

DELAWARE RIVER BASIN COMMISSION

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Kristen Bowman Kavanagh

Executive Director

REQUEST FOR PROPOSALS (RFP)

Analytical Support for Biological Monitoring

INFORMATION AND INSTRUCTIONS

1. GENERAL INFORMATION

As part of a long-term biological monitoring program, the Delaware River Basin Commission (“Commission” or “DRBC”) collects samples of benthic macroinvertebrates and periphyton from the non-tidal Delaware River. Annual or biennial macroinvertebrate, periphyton, and habitat surveys of accessible river sites, targeting the richest habitats (riffles, runs, island margins), have been used to create a reference baseline of the existing biological community to quantify ecological integrity for the entire 200-mile non-tidal river. The purpose of the ongoing biomonitoring program is to assess the biological quality of the Delaware River relative to the reference baseline. The Commission also periodically requires analysis of macroinvertebrate and periphyton samples from basin waters for purposes other than the biological monitoring program.

In support of the Commission’s biological monitoring program and other projects, the Commission is seeking a qualified contractor (“Contractor”) to conduct taxonomic identification of benthic macroinvertebrates and periphyton samples collected from basin waters by DRBC. The agreement between DRBC and Contractor will be for an initial period two years, and the Commission will have an option to renew the agreement for three (3) additional two-year periods, contingent upon satisfactory Contractor performance and approval by DRBC of revised analytical cost estimates and Contractor staffing changes.

Any changes to this RFP will be in the form of an addendum, which will be posted on the Commission’s website, www.drbc.gov.

The DRBC reserves the right to reject any or all submittals and to be the sole judge of each submittal’s merits. The selected firm will be chosen based on proposals received in response to this RFP, including any amendments to this RFP.

Questions regarding this RFP should be directed in writing to Jake Bransky, Senior Aquatic Biologist, at jacob.bransky@drbc.gov. Questions will be accepted until 4:00 p.m. Eastern Time, on Friday, April 10, 2026. Q&A will be posted on www.drbc.gov by Friday, April 17, 2026.

2. PROJECT OBJECTIVES

Historically, DRBC has sampled benthic macroinvertebrates and periphyton in the non-tidal Delaware River on a biennial basis, or approximately every other year, to assess the river's biological quality.¹ These samples must be processed and analyzed using the DRBC sorting and identification methods described below and in the Delaware River Biomonitoring Quality Assurance Project Plan (2025) ("Biomonitoring QAPP"), attached hereto as Appendix A. The Commission periodically requires processing and analytical services for other biomonitoring initiatives, for which sorting and identification methods may differ from those set forth in the Biomonitoring QAPP, but such differences are expected to be minor.

The Commission seeks a two-year agreement with an option to renew the agreement as many as three times (3), contingent upon satisfactory Contractor performance and approval by DRBC of revised analytical cost estimates and Contractor staffing changes.

The Commission's needs during the initial two-year agreement will include (but are not necessarily limited to) the analysis of twenty-six (26) samples collected by DRBC during the period 2021-2022 and an additional approximately twenty-six (26) samples to be collected by during the summer of 2026.² Both sets of samples are part of the biennial biological monitoring program. For each sample set, the Commission requires processing and analysis to be completed within six months of delivery of the samples to the Contractor.

Analysis and processing of samples will be conducted as follows:

(A) Macroinvertebrates

- The Commission will provide Contractor with Nalgene or HDPE sampling containers in which the contents of three large kick samples (12 square feet total) have been deposited and preserved in >70% ethanol.
- The Contractor shall count and classify the organisms in an unbiased, representative subsample of each composite sample and sort each subsample to achieve enumeration of 500 organisms (minimum), according to the Biomonitoring QAPP. Sorting debris shall be preserved separately from the remainder of the sample, placed in a container labeled inside and out, and returned to DRBC under chain-of-custody procedures.
- The Contractor shall attain at least the level of taxonomic resolution specified in the Biomonitoring QAPP. Only those organisms with a complete head and thorax, or complete thorax and abdomen, shall be identified. A standardized level of taxonomy is desired for all samples, though for some taxa this goal may not be reasonably achievable. These circumstances shall be noted by the Contractor in a comments portion of the data files as described in the Electronic Data Deliverable File Structure (attached hereto as Appendix B).
- The Contractor shall create a reference collection from the sample sets, updated and provided to the Commission after each new (biennial) set of samples. The reference collection and database shall consist of vial-preserved macroinvertebrate taxa or slides,

¹ Because sampling for the biological monitoring program is not performed in consecutive years, but rather biennially, each sampling period is deemed to encompass two years and is labeled accordingly. For example, "the 2026-2027 sampling period."

² Although a sampling year generally consists of twenty-six (26) samples, that number may vary depending on sampling conditions.

with an index to the taxa contained within the Electronic Data Deliverable, as described in Appendix B. The reference collection index shall also include links to digital photographs of the organisms. The index shall include fields to highlight taxa that are noteworthy with regard to distributional records/state records and possible new and/or rarely encountered taxa. The Contractor shall provide literature references noting the distributional records and/or frequency of occurrence for all taxa considered rare or range expanding.

(B) Periphyton

- The Commission will provide Contractor with algal samples preserved with formalin or Lugol's iodine in 500 mL amber bottles.
- Contractor shall analyze each periphyton sample as described in the Biomonitoring QAPP or with equivalent methods. The following components shall be analyzed:
 - Taxonomic identification of diatoms and soft algae (preserved in formalin or Lugol's iodine) conducted at the species level for diatoms and genus or species level for soft algae (lowest taxonomic unit possible). A standardized level of taxonomy is desired for all samples, though for some taxa this goal may not be reasonably achievable. These circumstances shall be noted in a comments portion of the data files as described in Appendix B.
 - Benthic chlorophyll and ash free dry mass (AFDM) taken from a rock scrape (filtered and frozen in field); and
 - Water column chlorophyll a (filtered and frozen in field).

(C) Data entry and quality control

- All samples will be provided to the Contractor by DRBC under chain-of-custody procedures.
- The Contractor shall track the samples to ensure that samples are not lost or mislabeled.
- The Contractor shall inspect all samples upon receipt, record the condition of each sample, and communicate the receipt and findings to the Commission's project manager within one week of sample receipt. If the Contractor assigns sample identification numbers that differ from those assigned by DRBC, the Contractor shall provide an index table of equivalent identification numbers together with the receiving log report provided to DRBC within one week of sample receipt.
- The Contractor shall provide data in a Microsoft Excel workbook or Microsoft Access database constructed in a one-record-per-row format as described in Appendix B.

(D) Deliverables

- Receiving log report (within one week of sample receipt).
- Monthly progress report (by e-mail to DRBC project manager), including the number of samples sorted/identified/entered into the database as well as the number of samples remaining.

- The final deliverable should include all data files (including the macroinvertebrate reference collection index), bench sheets, laboratory notes, digital photographs, mounted slides and individually preserved specimens (including those in the macroinvertebrate reference collection) comprising the results of each processed sample, as well as all remaining sorted, processed and detrital sample materials. All materials must be clearly labeled, preserved separately and not recombined when shipped back to DRBC.
- The Contractor shall complete sample sorting, enumeration, identification, and data entry in an expeditious manner such that 100% of the samples for each two-year sampling period are completed within six (6) months of the date the Contractor receives them.

3. SUBMITTAL REQUIREMENTS / PROPOSAL CONTENTS

Proposals must adhere to the format and content prescribed by this RFP. Interested firms must include the following within the proposal:

- General Description of the Proposed Approach. Provide a narrative of the proposed process and approach to the analytical services to be provided.
- Staffing Plan, Including Resumes. Identify and provide a resume for each key staff member who will work on the project, and identify their role.
- Multiple Contractors; Use of Subcontractors. The Commission reserves the right to select different contractors to perform subsets of the requested analyses, although this is not preferred. Alternatively, the selected contractor may if necessary subcontract with other entities for analyses that the selected contractor does not routinely conduct (preferred); provided, however, that the need for a subcontractor, and the identity and credentials of the potential subcontractor must be disclosed in the proposal. DRBC must approve the selection of any subcontractor.
- Point of Contact. The proposal must include the name and contact information for the bidding firm's point of contact.
- References. Please supply names and current contact information for three references for similar projects performed by the bidding firm.

Failure to adhere to these requirements, or the inclusion of conditions, limitations, or misrepresentations in the submittal, may be cause for rejection.

4. SUBMITTAL INSTRUCTIONS

Technical Proposal. Interested bidders are instructed to email an electronic (PDF) file of their technical proposal, consisting of the elements outlined in Section 3 above and *excluding the cost estimate*, to: DRBC.Proposals@drbc.gov. **All technical proposals must be transmitted via email.**

Cost Proposal. Cost proposals for the initial contract term shall be provided in the Analytical Services Bid Form included as Appendix C.

Cost proposals must be submitted in hard copy only. Interested bidders are instructed to mail or hand deliver one hard copy of the cost proposal in a sealed envelope clearly marked “Cost Proposal” to:

Elba L. Deck, Director of Finance and Administration
Delaware River Basin Commission
25 Cosey Road
P.O. Box 7360
West Trenton, NJ 08628-0360

Technical proposals (digital files) and sealed cost proposals (in hard copy only) must be received no later than 4:00 p.m. Eastern Time, on Thursday, April 30, 2026. Proposals received after this time will not be considered. The Commission reserves the right to reject any submittals for any reason, including for a bidder’s failure to adhere to these submittal instructions.

The Commission’s standard contract is available for review at https://www.nj.gov/drbc/library/documents/DRBC_StandardContract.pdf. If the bidder cannot execute the standard contract in its current form, the bidder must describe the exceptions in the proposal.

The Commission shall not be liable for any costs associated with the development, preparation, transmittal, or presentation of any proposal or material submitted in response to this RFP.

5. PROPOSAL SELECTION AND AWARD PROCESS

Proposals that conform to the submission requirements will be evaluated by a committee comprised of Commission staff members knowledgeable about the service(s) and/or product(s) that are the subjects of this RFP. Except in response to a request on behalf of the evaluation committee as a whole, members of the committee may not speak with bidder representatives regarding pending proposals between the time of submission and the Commission’s selection of a bidder.

