ASSESSMENT OF NUTRIENT SOURCES FROM MAINSTEM AND SELECTED WATERSHEDS IN THE SUSQUEHANNA RIVER BASIN

Quality Assurance/Quality Control Plan SRBC-QA048
January 2017 – December 2018

PROJECT OFFICER:

Kevin H. McGonigal
Susquehanna River Basin Commission
4423 N. Front Street
Harrisburg, PA 17110-1788

Gary Walters
PA Department of Environmental Protection
Rachel Carson State Office Building
400 Market Street
Harrisburg, PA 17101

Mark Brickner
PA Department of Environmental Protection
Rachel Carson State Office Building
400 Market Street
Harrisburg, PA 17101

James Hargett
Chesapeake Bay Program Office
U. S. Environmental Protection Agency
410 Severn Avenue, Suite 112
Annapolis, MD 21403

Richard Batiuk
Chesapeake Bay Program Office
410 Severn Avenue, Suite 109
Annapolis, MD 21403

QUALITY ASSURANCE OFFICER:

James P. Shallenberger
Susquehanna River Basin Commission
4423 N. Front Street
Harrisburg, PA 17110-1788

Richard Batiuk
Chesapeake Bay Program Office
410 Severn Avenue, Suite 109
Annapolis, MD 21403

TABLE OF CONTENTS

TABLES

APPENDICES

1.0 PROJECT DESCRIPTION

1.1 Background

Nutrients and SS entering the Chesapeake Bay (Bay) from the Susquehanna River Basin contribute to nutrient enrichment problems in the Bay (USEPA, 1982). In 1985, the Pennsylvania Department of Environmental Protection (PADEP) Bureau of Laboratories, the U.S. Environmental Protection Agency (USEPA), the U.S. Geological Survey (USGS), and the Susquehanna River Basin Commission (SRBC) conducted a five-year study to quantify nutrient and SS transported to the Bay via the Susquehanna River Basin. The initial network consisted of two mainstem sites on the Susquehanna and 10 tributary sites with the goal of developing baseline nutrient loading data. After 1989, several modifications to the network occurred, resulting in the current network consisting of 26 sites with five in New York, one in Maryland, and 20 in Pennsylvania.

1.2 Objective and Scope

A) Existing Monitoring

This sampling effort is the continuation of the 2013 network which included discontinuation of sampling at the Tioughnioga at Itaska, N.Y. The scope of the monitoring program includes the following objectives:

1.2.1 To measure concentrations and estimate nutrient and suspended-sediment loads in the Susquehanna River at Towanda, Danville, and Marietta, Pa.; the West Branch Susquehanna River at Lewisburg, Pa.; the Juniata River at Newport, Pa.; and the Conestoga River at Conestoga, Pa.

1.2.2 To establish a sound database for government, agriculture, industry, and the public to most effectively plan and implement immediate and long-range nutrient reduction efforts.

B) Enhanced Monitoring

While watershed model runs are used to predict the effectiveness of management actions to reduce loads, a nontidal water quality network is critical to measure and assess the actual nutrient and sediment concentration and load reductions in the tributary strategy basins across the watershed. Therefore, a nontidal water quality network has been designed for the Bay watershed, building from and integrating existing state and federal (USGS and USEPA) monitoring programs, by the Chesapeake Bay Program Office (CBPO) Non-Tidal Water Quality Workgroup (NTWG). The scope of the project includes the following objectives:

1.2.3 To measure and assess the actual nutrient and sediment concentration and load reductions in the tributary strategy basins across the watershed.

1.2.4 To improve calibration and verification of the partners' watershed models.

1.2.5 To help assess the factors affecting nutrient and sediment distributions and trends.

C) Status and Trends Analysis

This project will provide a trend update for the six long-term SRBC monitoring stations. The analyses will use the latest statistical protocols developed by the investigators in dialogue through the Chesapeake Bay Program's Integrated Trends Analysis Team, including adjustments for variations in flow, where appropriate, and selected application of nonlinear trend techniques. The trend analyses for water quality will include, at a minimum, where available, the following parameters: total and dissolved nitrogen; total and dissolved phosphorus; total and dissolved kjeldahl nitrogen; total and dissolved nitrate + nitrite; total and dissolved ammonia; dissolved orthophosphate; total organic carbon; total suspended solids; and suspended sediment. The scope of work for the project includes the following objectives:

1.2.6 To compile water quality data sets into a single database for trend analysis.

1.2.7 To process compiled datasets using USGS approved regression techniques to generate all trend statistics including flow corrected trends.

