in a logbook. One COC copy will be submitted to the taxonomist identifying the macroinvertebrate sample, and another is retained as record.

2.3.4 Fish Samples

Both internal and external labels for fish samples will be labeled with the date, reach or site ID, initials of the collector, and species name (if sample is a voucher specimen). This same information is entered into a logbook, which will also include the name of the sampled waterbody and the number of voucher specimens collected.

2.4 Analytical Methods (EPA QA/R-5 B4)

2.4.1 Field Measurements Methods

YSI ProDSS multimeter (or YSI EXO2 or EXO3 data sonde for deeper reaches) will be used to measure in-situ temperature, conductivity, pH, turbidity, and dissolved oxygen. At times, the YSI EXO2 or EXO3 data sonde will also be used to measure chlorophyll.

Discharge is measured using a SonTek FlowTracker2 handheld ADV.

2.4.2 Laboratory Analyses Methods (Off-Site)

Please see Table 3 for a summary of laboratory methods for water quality samples, environmental DNA samples, macroinvertebrates, and fish.

2.5 Quality Control Requirements (EPA QA/R-5 B5)

2.5.1 Field Sampling/Measurement Quality Control

When collecting water samples, the sampler is positioned facing upstream into the current to prevent collection of sediments kicked up by the sampler or field personnel. While the sample bottle is filled from the churn splitter, field personnel will not touch any part of the sample bottle that will make contact with the sample water, and the lip of the sample bottle will not touch the spout of the churn. The churn is rinsed between each sample collection with deionized water and sample water from the new sample site before a sample is taken.

Field measurement equipment and operations will be tested annually for pH and specific conductance with USGS standard samples. Project Managers will be responsible for ensuring that all field personnel are competent in measurement and collection techniques prior to fieldwork. Project Managers also will be responsible for the quality of all equipment and reagents. The Project QA Manager will perform a field audit near the beginning of sampling.

A YSI ProDSS multimeter (or YSI EXO2 or EXO3 data sonde for deeper reaches) will be used to measure in-situ temperature, conductivity, pH, turbidity, and dissolved oxygen. At times, the YSI EXO2 or EXO3 data sonde will also be used to measure chlorophyll. At the end of each sampling day, the field meters will be post-checked against calibration standards to check for drift. For the FlowTracker, the Automatic QC Test will be run once daily to insure proper functioning.

Please see Table 1 for Quality Control Requirements for Analyses and Field Measurements.

2.5.2 Laboratory Analysis Quality Control

The Pace Analytical Quality Manual details laboratory quality control methods (Pace Analytical, 2022). Pace Analytical is certified by USEPA (#00070), Maryland (#202), New York (#12028), and Pennsylvania (#41-00034) for analysis of drinking water, microbiology, inorganics, and organics.

The USFWS Quality Manual details laboratory quality control methods.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance (EPA QA/R-5 B6)

2.6.1 Field Measurement Instruments/Equipment

Project Managers or Field Sampling Leads will be responsible for inspecting and maintaining equipment. If any issues exist, the Project Manager will be notified and corrective actions taken. Extra batteries, meters, nets, and other equipment will, when practical, be brought along during field sampling for use in the event the original set of gear is damaged, malfunctioning, or broken. In the case of items for which transporting a back-up is impossible or impractical, additional supplies will be kept at the Commission office in Harrisburg, PA.

2.6.2 Laboratory Analysis Instruments/Equipment (Off-Site)

The Pace Analytical Quality Manual details methods for instrument testing, inspection, and maintenance.

The USFWS Quality Manual details laboratory quality control methods.

2.7 Instrument/Equipment Calibration and Frequency (EPA QA/R-5 B7)

2.7.1 Field Measurement Instruments/Equipment

The Project Manager or Field Sampling Lead will be responsible for calibrating equipment. If any issues exist, the Project Manager will be notified and corrective actions taken.

The dissolved oxygen probe on the YSI multimeter or data sonde will be calibrated using the air-saturated chamber technique prior to use each day. This calibration test will be repeated in the event of a membrane cap replacement or other maintenance that may affect the accuracy of the meter. Results will be recorded in the calibration log. A post check of adherence to calibration standards will be performed at the end of the day and recorded on the calibration log.

The conductivity probe on the YSI multimeter or data sonde will be calibrated prior to sampling by checking the meter readings against fresh specific conductance standard according to the expected conductance of the water being monitored. Calibration will be checked on weekly basis. Results will be recorded in the calibration log. Acceptable Criteria: 1) Standards (<1000 µmhos/cm), ± 4%, and 2) (>1000 µmhos/cm), ± 3%.

