SCENIC RIVERS MONITORING PROGRAM FOR THE NON-TIDAL DELAWARE RIVER: QUALITY ASSURANCE PROJECT PLAN 2008-2009

DELAWARE RIVER BASIN COMMISSION

DRBC Project Officer:	Thomas J. Fikslin	Date
DRBC Quality Assurance Officer:	Edward D. Santoro	Date
DRBC Program Officer	Robert L. Limbeck	Date
USEPA Project Officer	Patricia Iraci	Date

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1 Project Management Elements

The elements in this section address project management, including project history and objectives, roles and responsibilities of the participants. These elements document that the project has a defined goal and the approach to be used, and that the planning outputs have been documented.

1.1 Distribution List

Signed copies of this Quality Assurance Project Plan (QAPP) and all subsequent revisions will be sent to the following individuals by *electronic mail*:

Table 1. QAPP Distribution List

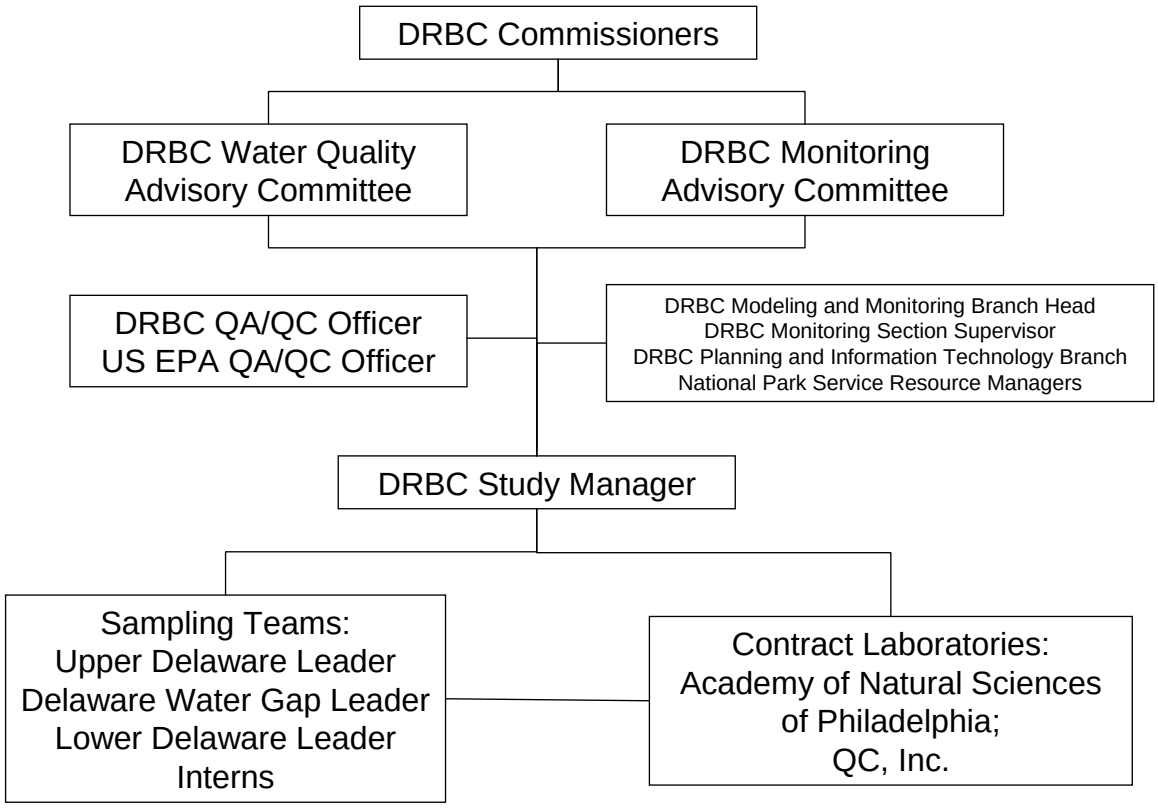
Individual	Organization
Dr. Thomas Fikslin	Delaware River Basin Commission
Mr. John Yagecic	Delaware River Basin Commission
Dr. Erik Silldorff	Delaware River Basin Commission
Mr. Robert Limbeck	Delaware River Basin Commission
Ms. Pamela V'Combe	Delaware River Basin Commission
Dr. Kenneth Najjar	Delaware River Basin Commission
Ms. Erin McCracken	Delaware River Basin Commission
Mr. Edward S. Santoro	Delaware River Basin Commission
Mr. Allan Ambler	National Park Service
Mr. Patrick Lynch	National Park Service
Mr. Donald Hamilton	National Park Service
Ms. Jamie Myers	National Park Service
Mr. Alan Ellsworth	National Park Service
Mr. Peter Murdoch	U.S. Geological Survey
Mr. Richard E. Draper	New York State Department of Environmental Conservation
Mr. James Newbold	Pennsylvania Department of Environmental Protection
Ms. Leslie McGeorge	New Jersey Department of Environmental Protection
Ms. Patricia Iraci	USEPA, Region 3, Office of Watersheds
Dr. David Velinsky	Academy of Natural Sciences of Philadelphia
Mr. Paul Kiry	Academy of Natural Sciences of Philadelphia
Mr. George Argiriou	QC Laboratories, Inc.
Mr. Thomas Hines	QC Laboratories, Inc.
Ms. Catherine Willis	QC Laboratories, Inc.

Printed copies will be available upon request. Furthermore, signed copies of this QAPP and all subsequent revisions will be available from the Delaware River Basin Commission (DRBC) web site at http://www.state.nj.us/drbc/

1.2 Project / Task Organization

Figure 1 below identifies the individuals and organizations participating in the project and outlines the formal lines of responsibility.

Figure 1. Lines of Responsibility and Authority



For the purposes of this QAPP, the Project Team consists of all federal and state personnel and contracted personnel actively involved in the development, coordination, and completion of the sampling program. Table 2 below briefly describes the duties and responsibilities of the members of the Project Team.

Table 2. Description of Responsibility

Key Individual	Title	Phone	Responsibility
Robert Limbeck, DRBC	Study Manager	609-883-9500 x230	Provide overall project coordination, including the preparation of a quality assurance project plan, the scheduling of project tasks to ensure timely completion, coordination and oversight of sampling and analyses, the review of the data to determine compliance with QA/QC requirements and the overall quality of the data, and preparation of a final report.
John Yagecic, P.E.	Monitoring Supervisor	609-883-9500 x271	Provide monitoring supervision; coordination with DRBC modeling section.
Edward D. Santoro, M.S. DRBC	DRBC QA/QC Officer	609-883-9500 x268	Ensure that the overall quality assurance of the project is achieved; and ensure that activities are coordinated between DRBC, National Park Service; U.S. EPA and the analytical laboratories to meet project schedule.
Donald Hamilton and Jamie Myers, NPS	NPS Sample Collection Team Leaders, Upper Delaware Scenic and Recreational River	570-729-7842	Oversee sample collection from the Delaware River and tributaries in the Upper Delaware Scenic and Recreational River; ensure sample collection in accordance with QAPP procedures; ensure sampling equipment decontamination between sampling locations; ensure proper sampling containers and preservation procedures; QA coordinator for field activities; and ensure response action implementation during sampling operations, if needed. Transmittal of field data to DRBC.
Allan Ambler, NPS	NPS Sample Collection Team Leader, Delaware Water Gap National Park	570-296-6952 x 22	Oversee sample collection from the Delaware River and tributaries in the Delaware Water Gap National Park; ensure sample collection in accordance with QAPP procedures; ensure sampling equipment decontamination between sampling locations; ensure proper sampling containers and preservation procedures; QA coordinator for field activities; and ensure response action implementation during sampling operations, if needed. Transmittal of field data to DRBC.
Robert Limbeck, DRBC	DRBC Sampling Team Leader, Lower Delaware Scenic and Recreational River	609-883-9500 x 230	Oversee collection of water samples from the Delaware River and tributaries in the Lower Delaware Scenic and Recreational River; ensure sample collection in accordance with QAPP procedures; ensure sampling equipment decontamination between sampling locations; ensure proper sampling containers and preservation procedures; QA coordinator for field activities; and ensure response action implementation during sampling operations, if needed.
Peter Murdoch, USGS	Study Manager for USGS/NPS Upper Delaware Project	518-285-5663	Coordinate with DRBC/NPS project to ensure concurrent USGS/NPS and DRBC/NPS studies are complementary; provide technical advice and assistance with data interpretation and study planning.
David Velinsky and Paul Kiry, Academy of Natural Sciences; and Thomas Hines George Argiriou Catherine Willis, QC Inc.	Laboratory Managers ANSP, Philadelphia, PA. QC Inc, Southampton, PA QC Inc, Wind Gap, PA	 215-299-1147 215-355-3900	Ensure that sample container preparation and analysis of samples specified in 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 QA/QC requirements are met; prepare analytical data package including precision and accuracy data; serve as QA coordinator for laboratory activities; ensure that response actions are implemented, if needed; and transmit analytical results to DRBC in a timely manner.

