Delaware River Biomonitoring Program

Quality Assurance Project Plan

Document Control Number: DRBC QA2003-002 / July 2003

Delaware River Basin Commission

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

Program Manager:	Thomas Fikslin, PhD	Date
Project Officer:	Robert Limbeck	Date
Quality Assurance Officer:	Edward Santoro	Date
EPA Project Officer:	Peter Bentley	Date

July 10, 2003

Table of Contents

List of Tables

List of Figures

1. Project Management

1.1 Distribution List

Table 1 is a list of all individuals associated with the Delaware River Biomonitoring program. Each of the following individuals will participate in some aspect of the Delaware River Biomonitoring Program. To ensure the quality of the Delaware River Biomonitoring Program, each of these listed individuals will receive a copy of the signed Quality Assurance Program Plan (QAPP) prior to initiation of the 2002 sampling season. In the case of a revision, each of the participants will receive the revised version electronically in *.pdf* format.

Table 1. Distribution list for the Delaware River Biomonitoring Program

Individual	**Organization**
Peter Bentley	U.S. Environmental Protection Agency
Thomas Fikslin, PhD.	Delaware River Basin Commission
Pat Lynch	National Park Service
Robert Limbeck	Delaware River Basin Commission
Geoffrey Smith	Delaware River Basin Commission
Edward Santoro	Delaware River Basin Commission
Michael Bilger	United States Geological Survey
Don Hamiliton	National Park Service (UPDE)
Al Ambler	National Park Service (DEWA)

1.2 Project/ Task Organization

Figure 1 is a chart describing the organization of the Delaware River Biomonitoring Program. Table 2 lists the individuals that will participate in at least part of the Delaware River Biomonitoring Program and the role that each of the participants will have in the program.

Figure 1. Organizational Chart of the Delaware River Biomonitoring Program

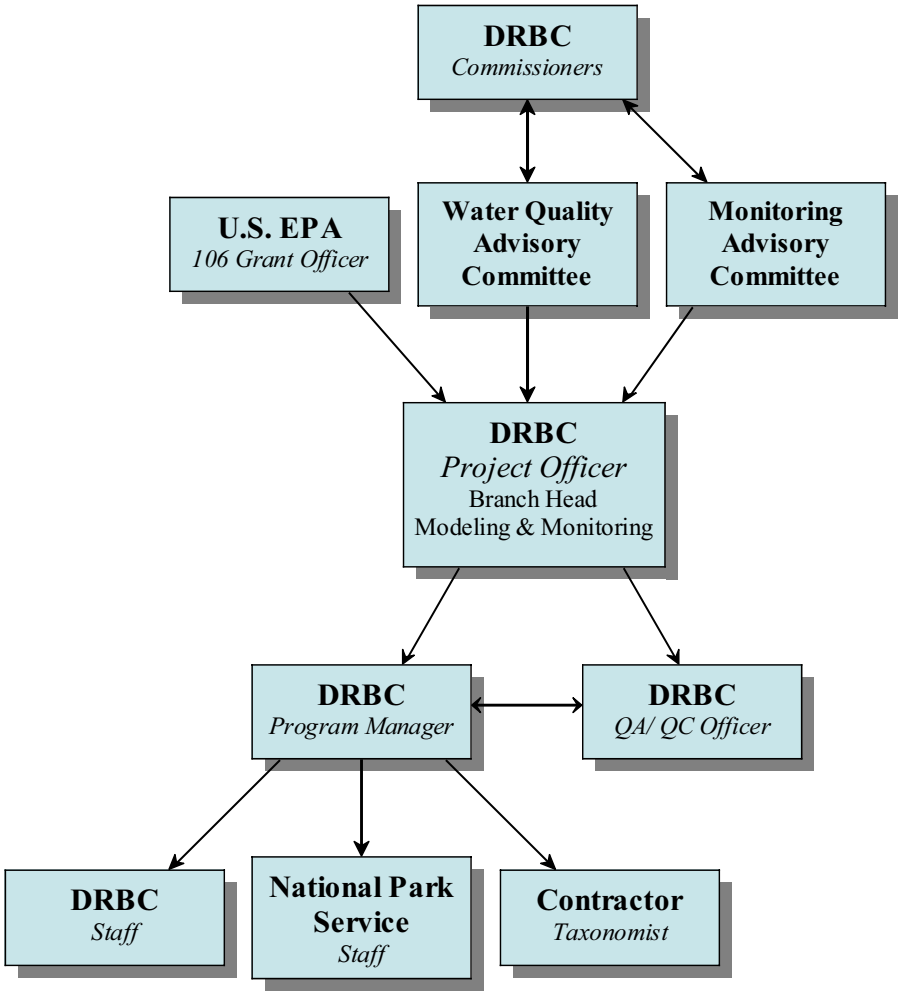


Table 2. Roles and responsibilities of individuals associated with Delaware River Biomonitoring Program

Name	Title	Organization	Role	Responsibility
Peter Bentley		U.S. EPA	Project Officer	*106 Grant Officer (funding source)
Thomas Fikslin, PhD.	Branch Head, Modeling & Monitoring Branch	DRBC	Project Manager (Monitoring)	*General oversight of Monitoring Program *Review of QAPP *Technical Support *Contract Officer
Robert Limbeck	Watershed Scientist	DRBC	Project Officer	*Site Selection *Macroinvertebrate Sample Collection *Criteria development *Data Analyst
Geoffrey Smith	Field Technician	DRBC	Sample Collection	*Coordination of Monitoring Efforts *Supervision of Personnel *QAPP creation *Site Selection *Macroinvertebrate Sample Collection *Data Manager *Data Analyst
Edward Santoro	Monitoring Coordinator	DRBC	QA/QC Officer	*Ensure the quality of all aspects of project
Contractor	Biologist	Contract Lab	Head Taxonomist	*QC of Invertebrate Samples *Technical Support
Karen Reavy	GIS Coordinator	DRBC	GIS Coordinator	*GIS Technical Support
Don Hamilton	Natural Resources Specialist	NPS-UPDE	Sample Collection	*Technical Support (UPDE) *Aid in sample collection
Al Ambler	Biologist	NPS-DEWA	Sample Collection	*Technical Support (DEWA) *Aid in sample collection

1.3 Problem Definition/ Background

The non-tidal Delaware River drains 6,780 square miles of New York, New Jersey and Pennsylvania, and enters the tidal Delaware Estuary at Trenton, NJ. Originating in New York's Catskill Mountains, the Delaware River flows freely through several physiographic regions including the Allegheny Plateau, Valley and Ridge, Piedmont, and Coastal Plain. Such landscape diversity has produced biological communities that are very rich, diverse, balanced, and sensitive to pollution. The Delaware River basin has been subjected to tremendous anthropogenic activity over the past 300 years. Forests were almost completely denuded by logging, converted to agricultural use, and subjected to industrial and urban growth from the 1700's through the 1970's. Large dams were built to harness water resources for use by cities and electric power generators. Canals, railroads, and highways were built along stream corridors to transport the harvest of natural resources such as lumber, coal, agricultural and industrial products, and water. Much of the forests have been restored over the past 100 years, and land and water resources have been protected through government action. Such protection has allowed water quality to remain high, though recent stressors threaten the resource. Drought, flooding, acid rain, suburban sprawl, invasive species, non-point source pollution, flow management, habitat loss, and competing uses create challenges for resource managers tasked to protect the resource.