1.3 Data Usage

The environmental measurements and analysis will provide baseline nutrient loading data for the mainstem and the selected major tributaries in sufficient detail to:

1.3.1 Allow model refinement and verification;

1.3.2 Track and better define nutrient loading dynamics;

1.3.3 Relate measured load fluctuations to changes in water discharge due to precipitation events of varying intensities, durations, and seasons; and

1.3.4 Evaluate nutrient loading trends.

1.4 Monitoring Network Design and Rationale

This section provides the rationale for establishing the sampling network that includes a series of mainstem and major tributary sites. All sites have been co-located with USGS stream gaging stations to obtain discharge data. The latitude and longitude of these sites and location map can be found in Appendix A. Existing long-term SRBC monitoring sites are listed under Group A, and enhanced monitoring sites are listed under Group B.

1.4.1 Group A

Susquehanna River at Towanda, Pa.

The Susquehanna River at Towanda was selected because it represents the contribution from New York State, although the drainage area does include a part of the Tioga River Basin in northern Pennsylvania and an area along the northern tier counties of northeastern Pennsylvania. The drainage area at Towanda is 7,797 square miles.

Susquehanna River at Danville, Pa.

The Susquehanna River at Danville has a drainage area of 11,220 square miles and includes part of northcentral Pennsylvania and much of southcentral New York. Data collected at Danville represent the loadings from the mainstem Susquehanna River.

West Branch Susquehanna River at Lewisburg, Pa.

Data collected from the West Branch Susquehanna River at Lewisburg represent the loadings from a major tributary to the mainstem. The West Branch Susquehanna River includes much of northcentral Pennsylvania and has a drainage area of 6,847 square miles. This watershed is predominantly forested (81 percent). The combined drainage area at Lewisburg and Danville represents 65.7 percent of the total Susquehanna River Basin.

Juniata River at Newport, Pa.

The Juniata River at Newport, another major tributary to the mainstem Susquehanna River, drains much of the southcentral area of Pennsylvania and has a drainage area of 3,354 square miles. The combined drainage area at Newport, Lewisburg, and Danville represents 77 percent of the total Susquehanna River Basin and 88.9 percent of the watershed above Harrisburg, Pa.

Susquehanna River at Marietta, Pa.

The Susquehanna River at Marietta is the southern-most sampling site upstream from the reservoirs on the Lower Susquehanna River and represents the inflow to the reservoirs from its 25,900-square-mile drainage area. This drainage area represents 94.5 percent of the total Susquehanna River Basin.

Conestoga River at Conestoga, Pa.

Data collected from the Conestoga River at Conestoga provide loadings from a major tributary watershed that is actively farmed and is experiencing an increase in agricultural nutrient management programs. Additionally, this watershed is experiencing an increase in urban and suburban development. The drainage area of this basin at the sampling site is 470 square miles.

1.4.2 Group B

The following rationale was considered and stations meeting the conditions below were given priority status when selecting sites for Group B:

a. Sites that are located at outlets of major streams draining the tributary strategy basins.
b. Sites that are located in areas within the tributary strategy basins that have the highest nutrient delivery to the Bay.
c. Sites that represent the overall range of conditions in the Bay watershed. This would include ranges of loads from different land cover types (urban, agriculture, and forestland covers), diverse physiographic/geologic settings, and different watershed sizes.

The initial selection of sites was designed to support a network for the tributary basins. These sites will be evaluated for representativeness of watershed characteristics, which is important for model calibration and simulation. In the future, the network may be modified to ensure that these objectives are met.

Group B sites in Pennsylvania, Maryland, and New York include:

Susquehanna River at Smithboro, N.Y.
Chemung River at Chemung, N.Y.
Cohocton River near Campbell, N.Y.
Susquehanna River at Conklin, N.Y.
Unadilla River at Rockdale, N.Y.
Susquehanna River near Wilkes-Barre, Pa.