1.3 Problem Definition and Background

The Scenic Rivers Monitoring Program (SRMP), a long-standing partnership between the Delaware River Basin Commission (DRBC) and the National Park Service (NPS), is responsible for monitoring and management of water quality in the Special Protection Waters of the Upper Delaware Scenic and Recreational River (UPDE), the Delaware Water Gap National Recreation Area (DEWA), and the Lower Delaware Scenic and Recreational River (LDEL). These regions cover approximately 200 miles of the non-tidal Delaware River and selected boundary locations within the 6,780 square mile drainage area (see Figures 2 and 3).

The Delaware River Basin Commission in partnership with the National Park Service is currently working on a 3 pronged approach to implementing and improving the DRBC's Special Protection Waters program; 1) monitoring, 2) modeling, and 3) stakeholder organization.

Since the inception of Upper and Middle Delaware River Special Protection Waters antidegradation rules in 1992, DRBC and NPS have encountered problems with applied assessment of water quality changes versus reach-wide existing water quality (EWQ) targets. Data from this study will be used to convert UPDE and DEWA reach-wide existing water quality targets so that site-specific concentration and loading targets can be created for project review applications and statistical comparison of new data to baseline EWQ. This "Control Point Approach" was applied successfully in the Lower Delaware, where rules approved in 2008 include EWQ defined on a site specific basis. In addition, this study also includes a Lower Delaware component. It has been 5 years since Lower Delaware data were last collected (2000-2004), and it is necessary to revisit those sites to determine whether or not existing water quality has changed. In the control point approach, Delaware River sites are known as Interstate Control Points (ICP) and tributary boundary sites are known as Boundary Control Points (BCP).

Data collected under this QAPP will serve a variety of purposes:

1. To develop site specific EWQ for UPDE and DEWA project review applications.
2. To define baseline water quality for assessment of water quality changes over time.
3. To provide antidegradation objectives for planning sustainable development.
4. To provide data in support of DRBC and state integrated listing decisions.
5. To determine whether Lower Delaware EWQ has measurably changed since 2004.
6. To provide data for development and use of water quality models.

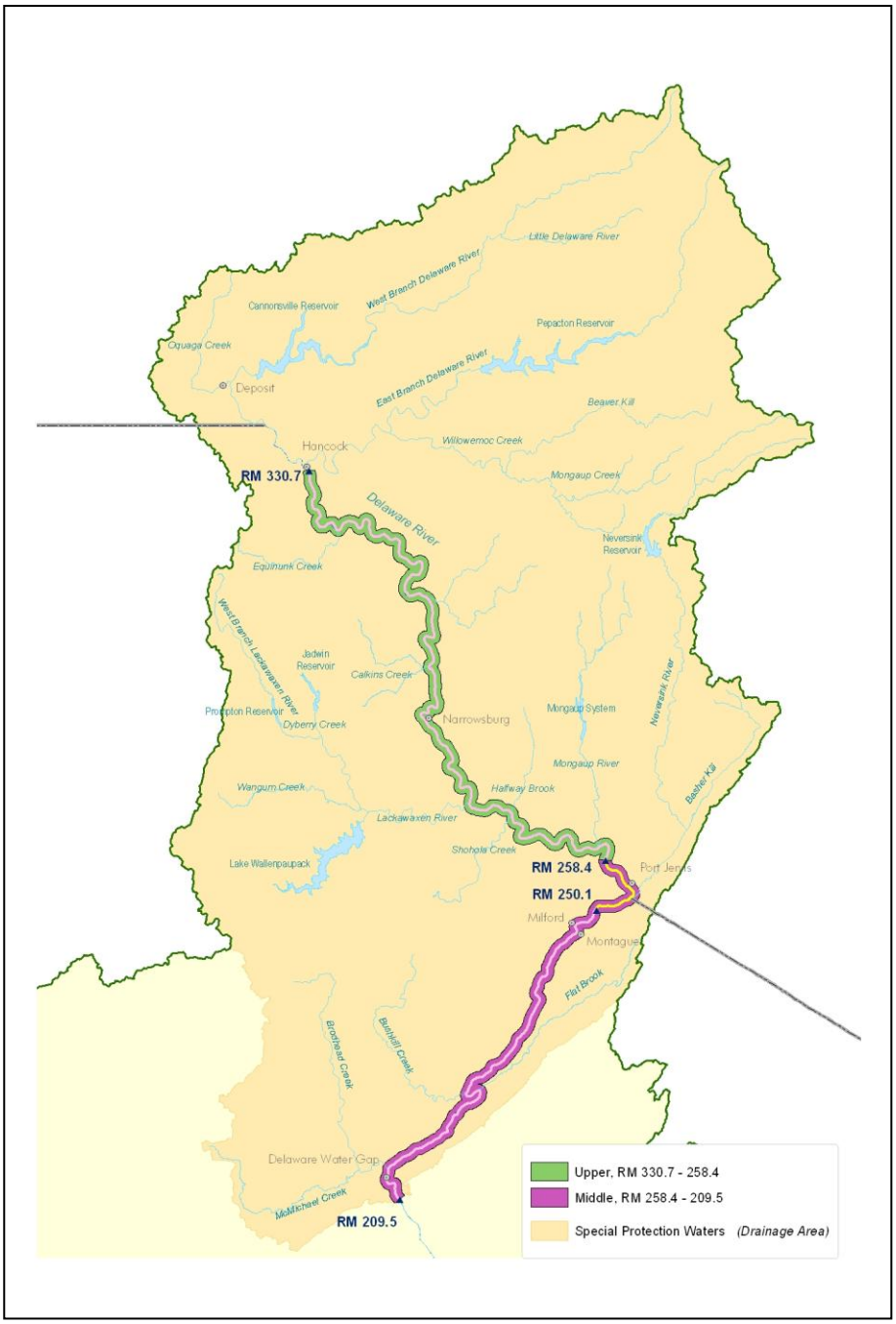


Figure 2. Upper and Middle Delaware River Special Protection Waters.