Historically, the Delaware River Basin Commission (DRBC) has focused resource protection efforts upon traditional chemical water quality monitoring, which proved very effective at reducing impacts created by point sources of pollution. Sewage and industrial waste treatment plants have improved treatment efficiency much over the past 30 years. With the creation of National Park Service units in the Upper and Middle Delaware River, DRBC created an antidegradation approach to water quality management that defined existing water quality and set very protective limits upon chemical constituents for protection of the resource.

In the 1990's the basin states began to use a more holistic approach to address non-point source pollution problems that threaten the high-quality water of the Delaware River. Unlike DRBC, the basin states' monitoring application included biological, chemical, physical, and toxics components. Planning and regulatory efforts of the Commission have expanded in focus to include not only protection of water chemistry, but also sustainable protection of biological integrity.

The DRBC/NPS Scenic Rivers Monitoring Program (SRMP) and the Lower Delaware Monitoring Program (LDMP) combine to monitor the entire 200-mile non-tidal length of the Delaware River.

This project plan defines only the benthic macroinvertebrate component of DRBC's biological monitoring program. Additional types of biological monitoring will be implemented in future years as resources allow, including fish, periphyton, plankton, submerged aquatic vegetation, and riparian condition. These activities, in addition to improved physical and chemical data gathering, should provide a well-rounded view of

water quality conditions in the Delaware River, and provide sufficient data for more meaningful management decisions.

DRBC intends to gather sufficient physical, chemical, and biological information to serve the following needs:

1. Implement Special Protection Waters regulations for the Delaware River's upper 120 miles. In 1991, DRBC approved rules providing anti-degradation protection of high water quality in the Upper and Middle Delaware River. In 1995, DRBC and the National Park Service (NPS) re-designed the SRMP so that Special Protection Waters implementation and effectiveness could be monitored. It was found that chemical monitoring frequency should be increased so that measurable changes to water quality could be detected at a 90% degree of confidence, as mandated in DRBC's Water Quality Regulations. As of 2001, the chemical monitoring program has improved. Sample analysis techniques and frequency of sampling have allowed to more accurate and precise results, paving the way for more critical water quality regulations. Biological criteria must yet be implemented for the Delaware River and tributary Boundary Control Points. This project serves to define biological quality of the Delaware River by 2003, but not the tributary Boundary Control Points.

2. Develop data sufficient to define and implement an anti-degradation level of protection to areas of known high water quality of the Lower Non-Tidal Delaware River (80 miles). Lower quality waters should be assessed so that water quality can be improved where necessary, and where practical (as recommended in the 1997 Lower Delaware Management Plan, and supported by DRBC resolution in 1998). As of 2003, chemical monitoring proceeds to meet this need. Biological criteria do not currently exist for the Lower Delaware River or near-confluence tributary locations. This project serves to define biological quality of the Delaware River through this reach by 2003, but not for tributary locations.

3. Develop a Benthic Index of Biological Integrity (B-IBI) for the non-tidal Delaware River. Starting with an intensive 3-year macroinvertebrate survey of accessible river sites, targeting the richest habitats (riffles, runs, island margins), a B-IBI will be developed to quantify ecological integrity for the entire 200-mile non-tidal river. Once the 3-year reference baseline is developed (years 2001-2003), further testing (years 2004-2005) of the most sensitive metrics for detecting 'measurable change' will be refined and incorporated into a B-IBI useful for protecting long-term ecological integrity of the river. The B-IBI's numerical reference values will be proposed to set an anti-degradation level of protection for the river's aquatic life, and to provide an "existing water quality" biological baseline for assessment of long-term changes. The Delaware River B-IBI will serve as the backbone for future biomonitoring of tributaries and specific stressor effects. As of 2003, initial reconnaissance has been completed (2001), macroinvertebrate collection and identification has begun (2002), and the biocriteria framework creation is underway. After sufficient data has been

collected(2005), a Delaware River B-IBI will be available for use in 305B assessments.

1.4 Project Task/ Description

This program will require an annual survey for the collection of benthic macroinvertebrates and various habitat measurements along the length of the non-tidal Delaware River. After a 5 year collection period ending in 2005, the analyzed data will be used to create a Benthic Index of Biotic Integrity (B-IBI) as well as numerical criteria for use in the Delaware River Basin Commission Water Quality Regulations.

Macroinvertebrate collection will be conducted using the Big River Frame Net (BFN) at each of 25 sites on the Delaware River. Wolman Pebble counts, velocity measurements, habitat assessments, and instantaneous water quality samples will be collected to characterize the habitat and water quality at the time of sampling. Collection will occur during the August to September index period unless conditions are not suitable. Macroinvertebrate collection will be conducted by DRBC Staff with the other parameters being collected by both DRBC staff and National Park Service (NPS) staff. Macroinvertebrate taxonomy will be conducted by the DRBC staff or by trained staff from contract laboratory.

The data produced during this survey will be compiled in Ecological Data Application System (EDAS) created by TetraTech, Inc. All metrics will be calculated using EDAS with statistical analysis being done using Analyze-It, a Microsoft Excel add-on program. Data will both be stored at DRBC for organizational use as well as uploaded onto EPA's STORET national data base for public usage. After a 3 year period ending in 2003, a preliminary report will be written and narrative criteria for the Water Quality Regulations will be created. After the 5 year collection period, a final report will be generated with quantitative criteria for recommended placement in DRBC Water Quality Regulations.

All participating staff will read and become familiar with QAPP prior to sampling. All participating staff currently are, or will be trained, in the methodology used for each of the measurements required for the survey prior to collection. The QA officer will be present for at least 10% (n=8) of samples collected during this survey and will produce a report of findings for assessment of program and to be included in program reports. To ensure that samples are similar, quantitative measurements will be taken to numerically characterize substrate and flow at sampling points to validate samples and rule out the subjectivity of site selection. Any samples that are proven to be dissimilar will be undergo further validation prior to their inclusion into the analysis.

1.5 Quality Objectives and Criteria for Measurement Data

The purpose of this program is to aid in the determination of the existing water quality of the Delaware River for development of numerical criteria for water quality regulations consistent with the goals of the Wild and Scenic designation as directed by Congress. Along with the development of regulatory criteria, the data gathered will be used to develop a B-IBI for the non-tidal Delaware River. Presently, no longitudinal surveys of this nature have been conducted on the non-tidal Delaware River, leaving little or no historical data to compare to for assuring data quality. Due to the lack of existing data, the data quality standards discussed in this QAPP will be used to validate collected data and will require investigators to determine limitations of data outside of DRBC's desired usage for development of water quality criteria and a B-IBI for the Delaware River.

Bias
All samples collected will be sorted in the laboratory. This allows for a more comfortable environment and more productive sorting effort.

Precision
Precision of samples will be determined will calculating the relative percent difference (RPD) between sample at the same sight, during the same year as well as against historical data. Any samples that have a RPD greater than 10% will be analyzed further and data disregarded at the discretion of the Project Officer.

Completeness
The completeness of gathered data will be dependant on the ability to physically collect samples as well the ability taxonomically identify samples. Conditions may not allow for collection of samples at all sites during the prescribed sampling year, this will create and incomplete sample set. In this case, samples will be collected in duplicate during the following year during the same index period. The conditions of some of the macroinvertebrates may also not allow for taxonomic identification, rendering the sample incomplete if a substantial number of individuals are in poor condition.

Comparability
Comparability of collected sample will be ensured by analyzing substrate and habitat condition by numerical data collected on-site. Simple correlation of the data will prove the comparability of collected samples. Sampling protocol calls for sampling in the Richest Targeted Habitat (Cuffney et al. 1993) which in this study will be perennially wetted cobble riffles of the Delaware River. Sample collection will be done by the same methodology and individuals in all cases. Stations will remain the same for each annual survey unless substantial change to conditions arises.