Accepted proposals will be reviewed by the evaluation committee and scored against the criteria outlined below. The committee may contact references and may request additional information or interviews with or presentations by the bidder (on-site or virtual). The resulting information will be used to score the proposals. The evaluation committee’s scoring will be tabulated, and proposals ranked based on the numerical scores received. The proposals will be scored using the following criteria:

Description	Points
General Description of the Proposed Approach	25
Analytical Capabilities	25
Staffing Plan	15
Cost Estimate	25
References	10
Total	100

APPENDIX A
DRBC BIOMONITORING QAPP



DELAWARE RIVER BIOMONITORING PROGRAM

Quality Assurance Project Plan

07/23/2025

07/23/2025 to 07/22/2030

Version 2025.1

Managing, Protecting and Improving
the Water Resources of the
Delaware River Basin since 1961



APPROVAL PAGE

Jake Bransky
DRBC Project Manager:



08-05-2025

Signature

Date

Namsoo Suk, Ph.D.
DRBC Quality Assurance Manager:



07-23-2025

Signature

Date

Doug Haltmeier
NJDOH Program Manager Inorganic Lab



08-04-2025

Signature

Date

Hannah Sanders
USEPA Project Officer

Signature

Date

USEPA-R3 ASQAB Officer

Signature

Date

TABLE OF CONTENTS

Approval Page	i
Table of Contents	iii
Document Control	v
1. Project Management and Information/Data Quality Objectives	8
1.1 Project Purpose, Problem Definition, and Background	8
1.1.1 Project Purpose and Problem Definition	8
1.1.2 Project Background.....	8
1.2 Project Task Description	9
1.3 Information/Data Quality Objectives and Performance/Acceptance Criteria	12
1.3.1 Precision.....	12
1.3.2 Accuracy.....	13
1.3.3 Representativeness.....	13
1.3.4 Comparability.....	13
1.3.5 Completeness.....	13
1.3.6 Sensitivity	14
1.4 Distribution List	14
1.5 Project Organization	15
1.6 Project QAM Independence	16
1.7 Project Organizational Chart and Communications	16
1.8 Personnel Training/Certification	17
1.9 Documents and Records	17
2. Implementing Environmental Information Operations	18
2.1 Identification of Project Environmental Information Operations	18
2.2 Methods for Environmental Information Acquisition	19

2.2.1	Field Activities Environmental Measurements	19
2.2.1.1	Macroinvertebrates	19
2.2.1.2	DRBC Standard Operating Procedure – Periphyton	21
2.2.1.3	Quantitative Instream Habitat.....	22
2.2.1.4	Water Quality: Physical.....	23
2.2.1.5	Qualitative Habitat Assessment: Rapid Bioassessment Protocol	24
2.2.1.6	Location Information	25
2.2.2	Laboratory Analyses.....	25
2.2.3	Laboratory Custody Procedures	29
2.2.4	Existing Information.....	29
2.2.5	Environmental Technology	29
2.3	Integrity of Environmental Information.....	29
2.3.1	Sample ID and Labeling.....	29
2.3.2	Chain of Custody Documentation.....	30
2.3.3	Sample Preservation, Holding, and Transportation	30
2.4	Quality Control	30
2.5	Instruments/Equipment Calibration, Testing, Inspection, and Maintenance	31
2.5.1	Instrument / Equipment Calibration and Frequency.....	32
2.6	Inspection/Acceptance of Supplies and Services	33
2.7	Environmental Information Management	33
3.	Assessment, Response Actions, and Oversight	33
3.1	Assessments and Response Actions	33
3.1.1	Incoming Samples	34
3.1.2	Sample Holding Times.....	34
3.1.3	Detection Limits.....	34
3.1.4	Method QC.....	34
3.2	Oversight and Reports to Management.....	35

4. Environmental Information Review and Usability Determination.....35

4.1 Environmental Information Review 35

4.2 Usability Determination..... 36

REFERENCES..... 39

Appendix A42

Appendix B43

DOCUMENT CONTROL

Document Title	Version #	Version Date	# of Pages
Delaware River Biomonitoring Program	2025.1	2025/07/23	43

List of Abbreviations and Acronyms

AFDM	Ash-Free Dry Mass, a biomass measurement
ANSP	Academy of Natural Sciences of Drexel University
ARGIS	Academic Research & Grants Information System
B-IBI	Benthic Index of Biotic Integrity
BFN	Big-River Frame Net
CE	Cole Ecological, Inc.
CFS	Cubic Feet per Second
CHLA	Chlorophyll-a
D50	Median particle size (Diameter, 50th percentile of a particle size distribution)
dd	Decimal Degrees
DO	Dissolved Oxygen
DO%	Dissolved Oxygen Percent Saturation
DEWA	Delaware Water Gap
DNREC	Delaware Department of Natural Resources and Environmental Conservation
DQO	Data Quality Objective
DRBC	Delaware River Basin Commission
DRBP	DRBC Delaware River Biomonitoring Program
DWGNRA	Delaware Water Gap National Recreation Area
EMAP	U.S. EPA's Environmental Monitoring and Assessment Program
EWQ	Existing Water Quality: baseline water quality data from defined time period
ft/sec	Feet per Second, a water velocity measurement
GPS	Global Positioning System
HDPE	High-Density Polyethylene
IDL	Instrument Detection Level
ITIS	Integrated Taxonomic Information System
LDEL	Lower Delaware (Delaware River mile 134.3 at Trenton to mile 209.5 at Portland)
MDL	Method Detection Level
mg/l	Milligrams per Liter, a unit of concentration
N+N	Nitrate plus Nitrite
NAD	North American Datum
NAWQA	USGS's National Water Quality Assessment
NJDEP	New Jersey Department of Environmental Protection
NJDOH	New Jersey Department of Health (ECLS – Environmental Chemistry & Laboratory Services)
NTU	Nephelometric Turbidity Units
NYSDEC	New York State Department of Environmental Conservation
ORD	U.S. EPA's Office of Research and Development
OTU	Operational Taxonomic Unit
PADEP	Pennsylvania Department of Environmental Protection
PAR	Photosynthetically Active Radiation
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
RBP	Rapid Bioassessment Protocol
RPD	Relative Percent Difference
RTH	Richest Targeted Habitat
SQL	Structured Query Language

SPW	Special Protection Waters
SRMP	Scenic Rivers Monitoring Program
SpC	Specific Conductance
TKN	Total Kjeldahl Nitrogen
TN	Total Nitrogen
TP	Total Phosphorus
UDSRR	Upper Delaware Scenic and Recreational River
µg/m ²	Micrograms per square meter, a measure of biomass per area
µg/m ³	Micrograms per cubic meter, a measure of biomass per volume
µmho/cm	Micro-mhos per centimeter, a unit of specific conductance (also µS/cm – micro-Siemens/cm)
UPDE	Upper Delaware
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WAA	Watershed Assessment Associates, LLC.
WQAC	DRBC's Water Quality Advisory Committee
WQN	Water Quality Network: PADEP's long-term fixed water quality stations
WQX	EPA's Water Quality Exchange

1. PROJECT MANAGEMENT AND INFORMATION/DATA QUALITY OBJECTIVES

1.1 PROJECT PURPOSE, PROBLEM DEFINITION, AND BACKGROUND

1.1.1 Project Purpose and Problem Definition

The purpose of this program is to assess the biological quality of the Delaware River as part of DRBC water quality regulations and consistent with the goals of the Wild and Scenic designation as directed by Congress. These data are used to assess the biological condition of Delaware River segments, and also as baseline metrics for maintenance of Existing Water Quality (EWQ) in DRBC antidegradation policies. This entire 200-mile reach of the Delaware River is designated by DRBC as Special Protection Waters (SPW), where there is a policy of “no degradation to Existing Water Quality.” There are few pre-2001 historical and comparable data available for long-term assessments or trend analyses. Due to this lack of historical existing data, data quality standards in this QAPP are intended to validate each season’s collected data, and to provide sufficient biological data to complete DRBC’s 305b assessment every two years. Because of the assessment methods used, within a narrow range of site conditions mandated by monitoring a water body of this size, it is questionable whether or not it is possible to develop a true multi-metric index. Only the best-performing sites within the river are used to define the reference conditions for comparison. We are still in the process of establishing a biological condition gradient for our IBI; comparing Delaware River conditions to other rivers of similar size and geology; and determining the applicability of our IBI in larger tributaries to the Delaware River from 4th to 8th stream order. USEPA-ORD continues to assist DRBC to determine the most useful model for future assessment of biological conditions in the Delaware River, and especially in determining what conditions constitute “reference” or “impaired” conditions.

1.1.2 Project Background

The Delaware River Biomonitoring Program (DRBP) is responsible for biomonitoring and biocriteria development for the non-tidal portion of the Delaware River. Along with selected chemistry data, aquatic assemblages are monitored in order to assess biological condition in the Delaware River.

This project plan defines the habitat, benthic macroinvertebrate and periphyton components of DRBC’s biological monitoring program. Additional types of biological monitoring are occasionally conducted as resources allow, including fish, Unionid mussels, plankton, submerged aquatic vegetation, and riparian condition. These activities, in addition to physical and chemical data gathering, provide a well-rounded view of water quality conditions in the Delaware River, and provide sufficient data for management decisions. This project targets the main stem non-tidal Delaware River and selected large tributaries for biocriteria development and biological assessment.

Annual or biennial macroinvertebrate, periphyton, and habitat surveys of accessible river sites, targeting the richest habitats (riffles, runs, island margins), have been used to create a reference baseline of the existing biological community to quantify ecological integrity for the entire 200-mile non-tidal river. Biological criteria were drafted in 2009 (Silldorff and Limbeck, 2009). Since then, a macroinvertebrate benthic index of biotic integrity (B-IBI) has been used to assess biological condition for the non-tidal portion of the Delaware River. In 2010, additional samples were collected from known reference and stressed locations on large tributaries to define the ability of the B-IBI to detect impairment and to establish a biological condition gradient.

A DRBC pilot study in 2005 for a periphyton monitoring network (DRBC 2006) found that eutrophication due to high nutrient concentrations may be problematic in the lower non-tidal portion of the Delaware River (between the Lehigh River confluence and Trenton). DRBC conducts annual or biennial periphyton community monitoring in richest targeted habitat for the purpose of biocriteria development related to general ecological health of the river, and specifically to detection of impacts due to excessive nutrients and eutrophication. After sufficient data have been collected, algal biological criteria for the non-tidal portion of the Delaware River will be proposed for use in 305B assessments.

1.2 PROJECT TASK DESCRIPTION

This program requires a biennial or an annual survey of benthic macroinvertebrates, periphyton and habitat at selected locations along the 200-mile length of the non-tidal Delaware River (Figure 1). After a sufficient multi-year collection period, the data are used to create, improve and employ biological criteria for use with the Delaware River Basin Commission Water Quality Regulations. All samples collected within a rolling five-year window are used to assess biological condition in DRBC's Water Quality Assessment Report.

Macroinvertebrates are collected from Richest Targeted Habitat (RTH) using the Big River Frame Net (BFN) at each of 25 Delaware River sites and occasionally from large tributary sites. Pebble counts, velocity measurements, qualitative RBP habitat assessments and instantaneous water quality samples are collected to characterize habitat and water quality at the time of sampling. Collection occurs during the August to September index period unless conditions are unsafe (Table 1). All data collection is done by DRBC and partner agency staff trained in these protocols. Macroinvertebrate taxonomy is completed by trained contract laboratory staff.

Periphyton samples are collected using the top-rock scrape method from 9 cobbles selected within RTH parallel to ~50m macroinvertebrate transects. Ancillary measurements include: canopy cover; ambient nutrient concentrations (Nitrate+Nitrite, Total Kjeldahl Nitrogen, Total Nitrogen, Total Phosphorus); benthic Chlorophyll-a; benthic Ash-Free Dry Mass (AFDM); water column Chlorophyll-a; area scraped from each cobble; depth/velocity profiles of the sampling areas; and surface/bottom PAR measurements.