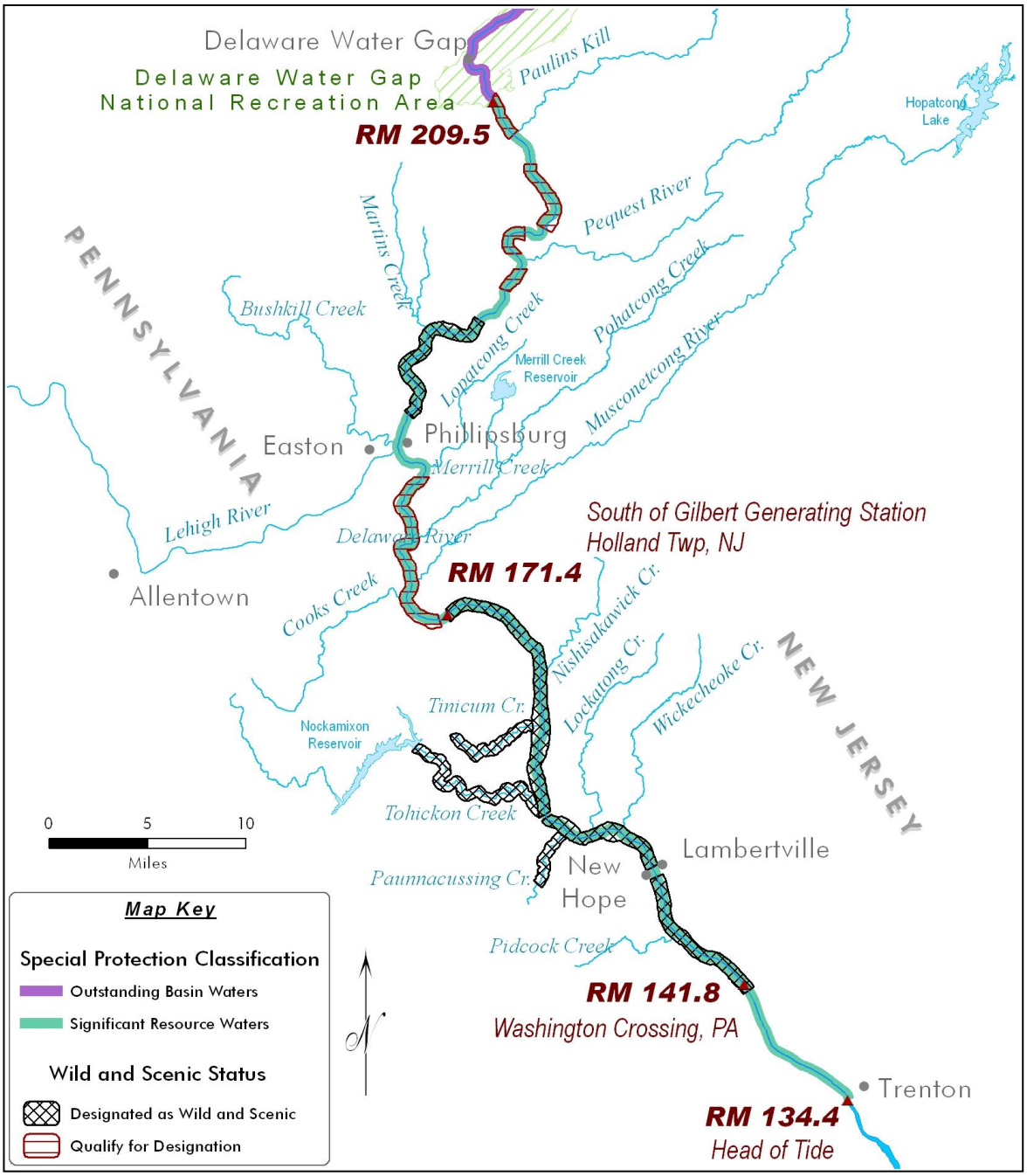


Figure 3. Lower Delaware River Special Protection Waters.

1.4 Project / Task Description

DRBC will collect water quality measurements beginning May 2008 to:

1) convert reach-wide EWQ targets to ICP and BCP targets in UPDE and DEWA;
2) prepare nodal hydrologic and water quality information for a longitudinal water quality model for SPW implementation;
3) gather sufficient water quality information to implement DRBC SPW regulations using a site-specific statistical approach to definition and assessment of changes to existing water quality; and
4) starting May 2009, determine whether Lower Delaware EWQ has measurably changed since 2004.

Sufficient historical water quality data exist to develop a preliminary water quality model, but not to convert reach-wide EWQ targets to site-specific EWQ targets. Additional data are needed to refine a model and to fully and evenly populate most BCP and ICP nodes along the river with water quality data. This QAPP is intended to address SRMP water quality data needs through 2010, though annual editions will reflect slight changes as new information becomes available.

1.5 Quality Objectives and Criteria

The purpose of this investigation is to characterize loadings and ambient concentrations of specific water column parameters in the Upper, Middle, and Lower Delaware River and tributaries to support DRBC Special Protection Waters rules.

1.5.1 Precision

Precision is the measure of the degree to which two or more measurements are in agreement. Precision is assessed through the collection and measurement of field replicates. Relative Percent Difference (RPD) shall be calculated for each of the replicates collected for all the parameters analyzed. Precision in the laboratory is assessed through the calculation of RPD for matrix spikes and matrix spike duplicates and of the field split samples.

RPD is calculated using the equation $RPD = \frac{S - D}{0.5(S + D)} \times 100$

Where:

S = Amount in Spike 1 **or** concentration of parameter in original
D = Amount in Spike 2 **or** concentration of parameter in replicate

1.5.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference value. Accuracy in the field is assessed through the use of rinsate (field) and trip blanks and through the adherence to all sample handling, preservation and holding times. The field accuracy objective is to have no quantifiable concentrations of the any of the analytical parameters in either the rinsate or the trip blanks, and to adhere to all sample handling, preservation and holding times. Laboratory accuracy and matrix interference is assessed through the analysis of matrix spikes and the determination of percent recoveries.

1.5.3 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 field duplicate samples.

1.5.4 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 amount of valid measurements obtained from all the measurements taken in the field. Laboratory completeness is a measure of the amount 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 with a specific matrix and/or analysis. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

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

Where:

V = Number of valid measurements.
P = Number of planned measurements.

Funding derived from EPA Grants will only be applied toward collection and analysis of complete, valid samples.

1.5.5 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.

1.6 Special Training / Certification

Sample collection must be performed by personnel who have experience in the collection of samples for chemical and physical analysis. All members of the sampling team must review and be familiar with this QAPP, and its references.

Chemical and physical analysis will be performed by individuals familiar with the analytical techniques described by this plan. These analyses will be conducted by contract laboratories using EPA-approved methods: QC, Inc. will provide bacterial analyses; and the Academy of Natural Sciences of Philadelphia will provide conventional and nutrient analyses.

No other specific training or certification is required.

1.7 Documents and Records

The Study 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.

Revisions to this QAPP which are made after signature will be provided to the individuals listed in Table 1 by electronic mail. If revisions are made after signature, the Revision No. at the top of the page will be changed to reflect the current Revision number. Changes made to this QAPP prior to signature will not result in a change in Revision number. The study manager will provide revisions to this QAPP to all the recipients listed in Table 1, after each revision, by electronic mail.

All electronic files associated with this project, including this QAPP and all electronic data deliverables, will be backed up onto compact disks (CDs) at a minimum of once per month and after each significant revision or update.

1.7.1 Standard Data Reporting Format

Data will be reported to DRBC from the selected analytical laboratory in both hardcopy and electronic data deliverable (EDD) form. Figure 2 below shows an example of hardcopy format.

Figure 4. Hardcopy format of Laboratory Analytical Data

Mr. Robert Limbeck
Delaware River Basin Commission
PO Box 7360
25 State Police Drive
West Trenton, NJ 08628-0360

Laboratory ID:
Date Received:
Discarded:

Page of

Project Name: Scenic Rivers Monitoring Program
Work Order ID:

PO #
COC #

Sample ID:
Date/Time Collected:

Matrix:
Collected By:

Analysis Parameter	Result	Units	Reporting Limit	Detection Limit	Method	Dilution	Date/Time Completed	Prep Date	Analyst Init
results……									
results……									
results……									
results……									

Comments

Laboratory Manager

2 Data Generation and Acquisition Elements

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 Sampling Process Design (Experimental Design)

Starting in May 2008, up to 59 stations will be sampled up to 10 times on a biweekly schedule from May through September (SRMP designated locations in Table 3). Sampling events will be staggered to capture a representative range of flow conditions, seasonal, and daily variability in order to develop representative seasonal (May to September) Existing Water Quality targets. All Upper, Middle and Lower Delaware ICP and BCP concentrations and loadings will be included in a time variable water quality model for Special Protection Waters implementation.

2.2 Sampling Methods

This project involves collection of measurements and water samples from the Delaware River and tributaries. Sampling locations and frequencies are listed in Table 3. EPA-approved field measurement methods are shown in Table 4. EPA-approved laboratory analytical methods are shown in Table 5.

Table 3. Sample Locations and Frequency

Note: FUTURE indicates that site is not sampled in 2009, but will be developed as a control point in the future.