1.6 Special Training / Certification

Sample collection will be performed by personnel trained in the various sample elements of this study. Only those individuals trained in EPAs Rapid Bioassessment (Barbor et al 1999) techniques and familiar with the BFN will collect macroinvertebrate samples.

Other personnel who are trained in gathering flow measurements, conducting Wolman Pebble Counts, and making habitat assessments will perform those duties. Any participants who are not familiar with these activities will be instructed prior to sample collection.

All participants will be trained in canoe/ small vessel safety if they do not already possess knowledge in this area. Participants will also have read and become familiar with the material contained in DRBC "Field Safety Manual".

Macroinvertebrate taxonomy will be conducted by a trained taxonomist on DRBC Staff. The macroinvertebrates will be identified and catalogued using ITIS and other taxonomic standards. A sub-set of samples (10%) will be sent to an outside contractor as part of the Quality Control requirements for the project. The contractor must have only trained staff complete the QA/QC portion of project.

1.7 Documents and Records

The Project Manager will be responsible for maintaining and archiving all documents that pertain to this survey. Hardcopies of all files will be kept by the Program Manager on file at the Delaware River Basin Commission office. Electronic data specific to this program will also be stored in house on compact discs and stored on-site as well as at an undisclosed outside location.

Standard Data Reporting Format
The standard data reporting format will be the bench sheet found in Appendix B, Figure 7. Both DRBC staff and Contract lab will record data on these sheets prior to entry by DRBC staff in Ecological Data Application System (EDAS) database.

2. Measurement/ Data Acquisition

2.1 Sampling Process Design

Macroinvertebrate samples will be collected at twenty-five stations along the mainstem, non-tidal Delaware River along with 1 sample in each the East and West Branch Delaware River, near their confluence. The stations will be distributed longitudinally over the entire 200 miles of non-tidal Delaware River with segmentation as even as the geology and hydrology allow. All samples will be collected during the August – September critical low flow index period. Table 3 shows the schedule of all tasks that are part of the biomonitoring program. Appendix A, Figure 1 shows sampling locations for 2002 Delaware River Biomonitoring Program.

Table 3. Schedule of events for Delaware River Biomonitoring Program 2003

Tasks	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct - Dec
QAPP Development										
Sample Collection										
Water Gap - Trenton										
Middle Delaware (DEWA)										
Upper Delaware (UPDE)										
Macroinvertebrate Taxonomy										
Habitat Assessment Data Analysis										
Macroinvertebrate Data Analysis										
QA/QC Report (if necessary)										

2.2 Sampling Methods

Macroinvertebrates
The macroinvertebrate sample collection for this project will be conducted in a modified RBP format. Samples will be collected using a Big River Frame Net (BFN) with a substrate frame. The net was designed by Wildco®, with specifications made by DRBC staff. The net is 3ft w. x 2 ft h. with 500µm mesh, closely resembling a slack sampler. In addition to the net, a 2ft w. x 2ft h. substrate frame is used to delineate a 4 ft^2 sampling area to provide the ability for a more quantitative analysis than a standard D-frame kick net or Slack Sampler and also providing an increased sample area. The design of this net 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 increased sample size was based on recommendations made by the National Park Service and Academy of Natural Sciences citing low densities and inconsistent distributions of macroinvertebrate communities in the Upper Delaware River (National Park Service, Report Nos. 01-5F, 01-7F).

The site selection will focus around the richest targeted habitat of the Delaware River, which has been specified as the midstream, cobble riffle microhabitat. The exact location of the sample will be chosen after a visual inspection by the principal investigator. The selection of the site will be based on the ideal substrate and flow characteristics required for macroinvertebrate colonization as well as representative of the entire riffle to be sampled.

Once the sampling location has been identified, samples will be collected using a modification of the Traveling Kick Method (Barbour et al, 1999). A person will stand down stream of the sampling area and be responsible for securing the net. The frame will be placed directly upstream of the net and will be held in place by a second individual while the area inside the frame is agitated by foot by the individual holding the net. Once the coarse agitation of the substrate has been completed, the individual holding the frame will do a final check to make sure that all of the delineated area has been disturbed, ensuring that the sample effort has been maximized. Any of the area that does not appear to have been disturbed will be agitated by hand.

The bulk of the sample will then be rinsed into a large, water-filled container to simplify the cleaning of the net. The macroinvertebrates that were not dislodged by the rinse will then be 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 will then be condensed by pouring it through a 500μm sieve, then transferred to the labeled sample container that contains the macroinvertebrates that where picked from the net. After careful inspection of both the net and container for remaining macroinvertebrates, both will be rinsed and prepared for the next sample. The macroinvertebrate samples are then preserved in Ethyl Alcohol (>75%) for later identification. The sample will contain labels both inside and outside of container. The sample label will accompany the sample through the entire sort-identify process. Example of the sample label can be found in Appendix B, Figure 1.

This sampling procedure will be conducted 3 times at each site, creating 3 discrete samples for each site. Each of these samples will be labeled separately with A being the first and C being the third. The naming scheme for the samples taken will be as follows:

DRBC 3350 A

Where **DRBC** is the organization responsible for site selection and designation, **3350** is the whole number river mile value at that site, and **A** is the letter signifying the first sample taken at that site (Delaware River Basin Commission, 1988).

In-stream Habitat

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

Pebble Count: A Wolman pebble count will be conducted at the each of the sampling site to numerically characterize the particle size of each of the sampled areas (Wolman, 1954). 100 particles gathered along the sampled transect will be measured using an AL-SCI Field Sieve from Albert Scientific. These particles will be placed in the sieve to determine the size class of each particle and the data recorded on surface of sieve until it can be transferred to a field sheet. Measurements will be analyzed to determine average size and class of substrate present. These measurements will be used to validate the comparability of the benthic community collected with each sample. The median particle size (D_{50}) should fall in the range between 40 and 70 mm. Outliers will be noted and examined further upon completion of statistical analysis. Example of field sheet can be found in Appendix B, Figure 4.

Velocity Measurement: Velocity measurements will be taken using a digital Pygmy meter at the left, center, and right edge of each of the areas sampled for macroinvertebrates. This will determine the velocity and depth to validate the comparability of the benthos collected in each sample. The velocity measurement taken at each site should fall in the range of 1.0 and 3.0 cfs. Any samples falling outside this range will be noted for further examination following statistical analysis if any issues arise. Depth of samples collected should range between 0.5 and 1.5 ft. Any outliers will be noted and examined further upon completion of statistical analysis. Example of field sheet can be found in Appendix B, Figure 2.

Water Quality: Physical

Instantaneous measurement of the physical properties of the water will be conducted at each of the sampling sites. A Hydrolab Quanta™ multi-parameter sonde will be used to collect data for the following parameters:

- Dissolved Oxygen (mg/L)
- Temperature (^{o}C)
- Conductivity (mS/cm)
- pH
- Turbidity (NTU)
- TDS (mg/L)

Examples of field sheet used for recording the physical water quality parameters can be found in Appendix B, Figure 3.

Instrumentation will be calibrated for all parameters on a daily basis with the exception of Dissolved Percent Saturation (DO %), which will be calibrated at each site, and Turbidity, which requires Formazin calibration that is not safe for field calibration and disposal. The calibrations will be recorded in a logbook for analysis following completion of sampling. Example of calibration sheet from calibration logbook can be found in Appendix B, Figure 10.

Other in-stream conditions will qualitatively be assessed as part of the RBP habitat assessment that will be conducted at each site. This habitat assessment system uses the following parameters to approximate the instream health of the system.