Habitat methods are being investigated relative to applicability in free-flowing large rivers. For Delaware River assessment, DRBC has primarily used the RBP habitat method for wadeable streams. Many RBP habitat parameters seem unsuitable for rivers as large as the Delaware, and there seem to be few relationships between habitat parameters and biological metrics. For this reason, DRBC also assesses habitat conditions using and comparing a variety of methods: the RBP

high gradient habitat protocol (Barbour et. al 1999); the EMAP Great Rivers field protocol (Angradi et. al 2004); EMAP habitat protocols for non-wadeable rivers and streams (Lazorchak et. al 2000); and the Qualitative Habitat Evaluation Index (Ohio EPA, Rankin 1989). The RBP presently remains DRBC's primary habitat evaluation method, but eventually DRBC expects to adopt other methods more suitable to rivers similar to the Delaware. At the transect level, the Pebble Count (Wolman 1954; Bunte & Abt 2001) is employed to characterize the substrate particle size distribution that was sampled. Median particle size and particle size <2 mm (sands and smaller) are important indicators that relate to macroinvertebrate community metrics. Additionally, we may find shifts in particle size distributions that are indicative of sediment deposition or erosion at each site over time.

Data produced during this survey are compiled in standardized Access or Excel databases and structured for import to the R statistical program. Metrics are calculated using R, Excel formulae, SQL scripts, or web applications. Statistics are analyzed using Analyse-It, a Microsoft Excel add-on program, or the R open-source statistical language. Data are stored at DRBC for organizational use, and are planned for upload onto EPA's WQX national database for public usage.

All study participants must read this QAPP prior to sampling. All participants are trained in the study methods as appropriate to their role. The QA officer must be present for at least 10% (n=3) of samples collected during this survey and will produce a memo of program assessment findings. To ensure that samples are similar, quantitative measurements are taken to numerically characterize: substrate (must be near gravel/cobble median particle size of about 40 to 90 mm); depth (0.5 to 2.5 feet); and flow (1 to 3 ft/sec) at sampling points to validate samples and rule out the subjectivity of site selection. Samples proven to be dissimilar must undergo further validation prior to their inclusion into the criteria data set.

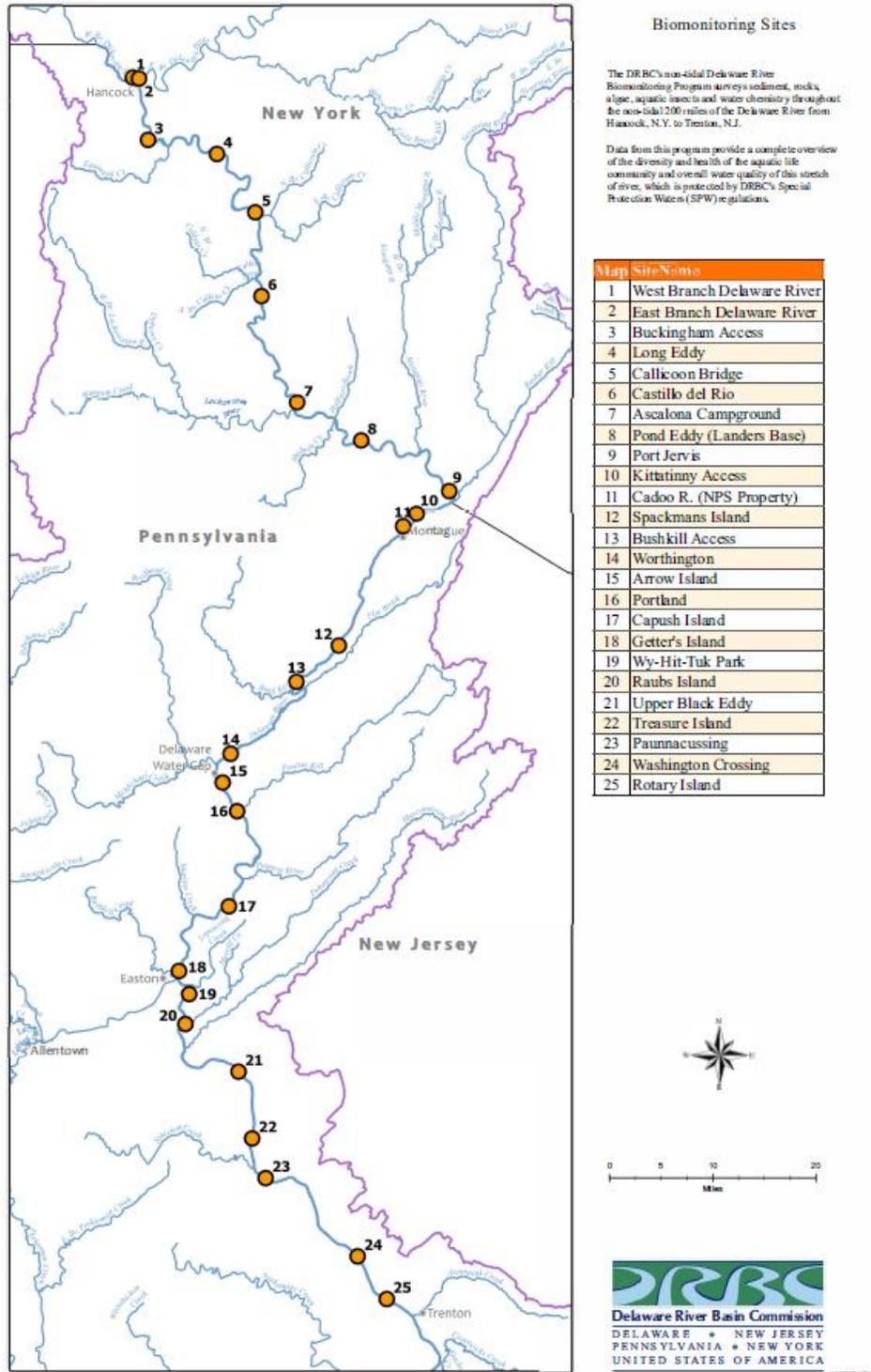


Figure 1. Biomonitoring sites

Table 1. Timeframe for goals

Task or Milestone	Timeframe
Sampling	August through September
Calculation of IBI scores	By December the year following the conclusion of the monitoring period

1.3 INFORMATION/DATA QUALITY OBJECTIVES AND PERFORMANCE/ACCEPTANCE CRITERIA

The purpose of this program is to assess the biological quality of the Delaware River as part of DRBC water quality regulations and consistent with the goals of the Wild and Scenic designation as directed by Congress. This section will discuss information, data quality objectives, and performance/acceptance criteria. Specific acceptance criteria can be found in sections 2 and 4.

1.3.1 Precision

Precision is the measure of the degree to which two or more measurements agree. Precision is assessed through the collection and measurement of lab replicates. Relative Percent Difference (RPD) shall be calculated for each of the replicates collected for all the parameters analyzed. For example, precision in the laboratory is assessed through the calculation of RPD for matrix spikes (MS) or as in the case of methods 1668A for PCBs and 1613 for Dioxins/Furans through assessment of a spiked labeled toxics window-defining stock solution (isotopic dilution). See methods for more details. Calculation of the RPD for the MS shall be performed by the Laboratory for all the MS performed.

RPD is calculated using the equation shown below.

$$RPD = \frac{(S - D)}{(0.5 (S + D))} \times 100$$

Where:

S = Amount in Spike 1 **or** concentration of parameter in original

D = Amount in Spike 2 **or** concentration of parameter in replicate

Field duplicates will be collected once per sample year (1 duplicate/25 samples/matrix).

1.3.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. The accuracy of water quality parameter measurements can be determined by comparing the measured value of a standard against the known value of the standard. The DRBC participates in annual proficiency tests for water quality testing as part of lab certification. Accuracy in the field is assessed using rinsate (field) and field blanks and through adherence to all sample handling, preservation, and holding times. The field accuracy objective is to have no quantifiable concentrations of any of the analytical parameters in either the rinsate or the field blanks and to adhere to all sample handling, preservation, and holding times. Laboratory accuracy and matrix interference are assessed through the analysis of matrix spikes and the determination of percent recoveries.

Field blanks will be collected once per sample year (1 duplicate/25 samples/matrix).

1.3.3 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the sampling and analysis plan is followed and that proper sampling techniques are used. Representativeness in the laboratory is ensured by using the proper analytical procedure, meeting sample holding times, and analyzing and assessing control and field samples.

1.3.4 Comparability

Comparability is an expression of the confidence with which one data set can be compared with another. Comparability is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the field sampling plan is followed and that proper sampling techniques are used. Planned analytical data will be comparable when similar sampling and analytical methods are used and documented in the QAPP. Comparability is also dependent on similar QA objectives.

1.3.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data that was expected to be obtained under normal conditions. Field completeness is a measure of the number of valid measurements obtained from all the measurements taken in the field. Samples broken after collection and before their transfer to the analytical lab will be re-sampled by the DRBC. Laboratory completeness is a measure of the number of valid measurements obtained from all the measurements taken in the project.

Completeness is the ratio of the number of sample results to the total number of samples analyzed within a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$\text{Completeness} = \frac{V}{P} \times 100$$

Where:

V = Number of valid measurements

P = Number of planned measurements

The completeness goal for this project is 95%. If this goal is not met, a note will be made in the final report package.

1.3.6 Sensitivity

Sensitivity ensures that the data collected meets the required standards and accurately reflects any changes or variations in the parameters being measured. Sensitivity is a measure of the capability of a lab or field method used to detect an analyte, commonly known as the detection limit. For field data, the sensitivity of the instrument, information usually provided by the instrument manufacturer, is described by its range, accuracy, and resolution. For laboratory instrumentation, the method detection limit (MDL) is typically used to describe sensitivity. The reporting limit (RL) is typically a little higher than the MDL and may also be used. Sensitivity plays a crucial role in guaranteeing the reliability of and accuracy of the data collected and needs to be considered to ensure that the instruments and methods are capable of providing data that meet the intended quality standards. For this project, all analytical method MDLs and RLs meet the data quality objectives.

1.4 DISTRIBUTION LIST

Signed copies of this Quality Assurance Project Plan (QAPP) and all subsequent revisions will be sent to individuals listed in Table 2 by electronic mail.

Table 2. Distribution List.

Individual	Organization
Kelly Somers	USEPA, Region III
Quality Assurance Delegated Approving Official	USEPA, Region III
Jake Bransky	Delaware River Basin Commission
Namsoo Suk, Ph.D	Delaware River Basin Commission
John Yagecic, P.E.	Delaware River Basin Commission
Relevant DRBC Field Crew	Delaware River Basin Commission
Doug Haltmeier	New Jersey Department of Health Laboratory

1.5 PROJECT ORGANIZATION

Table 3 briefly describes the duties and responsibilities of the members of the Project Team, which consists of all personnel and contracted personnel actively involved in the development, coordination, and completion of this project.

Table 3. Roles and Responsibilities of Key Project Individuals.