The pH probe on the YSI multimeter or data sonde will be calibrated against two buffers daily, before and after use. Calibration checks will be made after every 10 samples. These checks will be recorded in the calibration log.

The turbidity meter on the YSI multimeter or data sonde will be calibrated monthly against two standards. Calibration checks will be made after every 50 samples. These checks will be recorded in the calibration log.

The chlorophyll probe on the data sonde will be calibrated before each use. Results will be recorded in the calibration log.

For the FlowTracker, the Automatic QC Test will be run once daily to insure proper functioning.

YSI data sondes deployed for continuous instream monitoring will be calibrated according to standard operating procedures (SRBC, 2017).

2.7.2 Laboratory Analysis Instruments/Equipment (Off-Site)

The Pace Analytical Quality Manual details methods for instrument calibration.

The USFWS Quality Manual details laboratory quality control methods.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables (EPA QA/R-5 B8)

2.8.1 Field Sampling Supplies and Consumables

All water quality sampling bottles will be provided by Pace Analytical and will be labeled and pretreated with appropriate preservative. It is the responsibility of the Project Manager to inspect all bottles prior to sampling and ensure that the bottles are free of any contaminants. Deionized water is supplied by the Pennsylvania Department of Environmental Protection Bureau of Laboratories.

2.8.2 Laboratory Analyses (Off-Site) Supplies and Consumables

The Pace Analytical Quality Manual details methods for insuring quality of supplies and consumables.

The USFWS Quality Manual details laboratory quality control methods.

2.9 Non-Direct Measurements and Data from External Sources (EPA QA/R-5 B9)

Any secondary data used for program activities are covered under the Commission's Quality Assurance Project Plan for Collection and Use of Secondary Data (SRBC, 2022).

The Commission will use water quality data collected during program activities to calculate Basin-specific Water Quality Index (WQI) (Berry et al., 2020) scores. Benthic macroinvertebrate data will be converted into PADEP Index of Biotic Integrity Index (IBI) scores (PADEP, 2013).

2.10 Data Management (EPA QA/R-5 B10)

Contractors will email Project Managers results as Excel files and/or PDF files that also indicate analytical methods used and all internal documentation pertaining to the processing of the sample at their lab. Project Managers will save these electronic files in the project-designated workspace on the network drive. The data will be uploaded to the Access database. All emails between

contractors and the Commission pertaining to sample integrity or troubleshooting will be saved in the project-designated workspace.

3.0 ASSESSMENT AND OVERSIGHT

3.1 Assessments/Oversight and Response Actions (EPA QA/R-5 C1)

Project Managers will ensure collection of samples in ambient stream conditions as opposed to storm conditions. Project Managers will reschedule sampling in the event that high flow events or other stream conditions beyond our control occur. No sampling will occur within three days of a severe weather event.

Implementation of corrective action involving any of the sampling procedures, equipment, or data reduction and processing will be the responsibility of Project Managers and must be reported to the Project QA Manager. The Project QA Manager or the QA Coordinator, if necessary, will be responsible for seeing that such corrective action is taken. Implementation of corrective action involving laboratory analyses will be the responsibility of the Laboratory Services Manager or contractor. The results of any corrective actions taken will be documented by the individual(s) taking the necessary actions.

3.2 Reports to Management (EPA QA/R-5 C2)

Field operator techniques will be tested annually for pH and specific conductance with USGS standard samples. The subsequent USGS report is submitted to the QA Coordinator and the Deputy Executive Director.

Project Managers will report any issues and subsequent corrective action that was taken to the QA Coordinator via email. Any additional troubleshooting that needs to be taken with contractors will be formally documented by the QA Coordinator.

4.0 DATA VALIDATION AND USABILITY

4.1 Data Review, Verification, and Validation Requirements (EPA QA/R-5 D1)

Primary responsibility for data validation lies with the Project Manager. Field collections are conducted according to the above methodology to ensure accurate data. The use of blank samples and duplicates, the results of which are reviewed by the Project Manager, also validates the water quality analyses. The Project Manager verifies all sample labeling, chain-of-custody forms, and Pace Analytical lab reports to ensure they are in agreement and complete. The Project Manager also checks the data reports to ensure that no data were flagged by either lab and that the data were generated under proper methodology and holding time.

Temperature blanks are not submitted, but if samples were received by the lab above the required 6°C temperature threshold, data will be qualified. The Field Sampling Lead and other Commission scientists may assist the Project Manager in determining the acceptability of the data at the time of

receipt based on knowledge of the current and historic stream conditions. If needed, the site may be re-sampled. In this way, peer review of the data upon receipt helps verify and validate the data.