- Epifaunal Subtrate/ Available Cover

- Embeddedness
- Velocity Depth Regime
- Sediment Deposition
- Channel Flow Status
- Channel Alterations
- Frequency of Riffles (or Bends)

These measurements, once analyzed, will be used as possible explanations for deficiencies found in the macroinvertebrate community. Example can be found in Appendix B, Figure 5.

Riparian Habitat
A riparian habitat assessment will be conducted at each site consistent with the RBP habitat assessment protocol. Documentation will be made of any non-aquatic factors that may have influences on the health of the benthic community. The following parameters will be used in approximating the health of the riparian area.

- Bank Stablility
- Vegetative Protection
- Riparian Vegetative Zone Width

These will not be analyzed as part of the survey, only to explain discrepancies found in macroinvertebrate data. Field sheet example can be found in Appendix B, Figure 5.

Locational Information
Locational information will be collected at each site using a hand-held Magellan GPS unit. The positioning information will be used for Geographic Information System (GIS) presentation and analysis of data. Locational information and notes will also be reported on a set of DRBC "River Recreational Maps" for navigation on future studies.

2.3 Sample Handling and Custody Requirements

Samples will reside at the DRBC office for a brief period until identified taxonomically by DRBC Staff. While samples are in-house, they will be periodically checked to ensure that preservative is fresh and at an adequate concentration to prevent decay of tissue, which would render invertebrates unidentifiable.

All samples will be recorded on a sample log as they are collected by DRBC staff. This will help locate each of the samples and ensure that all samples are handled and identified in an appropriate manner. An example of a sheet from the sample log can be found in Appendix B, Figure 6. Also, a log will be completed documenting the sorting and taxonomy of all samples under this program. An example of this sheet can be found in Appendix B, Figure 7. This information will also be used for time allocation and budgeting for future studies.

An anticipated 10% (n=8) of samples will be sent to an outside contractor for Quality Control analysis following DRBC taxonomic identification. At this time, the randomly selected samples will be analyzed for sorting efficiency and taxonomic integrity of the DRBC staff taxonomist. The samples will be delivered to the contractor in person or by

mail, where custody will be relinquished at that time. The contractor will be given 120 days for sample analysis and data return to DRBC on bench sheets (Appendix B, Figure 9) following the DRBC format. Appendix B, Figure 8 is a sample chain of custody record for macroinvertebrate samples.

2.4 Analytical Methods

DRBC macroinvertebrate samples will be taxonomically identified by trained DRBC staff of by contract laboratory. Taxonomy will be conducted on a 200 organism sub-sample for use in a multi-metric analysis. The sub-sample will be 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 will be sorted until a total of 200 organisms is reached. Once this number is met, the individual will sort the remainder of that grid, and all organisms will be taxonomically identified. This is done to prevent bias of the 200 organisms and also give a more quanitative estimate of sample density. Identification of organisms will be to Genus-level or lowest achievable taxon. All taxonomic identities will be consistent with Integrated Taxonomic Identification System (ITIS) or other taxonomic standard.

At the current time, metrics used for analysis are currently under review. A committee of area experts plans to meet to discuss possible metric and biotic index techniques for use in the analysis and index development.

Instantaneous ambient water quality measurements will be collected using a Hydrolab Quanta™ multiparameter meter. Methodologies used can be found in Table 4:

Table 4: Perscribed methodologies for water quality monitoring using Hydrolab Quanta™

Measurement	Units	Methodology	Calibration
Dissolved Oxygen (DO mg/L)	mg/L	SM 4500-O.G.	Winkler Titration Method, SM 4500-O.C.
Dissolved Oxygen (DO %)	%	SM 4500-O.G.	Air Calibration (On-Site)
Specific Conductance (SpC)	mS/cm	ISO 7888-1985	Standard Solution (84mS/cm Standard)
Water Temperature	^{o}C	SM 2550	Factory Calibration
pH	pH units	SM 4500-H+	pH Buffer Solution (2 Point)
Total Dissolved Solids (TDS)	g/L	*Snoeynick & Jenkins	Standard Solution (84mS/cm Standard)
Turbidity (Turb)	NTU	GLI Method 2 ISO 7027:1999	4000 NTU Formazin Stock Solution (Dilution to 40 NTU) and a "Zero" (DIUF)

2.5 Quality Control

Field QA/QC will be obtained by using trained staff for all of sample and field measurement collection. All parties will have been trained in each of the measurement or sample collection procedure that they will participate in. Site selection and macroinvertebrate collection will be completed by the same personnel at all sites (G. Smith and R. Limbeck) to limit subjective errors. The QA officer will also oversee a set number of sample collections (n=3) to assure that sample collection is consistent with the methodologies described in this QAPP.

Laboratory QA/QC will be achieved by having all taxonomy completed by trained staff using taxonomic standards. All taxa will be verified using ITIS, ARGIS, or another taxonomic standard. Upon completion of taxonomy by DRBC Staff, 10% of samples will be sent to an outside contractor for sorting efficiency measurement and taxonomic verification. Sorting efficiency will be conducted on only the debris that is actually used for generation of the subsample (sort residue). If more than 20 organisms, or 10% of the subsample, are found in the sort residue, the sample is reconstituted and subsample conducted again.

2.6 Instrument / Equipment Testing, Inspection, and Maintenance

Macroinvertebrates will be collected using a Big River Frame Net (BFN) developed by Wildco in conjunction with DRBC staff. The net will be 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 adequately repaired.

Pygmy meters that will be used will under go careful inspection before each usage and must pass a 60-second spin test prior to usage to insure that data collected is valid. The "cups" for the meter will be cleaned, oiled, and stored as recommended by manufacturer after each usage.

The Hydrolab Quanta™ multiparameter meter will be inspected each day prior to usage. All probes will be maintained in compliance with manufacturer's recommendations and will be subjected to calibration on a daily basis

2.7 Instrument / Equipment Calibration and Frequency

The Hydrolab Quanta™ will be calibrated on a daily basis for all parameters to be measured, with the exception of Dissolved Oxygen percent saturation (DO %), which will undergo and air calibration at each site. If any values seem to fall outside of expected values, measurement will be noted and a calibration will be conducted after the completion of sampling to validate the measurement. Calibration procedures can be

found in Table 4. All calibrations will be logged and used to validate measurements during the data analysis period.

2.8 Data Management

All data generated by this program will be managed by the Delaware River Basin Commission. Incoming data will be delivered in a manner specified by the Commission prior to collection of data. Data will be managed and maintained using the EDAS biological database located in-house by trained staff members familiar with the monitoring program. Data will also reside on STORET national database.

3. Assessment and Oversight

3.1 Assessment and Response Actions

Assessment and responses to problems involving quality of data elements will be conducted routinely. The QA/ QC officer and Program Manager will be responsible for continuous assessment of sample collection procedures and the resulting data elements to ensure validity of the data reported. Any data that may be in question will be noted and the respective data handled in an appropriate manner. These measures will ensure data of the highest quality for data reporting, assessment, and criteria development.

3.2 Reporting

Reporting of the QA/ QC assessment will be conducted on an "as required" basis. A report of findings will be submitted to the program manager only if the quality of the data is in question. This report will identify the respective data set, the basis for its identification as invalid, and measures taken as a result of the findings. This report will also be included in the preliminary and final reports for the project validate the findings of the project.

4. Data Validation and Usability

4.1 Data Review, Verification, and Validation

All data elements that are generated by this project will undergo a review process prior to their analysis and subsequent release in report form. There will be various levels of review scheduled to ensure that the data generated is valid for analysis. See Table 5 for list of data validation methods.