Key Individual	Title	Contact	Responsibility
Jake Bransky	DRBC Project Operations Manager	609 477 7230 jacob.bransky@drbc.gov	Provide project coordination, including quality assurance project plan, scheduling of project tasks to ensure timely completion, coordination and oversight of sampling, review of the data to determine compliance with QA/QC requirements and the overall quality of the data, and preparation of a final report. Ensures that response actions are implemented during sampling operations if needed.
Doug Haltmeier	NJDOH Program Manager of Inorganic Testing	609 530 8409 Douglas.Haltmeier@doh.nj.gov	Ensure that sample container preparation and analysis of samples for the project plan are coordinated with the DRBC and that contractual obligations are met in a timely fashion. Schedule staff and allocate laboratory time to prepare and analyze samples within required holding time; ensure that all analytical quality assurance/quality control requirements are met; prepare analytical data package including precision and accuracy data; serve as quality assurance coordinator for laboratory activities; ensure that response actions are implemented, if needed; and transmit analytical results to DRBC in a timely manner.

<p>Namsoo Suk, Ph.D.</p>	<p>DRBC Quality Assurance Manager</p>	<p>609 477 7235 namsoo.suk@drbc.gov</p>	<p>Ensure that the overall quality assurance of the project is achieved; Serves as quality assurance coordinator for field activities; Ensures that samples are collected in accordance with procedures specified in the project plan. Annually review the QAPP to determine if major changes are made and coordinate the review of those changes with USEPA Region 3. Maintain the official version of the QAPP and send to staff on the distribution list.</p>
<p>John Yagecic, P.E.</p>	<p>DRBC Monitoring Supervisor</p>	<p>609 883 9500 john.yagecic@drbc.gov</p>	<p>Provide monitoring supervision; coordination with DRBC modeling section.</p>
<p>Kelly Somers</p>	<p>USEPA Project Officer</p>	<p>215-814-2719 somers.kelly@epa.gov</p>	<p>Coordination with USEPA.</p>

1.6 PROJECT QAM INDEPENDENCE

The project Quality Assurance Manager (QAM), as stated in DRBCs Quality Management Plan (QMP) has organizational independence from environmental information-generating operations. This independence is ensured by the QAM having an oversight role and not participating in environmental information-generating operations.

1.7 PROJECT ORGANIZATIONAL CHART AND COMMUNICATIONS

The individuals and organizations participating in the project and their lines of communication are shown in Figure 2. The DRBC Project Operations Manager will communicate directly with and participate in the field crew. The POM will also be the point of contact at DRBC for all analytical work done by NJDOH-ECLS.

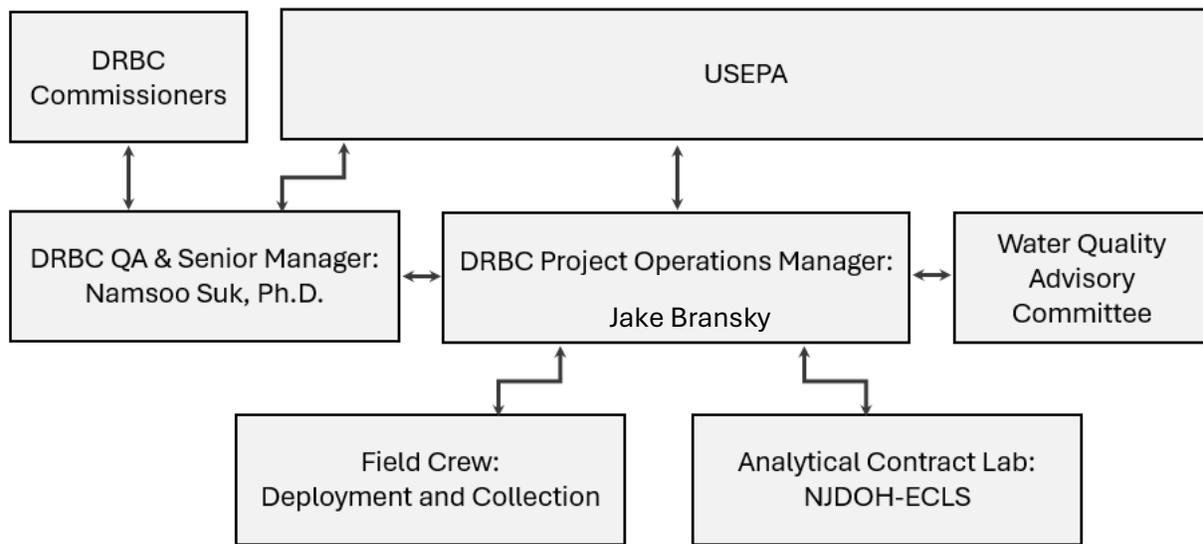


Figure 2. Lines of responsibility.

1.8 PERSONNEL TRAINING/CERTIFICATION

Sampling is performed by personnel trained in the various sample elements of this study. Only those individuals trained in EPA’s Rapid Bioassessment (Barbour et al. 1999) sampling and habitat assessment techniques, and familiar with the BFN will collect macroinvertebrate samples. Other personnel who are trained in gathering periphyton samples, flow measurements, conducting Wolman Pebble Counts, and making habitat assessments will perform those duties. Any participants unfamiliar with methods are instructed prior to sample collection. Jake Bransky, who is experienced with DRBCs macroinvertebrate sampling methodologies, will provide training to any necessary participants.

All participants are trained in canoe/ small vessel safety if they do not already possess such knowledge. Participants also have read and understood the DRBC “Field Safety Manual”.

Macroinvertebrate and periphyton taxonomy is conducted by trained taxonomists on the DRBC staff or contract laboratories. Macroinvertebrates are identified and catalogued using ITIS and other taxonomic standards. A sub-set of samples (10%) is sent to an outside contractor as part of the Quality Control requirements for the project. All QA/QC analyses are conducted by staff trained in taxonomy and sorting.

1.9 DOCUMENTS AND RECORDS

The Project Manager will be responsible for maintaining all documents and records associated with this project. Documents and records associated with this project will be kept and maintained in the project file at the Delaware River Basin Commission (DRBC) offices in West Trenton, New Jersey. Records will be

maintained for a minimum of 5 years after completion of sampling and analysis. Electronic data specific to this program are stored on digital media both on-site and off-site. The standard data reporting format is the bench sheet found in Appendix B. Both the DRBC staff and Contract lab record data on these sheets prior to entry by DRBC staff into our Access database.

2. IMPLEMENTING ENVIRONMENTAL INFORMATION OPERATIONS

The elements in this section address all aspects of data generation and acquisition to ensure that appropriate methods for sampling, measurement, analysis, data collection or generation, data handling, and QC activities are employed and documented.

2.1 IDENTIFICATION OF PROJECT ENVIRONMENTAL INFORMATION OPERATIONS

Macroinvertebrate and periphyton samples are collected at twenty-five stations along the main stem, non-tidal Delaware River, its East and West Branches, and occasionally at sites located on large tributaries to the Delaware (Table 4). The stations are distributed longitudinally over the entire 200 miles of non-tidal Delaware River with segmentation (approximately every 8 miles) as evenly as the geology and hydrology allow. All samples are collected during the August–September critical low flow index period. Table 4 shows the schedule of all tasks that are part of the biomonitoring program.

Table 4. Site list.

Site	Lat	Lon	Samples
Rotary Island	40.23879	-74.81975	1
Washington Crossing	40.29986	-74.87225	1
Bulls Island	40.40973	-75.04121	1
Rush Island	40.4651	-75.06546	1
Upper Black Eddy	40.55862	-75.09077	1
Raub's Island	40.6249	-75.18875	1
Wy-Hit-Tuk Access	40.66851	-75.1819	1
Getters Island	40.69793	-75.20152	1
Capush Island	40.7905	-75.10862	1
Portland	40.92401	-75.09401	1
Arrow Island	40.96455	-75.12012	1
Worthington State Forest	41.00391	-75.10673	1
Bushkill Access	41.10674	-74.98377	1
Spackmans Island	41.15604	-74.90539	1
Spackmans Island	41.15657	-74.90509	1

Caddoo Road	41.32344	-74.78604	1
Kittatinny Access	41.34251	-74.75838	1
Port Jervis	41.3734	-74.69861	1
Pond Eddy	41.44524	-74.86236	1
Ascalona Campground	41.49829	-74.9819	1
Castillo Del Rio	41.64771	-75.04889	1
Callicoon Bridge	41.76505	-75.06181	1
Long Eddy	41.84674	-75.13332	1
Buckingham	41.86591	-75.26279	1
East Branch Delaware	41.95175	-75.28104	1
West Branch Delaware	41.95332	-75.29198	1

Containers for each site: 1L widemouth plastic jars for macroinvertebrates, 500ml amber bottles for Chl-a and periphyton

Table 5. Standard schedule for the Delaware River Biomonitoring Program.

Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
QAPP Update												
EPA QAPP Approval												
Sample Collection												
Taxonomy												
Data Analysis												
Reporting												

2.2 METHODS FOR ENVIRONMENTAL INFORMATION ACQUISITION

2.2.1 Field Activities Environmental Measurements

2.2.1.1 Macroinvertebrates

Macroinvertebrate sample collection is a modified RBP format. Samples are collected using a Big River Frame Net (BFN) with a substrate frame. The net was designed in 2001 by DRBC and Wildco, Inc. The net is 3 feet wide by 2 feet high with tapered 595µm mesh top and canvas bottom, closely resembling a Slack sampler. A 2 foot wide by 2 foot long frame is used to delineate a 4 ft² sampling

area to provide for semi-quantitative analysis and a large and representative total sample area of 12 ft² from a 3-kick composite sample. This design limits the amount of sample lost due to escape around net caused by the effects of the flow on the organisms suspended as part of the collection procedure. The large sample area frame was based on recommendations by the National Park Service and Academy of Natural Sciences citing low sample densities and inconsistent patchy distribution of macroinvertebrates in cobble substrate (National Park Service, Report Nos. 01-5F, 01-7F).

Site selection focuses upon the richest targeted habitat of the Delaware River, which has been specified as the midstream or margin gravel-cobble riffle microhabitat. The exact location of the sample is chosen after a visual inspection by the principal investigators. The selection of the site is based on the targeted depth, substrate and flow characteristics required for macroinvertebrate colonization as well as representative of the entire riffle to be sampled. Specific limitations of flow, depth, and substrate are also observed: flow velocity between 1.0 and 3.0 ft/sec; water depth between 0.5 and 2.5 ft; and median substrate particle size between 40 and 90 mm. The 25 fixed sample locations were chosen in 2001 for accessibility and are representative of similar habitat throughout the non-tidal Delaware River. It is important to determine that the sampling transect has been continuously wet for at least 6 weeks leading up to the sample time. Rapidly rising and falling river stages can ruin the ability of macroinvertebrates to colonize and build a stable community in the 0.5-2.5 foot target depth range, and sampling this previously dry substrate can severely bias results. In such cases, the investigator should attempt to safely sample deeper water or return to the site later under more stable flow conditions.

Once the sampling location is identified, samples are collected using the BFN). A sampling transect line or arc is chosen, and sampling begins at the downstream end of 3 stations along transect. A person stands downstream of the sampling area and secures the net with one leg and both hands while kicking up substrate with the other leg within the frame. The frame is placed directly upstream of the net and is held in place by a second individual while the area inside the frame is agitated by foot by the individual holding the net. Prior to kicking the delineated sample area, large stones are hand-washed into the net by placing them in the net mouth and dislodging attached macroinvertebrates directly into the net (improves representativeness of heavy shells and stone-cased caddis). Once the coarse agitation of the substrate has been completed, a final check using a dive mask and snorkel is completed to ensure adequate sampling and to sample and/or record uncollected organisms (e.g., *Corbicula* clams added to net; Unionidae mussels tallied but not collected). An estimate of embeddedness is made by visual observation and difficulty of particle disturbance (easy-medium-hard). Last, a survey flag is placed at the upstream part of where the kick was completed, to mark the location for quantitative velocity, depth and substrate particle size profiling. This process is repeated at 2 more locations along the chosen transect.