West Branch Susquehanna River near Karthaus, Pa.
West Branch Susquehanna River near Jersey Shore, Pa.
Penns Creek at Penns Creek, Pa.
Raystown Branch Juniata River at Saxton, Pa.
Shermans Creek near Dromgold, Pa.
Conodoguinet Creek near Hogestown, Pa.
Swatara Creek near Hershey, Pa.
West Conewago Creek near Manchester, Pa.
Pequea Creek near Martic Forge, Pa.
Bald Eagle Creek near Castanea, Pa.
East Mahantango Creek near Dalmatia, Pa.
Paxton Creek near Penbrook, Pa.
Kishacoquillas Creek near Reedsville, Pa.
Octoraro Creek at Richardsmere, Md.

Samples collected at these sites will be used for load and trend determination. Therefore, the criteria for determining sampling frequency are based on loads, which have more stringent requirements. To effectively capture the loads being transported, 20 samples will be collected per year, consisting of 12 monthly samples and eight storm samples. Two storm samples will be collected on different days during each of four storms per year (one per season), targeting the rising and peak flow of the storm.

1.5 Monitoring Parameters and Frequency of Collection

Filtered and unfiltered samples will be analyzed for physical characteristics and constituents listed in Table 1.

All samples are collected using Equal Weight Intervals (EWI), and are depth integrated using either a DH-81, DH-95, or D-95. Individual verticals are composted into a single churn splitter and processed into appropriate sampling bottles. Samples collected at Group A site during the end of the month are referenced with the CBP sample type code "Other-Non-storm samples (ONS)." An additional date-based random flow sample will be collected during the middle of each month at all sites, regardless of the stream discharge. If a storm sample is collected on the random sample date, it will be considered the random sample. These samples will be referenced with the CBP sample type code "Routine (R)." Routine samples that are storm impacted will be handled as per the CBP Nontidal sampling procedures which state, "If high discharge occurs during routine monthly sampling, collect the samples on the scheduled date using procedures for storm event sampling, and including a SSC sample (primary stations only). These samples are to be counted as routine, monthly samples and designated as sample type "Routine, Storm-impacted (RSI)." A routine, storm-impacted event has a

rising discharge (cfs) of at least twice that of the pre-storm, average daily discharge."

Storm runoff samples for all sites will be collected during four high flow events per year, targeting one storm per season. Two discreet samples will be collected per storm, targeting one sample during the rise and one during the peak of flow on different days. These samples will be referenced with the CBP sample type code "Storm samples (S)."

Table 1. Parameters for Physical Characteristics and Other Constituents

Parameter	Number of Samples	Sample Matrix	Analytical Method Reference	Sample Preservation	Holding Time
Dissolved Oxygen	1,448	Water/sediment	Instream field measurement at each vertical	N/A	None
pH	1,448	Water/sediment	Instream field measurement at each vertical	N/A	None
Temperature	1,448	Water/sediment	Instream field measurement at each vertical	N/A	None
Specific Conductance	1,448	Water/sediment	Instream field measurement at each vertical	N/A	None
Turbidity	1,448	Water/sediment	Instream field measurement at each vertical	N/A	None
Suspended Sediment	552	Water/sediment	SRBC* - Filtration Method	N/A	N/A
Suspended Sediment	416	Water/sediment	ASTM Method D 3977-97	N/A	N/A
Sand-Fine Splits	208	Water/Sediment	ASTM Method D 3977-97	N/A	N/A
Total Nitrogen	1,248	Water/sediment	SM. 4500-Norg-D**	Chill at $4^{o}C$	None
Dissolved Nitrogen	1,248	Water	SM. 4500-Norg-D**	Chill at $4^{o}C$	None
Total Kjeldahl Nitrogen +	200	Water/sediment	USEPA 351.2	Chill at $4^{o}C$ H_2SO_4 to pH<2	28 Days
Dissolved Kjeldahl Nitrogen +	200	Water	USEPA 351.2	Chill at $4^{o}C$ H_2SO_4 to pH<2	28 Days
Total Ammonia	1,448	Water/sediment	USEPA 350.1	Chill at $4^{o}C$ H_2SO_4 to pH<2	28 Days
Dissolved Ammonia	1,448	Water	USEPA 350.1	Chill at $4^{o}C$ H_2SO_4 to pH<2	28 Days
Total Nitrate + Nitrite	1,448	Water/sediment	USEPA 353.2	Chill at $4^{o}C$	48 Hours
Dissolved Nitrate + Nitrite	1,448	Water	USEPA 353.2	Chill at $4^{o}C$	48 Hours
Total Phosphorus-TP	1,448	Water/sediment	USEPA 365.1	Chill at $4^{o}C$ H_2SO_4 to pH<2	28 Days
Dissolved Phosphorus-DP	1,448	Water	USEPA 365.1	Chill at $4^{o}C$ H_2SO_4 to pH<2	28 Days
Dissolved Orthophosphate	1,448	Water	USEPA 365.1	Chill at $4^{o}C$	48 Hours
Total Suspended Solids	1,248	Water/sediment	USGS-I-3765/3767 and SM 2540E	N/A	7 Days