Table 5: Data Review and Validation Procedures

Develoment Process

Aspect Under Review	Person(s)	Reason
Collection Methodolgy	QA/ QC Officer Project Officer	To guarantee that the protocol picked best fit the intent of data
Analysis Packages	QA/ QC Officer Project Officer	To guarantee that sample analysis methods will serve the prescribed function of the program

Collection Process

Aspect Under Review	Person(s)	Reason
Sample Collection	Project Officer	Sample collection is consistent with protocol as well as with each other
Calibration Log	QA/ QC Officer Project Officer	To ensure that physical measurements used to validate macroinvertebrate samples are in fact valid themselves

Sample Analysis Process

Aspect Under Review	Person(s)	Reason
Macroinvertebrate Sample	Taxonomist	Determine whether organisms are capable of being identified with confidence to desired taxon
Habitat Data	QA/ QC Officer Project Officer	To both validate the actual habitat data itself as well as the reproducability of macroinvertebrate samples collected
Macroinvertebrate Taxonomy	Head Taxonomist QA/QC Officer Project Officer	To ensure that macroinvertebrate data reported is valid prior to analysis

Data Analysis Process

Aspect Under Review	Person(s)	Reason
Data Entry	Project Officer	To ensure that data was correctly input into analysis package
Data Analysis	Project Officer	To ensure that methods used for analysis are valid prior to reporting
Data Storage/ Reporting	Project Officer	To ensure that data that is being received has not been altered during any step of the entry or analysis process, rendering it invalid

4.2 Reconciliation with Data Quality Objectives

The data gathered by this project will be used for the development of a B-IBI for the non-tidal Delaware River as well as for possible criteria development for The Delaware River Basin Water Quality Regulations. Once the valid macroinvertebrate data is gathered and analyzed, the findings will be used for determining the existing water quality (EWQ) of the Delaware River and for development of potential numerical water quality criteria to prevent degradation of the EWQ. The data gathered will also be used in the development of a B-IBI for use of point-to-point assessment of the riffle habitat of the non-tidal Delaware River.

5. References

Academy of Natural Resources. 1996. Bioassessment study for the Delaware Water Gap National Recreation Area and the Upper Delaware Scenic and Recreational River 1996-Year 2. National Park Service, Report No. 01-5F.

Academy of Natural Resources. 1997. Bioassessment study for the Delaware Water Gap National Recreation Area and the Upper Delaware Scenic and Recreational River 1997-Year 3. National Park Service, Report No. 01-7F.

Barbour, M.T., Gerritsen, J., Snyder, B.D., Stribling, J.B. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers. United State Environmental Protection Agency, EPA 841-B-99-002. pp. 5-1 – 5-31, 7-1 – 7-20.

Bunte, K., Abt, S.R. 2001. Sampling surface and Subsurface particle-size distributions in wadable gravel- and cobble-bed streams for analysis in sediment transport, hydraulics, and streambed monitoring. United States Department of Agriculture, General Technical Report RMRS-GTR-74.

Cuffney, T.F., Gurtz, M.E., Meador, M.R. 1993. Methods for collecting benthic invertebrtate samples as part of the National Water Quality Assessment Program. United States Geological Survey, Open-File Report 93-406. p. 22-23.

Delaware River Basin Commission. 1988. The Delaware River Basin Stream Mileage System. Staff Paper 105.

Delaware River Basin Commission. 2000. Field Safety Manual.

Delaware River Basin Commission. 1996. Water Quality Regulations, Administrative Manual-Part III. Resolution 96-12.

Rosgen, D.L. 1998. The Reference Reach Field Book. Pp. 96-97

United States Environmental Protection Agency. 1998. EPA guidance for quality assurance project plans. EPA QA/G-5.

Wolman, M.G. 1954. A method of sampling coarse river-bed material. Transactions, American Geophysical Union 35(6): pp. 952-956.

Appendix A

Figure 1: Map of sampling locations for Delaware River Biomonitoring Program

Table 1: Sampling sites and locations

Site Name	Site Number	River Mile	Latitude	Longitude
West Branch Delaware River	DRBC3310W	331.0	41.95250	-75.29121
East Branch Delaware River	DRBC3310E	331.0	41.95199	-75.28016
Buckingham Access	DRBC3250	325.0	41.86627	-75.26293
Long Eddy (Down's Residence)	DRBC3150	315.0	41.84669	-75.13317
Callicoon Bridge	DRBC3040	304.0	41.76508	-75.06120
Castillo del Rio	DRBC2935	293.5	41.64772	-75.04939
Ascalona Campground	DRBC2790	279.0	41.49817	-74.98205
Pond Eddy (Landers Base)	DRBC2690	269.0	41.44466	-74.86242
Port Jervis	DRBC 2550	255.0	41.37229	-74.69813
Kittatinny Access	DRBC 2499	249.9	41.34134	-74.75964
Cadoo Rd. (NPS Property)	DRBC 2475	247.5	41.32364	-74.78502
Spackman's Island	DRBC 2336	233.6	41.17032	-74.89400
Bushkill Access	DRBC 2285	228.5	41.10439	-74.98422
Worthington	DRBC 2150	215.0	41.00448	-75.10609
Arrow Island	DRBC 2108	210.8	40.96275	-75.11989
Portland	DRBC 2073	207.3	40.89449	-75.07563
Capush Island	DRBC 1949	194.9	40.79190	-75.10891
Getter's Island	DRBC 1843	184.3	40.69973	-75.20121
Forks of the Delaware	DRBC 1833	183.3	40.68362	-75.19946
Whippoorwill Island	DRBC 1798	179.8	40.65406	-75.19819
Upper Black Eddy	DRBC 1666	166.6	40.55148	-75.08178
Treasure Island	DRBC 1608	160.8	40.47566	-75.06330
Paunacussing Bar	DRBC 1556	155.6	40.40936	-75.04072
Washingtons Crossing	DRBC 1418	141.8	40.29657	-74.86853
Rotary Island	DRBC 1369	136.9	40.23963	-74.81852

Appendix B

Figure 1. Sample Label

Site Number: _____
Site Name: _____

Date: _____
Time: _____

Delaware River Basin Commission
DELAWARE • NEW JERSEY
PENNSYLVANIA • NEW YORK
UNITED STATES OF AMERICA

Type of Sample: _____
Preservative: _____
Method: _____
Collectors: _____

Container _____ of _____

Figure 2. Instantaneous Water Quality and Velocity Measurement Sheet

Delaware River Biomonitoring Program
Instream Habitat Assessment
Instantaneous Water Quality and Flow Velocity Measurements

Station Name: _____

Station Number: _____

Date (YYYY/MM/DD) **and Time** (Military) _____

Dissolved Oxygen	Method:	Hydrolab Quanta	mg/l
Air Temperature	Method:	Hydrolab Quanta	°C
Water Temperature	Method:	Hydrolab Quanta	°C
Specific Conductance	Method:	Hydrolab Quanta	µmhos/cm
pH	Method:	Hydrolab Quanta	pH units
Turbidity (*in situ*)	Method:	Hydrolab Quanta	NTU
Total Dissolve Solids	Method:	Hydrolab Quanta	g/L