The bulk of the 3-kick sample is composited and rinsed into a large, water-filled container to simplify the cleaning of the net. The macroinvertebrates that were not dislodged by the rinse are picked from the net using forceps and placed in a labeled sample container for preservation. Once the net has been picked, the contents of the larger container are condensed by pouring it through a 500µm sieve then transferred to the labeled sample container that contains the macroinvertebrates that were picked from the net. After careful inspection of both the net and container for remaining macroinvertebrates, both are rinsed and prepared for the next sample. The macroinvertebrate samples are then preserved in Ethyl Alcohol (>95%) for later identification. No container should be

more than half-full of sample material, so multiple jars may be used (n), with labels numbered 1 of n, 2 of n, etc. Each jar should contain labels both inside and taped outside of the container. The sample label accompanies the sample through the entire sort-identify process. Sample information should be recorded on the chain-of-custody form. A sample label and sample log form can be found in Appendix B.

2.2.1.2 DRBC Standard Operating Procedure – Periphyton

The periphyton sample collection method gathers periphyton from Richest Targeted Habitat, just like the macroinvertebrate method used by DRBC. Periphyton are sampled just after macroinvertebrates, at the same locations (just upstream and parallel to the macroinvertebrate sampling transect). Collection methods were adapted from Field Sampling Procedures for the New Jersey Algae Indicators Project (ANSP Procedure No. P-13-64, Charles et. al.2000).

After taking macroinvertebrate samples, a periphyton sampling transect is established in RTH upstream and parallel to the macroinvertebrate sampling transect. From this transect (approximately 30 to 50 m long), three (3) representative cobbles are taken and placed into a white plastic pan for benthic Chlorophyll-*a* and AFDM sampling. Locations where each cobble was taken are flagged. These rocks are photographed with a measurement scale and sample identification card. Using the top-rock scrape method described in the RBP (Barbour et. al 1999), a composite sample is scraped and transferred into a pre-weighed and numbered 250 ml dark plastic bottle. A metal cylinder is used to mark a uniform ring on the top of each rock that is then scraped into the bottle. This ensures consistency in area scraped.

The benthic AFDM/CHLA sample is dewatered if necessary in the field, frozen on dry ice at -20 to -70 C with no preservative, and delivered within 24.5 days to the environmental geochemistry laboratory at the Academy of Natural Sciences of Drexel University in Philadelphia, PA. Once received by the lab, the samples are analyzed under the following standard procedures, and results reported to DRBC:

1. Benthic Algae and Sediment Chlorophyll A Preparation and Analysis (ANSP Procedure No. P-16-117, Velinsky and DeAlteris, 2002)
2. Determination of Dry Weight and Percent Organic Matter for Sediments, Tissues and Benthic Algae (ANSP Procedure No. P-16-113, Kiry et. al. 2000).

An additional six (6) cobbles, preferably without large growths of *Podostemum* or filamentous algae, yet representative of cobbles found throughout RTH, are collected along the transect line and placed in a white plastic pan. Place flags to indicate locations where cobbles were taken. Cobbles are photographed with a sample identification index card and measurement scale, scraped, and rinsed with river water into a 500 ml dark amber plastic bottle and preserved with buffered formalin (constituting >5% of total sample volume). Samples are labeled and stored for later analysis of diatom taxonomy (by trained DRBC personnel or a contract diatom taxonomy lab). Diatom taxonomy follows the Standard Procedure:

1. Procedure for Semi-Quantitative Analysis of Soft Algae and Diatoms (ANSP Procedure No. P-13-65, Ponader and Winter, 2002).

Once the samples are taken, additional site measurements are taken and recorded on the Quantitative Targeted Habitat Periphyton Sample Field Data Sheet (Appendix B). Measurements include:

- 100-particle size class of substrate along the sample transect line/arc (using gravelometer template)
- At each flag, record depth, velocity, shading, percent canopy (spherical densiometer readings), and macroalgae color/type.
- At upstream end, middle, and downstream end of transect, measure PAR 400-700 nm light intensity at 3 depths: above water surface, top of water and at bottom depth.
- Also transfer weather, precipitation, water quality, clarity and color characteristics from other sheets.

Upon return to the office, trace the outline of each piece of foil to an 8.5x11" gridded sheet (10 squares per inch) and record label information on each sheet. Count the squares within each outline and record the total measured area of each rock sampled. Copy and create a pdf document of these 25-75 sheets and save the document to the DRBC Biomonitoring folder on the general drive. Enter the measurements in the algal site file so that Chlorophyll a, AFDM, and algal densities can be expressed in the data set. Forward these area measurements to the lab for density estimates and AFDM quantification.

2.2.1.3 Quantitative Instream Habitat

Pebble counts, depth profiles and flow measurements are conducted to quantitatively characterize the microhabitat of the samples taken to eliminate the subjectivity of the site selection process).

Pebble Count: A 100-particle pebble count is conducted at the each of the sampling sites to numerically characterize the particle size of each of the sampled areas (Wolman, 1954). 100 particles are gathered along the sampled transect and measured using an AL-SCI Field Sieve from Albert Scientific. Particles are placed in the sieve to determine the size class of each particle and the data recorded using a #2 pencil on the brushed aluminum surface of the sieve until data can be transferred to a field sheet. Measurements are analyzed in the field for completeness, and to determine the median particle size (D₅₀) and class of substrate present. These measurements are used to validate the comparability of the benthic community collected with each sample. The median particle size (D₅₀) should fall in the range between 40 and 90 mm. Outliers are noted in statistical analysis of results. Example of field sheet can be found in Appendix B.

Velocity Measurement: Velocity and depth are measured using a high-quality digital flow meter (e.g., Marsh-McBirney, Swiffer) and wading rod at the left, center, and right edge of each of the 2x2 ft kicks sampled for macroinvertebrates (total N=9), and once at each location where a cobble was taken for periphyton (total N=9). At each of these position, flow is measured at 0.6 depth to represent the average water column velocity (i.e., flow measurement are not taken near-bed). The average velocity and depth validates the comparability of samples. The average velocity at each site should fall in the range of 1.0 and 3.0 feet per second. Any samples falling outside this range will be noted in statistical analysis. Outliers are noted in statistical analysis. Sample field sheet is in Appendix B.

2.2.1.4 Water Quality: Physical

Instantaneous water quality measurements are taken once at each sampling site. The RBP Physical Characterization / Water Quality Field Sheet is completed once per site (see Appendix B). Eureka Manta2 multi-parameter meters (or other suitable, properly calibrate multi-parameter meters) are used to collect data for the following field parameters:

- Dissolved Oxygen (mg/L)
- Temperature (°C), air and water
- Conductivity (mS/cm)
- pH
- Turbidity (NTU)

A sample field sheet for water quality parameters is in Appendix B.

Water quality grab samples are taken with each biological sample and analyzed in the laboratory:

- Nitrate + Nitrite as N (mg/L) at NJDOH-ECLS lab
- Total Kjeldahl Nitrogen as N (mg/L) at NJDOH-ECLS lab
- Total Phosphorus as P (mg/L) at NJDOH-ECLS lab
- Total Nitrogen as N by summation (mg/L) at NJDOH-ECLS lab
- Water column Chlorophyll-a mg/m³ at lab
- Turbidity (NTU) at DRBC lab or in field using portable Hach 2100P Turbidimeter

See water quality sampling and analytical procedures below.

Instrumentation is calibrated according to DRBC Standard Operating Procedures under NJ laboratory certification requirements. Meter calibration is verified prior to measurements at each site. pH is calibrated at pH 4, 7, and 10 (three point calibration). Just after field measurements are taken, an additional check is made using pH 7 standard solution (not the same solution used for initial calibration) to ensure calibration. A sample calibration sheet from the calibration logbook can be found in Appendix B.

TKN, Nitrate + Nitrite, Total Phosphorus, Total Nitrogen sample collection: Collect sample into NJDOH certified clean 500 ml HDPE bottle by facing upstream at farthest upstream flag along transect. Triple rinse the sample container, then collect sample at mid-depth, capping the bottle underwater. There should be no head-space in the sample. On shore, let out a very small quantity of water then acidify the sample with H₂SO₄ supplied by NJDOH lab.

Water Column Chlorophyll-a sample collection: At farthest upstream flag along transect, triple rinse with river water and collect two samples from mid-depth into two 500 ml HDPE dark amber bottles. Cap the bottles underwater at the collection depth. Immediately take samples to shore for filtration.

Water column Chlorophyll-a filtration and storage: Agitate sample and pour 100-250 ml of sample into a 250-ml graduated cylinder. Place a Whatman glass fiber (0.7 um nominal pore size) 25 mm filter, “hatched” side up, onto filter assembly 1 and attach filtration cup to filter assembly atop a 500 ml flask with hand pump and hoses attached to flasks and T-junction. Do the same to

prepare filter assembly 2. Measure and record subsample volumes from the graduated cylinder and transfer subsamples into prepared filtration cups. Use hand pump to draw water through filters (at no more than 20 kPa pressure). If visible green or brown color has developed on the filters after 100-250 ml, stop and remove the filters (see below). If no visible green or brown color has yet developed on filters after 250 ml, add 100-250 ml sample volumes from the second sample bottle and filter them (make sure to accurately record the volume sampled). Do not suck the filters dry with the vacuum; instead slowly release the vacuum as the final volume passes near the filter level, then completely release the vacuum as the last of the water is pulled through the filter.

Record all filtration data on Chlorophyll Filtering Data Sheet, and sample information on chain of custody form.

Once filtration is complete, filter 4 drops of MgCO₃ (magnesium carbonate) then remove the filters with flat-edge tweezers from the filter bases, place the filters on clean aluminum foil, then fold the filters in half and blot excess water from the filters with a clean paper towel. Fold the aluminum foil over the folded filters to keep the chlorophyll from touching the surface of the foil. Label the foil with tape: Batch ID, Chem ID, ml filtered, date filtered, and "Chla." Place folded foil and filters into a labeled 60 ml centrifuge tube, cap the tube and tape the top with electrical tape. Store the sample on dry ice in the field at -20 to -70 C, in darkness, until delivery to the lab or to DRBC freezer. Deliver the sample within 24.5 days to the lab for analysis. Analysis Procedure:

Velinsky, D. and DeAlteris, J. 2002. Filtration, extraction and analysis of Chlorophyll *a* preparation and analysis for the Welschmeyer (1994) non-acidification method. Procedure No. P-16-92, Rev. 2 (04/02). Patrick Center for Environmental Research, Academy of Natural Sciences, Philadelphia, PA.

Turbidity: Triple rinse 125 ml plastic bottle with river water. Collect sample from mid-depth, bring sample ashore immediately. Transfer small volume into clean, unscratched vial for Hach 2100-P turbidity meter, wipe dry with lens paper and read turbidity 3 times. Record each result and report the average NTU.