Parameter	Number of Samples	Sample Matrix	Analytical Method Reference	Sample Preservation	Holding Time
Total Suspended Solids	200	Water/Sediment	SM 2540 D +	N/A	7 Days
Total Organic Carbon	1,248	Water/sediment	SM 5310C	Chill at 4°C H_2SO_4 to pH<2	28 Days
Total Organic Carbon	200	Water/sediment	SM20 5310C +	Chill at 4°C H_2SO_4 to pH<2	28 Days

* SRBC suspended sediment methodology listed in Appendix B
**Standard Methods, 19th Edition
+ New York analysis – ALS Environmental, Inc.

Additional storm runoff samples will be collected for Group A sites, including a fifth storm event targeted for the spring. In addition to the two discreet samples mentioned above, up to four additional discreet samples over the hydrograph (two on the rising and two on the falling stage) will be sent to the laboratory for analysis for Group A sites. These samples will be referenced with the CBP sample type code "Other-storm samples (OS)."

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

Data collection will be conducted by the SRBC with cooperation from the PADEP Bureau of Laboratories (PADEP Lab) and the Bureau of Conservation and Restoration (BCR), Division of Conservation. New York sites will be sampled by the New York State Department of Environmental Conservation (NYSDEC) during the months of April through September.

2.1 Data Collection and Analysis

2.1.1 SRBC
Project Officer: Kevin H. McGonigal
Quality Assurance Officer: James P. Shallenberger
Data Analysis: Kevin H. McGonigal

2.1.2 PADEP Lab
Director: Martina McGarvey
Inorganics Section Chief: Janelle Barry, Pam Higgins
Quality Assurance Officer: Luisa Lassova

2.1.3 NYSDEC
Contact: Jacqueline Lendrum

2.1.4 ALS Environmental
Project Manager: Janice Jaeger (New York Sampling)

2.2 Project Coordination and Overview

2.2.1 PADEP
Project Officers: Gary Walters, Mark Brickner

2.2.2 USEPA Chesapeake Bay Program Office
Project Officer: James Hargett
Quality Assurance Officer: Richard Batiuk

Data collection and data analysis will be performed by SRBC. Compliance with the Quality Assurance/Quality Control Plan (QAPP) will be the

responsibility of each agency's Quality Assurance Officer. Quarterly reports documenting data collection activities will be sent to the PADEP BCR Project Officer.

All Pennsylvania water samples, including QA samples, will be taken to the PADEP Lab. Appropriate quality assurance measures for sample analyses and lab procedures, as established by the PADEP Lab, will be the responsibility of the Inorganic Section Chief and the Quality Assurance Officer for the lab. Resolution of problems will be the responsibility of the Inorganic Section Chief and the respective Quality Assurance officers.

Project coordination and review will be the responsibility of the PADEP BCR Project Officer. Appropriate quarterly progress reports will be sent to the USEPA Project Officer by the PADEP BCR. Any problems that occur that cannot be solved by the project officers of each agency will be resolved by the identified PADEP BCR responsible individual.