Collectors: _____

Instrument: _____ **Spin Test** _____ **seconds**

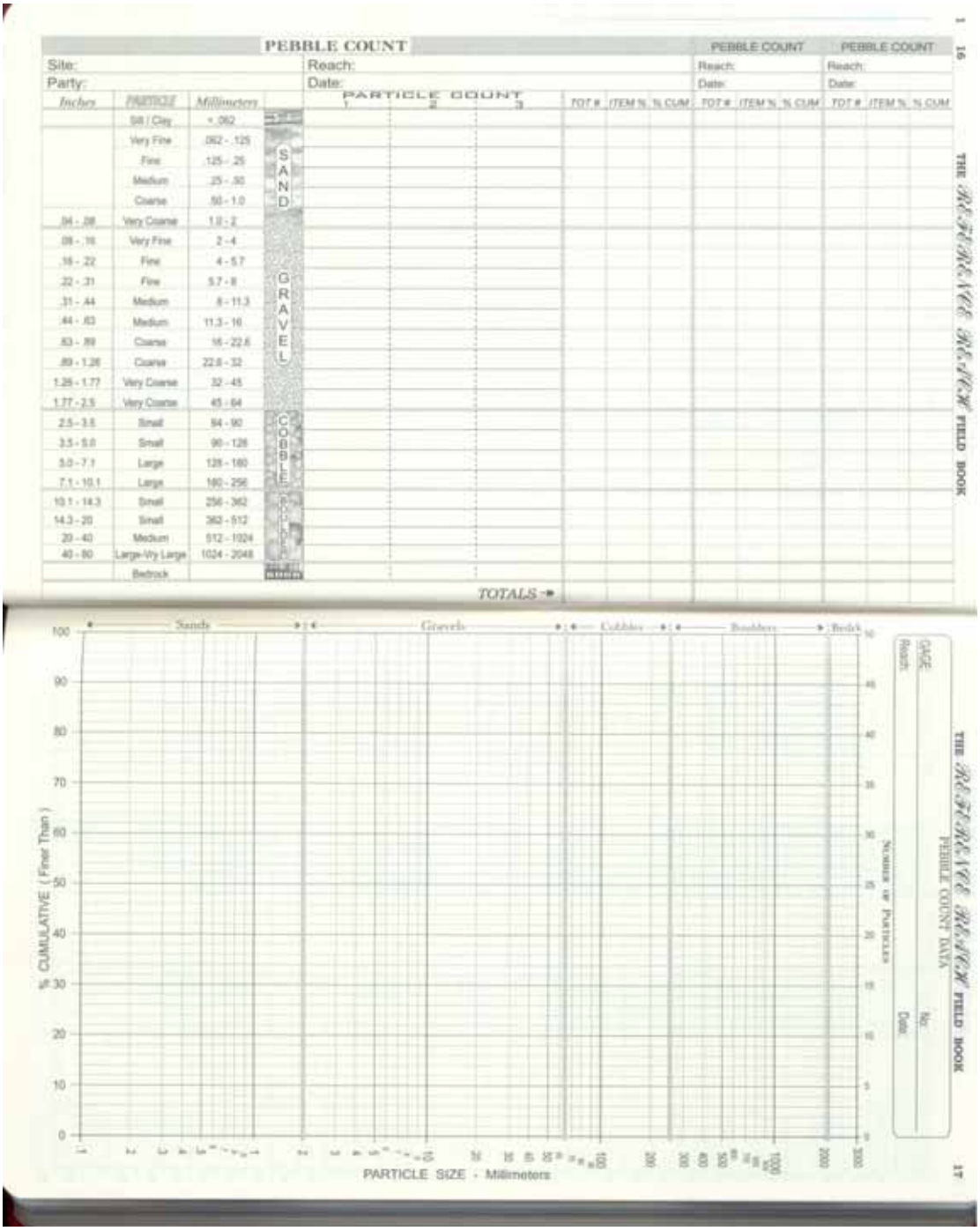
	Depth	Revolutions	Time	Velocity
Left				
Center				
Right				
Average				

	Depth	Revolutions	Time	Velocity
Left				
Center				
Right				
Average				

	Depth	Revolutions	Time	Velocity
Left				
Center				
Right				
Average				

Comments: _____

Figure 4. Pebble Count Form



(Rosgen, D.L., 1998)

Figure 5. Field Habitat Assessment Forms

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET
(FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

WEATHER CONDITIONS	**Now**	**Past 24 hours**	**Has there been a heavy rain in the last 7 days?** ❑ Yes ❑ No **Air Temperature**_____ ° C **Other**_____
	❑ storm (heavy rain) ❑ rain (steady rain) ❑ showers (intermittent) ____%❑ %cloud cover ❑ clear/sunny	❑ ❑ ❑ ❑____% ❑	
SITE LOCATION/MAP	**Draw a map of the site and indicate the areas sampled (or attach a photograph)**		
STREAM CHARACTERIZATION	**Stream Subsystem** ❑ Perennial ❑ Intermittent ❑ Tidal **Stream Origin** ❑ Glacial ❑ Spring-fed ❑ Non-glacial montane ❑ Mixture of origins ❑ Swamp and bog ❑ Other_____		**Stream Type** ❑ Coldwater ❑ Warmwater **Catchment Area**_____ km^2

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 1 A-5

(Barbour et al. 1999)

Figure 5. Field Habitat Assessment Forms (cont.)

PHYSICAL CHARACTERIZATION/WATER QUALITY FIELD DATA SHEET (BACK)

WATERSHED FEATURES	**Predominant Surrounding Landuse** ❑ Forest ❑ Commercial ❑ Field/Pasture ❑ Industrial ❑ Agricultural ❑ Other _____ ❑ Residential **Local Watershed NPS Pollution** ❑ No evidence ❑ Some potential sources ❑ Obvious sources **Local Watershed Erosion** ❑ None ❑ Moderate ❑ Heavy
RIPARIAN VEGETATION (18 meter buffer)	**Indicate the dominant type and record the dominant species present** ❑ Trees ❑ Shrubs ❑ Grasses ❑ Herbaceous **dominant species present** _____
INSTREAM FEATURES	**Estimated Reach Length** _____m **Estimated Stream Width** _____m **Sampling Reach Area** _____m^2 **Area in km^2 (m^2x1000)** _____km^2 **Estimated Stream Depth** _____m **Surface Velocity (at thalweg)** _____m/sec **Canopy Cover** ❑ Partly open ❑ Partly shaded ❑ Shaded **High Water Mark** _____m **Proportion of Reach Represented by Stream Morphology Types** ❑ Riffle _____% ❑ Run _____% ❑ Pool _____% **Channelized** ❑ Yes ❑ No **Dam Present** ❑ Yes ❑ No
LARGE WOODY DEBRIS	**LWD** _____m^2 **Density of LWD** _____m^2/km^2 **(LWD/ reach area)**
AQUATIC VEGETATION	**Indicate the dominant type and record the dominant species present** ❑ Rooted emergent ❑ Rooted submergent ❑ Rooted floating ❑ Free floating ❑ Floating Algae ❑ Attached Algae **dominant species present** _____ **Portion of the reach with aquatic vegetation** _____%
WATER QUALITY	**Temperature** _____°C **Specific Conductance** _____ **Dissolved Oxygen** _____ **pH** _____ **Turbidity** _____ **WQ Instrument Used** _____ **Water Odors** ❑ Normal/None ❑ Sewage ❑ Petroleum ❑ Chemical ❑ Fishy ❑ Other_____ **Water Surface Oils** ❑ Slick ❑ Sheen ❑ Globs ❑ Flecks ❑ None ❑ Other_____ **Turbidity (if not measured)** ❑ Clear ❑ Slightly turbid ❑ Turbid ❑ Opaque ❑ Stained ❑ Other_____
SEDIMENT/ SUBSTRATE	**Odors** ❑ Normal ❑ Sewage ❑ Petroleum ❑ Chemical ❑ Anaerobic ❑ None ❑ Other_____ **Oils** ❑ Absent ❑ Slight ❑ Moderate ❑ Profuse **Deposits** ❑ Sludge ❑ Sawdust ❑ Paper fiber ❑ Sand ❑ Relict shells ❑ Other_____ **Looking at stones which are not deeply embedded, are the undersides black in color?** ❑ Yes ❑ No