2.2.1.5 [Qualitative Habitat Assessment: Rapid Bioassessment Protocol](#)

Habitat conditions are qualitatively assessed using the high-gradient RBP (Barbour et. al 1999) habitat assessment once at each site. This habitat assessment system uses the following parameters to approximate the instream health of the system:

- Epifaunal Substrate/ Available Cover
- Embeddedness
- Velocity Depth Regime
- Sediment Deposition
- Channel Flow Status
- Channel Alterations
- Frequency of Riffles (or Meanders)
- Bank Stability

- Vegetative Protection
- Riparian Vegetative Zone Width

These measurements, once analyzed, are used to describe habitat conditions and identify factors attributing to biological changes. Field sheets are in Appendix B.

2.2.1.6 Location Information

Location information is collected at each site using a hand-held Garmin GPS unit set to decimal degrees at NAD83 datum. The positioning information is used for Geographic Information System (GIS) presentation and analysis of data. Location information and notes are reported on a set of DRBC “River Recreational Maps” and kept on hand for navigation during future studies.

Field notes are combined with field sheets for later data entry. Digital photographs are taken after sampling is completed in the following order at each site:

- Directly upstream (1)
- Upstream toward right shore (2) and left shore (3)
- Directly toward right shore (4) and left shore (5)
- Downstream toward right shore (6) and left shore (7)
- Directly downstream (8)
- Substrate photo of macroinvertebrate station A (downstream end of transect) (9)
- Substrate photo of macroinvertebrate station B (mid-transect) (10)
- Substrate photo of macroinvertebrate station C (upstream end of transect) (11)
- Photos of white pan containing mussels from A (12), B (13), and C (14)
- Photo of white pan, with measurement scale & sample ID, containing 3 Chlorophyll a / AFDM cobbles (15)
- Photo of white pan, with measurement scale & sample ID, containing 6 Diatom Taxonomy cobbles (16)
- Other photos as needed (NOTE in field notes, starting with #17 per site no.)

2.2.2 Laboratory Analyses

Analytical parameters are listed in Table 6. Samples will be stored in a cooler at a temperature of 4°C or less and submitted to the NJDOH-ECLS laboratory at the end of the sampling day or the following day. Team Leads will ensure the cooler retains a cold temperature and sealed securely prior to shipping overnight to NJDOH-ECLS using Fed-Ex from the NPS offices in the Delaware Water Gap Recreation Area and the Upper Delaware Scenic and Recreational River areas. If NPS Team Leads determine that the samples will not be shipped the same day, orthophosphate samples will be omitted as the holding time will be exceeded.

Table 6. Laboratory sample analysis and list of EPA-approved methods.

Parameter	Method	Detection Limit	Holding Time	Preservative
Nitrate + Nitrite as N, total	SM 4500 NO3	0.007 mg/L	28 days	H ₂ SO ₄
Phosphorus as P, total	EPA 365.1	0.002 mg/L	28 days	H ₂ SO ₄
TKN as N, total	EPA 351.2	0.041 mg/L	28 days	H ₂ SO ₄

Macroinvertebrate taxonomy is conducted on a 500 organism (minimum) sub-sample for use in multi-metric or multivariate analyses. The maximum subsample is the 500-organism minimum plus 10%. If a sorter goes over the maximum, computer subsampling is used to remove individuals. The sub-sample is collected by spreading the sample in a gridded pan and randomly selecting a grid to begin the sort. From this point, a series of randomly selected grids are sorted until a total of 500 organisms have been reached. Once a 500 count is met (minimum 500) the remainder of that grid is sorted, and all organisms are taxonomically identified. Completely sorting and identifying all organisms from the last randomly selected grid cell prevents the bias introduced by stopping at exactly 500 organisms, and allows quantitative estimates of sample density. Identification of organisms is to genus or lowest achievable taxon. Only those organisms with a complete head and thorax, or complete thorax and abdomen, are identified. All taxonomy is consistent with Integrated Taxonomic Identification System (ITIS) or other taxonomic standard.

Subsampling and sorting procedures shall be controlled and evaluated for efficiency and accuracy so that no errors are introduced. Taxonomic identifications of the samples will be reviewed using a separate taxonomist. The macroinvertebrate contractor shall assure that data entry is complete and correct. The macroinvertebrate contractor shall submit to DRBC their list of published taxonomic references and their in-house quality assurance / quality control documents.

Table 7 shows the current operational taxonomic units (OTU) used for calculation of DRBC macroinvertebrate metrics.

Table 7. Levels of benthic macroinvertebrate identification specified for this study.

Taxon	Level of Identification	Taxon	Level of Identification
Nematoda	Phylum	Megaloptera	Genus
Nemertea	Genus	Neuroptera	Genus
Turbellaria	Class	Trichoptera	Genus

Nematomorpha	Phylum	Lepidoptera	Genus
Mollusca	Genus	Coleoptera	Genus
Oligochaeta	Genus	Diptera	
Hirudinea	Genus	Chironomidae	Genus
Hydrachnida	Genus	Ceratopogonidae	Genus
Amphipoda	Genus	Tipulidae	Genus
Isopoda	Genus	Culicidae	Genus
Decapoda	Genus	Chaoboridae	Genus
Ephemeroptera	Genus	Simuliidae	Genus
Odonata	Genus	Other dipterans	Family/Genus
Plecoptera	Genus		
Hemiptera	Genus		

Details about DRBC's current bioassessment methods can be found in the following document attached in Appendix A:

Silldorff, E. and Limbeck, R. 2009. Interim Methodology for Bioassessment of the Delaware River for the DRBC 2010 Integrated Assessment. DRAFT 24-July-2009, Delaware River Basin Commission, West Trenton, NJ.

At present, DRBC has no periphyton taxonomy expertise, relying heavily upon outside phycology experience. Diatoms are prepared and analyzed using ANSP Procedure for Semi-Quantitative Analysis of Soft Algae and Diatoms (Ponader and Winter, 2002) and the methods are also described in USGS NAWQA protocols for analysis of algal samples (Charles et. al 2002). Taxonomic identification is conducted at the species level for diatoms and genus or species for soft algae (lowest taxonomic unit possible).

Instantaneous ambient water quality measurements are collected using Eureka multi-parameter meters (or comparable multi-parameter meters). Methods used can be found in Table 8:

Table 8. Methods for water quality monitoring using laboratory or multi-parameter meters.

Measurement	Units	Method	Calibration	Preservation	Holding Time
Dissolved Oxygen (DO mg/L)	mg/L	NFM 6.2.1-Lum	100% saturation at local barometric pressure (internal meter conversion to mg/l)	None	Immediate
Dissolved Oxygen (DO %)	%	NFM 6.2.1-Lum	100% saturation at local barometric pressure	None	Immediate
Specific Conductance (SpC)	mS/cm	ISO 7888-1985	Standard Solution (200 uS/cm, 500 uS/cm Standards as expected each day)	None	Immediate
Water Temperature	°C	SM 2550	Factory Calibration	None	Immediate
pH	pH units	SM 4500-H+	pH Buffer Solution (3 Point pH4, pH 7, pH10). pH7 check at each site using buffer solution that was not used for calibration.	None	Immediate
Lab Parameters	Units	Method	Measured MDL		
DRBC: Turbidity (NTU) – Hach 2100P	NTU	EPA 180.1	0.18 NTU	Ice <4C	24 hrs.
NJDOH: Nitrate + Nitrite as N, Total	mg/L	EPA 353.2 rev 2.0	0.007 mg/L	2 ml H2SO4, ice <4C	7 days
NJDOH: TKN as N, Total	mg/L	EPA 351.2 rev 2.0	0.038 mg/L	2 ml H2SO4, ice <4C	7 days
NJDOH: Phosphorus, Total as P	mg/L	EPA 365.1 rev 2.0	0.002 mg/L	2 ml H2SO4, ice <4C	7 days
NJDOH: Nitrogen as N, Total	mg/l	Calculated	0.045 mg/l (sum of above N+N + TKN)	2 ml H2SO4, ice <4C	7 days
ANSP: Water Column Chlorophyll-a	mg/m3	EPA 445.0 / ANSP Proc. P-16-92 rev 2	IDL Calculated from recommended dilution series 2.67 to 640.0 µg/l Chlor-a.	Dry ice frozen in field, store frozen	24.5 days
ANSP: Benthic Periphyton Chlorophyll-a	µg/m2	ANSP Proc. P-16-117 Rev. 1	Precision est. 20 µg/g wet	Dry ice frozen in field, store frozen	24.5 days
ANSP: Benthic Ash-Free Dry Mass (AFDM)	mg/m2	ANSP Proc. P-16-113 Rev. 1	0.5 mg constant dry weight	Dry ice frozen in field, store frozen	24.5 days

2.2.3 Laboratory Custody Procedures

Upon receipt of the sample cooler(s), the Laboratory shall initiate a documentation procedure to verify the custody and condition of the samples. On a standard check-in sheet or in a notebook, the Laboratory shall note the presence and number of sample custody seals, including seal number and condition of seals. Immediately upon opening the cooler, the Lab shall measure the internal temperature of the cooler and document the temperature. Also, the sample log-in sheet shall include a record of the presence and condition of the chain of custody documentation and the number of samples received. The log-in sheet shall be signed and dated by the log-in personnel.

2.2.4 Existing Information

DRBC will use databases, software applications, decision support tools, websites, existing literature, and other sources as necessary. The United States Geological Survey (USGS) National Water Information System (NWIS) offers an abundance of continuous data from gaged Delaware River and tributaries. Most often, discharge flow or gage height are recorded, but other parameters, such as specific conductance, temperature, dissolved oxygen, and pH are also measured. The USGS has their own set of protocols to accept data from provisional status. The Project Operations Manager will update “provisional” data obtained from NWIS once the USGS converts it to “actual.” DRBC will likely also use USGS’s StreamStats application to obtain basin characteristics, estimates of stream flow, and flow statistics.

2.2.5 Environmental Technology

This section does not apply because it does not involve environmental technology for pollution prevention, contamination containment, storage, or remediation.

2.3 INTEGRITY OF ENVIRONMENTAL INFORMATION

2.3.1 Sample ID and Labeling

A unique sample ID shall be assigned to each sample (Figure 3). The sample ID shall incorporate the body of water where the sample was collected along with sample collection data as shown below:

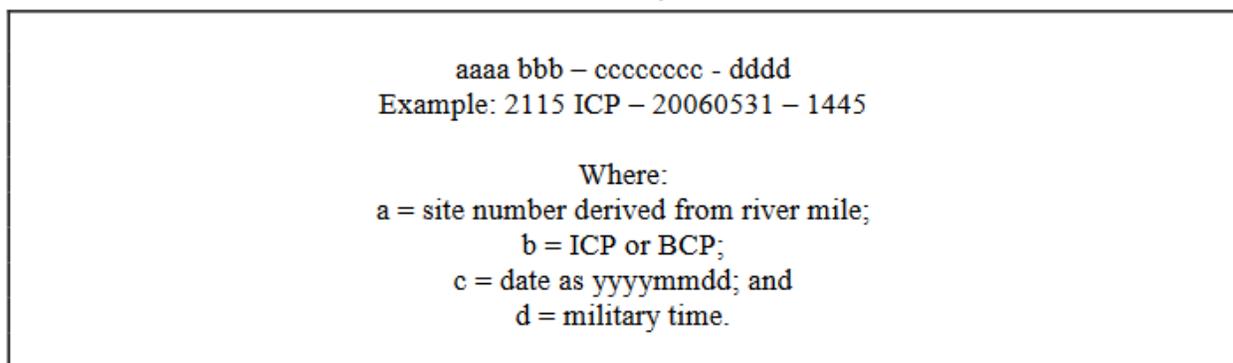


Figure 3. Sample Identification Key

All bottles will be labeled with sample numbers and locations. Blank or replicate samples should be labeled with times that are different from primary samples. The field data sheet should indicate that primary, blank, or replicate samples were taken, by recording each sample number with the notation PRIMARY, BLANK, or REPLICATE. The bottle label and the chain of custody form should only indicate sample numbers and site numbers, but not blank or replicate designations, so that they are blind to the analytical laboratory. Sample labels are to be completed for each sample using waterproof ink.