ICP or BCP	Site Name	River Mile	Longitude	Latitude	Site No	Number of Samples 2008	Number of Samples 2009
Upper Delaware SRR							
ICP	West Branch Delaware River	331.20	-75.29121	41.95250	3312 BCP	10	10
BCP	East Branch Delaware River, NY	330.70	-75.28016	41.95199	3307 BCP	10	10
BCP	Shehawken Ck, PA	331.00	-75.28928	41.94009	3310 BCP	Future	Future
BCP	Equinunk Ck, PA	322.50	-75.22528	41.85333	3225 BCP	-	10
ICP	Delaware River at Lordville Bridge	321.60	-75.21444	41.86917	3216 ICP	10	10
BCP	Basket Ck, NY	314.10	-75.10139	41.84444	3141 BCP	Future	Future
BCP	Little Equinunk Ck, PA	312.70	-75.12083	41.82583	3127 BCP	Future	Future
ICP	Delaware River at Kellams Bridge	312.59	-75.11417	41.82333	3126 ICP	10	10
ICP	Delaware River at Callicoon Bridge	303.70	-75.06167	41.76472	3037 ICP	10	10
BCP	Callicoon Ck, NY	303.60	-75.03278	41.76444	3036 BCP	10	10
ICP	Delaware River at Damascus Bridge	298.40	-75.06750	41.70500	2984 ICP	10	10
BCP	Calkins Ck, PA	295.60	-75.06528	41.67361	2956 BCP	-	10
ICP	Delaware River at Narrowsburg Bridge	289.90	-75.06222	41.60944	2899 ICP	10	10
BCP	Tenmile River, NY	284.20	-75.00111	41.57083	2842 BCP	-	10
BCP	Masthope Ck, PA	282.50	-75.02778	41.53806	2825 BCP	-	10
ICP	Delaware River at USGS Gage 01428500	279.21	-74.98611	41.50889	2792 ICP	10	10
BCP	Lackawaxen River, PA	277.71	-74.99222	41.48639	2777 BCP	10	10
ICP	Delaware River at Barryville Bridge	273.50	-74.91389	41.47694	2735 ICP	10	10
BCP	Halfway Brook, NY	273.40	-74.91056	41.47708	2734 BCP	Future	Future
BCP	Shohola Ck, PA	273.20	-74.91319	41.47222	2732 BCP	-	10
BCP	Mill Brook, NY	265.60	-74.82167	41.43889	2656 BCP	Future	Future
ICP	Delaware River at Pond Eddy Bridge	265.50	-74.82028	41.43944	2655 ICP	10	10
BCP	Mongaup River, NY	261.10	-74.75611	41.42694	2611 BCP	10	10
ICP	Delaware River at Millrift RR Bridge	258.40	-74.73917	41.40639	2584 ICP	10	10
Delaware Water Gap NRA							
ICP	Delaware River at Port Jervis Bridge	254.75	-74.69778	41.37167	2548 ICP	10	10
BCP	Neversink River, NY	253.64	-74.68556	41.36111	2536 BCP	10	10
ICP	Delaware River at DEWA Boundary **	250.20	-74.75778	41.34361	2502 ICP	10	10
BCP	Vandermark Ck, PA	247.30	-74.79694	41.32500	2473 BCP	10	Completed 2008
BCP	Sawkill Ck, PA	247.00	-74.80000	41.31722	2470 BCP	10	Completed 2008
BCP	Shimers Brook, NJ	246.60	-74.78125	41.31305	2466 BCP	10	Completed 2008
ICP	Delaware River at Montague, NJ **	246.38	-74.79556	41.30917	2464 ICP	10	10
BCP	Raymondskill Ck DEWA bdy PA	243.90	-74.85167	41.30556	2439 BCP	10	Completed 2008
BCP	Adams Ck DEWA boundary, PA	240.30	-74.88250	41.25250	2403 BCP	10	Completed 2008

ICP or BCP	Site Name	River Mile	Longitude	Latitude	Site No	Number of Samples 2008	Number of Samples 2009
BCP	Dingmans Ck DEWA bdy, PA	239.20	-74.92000	41.23806	2392 BCP	10	Completed 2008
ICP	Delaware River at Dingmans Access **	238.67	-74.86194	41.21528	2387 ICP	10	10
BCP	Hornbecks Ck DEWA bdy, PA	236.40	-74.90972	41.19555	2364 BCP	10	Completed 2008
BCP	Toms Ck DEWA boundary, PA	230.40	-74.95528	41.15195	2304 BCP	10	Completed 2008
ICP	Delaware River at Bushkill Access **	228.11	-74.98194	41.10833	2281 ICP	10	10
BCP	Bushkill Ck DEWA bdy, PA	226.90	-75.03833	41.08861	2269 BCP	10	10
BCP	Little Bushkill Ck DEWA bdy PA	226.90	-75.00417	41.09778	2269A BCP	10	10
BCP	Sand Hill Ck DEWA bdy, PA	226.90	-75.00888	41.08500	2269B BCP	Future	Future
BCP	Big Flatbrook DEWA bdy, NJ	225.30	-74.84583	41.19000	2253 BCP	10	10
BCP	Little Flatbrook DEWA bdy, NJ	225.30	-74.84694	41.19028	2253A BCP	10	10
BCP	Van Campens Bk DEWA bdy NJ	219.90	-75.00333	41.05778	2199 BCP	10	Completed 2008
ICP	Delaware River at Smithfield Access **	218.36	-75.05972	41.02444	2184 ICP	10	10
BCP	Brodhead Ck, PA	213.00	-75.14306	40.99792	2130 BCP	10	10
BCP	Marshalls Ck, PA	213.00	-75.13833	40.99861	2130A BCP	10	10
BCP	Cherry Ck, PA	212.60	-75.13750	40.98611	2126 BCP	Future	Future
ICP	Delaware River at Kittatinny Access **	211.50	-75.13750	40.97000	2115 ICP	10	10
BCP	Dunnfield Ck DEWA bdy, NJ	211.40	-75.12695	40.97056	2114 BCP	Future	Future
Lower Delaware Scenic and Recreational River							
ICP	Delaware River at Portland Foot Bridge	207.40	-75.09611	40.92417	2074 ICP	-	5
BCP	Paulins Kill, NJ	207.00	-75.08833	40.92083	2070 BCP	-	5
ICP	Delaware River at Belvidere Bridge	197.84	-75.08500	40.82889	1978 ICP	-	5
BCP	Pequest River, NJ	197.80	-75.06111	40.83417	1978 BCP	-	10
ICP	Delaware River at Martins Ck RR Bridge	194.30	-75.11591	40.78940	1943 ICP	-	10 (NEW 2009-11)
BCP	Martins Ck, PA	190.65	-75.18472	40.78472	1907 BCP	-	10
BCP	Bushkill Ck, PA	184.10	-75.20611	40.69528	1841 BCP	-	10
ICP	Delaware River at Northampton St Bridge	183.82	-75.20417	40.69111	1838 ICP	-	5
BCP	Lehigh River, PA	183.66	-75.23667	40.66917	1837 BCP	-	10
BCP	Lopatcong Ck, NJ	182.00	-75.17499	40.67949	1820 BCP	-	10 (NEW 2009-11)
BCP	Pohatcong Ck, NJ	177.40	-75.18611	40.62472	1774 BCP	-	5
ICP	Delaware River at Riegelsville Bridge	174.80	-75.19111	40.59389	1748 ICP	-	5
BCP	Musconetcong River, NJ	174.60	-75.18667	40.59250	1746 BCP	-	10
BCP	Cooks Ck, PA	173.70	-75.21157	40.58737	1737 BCP	-	5
ICP	Delaware River at Upper Black Eddy	167.70	-75.93222	40.56639	1677 ICP	-	5
BCP	Nishisakawick Ck, NJ	164.10	-75.06028	40.52639	1641 BCP	-	5
BCP	Tinicum Ck, PA	161.60	-75.05583	40.48528	1616 BCP	-	5
BCP	Tohickon Ck, PA	157.00	-75.06667	40.42306	1570 BCP	-	5
BCP	Paunnacussing Ck, PA	155.60	-75.04167	40.39889	1556 BCP	-	5
ICP	Delaware River at Bulls Island Footbridge	155.40	-75.03778	40.40750	1554 ICP	-	5
BCP	Lockatong Ck, NJ	154.00	-75.01806	40.41583	1540 BCP	-	5

ICP or BCP	Site Name	River Mile	Longitude	Latitude	Site No	Number of Samples 2008	Number of Samples 2009
BCP	Wickecheoke Ck, NJ	152.50	-74.98694	40.41167	1525 BCP	-	5
ICP	Delaware River at Lambertville Bridge	148.70	-74.94917	40.36583	1487 ICP	-	5
BCP	Pidcock Ck, PA	146.30	-74.94525	40.32873	1463 BCP	-	5
ICP	Delaware River at Washington Crossing	141.80	-74.86889	40.29528	1418 ICP	-	5
ICP	Delaware River at Calhoun St Bridge	134.34	-74.77833	40.21972	1343 ICP	-	5

** These locations are sampled by canoe while crossing a representative transect across the Delaware River as near as possible to those locations specified in Figure 3. All other Delaware River locations are composite-sampled from bridges. If conditions are unsafe for boating, samples are taken by wading near shore. Such side channel samples shall be clearly marked in all records.

Specific locations have been identified by global positioning system.

If a sampling site is temporarily inaccessible, the sampling team will return to the sampling site as soon as the site becomes accessible. If a sampling site is permanently inaccessible, the Study Manager and Sample Collection Team leader will select an alternate site on the same tributary and document the change and rationale in a memorandum for the record.

At each sample location, the field measurements shown in Table 4 will be collected. All water column field measurements will be collected using a Hydrolab Quanta multi-parameter sonde, if available. If the Hydrolab Quanta multi-parameter sonde is not available, water column field measurements will be made using the YSI 52, YSI 30, and Isfet meters as indicated. Measurements will be taken by lowering the sonde directly into water body to a depth approximately 1/3 of the total depth at that location and allowing it to stabilize prior to recording of data. For each sampling location, field measurements will be made at 3 points across the channel: (1) at approximately the thalweg (where the channel is deepest), (2) at a point approximately midway between the thalweg and the right bank, and (3) at a point approximately midway between the thalweg and left bank. Since the thalweg may not be located midway between the two banks, the distances between the samples may not be equal and will be different from location to location. Between sites, meter will be rinsed and stored in deionized water as recommended by manufacturer. While onsite, weather and site observations will also be recorded.