INORGANIC SUBSTRATE COMPONENTS (should add up to 100%)			ORGANIC SUBSTRATE COMPONENTS (does not necessarily add up to 100%)		
Substrate Type	**Diameter**	**% Composition in Sampling Reach**	**Substrate Type**	**Characteristic**	**% Composition in Sampling Area**
Bedrock			Detritus	sticks, wood, coarse plant materials (CPOM)	
Boulder	> 256 mm (10")				
Cobble	64-256 mm (2.5"-10")		Muck-Mud	black, very fine organic (FPOM)	
Gravel	2-64 mm (0.1"-2.5")				
Sand	0.06-2mm (gritty)		Marl	grey, shell fragments	
Silt	0.004-0.06 mm				
Clay	< 0.004 mm (slick)				

A-6 *Appendix A-1: Habitat Assessment and Physicochemical Characterization Field Data Sheets - Form 1*

Figure 5. Field Habitat Assessment Forms (cont.)

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (FRONT)

STREAM NAME	LOCATION	
STATION #_____ RIVERMILE_____	STREAM CLASS	
LAT _____ LONG _____	RIVER BASIN	
STORET #	AGENCY	
INVESTIGATORS		
FORM COMPLETED BY	DATE _____ TIME _____ AM PM	REASON FOR SURVEY

Parameters to be evaluated in sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
1. Epifaunal Substrate/ Available Cover	Greater than 70% of substrate favorable for epifaunal colonization and fish cover; mix of snags, submerged logs, undercut banks, cobble or other stable habitat and at stage to allow full colonization potential (i.e., logs/snags that are not new fall and not transient).	40-70% mix of stable habitat; well-suited for full colonization potential; adequate habitat for maintenance of populations; presence of additional substrate in the form of newfall, but not yet prepared for colonization (may rate at high end of scale).	20-40% mix of stable habitat; habitat availability less than desirable; substrate frequently disturbed or removed.	Less than 20% stable habitat; lack of habitat is obvious; substrate unstable or lacking.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
2. Embeddedness	Gravel, cobble, and boulder particles are 0-25% surrounded by fine sediment. Layering of cobble provides diversity of niche space.	Gravel, cobble, and boulder particles are 25-50% surrounded by fine sediment.	Gravel, cobble, and boulder particles are 50-75% surrounded by fine sediment.	Gravel, cobble, and boulder particles are more than 75% surrounded by fine sediment.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
3. Velocity/Depth Regime	All four velocity/depth regimes present (slow-deep, slow-shallow, fast-deep, fast-shallow). (Slow is < 0.3 m/s, deep is > 0.5 m.)	Only 3 of the 4 regimes present (if fast-shallow is missing, score lower than if missing other regimes).	Only 2 of the 4 habitat regimes present (if fast-shallow or slow-shallow are missing, score low).	Dominated by 1 velocity/ depth regime (usually slow-deep).
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
4. Sediment Deposition	Little or no enlargement of islands or point bars and less than 5% of the bottom affected by sediment deposition.	Some new increase in bar formation, mostly from gravel, sand or fine sediment; 5-30% of the bottom affected; slight deposition in pools.	Moderate deposition of new gravel, sand or fine sediment on old and new bars; 30-50% of the bottom affected; sediment deposits at obstructions, constrictions, and bends; moderate deposition of pools prevalent.	Heavy deposits of fine material, increased bar development; more than 50% of the bottom changing frequently; pools almost absent due to substantial sediment deposition.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
5. Channel Flow Status	Water reaches base of both lower banks, and minimal amount of channel substrate is exposed.	Water fills >75% of the available channel; or <25% of channel substrate is exposed.	Water fills 25-75% of the available channel, and/or riffle substrates are mostly exposed.	Very little water in channel and mostly present as standing pools.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0

Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition - Form 2 A-7

Figure 5. Field Habitat Assessment Forms (cont.)

HABITAT ASSESSMENT FIELD DATA SHEET—HIGH GRADIENT STREAMS (BACK)

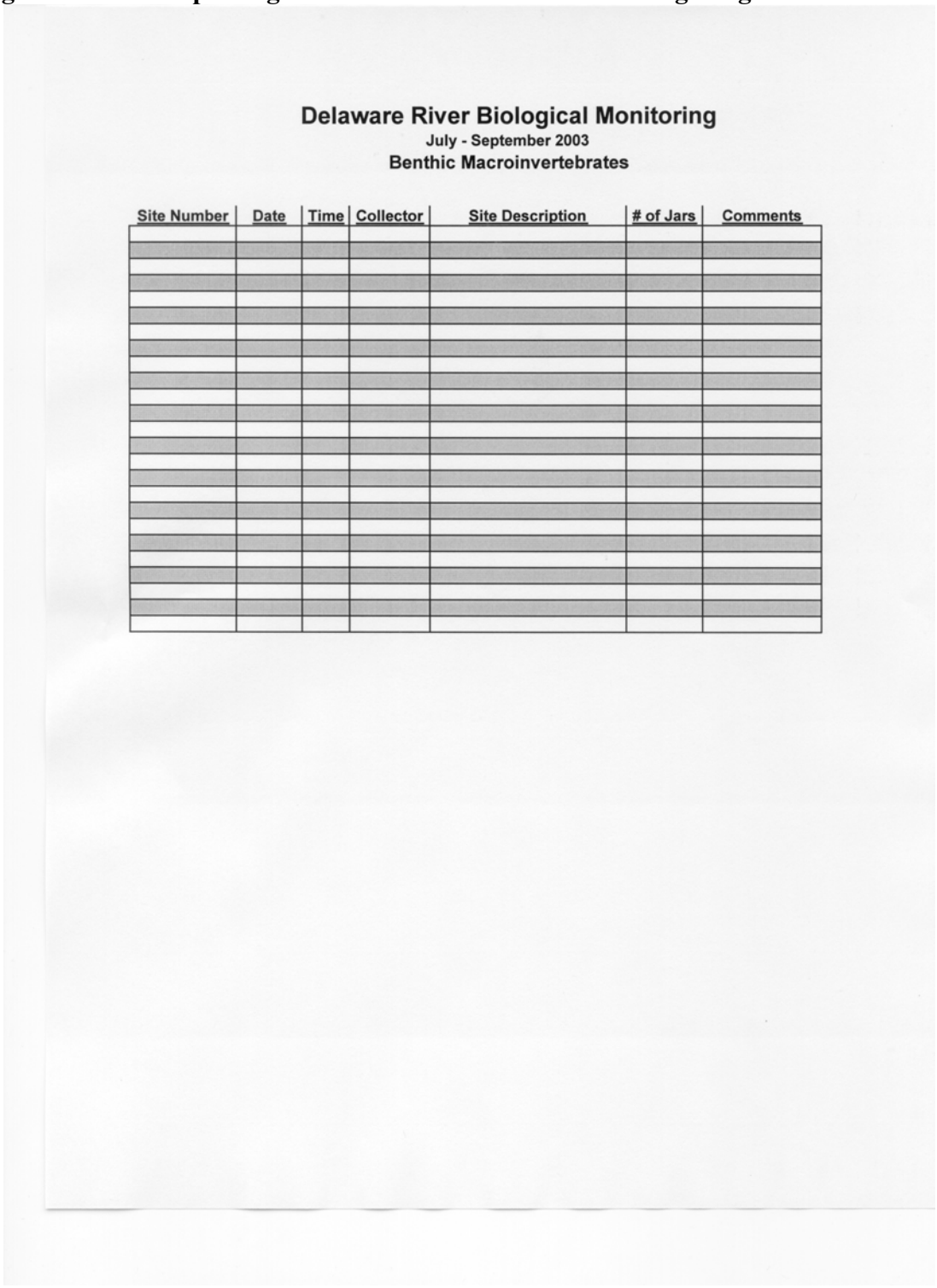
Parameters to be evaluated broader than sampling reach