2.3.2 Chain of Custody Documentation

The sample collection team is responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples. The sample collection team must complete the chain of custody form documenting the custody of each sample as soon as the samples are collected. Samples must be accompanied by a properly completed chain of custody form. The sample numbers and locations will be listed on the chain of custody form. When transferring the possession of the samples, the individuals relinquishing and receiving will sign, date, and note the time on the form. This form documents transfer of custody of the samples from sampler to another person, to a mobile laboratory, or to/from secure storage.

Samples will be properly packaged for transport to the laboratory for analysis, accompanied by the form. For this project, DRBC will convey the samples directly to the lab.

2.3.3 Sample Preservation, Holding, and Transportation

The sample collection team shall place samples into pre-preserved sample bottles and maintain samples at or below 4 °C on site, during transport, and until receipt by the lab. A temperature blank will be placed in the coolers to ensure temperature is kept. The Laboratory shall maintain the samples and any sample extracts at or below 4 °C until analysis. Each filled labeled sample bottle shall be sealed inside a sealable plastic bag, to prevent direct contact with melt water from the ice. Containers will be supplied by the lab, certified clean, and preserved with the appropriate preservative for the analysis requested.

Table 7 in Section 2.2.2 shows the maximum holding time and preservative requirements for each analysis under this QAPP.

2.4 QUALITY CONTROL

Field QA/QC is obtained by using trained staff for all sampling and field measurements. All are trained in each procedure. Site selection and macroinvertebrate collection is completed by the same personnel at all sites to limit subjective errors. The QA officer oversees 10% of sampling (n=3) to assure that sampling is consistent with the methods described in this QAPP.

Visual inspection of net performance is conducted during collection of each sample. Prior to sampling, the net is visually inspected to ensure that no tears in the mesh are present. During sample collection, the sediment plume created by the sample collection is observed to make certain that the entire plume passes through the net. By doing this, it is safe to assume that no organisms are escaping around or over the net during collection and ensuring that sample collected is complete. Also, during this time, the passage of the water through the net is visually monitored to ensure that no portion of the sample is lost due to back wash caused by the net becoming clogged

by detritus. In addition, the collectors observe and capture large and mobile species that attempt to escape capture, though this rarely occurs.

Laboratory QA/QC is achieved by having all taxonomy completed by trained staff using current taxonomic standards. All taxa will be verified using ITIS, ARGIS, or another taxonomic standard. Upon completion of taxonomy, 10% of samples will be sent to the United States Environmental Protection Agency, Region 3 Field Laboratory (or other suitable independent laboratory) for sorting efficiency measurement and taxonomic verification. Sorting efficiency is conducted on only the debris that is actually used for generation of the subsample (sort residue). If more than 50 organisms, or 10% of the subsample, are found in the sort residue, the sample is reconstituted and subsampling is conducted again.

Macroinvertebrates are collected using a Big River Frame Net (BFN) developed by DRBC and Wildco. The net is rinsed and inspected for tears prior to each sample collected to prevent sample contamination and sample loss, respectively. If a tear is found, sample collection will be postponed until the net has been repaired.

Flow velocity meters undergo careful inspection before each usage and manufacturer specifications are followed. Connections are checked and instruments are cleaned before and after each use, and spare batteries are always available.

Eureka multi-parameter meters (or other suitable multi-parameter meters) are inspected each day prior to usage. All probes are maintained in compliance with manufacturer's recommendations and are calibrated daily.

2.5 INSTRUMENTS/EQUIPMENT CALIBRATION, TESTING, INSPECTION, AND MAINTENANCE

To ensure that all data collected under this project are of sufficient quality, all instruments and equipment used are maintained on a regular basis. Records of all maintenance activities are documented in an Equipment Service Logbook that is stored in the DRBC laboratory, near the equipment preparation area. A kit, which includes replacement parts for each of the pieces of equipment to be used as well as tools to conduct the maintenance, is present at time of sampling.

Eureka Water Probes Sub2 or Sub3 Meters

These are subject to daily, routine maintenance as well as annual maintenance. The daily maintenance includes both lab and field procedures to ensure that all measurements taken are both accurate and precise. Between sites, the sonde is rinsed with deionized water to prevent fouling by accumulation of contaminants found in the water samples. The storage cup, used to store the sonde while transporting from site to site, is filled with tap water, according to manufacturer's recommendations. After daily sampling is complete, the sonde is cleansed with a gentle soap and brush and rinsed with tap water. For long-term storage, the storage cup is filled with pH 4 standard solution to prevent colonization of bacteria and other biological contaminants on the sonde. Upon completion of the sampling season, the entire unit is sent to the manufacturer for annual maintenance as prescribed by the manufacturer. All service performed on the units is documented in DRBC's Equipment Service Logbook in the lab.

2.5.1 Instrument / Equipment Calibration and Frequency

Eureka Sub2 or Sub3 All calibrations will be conducted as recommended by the manufacturer. Meter calibration procedures and frequency of calibration can be found in Table 9. If during the time of collection any values seem to fall outside of the expected range, these values will be noted, and a calibration will occur upon completion of sampling to verify measurements taken. All calibrations will be documented in the Calibration Logbook. Table 9 below summarizes the calibration procedures for both the Eureka meters.

Table 9. Field Meter Calibration and Check Summary.

Parameter	Calibration / Check Description	Frequency	Location Performed
Water Temperature	Checked against NIST certified thermometer at 3 different temperature ranges (0-5 °C, 15-20 °C, and 30-35 °C)	Once per quarter	DRBC laboratory
Dissolved Oxygen (DO)	Checked against Winkler Titration measurement of DO	Within one week of sampling activity	DRBC laboratory
	Saturated water calibration, as recommended by the manufacturer	At least once per day, prior to field measurements	In the field
Conductivity	Calibration at 500 μ S/cm and check at 200 or 500 μ S/cm (1% acceptance criteria)	At least once per day, prior to field measurements	DRBC laboratory
pH	3-point calibration with pH 4, pH 7, and pH 10 buffers, followed by a check against pH 7 buffer	At least once per day, prior to field measurements	DRBC laboratory
	pH 7 buffer check (less than 0.3 pH units from post-calibration check)	Every 3 hours	In the field

2.6 INSPECTION/ACCEPTANCE OF SUPPLIES AND SERVICES

All field supplies and consumables will be inspected by the sample collection team, including the Project Operations Manager and Field Staff, for defects and obvious signs of improper handling before use. Supplies and consumables which show signs of defects or improper handling will not be used by the sample collection team.

All laboratory supplies and consumables are the responsibility of the analytical laboratory. Requirements for the inspection and acceptance of supplies and consumables are defined in the analytical methods. The reader is directed to the methods in Table 7 for a complete discussion of these requirements.

2.7 ENVIRONMENTAL INFORMATION MANAGEMENT

The DRBC and NJDOH Laboratory will manage all data generated from this work. EDD files and transcribed field notes will be stored electronically on DRBC computers with backup copies on digital media. Namsoo Suk will have ultimate responsibility for ensuring that data are maintained and secured.

After review and acceptance of the data, the data will be uploaded to WQX . For this project, uploading laboratory and field data to WQX is the responsibility of the Project Operations Manager.

3. ASSESSMENT, RESPONSE ACTIONS, AND OVERSIGHT

The elements in this section address the activities for assessing the effectiveness of project implementation and associated QA and QC activities. The purpose of assessment is to ensure that the QAPP is implemented as described.

3.1 ASSESSMENTS AND RESPONSE ACTIONS

When errors, deficiencies, or out-of-control situations exist, the Laboratory's QA program shall provide systematic procedures, called "response actions," to resolve problems and restore proper functioning to the analytical system(s). Laboratory personnel are alerted that response actions are necessary if:

- QC data are outside the acceptable windows for precision and accuracy
- Blanks, duplicate control samples, or single control samples contain contaminants above acceptable levels
- Undesirable trends are detected in spike recoveries or RPD between duplicates

- There are unusual changes in method detection limits
- Deficiencies are detected by the Laboratory QA department during internal or external audits or during performance evaluations

Response action procedures may be handled by the analyst, who reviews the preparation and extraction procedure for possible errors, checks the instrument calibration, spike, and calibration mixes, and instrument sensitivity. If the problem persists or cannot be identified, the matter is referred to the Laboratory supervisor, manager, and/or QA department for further investigation. When a problem is referred to the Laboratory Supervisor, the Laboratory Supervisor must notify the Project Officer, by telephone, immediately, for consultation in resolving the problem. Once resolved, full documentation of the response action procedure shall be included with the Laboratory report. The following response actions and/or procedures will be required as part of this QAPP.

3.1.1 Incoming Samples

Problems noted during sample receipt shall be documented on an appropriate sample log-in form. The DRBC Project Operations Manager shall be contacted immediately for consultation regarding problem resolution. All response actions taken shall be thoroughly documented and submitted to the DRBC Project Operations Manager.

3.1.2 Sample Holding Times

If samples cannot be extracted and/or analyzed within the appropriate method required holding times, the DRBC Project Operations Manager shall be immediately notified, such that an appropriate response action plan can be generated. All response actions taken shall be thoroughly documented. Data outside the quality objectives and criteria will be flagged, so that data recipients can exercise discretion in determining appropriate data uses and limitations.

3.1.3 Detection Limits

Appropriate sample cleanup procedures shall be employed to attempt to achieve the required detection limits. Cleanup methods employed are left to the discretion of the analyst or other appropriate Laboratory personnel, in accordance with the specified analytical method. Cleanup methods and dilutions shall be documented, with the rationale, along with revised method detection limits for those analytes directly affected. Data outside the quality objectives and criteria will be flagged, so that data recipients can exercise discretion in determining appropriate data uses and limitations.

3.1.4 Method QC

All method QC, including blanks, matrix duplicates, matrix spikes, matrix spike duplicates, surrogate spikes, laboratory control samples, and other method-specified QC, shall meet the requirements as specified in this QAPP. Failure of the method required QC shall result in the review of all affected data. If no errors can be noted, the affected samples shall be reanalyzed and/or re-extracted then reanalyzed within method holding times to verify the presence or absence of a matrix effect. Affected data shall be flagged accordingly using the EPA flagging symbols and criteria. Data outside the

quality objectives and criteria will be flagged, so that data recipients can exercise discretion in determining appropriate data uses and limitations.