Pace Analytical verifies and validates data using protocols outlined in the Pace Analytical Quality Manual. The Project Manager will review QA/QC reports supplied by Pace Analytical for the periods of time in which samples for the project are processed. The Project Manager will immediately contact Pace Analytical for further investigation if data are missing or appear to be in error or improper techniques were used.

The data are subject to a series of validations as they are entered into the database, including checking values for duplicate samples against one another, comparing computer entries to field and laboratory data sheets, looking for data gaps and missing information, checking flow calculations, and examining raw data for outliers or inappropriate measurements. Peer review by other Commission personnel of the information after input is done to ensure correct data entry.

Ten percent of the macroinvertebrate samples identified by one biologist will be validated by a second biologist not affiliated with the first biologist to avoid bias and recorded in the logbook. A biologist will spot-check 10 percent of the samples picked by laboratory personnel during subsampling and will record the samples in the logbook. Ten percent of fish voucher specimens will be identified by a second Commission biologist in the laboratory and recorded in the log book.

5.0 REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. USEPA 841-B-99-002. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

Berry, J.L., L.Y. Steffy, and M.K. Shank. 2020. Development of a Water Quality Index (WQI) for the Susquehanna River Basin. Publication No. 322. Susquehanna River Basin Commission, Harrisburg, Pennsylvania.

Buchanan, T.J. and W.P. Somers. 1969. Discharge Measurements at Gaging Stations. USGS Techniques of Water-Resources Investigations, Book 3, Chapter A8.

Flotemersch, J.E., J.B. Stribling, and M.J. Paul. 2006. Concepts and Approaches for the Bioassessment of Non-wadeable Streams and Rivers. USEPA 600-R-06-127. U.S. Environmental Protection Agency, Cincinnati, Ohio.

Pace Analytical Services (Pace Analytical), LLC. 2022. Quality Manual, Document Number: ENV-MAN-WILL-0001 v03_Quality Manual. 104 pp. Williamsport, Pennsylvania.

Pennsylvania Department of Environmental Protection (PADEP). 2013. A Benthic Macroinvertebrate Index off Biotic Integrity for Wadeable Freestone Riffle-Run Streams in Pennsylvania. PADEP Division of Water Quality Standards.

Shank, M., A. Henning, and A. Leakey. 2016. Examination of a Single-Unit, Multiple-Pass Electrofishing Protocol to Reliably Estimate Fish Assemblage Composition in Wadeable Streams of the Mid-Atlantic Region of the USA, North American Journal of Fisheries Management, 36:3, 497-505.

SonTek. 2019. FlowTracker2 User's Manual 1.6, Software Version 1.6, Firmware Version 1.3 (January 2019).

Susquehanna River Basin Commission (SRBC). 2022. Quality Assurance Project Plan for Collection and Use of Secondary Data. Document Control Number SRBC-QA082. Harrisburg, Pennsylvania.

SRBC. 2021. Susquehanna River Basin Commission Quality Management Plan. Document Control Number SRBC-QA001. Harrisburg, Pennsylvania.

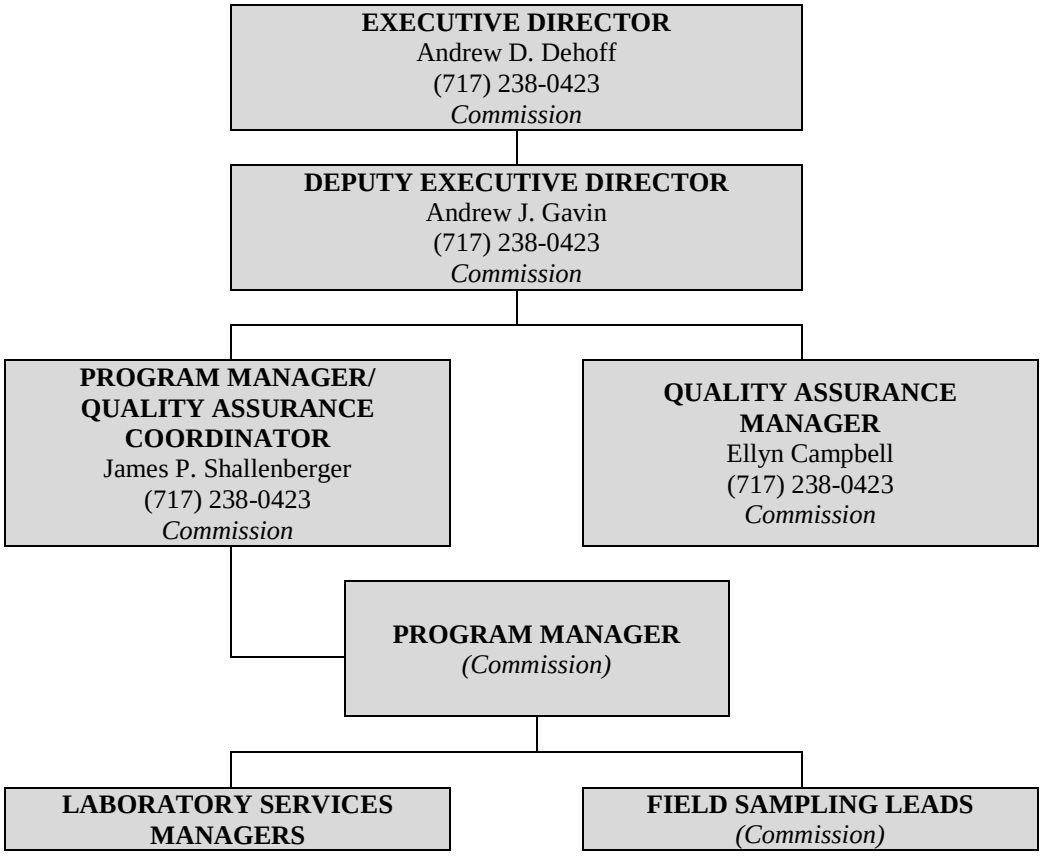
SRBC. 2017. Standard Operating Procedure, Remote Water Quality Monitoring Network. Harrisburg, Pennsylvania.