Habitat Parameter	Condition Category			
	Optimal	Suboptimal	Marginal	Poor
6. Channel Alteration	Channelization or dredging absent or minimal; stream with normal pattern.	Some channelization present, usually in areas of bridge abutments; evidence of past channelization, i.e., dredging, (greater than past 20 yr) may be present, but recent channelization is not present.	Channelization may be extensive; embankments or shoring structures present on both banks; and 40 to 80% of stream reach channelized and disrupted.	Banks shored with gabion or cement; over 80% of the stream reach channelized and disrupted. Instream habitat greatly altered or removed entirely.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
7. Frequency of Riffles (or bends)	Occurrence of riffles relatively frequent; ratio of distance between riffles divided by width of the stream <7:1 (generally 5 to 7); variety of habitat is key. In streams where riffles are continuous, placement of boulders or other large, natural obstruction is important.	Occurrence of riffles infrequent; distance between riffles divided by the width of the stream is between 7 to 15.	Occasional riffle or bend; bottom contours provide some habitat; distance between riffles divided by the width of the stream is between 15 to 25.	Generally all flat water or shallow riffles; poor habitat; distance between riffles divided by the width of the stream is a ratio of >25.
SCORE	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1 0
8. Bank Stability (score each bank) Note: determine left or right side by facing downstream.	Banks stable; evidence of erosion or bank failure absent or minimal; little potential for future problems. <5% of bank affected.	Moderately stable; infrequent, small areas of erosion mostly healed over. 5-30% of bank in reach has areas of erosion.	Moderately unstable; 30-60% of bank in reach has areas of erosion; high erosion potential during floods.	Unstable; many eroded areas; "raw" areas frequent along straight sections and bends; obvious bank sloughing; 60-100% of bank has erosional scars.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
9. Vegetative Protection (score each bank)	More than 90% of the streambank surfaces and immediate riparian zone covered by native vegetation, including trees, understory shrubs, or nonwoody macrophytes; vegetative disruption through grazing or mowing minimal or not evident; almost all plants allowed to grow naturally.	70-90% of the streambank surfaces covered by native vegetation, but one class of plants is not well-represented; disruption evident but not affecting full plant growth potential to any great extent; more than one-half of the potential plant stubble height remaining.	50-70% of the streambank surfaces covered by vegetation; disruption obvious; patches of bare soil or closely cropped vegetation common; less than one-half of the potential plant stubble height remaining.	Less than 50% of the streambank surfaces covered by vegetation; disruption of streambank vegetation is very high; vegetation has been removed to 5 centimeters or less in average stubble height.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0
10. Riparian Vegetative Zone Width (score each bank riparian zone)	Width of riparian zone >18 meters; human activities (i.e., parking lots, roadbeds, clear-cuts, lawns, or crops) have not impacted zone.	Width of riparian zone 12-18 meters; human activities have impacted zone only minimally.	Width of riparian zone 6-12 meters; human activities have impacted zone a great deal.	Width of riparian zone <6 meters: little or no riparian vegetation due to human activities.
SCORE ___ (LB)	Left Bank 10 9	8 7 6	5 4 3	2 1 0
SCORE ___ (RB)	Right Bank 10 9	8 7 6	5 4 3	2 1 0

Total Score _____

A-8 *Appendix A-1: Habitat Assessment and Physicochemical Characterization Field Data Sheets - Form 2*

Figure 6. Sample Log for Delaware River Biomonitoring Program



Delaware River Biological Monitoring
July - September 2003
Benthic Macroinvertebrates

Site Number	Date	Time	Collector	Site Description	# of Jars	Comments

Figure 7. Laboratory Matrix for Sorting and Taxonomic Identification

Delaware River Biomonitoring Program

Laboratory Matrix - Sampling Season 2003

Site Number	Site Description	Portion	Date Sorted	Time Expended	Date Identified	Time Expended
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				
		A				
		B				
		C				

Figure 8. Sample Chain of Custody Record

Delaware River Biomonitoring Program
CHAIN-OF-CUSTODY RECORD

Page: 1 of 1

Principal Investigator:		Geoffrey Smith			Agency: Delaware River Basin Commission			
Address & Phone:		PO Box 7360, W. Trenton NJ 08628 609-883-9500 x 234			Project: Delaware River Biomonitoring Program			
Date Collected (YYYYMM)	Time Collected (Mil. HHMM)	Site No.	Location	# jars	Sample Type (see below)	Preserv-ation (see below)	Collect. Method	Log Number (Seq+)
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
					Benthos	ETOH	BFN Comp.	
Sampled by (signature):								
Received by (signature):					Date		Time	
Received by (signature):					Date		Time	
Received by (signature):					Date		Time	
Received by (signature):					Date		Time	
Received by (signature):					Date		Time	

Instructions:

Record all information concerning samples.
Check log numbers against containers to assure all samples are present, then sign in appropriate spaces.
Keep original Chain-of-Custody Record with samples.
Person relinquishing samples should receive a photocopy of this form.
Notify Project Manager immediately of any damaged or missing samples.

Figure 9. Sample Bench Sheet for Macroinvertebrate Taxonomy

Delaware River Biomonitoring Program

Bench Tally Sheet

Site Name: _____ **Date:** _____

Site Number: _____ **Time:** _____

Collectors: _____ **Method:** _____

Taxonomist: _____ **Grids:** ___ of _____

Taxa	No.		Taxa	No.
1.			26.	
2.			27.	
3.			28.	
4.			29.	
5.			30.	
6.			31.	
7.			32.	
8.			33.	
9.			34.	
10.			35.	
11.			36.	
12.			37.	
13.			38.	
14.			39.	
15.			40.	
16.			41.	
17.			42.	
18.			43.	
19.			44.	
20.			45.	
21.			46.	
22.			47.	
23.			48.	
24.			49.	
25.			50.	

* Resized to fit page

Figure 10: Example of Page from Calibration Logbook

Hydrolab Quanta Calibration Sheet

Date: _____ Time: _____

DO Percentage *Air Calibration

	Initial Value	Calibration	Final Value	Initials
Air Temperature:		Y or N		

DO Concentration (mg/L)

	Initial Value	Calibration	Final Value	Initials
Water Temperature:				
DO (mg/L):		Y or N		

Winkler Titrations

1. _____
2. _____
3. _____

Comments: _____

pH Calibration (2pt)

	Initial Value	Calibration	Final Value	Initials
7.0 Buffer:		Y or N		
4.0 Buffer:		Y or N		

*anticipated values less than 7.0

7.0 Buffer:		Y or N		
10.0 Buffer:		Y or N		

*anticipated values greater than 7.0

Comments: _____

Specific Conductance (84 µS/cm Standard)

	Initial Value	Calibration	Final Value	Initials
Specific Conductivity:		Y or N		
Temperature:				

Comments: _____

Tubidity (2pt, 4000 NTU Stock)

*dilution created using 1mL stock and 99mL water

	Intial Value	Calibration	Final Value	Initials
Zero (DI water):		Y or N		
40 NTU Standard:		Y or N		

Comments: _____