New York samples will be collected by SRBC. Additional samples will be collected by NYSDEC from April to September at Chemung and Smithboro. Quality assurance of sample collection will be insured by both following the sample procedure listed in section 4.0. Water samples and duplicates collected at New York sites will be sent to ALS Environmental for analysis. Samples will be analyzed according to the lab's approved QAPP. Contact information for ALS Environmental is as follows:

ALS Environmental
1565 Jefferson Road
Building 300, Suite 360
Rochester, NY 14623
Phone: (585) 288-5380
Janice Jaeger, Project Manager
Janice.Jaeger@alsglobal.com

Sand/fine particle analysis and sediment analysis for storm samples will be conducted at the USGS Sediment Lab in Kentucky. Contact information for the USGS Sediment Lab is as follows:

Aimee C. Downs, Laboratory Chief
KY Water Science Center Sediment Laboratory
U.S. Geological Survey
9818 Bluegrass Parkway
Louisville, KY 40299
acdowns@usgs.gov
Phone: (502) 493-1916
Fax: (502) 493-1909

Suspended-sediment analysis for routine sampling at Group A sites will be conducted at SRBC. The SRBC suspended sediment standard operating procedure (SOP) is listed in Appendix B.

3.0 QUALITY ASSURANCE OBJECTIVES

Data collected during this study will be used to help define magnitude, timing, and severity of nutrient and suspended-sediment inputs to the Bay and to provide a comparison with data collected from the Susquehanna River at Conowingo, Md. For this reason, several quality assurance objectives must be met.

3.1 Detection Limits

Analytical methods and detection limits must be compatible with those used by other data collection agencies.

The analytical methods and detection limits selected for the constituents of concern were determined by consultation with the USGS and the PADEP Lab to assure compatibility of the results. Detection limits, accuracy, and precision data contained in the Quality Assurance Plan for the PADEP Lab have been found acceptable for this project. A list of the constituents and their detection limits are presented in Table 2.

Table 2. Detection Limits

Parameter	Detection Limits for ALS Environmental (mg/l)	Detection Limits for PADEP Labs (mg/l)
Total Nitrogen	N/A	0.040
Dissolved Nitrogen	N/A	0.040
Total Kjeldahl Nitrogen	0.050	N/A
Dissolved Kjeldahl Nitrogen	0.050	N/A
Total Ammonia	0.05	0.020
Dissolved Ammonia	0.05	0.020
Total Nitrite + Nitrate	0.002	0.040
Dissolved Nitrite + Nitrate	0.002	0.040
Total Phosphorus-TP	0.002	0.020
Dissolved Phosphorus-DP	0.002	0.020
Orthophosphate-P	0.001	0.002
Total Suspended Solids	1.0	2.000*
Total Organic Carbon	1.0	0.500

* Reporting limit

3.2 Representativeness-Site Representation

The collection of water quality samples representative of river conditions is essential for the program to be successful. Spatial variability inherent to a sampling site is addressed by taking depth-integrated, isokinetic water samples across the cross section at the sampling site; the sample thus reflects the composite effect of occurrences upstream from the site. Data will be collected within the same time frame at all locations. Therefore, data collected at all sites should be representative of conditions in the Susquehanna River Basin within a specified timeframe. Collection of greater than 90 percent of the programmed samples will be considered as fulfilling the program objective.

3.3 Data Comparability

Use of USEPA-approved laboratory methods and USGS field techniques provide a uniform methodology for both field and laboratory analysis. Data from this project are intended to be comparable with data collected for the Chesapeake Bay River Input Monitoring Program. To ensure data are comparable with the River Input Program, similar data collection methods and analysis are used. The PADEP Lab routinely analyzes CBP split samples and USGS reference samples to check the comparability of the field and laboratory data.