United States Fish and Wildlife Service (USFWS). 2019. Quality Assurance plan eDNA monitoring of bighead and silver carps. Bloomington, Minnesota.

USFWS. 2018. Northeast Fishery Center Conservation Genetics Lab, Protocol: Field Collection of Environmental DNA (eDNA) Water Samples from Streams. Lamar, Pennsylvania.

FIGURES

Figure 1. Program Organization Chart



TABLES

Table 1. Quality Control Requirements for Analyses and Field Measurements

Matrix/Media: Aqueous			
Analytical Parameter	**Detection Limit (mg/l)**	**Accuracy**	**Precision**
LABORATORY ANALYSES:			
Total Alkalinity	1.0	±10%	±10%
Total Aluminum	0.034	±10%	±10%
Calcium	0.058	±10%	±10%
Total Iron	0.052	±10%	±10%
Magnesium	0.020	±10%	±10%
Total Manganese	0.00037	±10%	±10%
Nitrate	0.025	±10%	±10%
Total Phosphorus	0.01	±10%	±10%
Potassium	0.035	±10%	±10%
Total Organic Carbon	0.12	±10%	±10%
Chloride	0.046	±10%	±10%
Sodium	0.41	±10%	±10%
Sulfate	0.051	±10%	±10%
FIELD MEASUREMENTS:			
Temperature	°C	0.01	-5°C to 50°C
Dissolved Oxygen	mg/l	± 1%	0 to 50 mg/l
pH	SU	0.1 SU	0 to 14
Specific Conductance	µS/cm	± 1%	0 to 100,000 µS/cm
Turbidity	NTU	±10%	±10%
Chlorophyll	µg/L	±10%	±10%
Discharge	cfs	0.001	N/A

Table 2. Summary of Parameters and QC Samples Collected

Matrix/Media: Aqueous			
Analytical Parameter	**Location**	**Number of Field Duplicates**	**Number of Equipment Blanks**
CHEMICAL			
LABORATORY ANALYSES:			
Total Alkalinity	Depth-integrated	1 for every 10 samples	1 for every 10 samples
Total Aluminum	Depth-integrated		
Calcium	Depth-integrated		
Total Iron	Depth-integrated		
Magnesium	Depth-integrated		
Total Manganese	Depth-integrated		
Nitrate	Depth-integrated		
Potassium	Depth-integrated		
Total Phosphorus	Depth-integrated		
Total Organic Carbon	Depth-integrated		
Chloride	Depth-integrated		
Sodium	Depth-integrated		
Sulfate	Depth-integrated		
FIELD MEASUREMENTS:			
Temperature	Stream bottom	N/A	N/A
Dissolved Oxygen	Stream bottom	N/A	N/A
pH	Stream bottom	N/A	N/A
Specific Conductance	Stream bottom	N/A	N/A
Turbidity	Stream bottom	N/A	N/A
Chlorophyll	Various	N/A	N/A
BIOLOGICAL			
ENVIRONMENTAL DNA	Stream reach	N/A	before & after sampling
BENTHIC MACROINVERTEBRATES	Stream reach	1 for every 10 samples	N/A
FISH	Stream reach	N/A	N/A
PHYSICAL			
STREAM DISCHARGE	Transect	N/A	N/A
INSTREAM / RIPARIAN HABITAT	Stream reach	N/A	N/A