3.2 OVERSIGHT AND REPORTS TO MANAGEMENT

Given the expected duration of this project, the laboratory reports to be submitted at the completion of the project will serve as the Quality Assurance Reports to the QA Manager and DRBC management. No interim reports will be required. The laboratory's Final Reports must include all the items specified in this QAPP.

To verify that collected data are of good quality, both DRBC and NJDOH are subject to audits by NJDEP's Office of Quality Assurance under New Jersey's Environmental Laboratory Certification Program.

4. ENVIRONMENTAL INFORMATION REVIEW AND USABILITY DETERMINATION

4.1 ENVIRONMENTAL INFORMATION REVIEW

All analytical data generated by the Laboratory shall be reviewed prior to report generation to ensure the validity of the reported data. This internal data validation process shall consist of data generation, reduction, and a minimum of three levels of documented review. In each stage, the review process shall be documented using an appropriate checklist form that is signed and dated by the reviewer. The analyst who generates the analytical data has the prime responsibility for the correctness and completeness of the data. Each step of this review process involves the evaluation of data quality based on both the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data of high quality are generated consistently. All data generated and reduced shall follow well-documented in-house protocols. Data outside the quality objectives and criteria will be flagged, so that data recipients can exercise discretion in determining appropriate data uses and limitations.

Each analyst reviews the quality of their work based on an established set of guidelines. This review shall, at a minimum, ensure the following:

- Sample preparation information is correct and complete
- Analysis information is correct and complete;
- The appropriate SOPs have been followed;
- Analytical results are correct and complete;
- QC samples are within established control limits;
- Blanks and laboratory control samples are within appropriate QC limits;
- Special sample preparation and analytical requirements have been met;

- Documentation is complete (i.e., all anomalies in the preparation and analysis have been documented, anomaly forms are complete, holding times are documented, etc.).

Level 1 data review shall be documented using a checklist form and by signature and date of the reviewer.

Level 2 review shall be performed by a supervisor or data review specialist whose function is to provide an independent review of the data package. This review shall also be conducted according to an established set of guidelines and is structured to ensure that:

- All appropriate Laboratory SOPs have been followed;
- Calibration data are scientifically sound, appropriate to the method, and completely documented;
- QC samples are within established guidelines;
- Qualitative identification of sample components is correct;
- Quantitative results are correct;
- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented, anomaly forms are complete, holding times are documented, etc.);
- The data are ready for incorporation into the final report;
- The data package is complete and ready for data archive

Level 2 review shall be structured so that all calibration data and QC sample results are reviewed, and all the analytical results from at least 10% of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional 10% of the sample results shall be checked back to the bench sheet. This cycle repeats until either no errors are found in the data set checked or all the data has been checked. All errors and corrections noted shall also be documented on a checklist with the signature and date of the reviewer.

Level 3 review is performed by the quality assurance officer or the program administrator at the Laboratory. This review should be similar to the review provided in Level 2, except that it should provide a total overview of the data package to ensure its consistency and compliance with this contract. All errors noted shall be corrected and documented. Level 3 data review shall also be documented on a checklist with the reviewer's signature and date.

4.2 USABILITY DETERMINATION

In order to ensure that all the data is consistent with the project requirements, DRBC will perform a Data Quality Assessment on the completed data set. All data quality assessment results will be documented in a memorandum by DRBC or a contractor to the file.

DRBC will review the entire data set (100% of the data) and perform each of the following checks:

- Determine if all the requested data is present. Document any missing data. If there are no deficiencies, document that the data set is complete.

- Check the analyte-specific holding times. Document any exceeded holding times. If there are no deficiencies, document that all holding times were met.
- Check the detection limits against those specified in the QAPP. Document any detection limits that exceeded those required by the QAPP. Where detection limits were exceeded, document any explanation included in the laboratory report, such as “matrix interferences.” If there are no deficiencies, document that all detection limits were met.
- Check the field and method blanks to determine if they were run at the frequency required in the QAPP. Document any deficiency in the blanks, including any blank in which a quantifiable concentration of the analyte was detected. If there are no deficiencies, document that sufficient blanks were analyzed and none had quantifiable concentrations of any analyte.
- Check the initial and continuing calibration information to determine whether or not calibration was achieved and maintained. Document any deficiencies. If there are no deficiencies, document that the initial and continuing calibration information is complete and acceptable.
- Check the documented quantitation processes against the process requirements described in the analytical method. Document any deficiencies. If there are no deficiencies, document that the quantitation process is complete and acceptable.
- Check the Matrix Spike and Matrix Spike Duplicates (MS/MSD) to determine if they were run at the required frequency. Check the % recoveries and the relative percent differences (RPD) against the acceptance criteria listed in the QAPP. Document any deficiencies in the frequency of MS/MSD or any % recoveries or RPDs that exceeded the acceptance criteria. If there are no deficiencies, document that the MS/MSDs are complete and acceptable.
- Check all field and laboratory duplicates to determine if duplicates were performed at the frequency required by the QAPP. Check the RPD against the acceptance criteria listed in the QAPP. Document any deficiencies in the frequency of duplicates, or any RPDs outside the acceptance criteria. If there are no deficiencies, document that the duplicates are complete and acceptable.
- Check the laboratory control samples to determine if they were analyzed at the frequency and for the parameters specified in the QAPP. Check the % recovery (or other measures such as the Response Factor, where appropriate) against the acceptance criteria listed in the QAPP. Document any deficiencies in frequency or any percentage recoveries outside the detection limits. If there are no deficiencies, document that the laboratory control samples are complete and acceptable.
- Check the surrogate recoveries to determine if they were performed at the frequency and for the parameters specified in the QAPP. Check the % recoveries against the acceptance criteria specified in the QAPP. Document any deficiencies in frequency or any % recoveries outside the detection limits. If there are no deficiencies, document that the surrogates are complete and acceptable.
- Check for the presence and content of response action forms where any deficiencies in any of the above categories exist. Document the existence and content of response action forms.
- Check 100% of any information transcribed from field notes and logs to electronic files and databases. Document any transcription errors, verify the correct value or notation, advise the database or file manager to correct the erroneous transcription, and document the correction.

- Check related laboratory data to determine if the results are logical and reasonable. For example, if a sample is analyzed for a total and dissolved fraction of a given parameter, the results for the total fraction should be greater than (or at least equal to) the dissolved fraction. Document any deficiencies or any data that appears to be illogical or incorrect.

DRBC will prepare a memorandum outlining all the documented deficiencies for submission to the QA Officer. The last paragraph of the memo should state the reviewer's recommendation for accepting or not accepting the data package. Based on the review of the data package, the DRBC QA Manager will determine if (1) the data package is acceptable based on the QAPP; and (2) the data is sufficient for its intended purpose. It should be noted that DRBC may accept the data package even if minor deficiencies exist, provided that the data can still be used for its intended purposes.

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APPENDIX A

Interim Methodology for Bioassessment of the Delaware River for the DRBC 2010 Integrated Assessment

APPENDIX B

Field Forms and Sheets

Appendix B

Electronic Data Deliverable File Structure

Data to be entered shall include:

- Full phylogeny and taxonomic authority of all taxa identified at each site, including ITIS identification information or more recent reference and synonymy as appropriate.
- Index information for reference collection vial or slide location.
- Links to digital photos or other digital documentation pertaining to the sample information or sample result record.
- The count of each taxon encountered at each site.

All materials described herein, including but not limited to the Microsoft Access database, Microsoft Excel workbooks, other digital files such as photos or linked web pages, and the paper data sheets (bench sheets), shall be provided to the Commission upon completion of each sample batch.

Benthic data shall be summarized in linked Microsoft Access files or in two worksheets within a Microsoft Excel workbook:

1. The first table or workbook tab, "Sample Information," shall consist of rows (records) representing individual samples and columns (fields) representing variables associated with each sample. The information in this table or tab is applicable to an entire sample. The first six columns are information taken from the sample label and sample log from DRBC.
 - a. Sample identification number/code
 - b. Site name
 - c. Water body name
 - d. Date / time sample collected
 - e. Type of sample: Primary or Replicate (sample time of replicate should differ from sample time of primary)
 - f. The total number of containers / jars included in the sample
 - g. Latitude and Longitude (NAD83 decimal degrees format dd.ddddd, -dd.ddddd)
 - h. Date sample was received by Contractor
 - i. Contractor sample ID code (if different from sample identification number)
 - j. Data qualifiers (flags) and comments regarding condition upon receipt or issues arising from laboratory processing and identification
 - k. Date sample sorted
 - l. Name of person completing the sort
 - m. Date all IDs were completed
 - n. Grids counted
 - o. Total grids in pan
 - p. Proportion of sample subsampled to obtain required count (sorted/total grids)
 - q. Correction Factor used to correct abundances for subsampling in the lab.

2. The second data table or workbook tab, "Sample Results" shall contain the count data for all samples, and shall be organized as a matrix in which each row (record) represents an individual taxon counted in a subsample with associated information. The first several variables are common with the Sample Information File.
 - a. Sample identification number - from sample label and sample log form
 - b. Date / time sample collected - from sample label and sample log form
 - c. Water body name - from sample label and sample log form
 - d. Site name - from sample label and sample log form
 - e. Type of Sample: Primary or Replicate (sample time of replicate should differ from sample time of primary) – from sample label and sample log form
 - f. The final, lowest, taxonomic group corresponding to the count (generally genus)
 - g. Number of Larvae in subsample
 - h. Number of Pupae in subsample
 - i. Number of Adults in subsample
 - j. Total number of individuals counted in the subsample (larvae + pupae + adults)
 - k. Corrected Total (abundance corrected for subsampling in the lab)
 - l. Individual columns that collectively provide the complete taxonomic information for each taxon, beginning with phylum and ending with the lowest taxonomic level assigned to a taxon, including intermediate levels (e.g., tribe, subfamily, etc.):
 - Phylum
 - SubPhylum
 - Class
 - SubClass
 - InfraClass
 - Division
 - Order
 - SubOrder
 - SuperFamily
 - Family
 - SubFamily
 - Tribe
 - Genus
 - Species (if known)
 - m. Additional taxonomic grouping (e.g. complex, group, odd anatomical note, etc.)
 - n. ITIS taxon code
 - o. If ITIS code is outdated, provide link to reference that provides complete taxonomic information.
 - p. A variable code, such as "distinct", to indicate whether taxa not classified to the specified level from Table 1 are distinct from other taxa not classified to that level in the sample (e.g., sp.1, sp. 2, etc.)
 - q. ID Notes – taxonomist notes.
 - r. Name of Taxonomist completing identification of this taxon.
 - s. Link to identifier in reference collection index
 - t. Link to photo or if more than one photo of specimen, to subdirectory where photos are contained in media delivered to DRBC.

Appendix C
Analytical Services Bid Form

Component	Unit Cost Per Sample
Macroinvertebrate Taxonomy	
Macroinvertebrate Reference Collection	
Periphyton Taxonomy	
Benthic Chlorophyll a and AFDM	
Water Column Chlorophyll a	