Table 4. Field Measurements at Each Sample Location

Parameter	Meter	Unit	Method
Water Temp.	Hydrolab Quanta	°C	SM 2550 Thermometric
Dissolved Oxygen	Hydrolab Quanta	mg/L	SM 4500 O Membrane Electrode
pH	Hydrolab Quanta	Units	SM 4500 H+ Electrometric
Conductivity	Hydrolab Quanta	mS/cm	ISO 7888-1985
Air Temp.	Thermometer	°C	SM 2550 Thermometric
Air Temp.	YSI 52	°C	SM 2550 Thermometric
Water Temp.	YSI 52	°C	SM 2550 Thermometric
Dissolved Oxygen	YSI 52	mg/L	SM 4500 O Membrane Electrode
pH	Isfet probe	Units	SM 4500 H+ Electrometric
Conductivity	YSI 30	µS/cm	SM 2510 Platinum electrode conductivity cell
Gage Height	Wire weight cable	0.01 feet	USGS TWRI 3, A7-A8

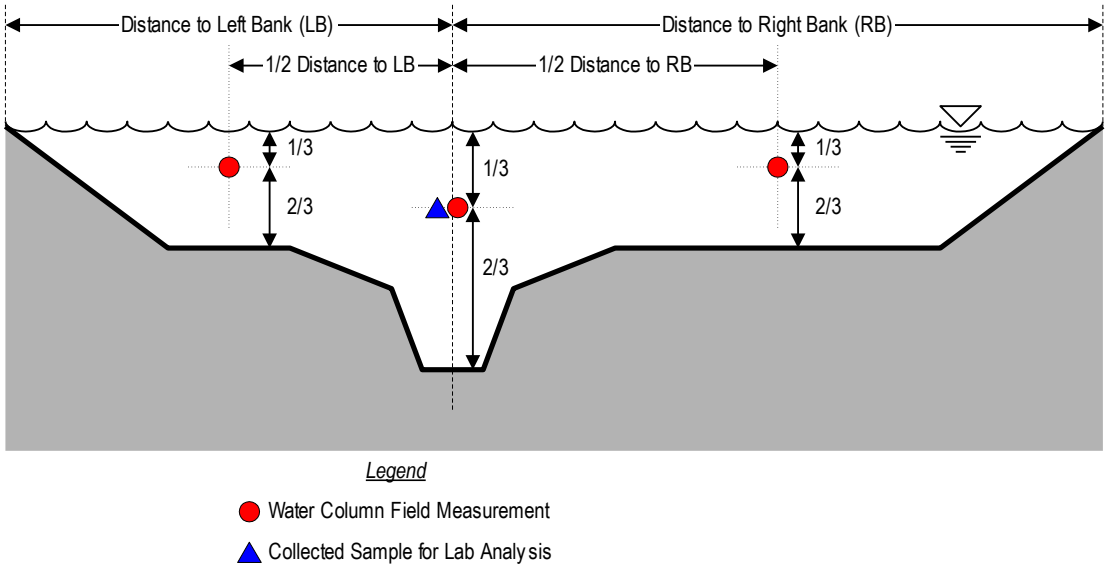
At each sample location, water samples will be collected and submitted to the analytical laboratory for the analyses indicated in Table 5. Samples will be collected at a predetermined point near the thalweg of the water body to be sampled. The bottle will be lowered into the water to a depth approximately 1/3 of the total depth at the location and the subsequent retrievals will be poured into sample bottles prepared by laboratory prior to sampling. Once all bottles are filled, they will be returned to the labeled bag from which they were removed and placed in an iced cooler for transportation to the laboratory.

Table 5. Sample Analysis for Each Sample Location

Parameter	Method	Detection Limit
Alkalinity, Total	SM 2320B	0.39 mg/l
Chloride	EPA 300.0 rev 2.1 & 300.1 rev 1.0	0.37 mg/L
Hardness	SM 2340C Hard	1.01 mg/l
Nitrate + Nitrite as N	EPA 353.2 rev 2.0	0.007 mg/L
Ammonia as N	EPA 350.1 rev 2.0	0.005 mg/L
TKN	EPA 351.2 rev 2.0	0.038 mg/L
Phosphorus, Total as P	EPA 365.1 rev 2.0	0.002 mg/L
Orthophosphate as P	EPA 365.1 rev 2.0	0.002 mg/L
TDS	SM 2540C	3.10 mg/l
TSS	SM 2540D	0.43 mg/l
E. coli	EPA 1103.2	1 col/100ml
Enterococcus	SM 9230C	10 col/100ml
Fecal coliform	SM 9222D	1 col/100ml

Figure 5 shows relative depth and distance from the thalweg where both field measurements and analytical samples will be collected.

Figure 5. Field Measurement and Sample Collection Schematic



2.2.1 Sampling Equipment

All samples will be collected using a rope and bottle apparatus lowered from predetermined points from bridges or canoe transects across each of the water bodies to be sampled. The contract laboratory provides a packaged, labeled set of bottles for each of the samples to be collected. Each package contains all bottles necessary for collection of the correct volume for analysis. The bottles contain preservatives required for proper analysis as described in the analytical methods for each of the parameters to be measured. This ensures proper fixation of appropriate samples and limits improper preservation and possible accidents associated with chemical preservation methods.

2.2.2 Discharge Measurement

A discharge value will be associated with each of the field measurements and samples collected by the Scenic Rivers Monitoring Program. A gage height measurement will be taken at all sites where there is no USGS continuous monitor present. This measurement will be taken from a marked point using a fiberglass surveyor's tape. A weighted tape will be lowered until weight just breaks water's surface. The measurement will then be recorded at the point marked. This point was determined prior to sampling and surveyed so that its location is known in case the channel cross section changes. These gage heights will then be associated with a flow rating curve that is specific to each water body. The rating curve will be developed using the incremental velocity-area method (Wahl et al. 1995). A series of discharge measurements ($n \geq 5$) will be taken over the expected range of flows using a Gurley digital pygmy meter and wading rod for use in development of the rating curve. With each of the discharge measurements, a gage height will be recorded so that the measurement can be related to a point on the curve. Table 6 lists sites and methods of discharge determination.

A pair of Design Analysis Associates, Inc. DH-21 water level loggers may also be used for discharge measurement. These monitors are continuous, pressure gages that monitor gage height on a set increment. These monitors will be placed in selected streams as needed for the monitoring season. The monitors will be set to take reading at 30 minute intervals until the water level raises 0.04 ft. and then the frequency increases to every 10 minutes until the level no longer fluctuates more than 0.04 ft in the 30 minute time period. Data will be downloaded from data logger monthly to conserve usage of memory on the unit and minimize possibility of breaks in the data set as a result of expended memory or failure of equipment.

The discharge values generated by the United States Department of the Interior, United States Geological Survey (USGS) will be used for the Delaware River and gaged tributaries. For sites

where a USGS gage is not located at sampling point but does exist in the watershed, a discharge value will be calculated based on drainage area weighting. The formulas used are as follows;

Using 2 known discharge values

$$Q_x = Q_d - [((Q_d - Q_u)/(DA_d - DA_u)) \times (DA_d - DA_x)]$$

Where:
Q_x = Discharge of Unknown
Q_d = Discharge of Downstream Point
Q_u = Discharge of Upstream Point
DA_x = Drainage Area of Unknown Point
DA_d = Drainage Area of Downstream Point
DA_u = Drainage Area of Upstream Point

Using 1 known discharge value

$$Q_x = Q_d - [(Q_d / DA_d) \times (DA_x - DA_d)]$$

Where:
Q_x = Discharge of Unknown
Q_d = Discharge at Downstream Gage
DA_x = Drainage Area of Unknown
DA_d = Drainage Area at Downstream Gage

The calculations will be computed using 15-minute measurement data. Values selected will be those closest to actual sampling time.