Table 3. Analytical Methods, Containers, Preservation, and Holding Time Requirements

Matrix/Media: Aqueous				
Analytical Parameter	**Analytical Method Number**	**Containers**	**Preservation Requirements**	**Maximum Holding Times**
LABORATORY ANALYSES:				
Total Alkalinity	SM 2320B	250 ml, plastic	Cooling to 6°C	14 days
Total Aluminum	EPA 200.7	250 ml, plastic	HNO_3 to pH < 2	6 months
Calcium	EPA 200.7	250 ml/plastic	HNO_3 to pH < 2	6 months
Total Iron	EPA 200.7	250 ml/plastic	HNO_3 to pH < 2	6 months
Magnesium	EPA 200.7	250 ml/plastic	HNO_3 to pH < 2	6 months
Total Manganese	EPA 200.8	250 ml/plastic	HNO_3 to pH < 2	6 months
Nitrate	EPA 300.0	250 ml/plastic	Cooling to 6°C	48 hours
Total Phosphorus	EPA 365.1	1L/plastic	Cooling to 6°C, H_2SO_4 to pH < 2	28 days
Potassium	EPA 200.7	250 ml/plastic	HNO_3 to pH < 2	6 months
Total Organic Carbon	SM 5310B	125 ml/amber glass	Cooling to 6°C, H_2SO_4 to pH < 2	28 days
Chloride	EPA 300.0	250 ml/plastic	Cooling to 6°C	28 days
Sodium	EPA 200.7	250 ml/plastic	HNO_3 to pH < 2	6 months
Sulfate	EPA 300.0	250 ml/plastic	Cooling to 6°C	28 days
FIELD MEASUREMENTS:				
Temperature	In situ	N/A	N/A	N/A
Dissolved Oxygen	In situ	N/A	N/A	N/A
pH	In situ	N/A	N/A	N/A
Specific Conductance	In situ	N/A	N/A	N/A
Turbidity	In situ	N/A	N/A	N/A
Chlorophyll	In situ	N/A	N/A	N/A
ENVIRONMENTAL DNA	In situ	2L/plastic	N/A	indefinite
BENTHIC MACROINVERTEBRATES	In situ	1L/plastic	95% ethanol then 70% ethanol	indefinite
FISH	In situ	plastic then glass	10% formalin then 70% ethanol	indefinite
STREAM DISCHARGE	In situ	N/A	N/A	N/A
INSTREAM / RIPARIAN HABITAT	In situ	N/A	N/A	N/A

ATTACHMENTS

Attachment A. Pace Analytical Chain of Custody

CHAIN-OF-CUSTODY Analytical Request Document

Pace Analytical®

Chain-of-Custody is a LEGAL DOCUMENT- Complete all relevent fields

LAB USE ONLY- Affix Workorder/Login Label Here or List Pace Workorder Number or MTJL Log-in Number Here

ALL SHADED AREAS are for LAB USE ONLY

Company: Susquehanne River Basin Commission	Billing Information: send invoice depicting samples recevied by date to client's PM.
Address: 4423 North Front Street, Harrisburg, PA 17110	
Report To:	Email To:
Copy To:	Site Collection Info/Address:
Customer Project Name/Number:	State: PA / County/City: Time Zone Collected: [ ]PT [ ]MT [ ]CT [x]ET
Phone: 717-238-0423 Email:	Site/Facility ID #:
Collected By (print):	Purchase Order #: Quote #:
Collected By (signature):	Turnaround Date Required:
Sample Disposal: [ ] Dispose as appropriate [ ] Return [ ] Archive: _____ [ ] Hold:	Rush: [ ] Same Day [ ] Next Day [ ] 2 Day [ ] 3 Day [ ] 4 Day [ ] 5 Day (Expedite Charges Apply)

Compliance Monitoring? [ ] Yes [ ] No	Container Preservative Type ** / Lab Project Manager:
DW PWS ID #: DW Location Code:	
Immediately Packed on Ice: [ ] Yes [ ] No	Analyses / Lab Profile/Line:
Field Filtered (if applicable): [ ] Yes [ ] No Analysis: _____	

** Preservative Types: (1) nitric acid, (2) sulfuric acid, (3) hydrochloric acid, (4) sodium hydroxide, (5) zinc acetate, (6) methanol, (7) sodium bisulfate, (8) sodium thiosulfate, (9) hexane, (A) ascorbic acid, (B) ammonium sulfate, (C) ammonium hydroxide, (D) TSP, (U) Unpreserved, (O) Other _____