3.4 Precision and Accuracy

Variability within the PADEP Lab will be quantified with field-split samples. Field blanks will be used to determine total measurement error due to contamination. If contamination of the blank is found, additional field blanks will be submitted, along with samples from the same volume of distilled water poured directly into the precleaned sample bottle. This procedure will help to determine

the source of contamination. Samples sent to the laboratory for analyses will include >5 percent field-split samples including; 24 duplicates in PA, 10 duplicates in NY, 21 field blanks in PA, five field blanks in NY, four source water blanks in PA, and one source water blank in NY. Random number generation will be used to determine where and when QA samples will be collected, as well as whether they will be collected during the routine sampling round of a given month or during a storm/storm impacted round. Duplicate sample results with greater than 20 percent difference from the primary sample will be discarded. Field blank results should be less than 10 percent of the lowest value in the sample batch. Variability among laboratories will be quantified through the use of Chesapeake Bay Program field-split duplicate samples that will be sent to the USGS and the PADEP laboratories. This activity is being conducted in cooperation with the USGS Water Science Center in Catonsville, Md., which has the responsibility for interlaboratory quality assurance.

Detection limits, accuracy, and precision of data are included in each lab's individual Quality Assurance Plan and are acceptable for this project. For all analytes, 10 percent of samples analyzed have duplicates completed. For all analytes, a spike analysis is completed for every 10 samples. Recovery amounts are listed in Table 3. Data analysis methods will be based on approved USEPA and USGS techniques.

Table 3. Recovery Amounts

Parameter	Spike Recovery Limits %		Duplicate Max Variation %	
	PADEP	ALS	PADEP	ALS
Total Nitrogen	± 10%	N/A	± 10%	20%
Dissolved Nitrogen	± 10%	N/A	± 10%	20%
Total Kjeldahl Nitrogen	± 10%	71-120	± 10%	20%
Dissolved Kjeldahl Nitrogen	± 10%	71-120	± 10%	20%
Total Ammonia	± 10%	90-110	± 10%	20%
Dissolved Ammonia	± 10%	90-110	± 10%	20%
Total Nitrite + Nitrate	± 10%	90-110	± 10%	20%
Dissolved Nitrite + Nitrate	± 10%	90-110	± 10%	20%
Total Phosphorus-TP	± 10%	81-112	± 10%	20%
Dissolved Phosphorus-DP	± 10%	81-112	± 10%	20%
Orthophosphate-P	± 10%	90-110	± 10%	20%
Total Suspended Solids < 100 mg/L	± 10%	80-120	± 10%	20%
Total Suspended Solids >100 mg/L	± 20%	80-120	± 10%	20%
Total Organic Carbon	± 20%	86-117	± 10%	20%

4.0 SAMPLING PROCEDURES

All samples will be depth-integrated, isokinetic samples, using USGS standard equipment and techniques. A complete description of the sampling procedures used for this study can be found in Brown and others (1970), in Guy and Norman (1970), and in

USGS (2006). Descriptions of sampling devices are found in the National Handbook of Recommended Methods for Water-Data Acquisition, Chapter 3, pp. 3-18 to 3-24. Equipment used includes DH-81, DH-95, and D-95.

A copy of the sample identification and lab request form is found in Appendix C. Information on the form includes the collector's name and telephone number, date, time, sample number, and stream name. The first four digits of the sample number identify the collecting agency (SRBC) and the last three digits identify the sample in sequential order.

All water quality parameters including temperature, dissolved oxygen, conductivity, and pH, will be taken instream at each vertical, and the median value will be recorded. During times when this is not possible due to high flow, all water quality will be taken from the composite sample after the water quality sample has been processed from the churn.

Whole-water (unfiltered) samples will be collected to ensure that the samples are representative of stream conditions. Samples will be collected by compositing depth-integrated samples from equal increments of discharge along the cross section in a precleaned churn splitter. Sample bottles will be filled while gently churning the water. Field-split samples will be collected by filling sample bottles from the same volume of water in the churn splitter. Samples will be filtered in the field using Fondriest medium capacity dispos-a-filter, 0.45 micron size, 350cm2 filter area. All automatically collected samples are composited on a time-weighted basis.

Field-blank samples will be processed in the field. Water for blank samples will be transported to the sampling site and processed through the pre-cleaned sampling equipment and churn splitter before filling the sample bottles. Field blanks collected in Pennsylvania will be analyzed at ALS Environmental in Middletown, Pa. and field blanks from NY will be analyzed at ALS Environmental in Rochester NY.