Table 6. Methods used for determination of discharge values for the Scenic Rivers Monitoring Program

Site Number	Site Name	Drainage Area Square Miles	Gage Type	USGS Gage No. or Discharge Est. Method
3312 BCP	West Branch at Hale Eddy (WBR)	595	USGS Continuous	01426500
3307 BCP	East Branch at Fish Eddy (EBR)	784	USGS Continuous	01421000
3225 BCP	Equinunk Ck, PA	57.7	Instantaneous	DRBC Rating
3216 ICP	Delaware River at Lordville Bridge	1,590	Calculated	use WBR+EBR & CAL
3126 ICP	Delaware River at Kellams Bridge	1,670	Calculated	use WBR+EBR & CAL
3035 ICP	Delaware River at Callicoon Bridge	1,820	USGS Continuous	01427510
3036 BCP	Callicoon Ck, NY	111	USGS Continuous	01427500
2984 ICP	Delaware River at Damascus Bridge	1,840	Calculated	use CAL & BAR
2956 BCP	Calkins Ck, PA	44.0	Instantaneous	DRBC Rating
2899 ICP	Delaware River at Narrowsburg Bridge	1,910	Calculated	use CAL & BAR
2842 BCP	Tenmile River, NY	48.8	Instantaneous	DRBC Rating
2825 BCP	Masthope Ck, PA	32.0	Instantaneous	DRBC Rating
2792 ICP	Delaware River abv Lackawaxen (BAR)	2,020	USGS Continuous	01428500
2777 BCP	Lackawaxen River at Rowland, PA	597	Calculated	USGS Rating Table
2735 ICP	Delaware River at Barryville Bridge	2,660	Calculated	Use BAR & POJ
2732 BCP	Shohola Ck, PA	85.2	Instantaneous	DRBC Rating
2655 ICP	Delaware River at Pond Eddy Bridge	2,820	Calculated	Use BAR & POJ
2611 BCP	Mongaup River, NY	207	Calculated	River Master rpt
2584 ICP	Delaware River at Millrift RR Bridge	3,045	Calculated	Use BAR & POJ
2548 ICP	Delaware River at Port Jervis (POJ)	3,070	USGS Continuous	01434000
2536 BCP	Neversink River, NY	349	Calculated	01437500 DAW
2502 ICP	Delaware River at DEWA N Boundary	3,420	Calculated	Use POJ & MON
2473 BCP	Vandermark Ck, PA	5.19	Instantaneous	DRBC Rating
2470 BCP	Sawkill Ck, PA	24.7	Instantaneous	DRBC Rating
2466 BCP	Shimers Brook, NJ	7.5	Instantaneous	DRBC Rating
2464 ICP	Delaware River at Montague (MON)	3,480	USGS Continuous	01438500
2439 BCP	Raymondskill Ck, PA	24.3	Instantaneous	DRBC Rating
2403 BCP	Adams Ck, PA	8.0	Instantaneous	DRBC Rating
2392 BCP	Dingmans Ck, PA	16.5	Instantaneous	DRBC Rating
2387 ICP	Delaware River at Dingmans Access	3,542	Calculated	Use MON & BEL
2364 BCP	Hornbecks Ck, PA	9.5	Instantaneous	DRBC Rating
2304 BCP	Toms Ck, PA	9.4	Instantaneous	DRBC Rating
2281 ICP	Delaware River at Bushkill Access	3,625	Calculated	Use MON & BEL
2269 BCP	Bushkill Ck, PA	117	Calculated	01439500 DAW
2269A BCP	Little Bushkill Ck, PA (trib to Bushkill)	33.0	Calculated	01439500 DAW
2253A BCP	Flatbrook, NJ	32.7	Calculated	01440000 DAW
2253B BCP	Little Flatbrook, NJ (trib to Flatbrook)	16.0	Calculated	01440000 DAW
2199 BCP	Van Campens Brook, NJ	8.0	Instantaneous	DRBC Rating
2184 ICP	Delaware River at Smithfield Access	3,850	Calculated	Use MON & BEL
2130 BCP	Brodhead Ck, PA	259	USGS Continuous	01442500
2130A BCP	Marshalls Ck, PA	27.1	Calculated	Brodhead DAW
2115 ICP	Delaware River at Kittatinny Access	4,150	Calculated	Use MON & BEL
2074 ICP	Delaware River at Portland Foot Bridge	4,165	Calculated	Use MON & BEL
2070 BCP	Paulins Kill, NJ	177	Calculated	01443500 DAW
1978 ICP	Delaware River at Belvidere, NJ (BEL)	4,535	USGS Continuous	01446500
1978 BCP	Pequest River, NJ	157	Calculated	01445500 DAW
1943 ICP	Delaware River at Martins Ck RR Bridge	4,546	Calculated	Use BEL & RGL
1907 BCP	Martins Ck, PA	44.5	Instantaneous	DRBC Rating
1841 BCP	Bushkill Ck, PA	80.0	Calculated	01446776 DAW
1838 ICP	Delaware River at Northampton St	4,717	Calculated	Use BEL & RGL
1837 BCP	Lehigh River, PA	1,361	USGS Continuous	01454700
1820 BCP	Lopatcong Ck, NJ	14.7	Instantaneous	DRBC Rating

Site Number	Site Name	Drainage Area Square Miles	Gage Type	USGS Gage No. or Discharge Est. Method
1774 BCP	Pohatcong Ck, NJ	57.1	Instantaneous	DRBC Rating
1748 ICP	Delaware River at Riegelsville Bridge (RGL)	6,328	USGS Continuous	01457500
1746 BCP	Musconetcong River, NJ	156	Calculated	01457000 DAW
1737 BCP	Cooks Ck, PA	29.5	Instantaneous	DRBC Rating
1677 ICP	Delaware River at Upper Black Eddy	6,381	Calculated	Use RGL & TRN
1641 BCP	Nishisakawick Ck, NJ	11.1	Instantaneous	DRBC Rating
1616 BCP	Tinicum Ck, PA	24.0	Instantaneous	DRBC Rating
1570 BCP	Tohickon Ck, PA	112	Calculated	01459500 DAW
1556 BCP	Paunnacussing Ck, PA	7.9	Instantaneous	DRBC Rating
1554 ICP	Delaware River at Bulls Island Foot Bridge	6,598	Calculated	Use RGL & TRN
1540 BCP	Lockatong Ck, NJ	23.2	Instantaneous	DRBC Rating
1525 BCP	Wickecheoke Ck, NJ	26.6	Instantaneous	DRBC Rating
1487 ICP	Delaware River at Lambertville Bridge	6,680	Calculated	Use RGL & TRN
1463 BCP	Pidcock Ck, PA	12.7	Instantaneous	DRBC Rating
1418 ICP	Delaware River at Washington Crossing	6,735	Calculated	Use RGL & TRN
1343 ICP	Delaware River at Calhoun St Bridge (TRN)	6,780	USGS Continuous	01463500

2.3 Sample Handling and Custody

2.3.1 Decontamination of Field Sampling Equipment

Each item of field sampling equipment, which will come into direct contact with an analytical sample, will be triple rinsed with distilled de-ionized water between sites. The distilled de-ionized water rinses will minimize cross contamination between sites, while the sample water rinse will minimize dilution of the sample associated with residual distilled de-ionized water.

2.3.2 Sample ID and Labeling

A unique sample ID shall be assigned to each sample. The sample ID shall incorporate the body of water where the sample was collected and sample collection data as shown below:

Figure 6. Sample Identification Key

aaaa bbb – cccccccc - dddd
Example: 2115 ICP – 20060531 – 1445

Where:
a = site number derived from river mile;
b = ICP or BCP;
c = date as yyyymmdd; and
d = military time.

All the 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.

2.3.3 Sample Preservation, Holding, and Transportation

The sample collection team shall place samples into pre-preserved sample jars and maintain samples at or below 4 °C on site, during transport, and until receipt by the lab. 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 below shows the sample bottle material, maximum holding time, and preservative requirements for each analysis under this QAPP.

Table 7. Sample Preservation and Holding Time Requirements

Parameter	Sample Container	Preservative	Transport/Storage	Holding Time
Alkalinity	500 ml plastic	Unpreserved No Headspace	Ice (Temp<4C)	14 days
Hardness	250 ml plastic	HNO_3 (pH<2)	Ice (Temp<4C)	6 months
Orthophosphate	250 ml plastic	Unpreserved, Field Filtered 45µm	Ice (Temp<4C)	48 hours
Chloride	1 L Plastic	Unpreserved	Ice (Temp<4C)	28 days
TDS				7 days
TSS				7 days
Phosphorus, total as P	1 Liter plastic	H_2SO_4 (pH<2)	Ice (Temp<4C)	28 days
Ammonia as N				28 days
Nitrate+Nitrite as N				28 days
TKN				28 days
Turbidity	250 ml plastic	Unpreserved	Dark, Ice (Temp<4C)	24 hours
Fecal Coliform	Sterilized 125 ml plastic	$Na_2S_2O_3$ dechlorination	Ice (Temp<4C)	6 hours
E. coli	Sterilized 125 ml plastic	Unpreserved	Ice (Temp<4C)	6 hours
Enterococcus	Sterilized 125 ml plastic	Unpreserved	Ice (Temp<4C)	6 hours

2.3.4 Chain of Custody Documentation

The sample packaging and shipment procedures summarized below will insure that the samples will arrive at the Laboratory with the chain of custody intact.

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 a 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 samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody from the sampler to another person, to a mobile laboratory, or to/from secure storage.

Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis, with a separate signed custody, record enclosed in each sample box or cooler. The completed chain of custody documentation shall accompany the samples at all times.

Given the short holding times for several parameters, a courier may be used to transport analytical samples to the laboratory. In this case, custody seals are generally not used. However, the cooler being delivered should be well-sealed and placed in a stable location in the delivery vehicle. Samples within the cooler should be in closed Ziploc bags. The bags should be generously iced. The courier must sign the chain of custody form documenting his receipt of the samples and again when he relinquishes the samples to the lab.

2.3.5 Field Log Books and Field Data Forms

The sample collection team may record important field information in a project field log book or upon field data sheets. Field logbooks will be bound, field survey books or notebooks, with printed page numbers.

The title page of each logbook should contain the following: person to whom the logbook is assigned; logbook number; project name; project start date; project end date.

Logbook entries may contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present and the signature of the person making the entry will be entered. The date and time that each sample is collected will be recorded in the logbook. The names of visitors to the site, field sampling or investigation team personnel and the purpose of their visit will be recorded in the field logbook. Measurements

made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark. Whenever a sample is collected, or a measurement is made, a detailed description of the location of the station shall be recorded.

2.3.6 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 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.

2.4 Analytical Methods

Samples will be analyzed for the parameters shown in Table 8 below:

Table 8. Analytical Methods

Parameter	Method	Detection Limit
Alkalinity, Total	SM 2320B	0.39 mg/l
Chloride	EPA 300.0 rev 2.1 & 300.1 rev 1.0	0.37 mg/L
Hardness	SM 2340C Hard	1.01 mg/l
Nitrate + Nitrite as N	EPA 353.2 rev 2.0	0.007 mg/L
Ammonia as N	EPA 350.1 rev 2.0	0.005 mg/L
TKN	EPA 351.2 rev 2.0	0.038 mg/L
Phosphorus, Total as P	EPA 365.1 rev 2.0	0.002 mg/L
Orthophosphate as P	EPA 365.1 rev 2.0	0.002 mg/L
TDS	SM 2540C	3.10 mg/l
TSS	SM 2540D	0.43 mg/l
E. coli	EPA 1103.2	1 col/100ml
Enterococcus	SM 9230C	10 col/100ml
Fecal coliform	SM 9222D	1 col/100ml

2.5 Quality Control

Field QA/QC procedures and criteria are presented in Table 9 below.

Laboratory QA/QC procedures and criteria are fully defined in the analytical methods. A summary of project required QA/QC procedures is provided in Table 9 below, but for a full discussion of the Laboratory QA/QC requirements, the assessment method, and the acceptance criteria, the reader is directed to the analytical methods listed in Table 8. Distilled de-ionized water, for the performance of bottle blanks and rinsate blanks, will be provided by the analytical laboratory.

Table 9. QA/QC Assessments and Goals

QC Sample	Rate	Assessment	QC Goals
Field QA/QC Samples			
Bottle Blanks	once per team every sampling day	detection	Below Detection Limits
Rinsate Blanks	once per team every sampling day	detection	Below Detection Limits
Field Replicate	10%: at least one duplicate for each sampling site per year, time of day varies	RPD to duplicated sample	≤30%
Split Samples	None Specified Available to 3rd party upon written request	None specified	None specified
Laboratory QA/QC Samples			
Lab Duplicates	≥ 1 per batch, where applicable	RPD	As defined by the analytical methods
Method Blanks	≥ 1 per batch, where applicable	detection	Below Detection Limits
Surrogate Spikes	*all samples, where applicable*	%R	As defined by the analytical methods
Lab Control Sample	≥ 1 per batch	As defined by analytical Methods	As defined by the analytical methods

Notes:
1. %R = % recovery
2. RPD = relative percent difference
3. N/A = not applicable

2.5.1 Bottle Blank

A bottle blank is a controlled water sample, free from the contaminants of concern, which is placed into the sample bottles used to contain the analytical samples. The bottle blank is intended to determine if extraneous contaminants associated with the sample bottles are impacting the analytical samples. *For this project, one bottle blank shall be collected by each of the 3 teams on each day of sampling.*

2.5.2 Rinsate Blank

Rinsate blanks are samples collected from a final rinse of sampling equipment with analyte-free water after the decontamination procedure has been performed. In this instance, rinsate blanks should be collected after the distilled de-ionized water rinse, but before the site water rinse. The purpose of rinsate blanks is to document adequate decontamination and to determine whether the sampling equipment is causing cross contamination of samples. *For this project, one rinsate blank will be collected by each of the 3 teams during each sampling day.*

2.5.3 Field Replicate Samples

Replicate Samples are analytical samples that are collected as a single sample, divided into two or more equal parts, and placed into separate containers. The replicate sample is given a different sample ID time, and submitted to the laboratory accompanying the remainder of the analytical samples. *For this project, one field replicate will be submitted for each sampling site. Each station will be replicate-sampled at least once per year during this project.*

2.5.4 Field Split Samples

Field split samples are analytical samples that are collected as a single sample, divided into two or more equal parts, and placed into separate containers. Field split samples differ from field replicate samples in that they are delivered into the custody of an independent third party at the sampling site, and are typically analyzed by a different laboratory. Field split samples are sometimes utilized to assess the precision and accuracy of sample results. *For this project, no split samples are specifically required. However, a third party may make a written request to DRBC for a split sample. In order to be considered, the request must be made at least 1 week prior to sample collection. The third party requesting the split sample must be prepared to take custody of the sample at the sampling site, and must provide appropriate sample bottles, labels, forms, and coolers. DRBC will not pay for the analysis of any split sample.*

2.6 Equipment Testing, Inspection, and Maintenance

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

Hydrolab Quanta

The Hydrolab Quanta will be subject to daily, routine maintenance as well as a 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 will be rinsed with deionized water to prevent fouling by accumulation of contaminants found in the waters samples. The storage cup, used to store sonde in while transporting from site to site, will be filled with fresh, deionized water after each site, according to manufacturer's recommendations. After daily sampling is complete, sonde will be disinfected with an Alconox Soap Solution (4%) to prevent accumulation of bacteria or other biological contaminants. The soap will be applied to all parts of the sonde, excluding the Dissolved Oxygen membrane, using a cotton swab and then rinsed with deionized water to remove soap residues. For long-term storage, storage cup will be filled with tap water to further prevent colonization of bacteria and other biological contaminants on sonde. Upon completion of sampling season, the entire Quanta unit will be sent to manufacturer for annual maintenance as prescribed by the manufacturer. All service performed on the Hydrolab Quanta unit will be documented in the Equipment Service Logbook.

Gurley Pygmy Meters

The Gurley pygmy flow meters will also be subjected to extensive maintenance throughout the sampling season. Due to the fragile nature of this piece of equipment, all storage, transport, and usage instructions described by manufacturer will be followed explicitly. Before each usage of the pygmy meters, all moving parts will be well oiled to allow them to move freely. After usage, the cup apparatus will be rinsed thoroughly to flush out all particles that may have adhered to the oil. Once rinse is complete, the apparatus will be allowed to dry and then oiled prior to storage. During storage and transport, the "measurement" pin will be removed and the "transport" pin will be placed in the unit as recommended by the manufacturer. All wiring and other electrical equipment associated with the pygmy will be inspected frequently. All services conducted on the Gurley pygmy meters will be documented in the Equipment Service Logbook.

Design Analysis Associates, Inc. DH-21 Waterloggers

DH-21 Waterlogger units will be frequently inspected following their deployment to ensure that the resulting data is of the highest quality. When data is downloaded from unit, the person conducting the download will inspect the cable, logger, and transmitter for damage prior to reinitializing data collection mode. In addition to visual inspection of equipment, the resulting data is analyzed, looking for erroneous data that may indicate a malfunction in the equipment. If the need arises, maintenance will be conducted by manufacturer. An annual maintenance and recalibration procedure will be conducted by manufacturer following the completion of the sampling season. All services conducted on DH-21 Waterloggers will be documented in the Equipment Service Logbook.

2.7 Instrument / Equipment Calibration and Frequency

Hydrolab Quanta

All calibrations will be conducted as recommended by manufacturer. Hydrolab calibration procedures and frequency of calibration can be found in Table 10. 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. An annual factory calibration will be done prior to each sampling season. All calibrations will be documented in the Calibration Logbook. Table 10 summarizes the calibration procedures for the Hydrolab Quanta.

Gurley Pygmy Meters

Preparation procedure for the pygmy meters will be a 60-second spin test prior to sampling. This will ensure that cups are moving freely and results will be precise and accurate.