Lab Sample Receipt Checklist:
Custody Seals Present/Intact Y N NA
Custody Signatures Present Y N NA
Collector Signature Present Y N NA
Bottles Intact Y N NA
Correct Bottles Y N NA
Sufficient Volume Y N NA
Samples Received on Ice Y N NA
VOA -Headspace Acceptable Y N NA
USDA Regulated Soils Y N NA
Samples in Holding Time Y N NA
Residual Chlorine Present Y N NA
Cl Strips: _____
Sample pH Acceptable Y N NA
pH Strips: _____
Sulfide Present Y N NA
Lead Acetate Strips: _____

LAB USE ONLY:
Lab Sample # / Comments:

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Wastewater (WW), Product (P), Soil/Solid (SL), Oil (OL), Wipe (WP), Air (AR), Tissue (TS), Bioassay (B), Vapor (V), Other (OT)

Customer Sample ID	Matrix *	Comp / Grab	Collected (or Composite Start) Date	Collected (or Composite Start) Time	Composite End Date	Composite End Time	Res Cl	# of Ctns
	WW	Grab						0
	WW	Grab						0
	WW	Grab						0
	WW	Grab						0
	WW	Grab						0
	WW	Grab						0
	WW	Grab						0
	WW	Grab						0
	WW	Grab						0
	WW	Grab						0

RL 5 mg/L for TDS
** Low Level Phos

Customer Remarks / Special Conditions / Possible Hazards:	Type of Ice Used: Wet Blue Dry None Packing Material Used: Radchem sample(s) screened (<500 cpm): Y N NA	SHORT HOLDS PRESENT (<72 hours): Y N N/A Lab Tracking #: Samples received via: FEDEX UPS Client Courier Pace Courier

LAB Sample Temperature Info:
Temp Blank Received: Y N NA
Therm ID#: _____
Cooler1 Temp Upon Receipt: ___oC
Cooler1 Therm Corr. Factor: ___oC
Cooler1 Corrected Temp: ___oC
Comments:

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:	MTJL LAB USE ONLY Table #:	
Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:	Acctnum: Template: Prelogin:	Trip Blank Received: Y N NA HCL MeOH TSP Other
Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:	PM: PB:	Non Conformance(s): YES / NO Page: ____ of: ____

Attachment B. Field Measurement Log Book Sheet

LOCATION	
DATE	
TIME	
FLOW	
TEMP	
pH	
CONDUCTIVITY	
DO	
TURBIDITY	
LOCATION	
DATE	
TIME	
FLOW	
TEMP	
pH	
CONDUCTIVITY	
DO	
TURBIDITY	
LOCATION	
DATE	
TIME	
FLOW	
TEMP	
pH	
CONDUCTIVITY	
DO	
TURBIDITY	
LOCATION	
DATE	
TIME	
FLOW	
TEMP	
pH	
CONDUCTIVITY	
DO	
TURBIDITY	

Attachment C. Environmental DNA Sample Collection Sheet

Site Table: eDNA Sample Collection and Filtration										
Site ID	Site Description	Trip Date	Trip Time	Water Temp (°C)	pH	Turbidity	Flow (cfs)	Latitude	Longitude	Crew
Notes										

Attachment D. Environmental DNA Sample Filtration Sheet

Sample Table: eDNA Sample Collection and Filtration										
Sample ID	Site ID	Collection Date	Collection Time	Filtration Start Time	Filtration End Time	Volume Filtered (L)			Latitude*	Longitude*
						Filter 1	Filter2	Filter 3		
Notes										
* Only needed if transect-based sampling on larger systems or in situations where multiple grab samples are collected at a given site										

Attachment E. Macroinvertebrate Sample Collection Sheet

Station	Stream	Date	# of Bottles	Collector	Duplicate?

Attachment F. Macroinvertebrate Sample Processing Bench Sheet

COLLECTION			SUBSAMPLING				IDENTIFICATION	
Station	Date Collected	# of bottles	Date Subsampled	Subsampled by:	Grid count	Bug count	Date Identified	Identified by:

Attachment G. Macroinvertebrate Enumeration List

SITE _____ **DATE** _____
IDENTIFIED BY: _____ **DATE IDENTIFIED:** _____

FAMILY/GENUS	NUMBER OF INDIVIDUALS
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	
18.	
19.	
20.	
21.	
22.	
23.	
24.	
25.	

Attachment H. Fish Field Data Sheet

Stream Name:			Location:		
Station Abbreviation:					
GPS Coordinates:		TOP:		BOTTOM:	
Date:		Time:		Crew:	
Pass #	**1**		**2**		**3**
Shock Time					
SAMPLE COLLECTION (include electrofisher settings)	**How were fish captured?**	Generator Backpack	Battery Backpack	**Output Voltage?**	
	Block nets used?	Yes		No	
HABITAT TYPES	**Indicate the percentage of each habitat type present**				
	Riffles %	Pools %	Runs %	Snags %	
	Submerged Macrophytes %		Other % ( )		
GENERAL COMMENTS (include conductivity and flow conditions)	**Reach Length:** FIVE STREAM WIDTHS: 1. 2. 3. 4. 5.				
Brand and Model of EF Unit			Conductivity :		
Amps					
Volts			Water temp :		
# anodes					
# cathodes					

Fish Taxa Data (document any DELTS including a digital photograph)		
Species	Count	Weight(oz)
Total:		
Total:		
Total:		
Total:		
Total:		
Total:		
Total:		
Total:		

Attachment I. Fish Laboratory Identification Sheet

Site name:	
Sample Date:	
Lab ID Date:	
ID'd by:	

Fish Species	Count	Aggregate Weight (g)

Attachment J. Riffle/Run Habitat Assessment Sheet

Riffle/Run Habitat Assessment Sheet

Stream	**Date**
Station ID	**Time**
Sample #	**Crew**
Location Description:	

Stream type: Limestone Sandstone Valley Headwater Large River Glacial Other _____

Habitat Assessment		**Weather Conditions**
Parameter	Score	Air Temperature © _____
1. Epifaunal Substrate		Current Conditions: Sunny Cloudy Partly Cloudy
		Present Precipitation: None Rain Snow Mixed Precip.
		Heavy? (> 1 inch) Yes No
2. Instream Cover		Precip. Within last 24 hours: None Rain Snow Mixed Precip.
		Heavy? (> 1 inch) Yes No
		Ice Present at Site? Yes No
3. Embeddedness		**Functionally Important Stream Characteristics**
4. Velocity/ Depth Regimes		
5. Sediment Deposition		
6. Channel Flow Status		
7. Channel Alteration		**Predominant Substrate Material (circle one)**
8. Frequency of Riffles		Bedrock (> 160 inches in diameter) Boulder (10 – 160 inches in diameter) Cobble (2.5 – 10 inches in diameter) Gravel (0.1 – 2.5 inches in diameter) Sand/Silt/Clay (< 0.1 inches in diameter)

9. Condition of Banks (Score each bank)		Residential		Commercial	
		Industrial		Cropland	
		Nursery		Pasture	
Left Bank		Abd. Mining		Old Fields	
		Forest		Other	
Right Bank		**Comments:**			
10. Vegetative Protective Cover (score each bank)					
Left Bank					
Right Bank					
11. Riparian Vegetative Zone Width (score each bank)					
Left Bank		**Temp.**	**Cond.**		**D.O.**
Right Bank		**pH**	**Acid.**		**Alk.**

Riffle/Run Habitat Assessment Criteria (continued)

HABITAT PARAMETER	CATEGORY			
	OPTIMAL (20-16)	SUBOPTIMAL (15-11)	MARGINAL (10-6)	POOR (5-0)
1. Epifaunal Substrate	Well-developed riffle/run; riffle is as wide as stream and length extends 2 times the width of stream; abundance of cobble	Riffle is as wide as stream but length is less than 2 times width; abundance of cobble; boulders and gravel common	Run area may be lacking; riffle not as wide as stream and its length is less than 2 times the stream width; some cobble present	Riffle or run virtually nonexistent; large boulders and bedrock prevalent; cobble lacking
2. Instream Cover	> 50% mix of boulders, cobble, submerged logs, undercut banks, or other stable habitat	30–50% mix of boulder, cobble, or other stable habitat; adequate habitat	10–30% mix of boulder, cobble, or other stable habitat; habitat availability less than desirable	<10% mix of boulder, cobble, or other stable habitat; lack of habitat is obvious
3. Embeddedness	Gravel, cobble, and boulder particles are 0–25% surrounded by fine sediments	Gravel, cobble, and boulder particles are 25–50% surrounded by fine sediments	Gravel, cobble, and boulder particles are 50–75% surrounded by fine sediments	Gravel, cobble, and boulder particles are >75% surrounded by fine sediments
4. Velocity/ Depth Regimes	All 4 velocity/depth regimes present (slow/deep, slow/shallow, fast/deep, fast/shallow)	Only 3 of 4 regimes present (if fast/shallow is missing, score lower than if missing other regimes)	Only 2 of 4 regimes present (if fast/shallow or slow/shallow are missing, score low)	Dominated by 1 velocity/depth regime
5. Sediment Deposition	Little or no enlargement of islands or point bars and <5% of the bottom affected by sediment deposition	Some new increase in bar formation, mostly from coarse gravel; 5–30% of the bottom affected; slight deposition in pools	Moderate deposition of new gravel, coarse sand on old and new bars; 30–50% of the bottom affected; sediment deposits at obstructions; moderate deposition of pools prevalent	Heavy deposits of fine material, increased bar development; >50% of the bottom changing frequently; pools almost absent due to sediment deposition
6. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools
7. Channel Alteration	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted	Banks shored with gabion or cement; >80% of the reach channelized and disrupted