Design Analysis Associates, Inc. DH-21 Waterlogger

Each of the DH-21 Waterloggers will be subject to an annual factory calibration prior to sampling. When calibration is conducted, a pre- and post-calibration measurement is taken to ensure the accuracy of the equipment. These values will then be used to adjust measurements if difference is found to be significant.

Table 10. Hydrolab Quanta Calibration Summary

Parameter	Unit	Laboratory Preparation	Frequency	Field Prep.	Frequency
Air Temperature	^{o}C	Factory Calibration	*NA*	*NA*	*NA*
Water Temperature	^{o}C	Factory Calibration	Annual	*NA*	*NA*
Dissolved Oxygen (DO)	mg/L	Winkler Titration	Daily	Air Calibration	Per Site
Conductivity	mS/cm	2 point; 0 & 84μS standards	Daily	DI Rinse	Per Site
pH		2 point: 7 & 10 standards	Daily	DI Rinse	Per Site

2.8 Inspection / Acceptance of Supplies and Consumables

All field supplies and consumables will be inspected by the sample collection team 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 8 for a complete discussion of these requirements.

2.9 Non-direct Measurements

In the context of this QAPP, non-direct measurements refer to pre-existing data and estimates of values generated by mathematical models. No non-direct measurements will be generated to support this sampling effort.

3.10 Data Management

The Delaware River Basin Commission 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 CD maintained in the project files. Dr. Fikslin will have ultimate responsibility for ensuring that data is maintained and secured. Compatibility of hardware / software configurations will be determined through observations associated with routine usage. Hardware / software compatibility problems will be referred to the Information Services branch of DRBC for correction.

3 Assessment and Oversight Elements

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 during sample collection, the sample collection team will contact the Study Manager for guidance and clarification. If appropriate response actions can not be implemented in the field, sample collection will be terminated and resume as soon as response actions have been implemented and field conditions are appropriate.

When errors, deficiencies, or out-of-control situations exist in the Laboratory, 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 can not be identified, the matter is referred to the Laboratory supervisor, manager, and/or QA department for further investigation. 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 Study Manager shall be contacted immediately for consultation regarding problem resolution. All response actions taken shall be thoroughly documented and submitted to the DRBC Study Manager.

3.1.2 Sample Holding Times

If samples can not be extracted and/or analyzed within the appropriate method required holding times, the DRBC Study Manager shall be immediately notified, such that an appropriate response action plan can be generated. All response actions taken shall be thoroughly documented.

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.

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. If the matrix effect is confirmed, the corresponding data shall be flagged accordingly using the EPA flagging symbols and criteria.

3.2 Reports to Management

Reports from the Laboratory are to be submitted annually and at the completion of the project. These will serve as Laboratory Quality Assurance Reports to management. The reports from the Laboratory must include all the items specified in this QAPP. At a minimum, the laboratory

deliverables must include items to support reconciliation with user requirements described in Section 4.3.

4 Data Validation and Usability Elements

Data validation and usability procedures will include, as the minimum, the elements described below:

4.1 Data Review, Verification, and Validation

All analytical data generated by the Laboratory shall be reviewed prior to report generation to assure the validity of the reported data. This internal laboratory data validation process shall consist of data generation, reduction, and a minimum three levels of documented review. In each stage, the review process shall be documented using an appropriate check list 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 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.

4.2 Verification and Validation Methods

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 check list form and by signature and date of the reviewer.

Level 2 reviews 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 reviews 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 check list with the signature and date of the reviewer.

Level 3 reviews are performed by the quality assurance officer or the program administrator at the Laboratory. This review should be similar to the review as 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 check list with the signature and date of the reviewer.

4.3 Reconciliation with User Requirements

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.

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 holding times which were exceeded. If there are no deficiencies, document that all holding times were met.

- Check the detection limits against those specified in the SAP or the QAPP. Document any detection limits which exceeded the detection limits required by the SAP or 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 blanks were run at the frequency required in the SAP or QAPP. Document any deficiency in blanks. Document 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 results (MS) 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 SAP or QAPP. Document any deficiencies in frequency of MS or any % recoveries or RPDs that exceeded the acceptance criteria. If there are no deficiencies, document that the MS are complete and acceptable.

- Check all field and laboratory duplicates to determine if duplicates were performed at the frequency required by the SAP or the QAPP. Check the RPD against the acceptance criteria listed in the SAP or 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 SAP and the QAPP. Check the % recovery (or other measures such as Response Factor, where appropriate) against the acceptance criteria listed in the SAP or the QAPP. Document any deficiencies in frequency or any % 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 SAP and the QAPP. Check the % recoveries against the acceptance criteria specified in the SAP or 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 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 which appears to be illogical or incorrect.

DRBC will prepare a memorandum outlining all the documented deficiencies. 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, DRBC will determine if (1) the data package is acceptable based on the SAP and 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.

5 References

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U.S. Geological Survey. 1999. Techniques of Water Resources Investigations – Book 9. National Field Manual for the Collection of Water Quality Data: Chapter A4. Collection of Water Samples. U.S. Geological Survey, Reston, VA.

U.S. Environmental Protection Agency. 2001. EPA Requirements for Quality Assurance Project Plans: EPA QA/R-5. EPA/240/B-01/003. U.S. Environmental Protection Agency, Washington, DC.

U.S. Environmental Protection Agency. 2000. Guidance for the Data Quality Objectives Process: EPA QA/G-4. EPA/600/R-96/055. U.S. Environmental Protection Agency, Washington, DC.

U.S. Geological Survey. TWRI 3 A-7 and A-8.

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APPENDIX A

Forms

SCENIC RIVERS MONITORING PROGRAM
CHAIN-OF-CUSTODY RECORD

CoCR No.: 042706A Page: of

Project Manager:	Return completed form to Robert L. Limbeck			Agency: Delaware River Basin Commission			
Address & Phone:	PO Box 7360, W. Trenton NJ 08628 609-883-9500 x 230			Project: Scenic Rivers Monitoring Program			
Date Collected (YYYYMMDD)	Time Collected (Mil. HHMM)	Site No. Location	# jars	Check if all samples taken (note if set incomplete)	Preserv-ation (see below)	Collect. Method (Grab / Composite)	Log Number (Seq+)
Sampled by (signature):							
Received by (signature):				Date		Time	
Received by (signature):				Date		Time	
Received by (signature):				Date		Time	

Instructions/Notes:

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 relinguishing samples should receive a photocopy of this form.
Notify Project Manager immediately of any damaged or missing samples.

Scenic Rivers Monitoring Program
Water Quality Monitoring Form

1.) River Mile (RM/ Trib 1/ Trib 2/ State) _____

Station Name: _____

Station Number: _____

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

3.) Dissolved Oxygen Method: _____ _____ mg/l

4.) Air Temperature Method: _____ _____ °C

5.) Water Temperature Method: _____ _____ °C

6.) Specific Conductance Method: _____ _____ µmhos/cm

7.) pH Method: _____ _____ pH units

9.) Gage Height _____ (measurement) + _____ (leader) = _____ ft.

10.) Weather Conditions: _____

_____

Dates of Last Rain: _____ and _____

11.) Water and Site Conditions: _____

_____

12.) Personnel

Name	Role

SCENIC RIVERS MONITORING PROGRAM
STREAMFLOW DATA SHEET

Station Name _____
River Mile ___.___
Station Number _____
Date (MM/DD/YYYY) ____/____/____ Time (HHMM): _____
Party _____ Agency: _____
Location of Test Site From Gage Station: _____
Weather Conditions _____
Dates Last Rain ___/___/___ _____inches
___/___/___ _____inches

Gage Read-ings		Time	Tape Reading		Leader Length		Total Gage
	Before			+		=	
	After			+		=	

Gage Height at Substrate
Meter Type: Pygmy
Spin Test (sec)
Interval Width Chosen
Total Number of Intervals

Tape Reading @ Near Bank
Tape Reading @ Far Bank
Total Width of Stream

Flow Width = (total width)-(zero flow intervals)
Flow Area = Sum(incremental width X incremental depth)
Average Depth = flow area / flow width
Average Velocity = total discharge / total flow area

VELOCITY BASED ON REGRESSION:

INCREMENTAL VELOCITY = 0.977 (REVOLUTIONS/SEC) + 0.028

USE ADDITIONAL SHEET IF NECESSARY

Mark REF, REW, LEF and LEW

Inter-vals	Tape Reading[1]	Dist. From stream edge[2]	Interval Width (tenths)	Interval Depth Depth (tenths)	Observ. Depth[3] (tenths)	Rev oluti ons[4]	Time (sec)	rev/sec	Velocity @ point	Interval Area (W X D)	Interval Discharge (A X V)
1											
2											
3											
4											
5											
6											
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36											
37											
38											
39											
40											
Totals			0.00						Totals	0	0.000