Attachment K. Glide/Pool Habitat Assessment Sheet

Glide/Pool Habitat Assessment Sheet

Stream	**Date**
Station ID	**Time**
Sample #	**Crew**
Location Description:	

Stream Type: Limestone Sandstone Valley Headwater Large River Glacial Other

Habitat Assessment		**Weather Conditions**
Parameter	Score	Air Temperature (°C)
1. Epifaunal Substrate		Current Conditions: Sunny Cloudy Partly Cloudy
		Present Precipitation: None Rain Snow Mixed Precip.
		Heavy? (> 1 inch) Yes No
2. Instream Cover		Precip. within last 24 Hours: None Rain Snow Mixed Precip.
		Heavy? (>1 inch) Yes No
		Ice Present at Site? Yes No
3. Pool Substrate Characterization		**Functionally Important Stream Characteristics**
4. Pool Variability		
5. Sediment Deposition		
6. Channel Flow Status		
7. Channel Alteration		**Predominant Substrate Material (circle one)**
8. Channel Sinuosity		Bedrock (>160 inches in diameter) Boulder (10-160 inches in diameter) Cobble (2.5 – 10 inches in diameter) Gravel (0.1 – 2.5 inches in diameter) Sand/Silt/Clay (<0.1 inches in diameter)
9. Condition of Banks (Score each bank)		
Left Bank		Residential % Commercial %
		Industrial % Cropland %
Right Bank		Nursery % Pasture %
		Abd. Mining % Old Fields %
10. Vegetative Protective Cover (score each bank)		Forest % Other %
		Comments:
Left Bank		
Right Bank		
11. Riparian Vegetative Zone Width (score each bank)		
Left Bank		**Temp.** **Cond.** **D.O.**
Right Bank		pH **Acid.** **Alk.**

Glide/Pool Habitat Assessment Criteria (continued)

HABITAT PARAMETER	CATEGORY			
	OPTIMAL (20-16)	SUBOPTIMAL (15-11)	MARGINAL (10-6)	POOR (5-0)
1. Epifaunal Substrate	Preferred benthic substrate abundant throughout stream site and at stage to allow full colonization (i.e., log/snags that are not new fall and not transient)	Substrate common but not prevalent or well suited for full colonization potential	Substrate frequently disturbed or removed	Substrate unstable or lacking
2. Instream Cover	> 50% mix of snags, submerged logs, undercut banks or other stable habitat; rubble, gravel may be present	30-50% mix of stable habitat; adequate habitat for maintenance of populations	10-30% mix of stable habitat; habitat availability less than desirable	Less than 10% stable habitat; lack of habitat obvious
3. Pool Substrate Characterization	Mixture of substrate materials, with gravel and firm sand prevalent; root mats and submerged vegetation common	Mixture of soft sand, mud, or clay; mud may be dominant; some root mats and submerged vegetation present	All mud or clay or sand bottom; little or no root mat; no submerged vegetation	Hard-pan clay or bedrock; no root mat or vegetation
4. Pool Variability	Even mix of large-shallow, large-deep, small-shallow, small-deep pools present	Majority of pools large-deep; very few shallow	Shallow pools much more prevalent than deep pools	Majority of pools small-shallow or pools absent
5. Sediment Deposition	Less than 20% of bottom affected; minor accumulation of fine and coarse material at snags and submerged vegetation; little or no enlargement of island or point bars	20-50% affected; moderate accumulation; substantial sediment movement only during major storm event; some new increase in bar formation	50-80% affected; major deposition; pools shallow, heavily silted; embankments may be present on both banks; frequent and substantial movement during storm events	Channelized; mud, silt, and/or sand in braided or non-braided channels; pools almost absent due to substantial sediment deposition
6. Channel Flow Status	Water reaches base of both lower banks and minimal amount of channel substrate is exposed	Water fills >75% of the available channel; or <25% of channel substrate exposed	Water fills 25-75% of the available channel and/or riffle substrates are mostly exposed	Very little water in channel and mostly present as standing pools
7. Channel Alteration	No channelization or dredging present	Some channelization present, usually in areas of bridge abutments; evidence of past channelization (>20 yr) may be present, but not recent	New embankments present on both banks; and 40-80% of stream reach channelized and disrupted	Banks shored with gabion or cement; >80% of the reach channelized and disrupted