Appropriate labels with the sample number, location, date, time, and fixative (where appropriate) will be affixed to each sample container. Samples will be stored on ice and transported to the lab within 24 hours of collection.

The standard USGS depth-integrating samplers, DH-81, DH-95, and D-95, will be used for sampling. A 1/8, 1/4, 3/8, or 1/2 inch nozzle will be used for isokinetic sampling. A newly cleaned plastic bottle will be used at each site. All equipment will be cleaned in the laboratory with 0.1 percent v/v ratio of Liquinox: tap water and rinsed with tap water followed by distilled water. The equipment will be rinsed with river water at each site prior to sample collection. The churn will be rinsed with distilled water after completion of sample collection at each site and repackaged in plastic for the following site.

5.0 SAMPLE CUSTODY PROCEDURES

Immediately upon collection, samples will be chilled on ice and transported to the lab within 24 hours. The lab will perform the necessary analyses within the holding time limits specified in its Quality Assurance Plan.

All samples will be submitted with the appropriate analysis request form (Appendix C), as provided by the PADEP Lab and ALS Environmental. This form includes the site location, name of person collecting the sample, and the standard analysis code, as well as any other pertinent information the lab or the sampler needs for future reference.

Field-tracking forms are not needed, since only one person will be handling and transmitting samples to the lab. A field notebook will be kept by personnel collecting the samples. A copy of the note sheet is included in Appendix C. Data to be recorded in the field notebook include the date, time, weather, field data collected, and any comments the collector has concerning the conditions at the site or problems encountered while collecting the sample.

Custody of samples at the lab will follow procedures as established by each lab's individual Quality Assurance Plan, with appropriate documentation. A complete flow chart for data collection through data submission is listed in Appendix D.

6.0 CALIBRATION PROCEDURES AND PREVENTIVE MAINTENANCE

Due to the discontinuation of the YSI 6820 series sondes, SRBC conducted an in-house comparison of several meters from a variety of manufacturers with the Eureka Manta+30 unit being found as the best alternative moving forward. Field staff will be transitioning from the YSI multi-probe meters to the Manta 30 for instream measurement of pH, specific conductivity, dissolved oxygen, turbidity, and temperature during routine samples. During times when this is not possible due to high flow, all water quality will be taken from the composite sample after the water quality sample has been processed from the churn. Every instrument used to collect water quality data will be returned for factory maintenance/calibration as needed. Additionally, field personnel will conduct normal calibration checks and maintenance and check for accuracy as follows. Data will be collected by both the Manta+30 and the YSI 6820 series sonde at several sites over a variety of flows to compare results. Additionally, both sondes will be used for any side by side analysis that is conducted comparing the pre-audit protocols to the post-audit protocols.

6.1 Specific Conductance Meter

Primary Meter: Eureka Manta 30 will be used. SRBC personnel will keep meters in working order and calibrated monthly against one specific conductance standard (usually 1000 umhos/cm), obtained within six months.

Acceptance Criteria:

Standards (<1,000 umhos/cm) ± 4 percent
(>1,000 umhos/cm) ± 3 percent

Backup Meter: YSI 650 MDS with 6820 V2 logger will be used. SRBC personnel will keep meters in working order and calibrated monthly against one specific conductance standard (usually 1000 umhos/cm), obtained within six months.

6.2 pH Meter

Primary Meter: Eureka Manta 30 will be used. SRBC personnel will calibrate meters daily prior to use using two pH buffer standards (7 and 10), purchased within six months to insure the meters are working properly.

Backup Meter: YSI 650 MDS with 6820 V2 logger will be used. SRBC personnel will calibrate meters daily prior to use using two pH buffer standards (7 and 10), purchased within six months to insure the meters are working properly.

6.3 Thermometer

Eureka Manta+30 will be used. The sondes utilize a thermistor of sintered metallic oxide that changes predictably in resistance with temperature variation. The algorithm for conversion of resistance to temperature is built into the sonde, software, and accurate temperature readings in degrees Celsius, Kelvin, or Fahrenheit are provided automatically. No calibration or maintenance of the temperature sensor is required.

In accordance with the 2008 CBPO Nontidal WQ Procedures, thermistor will be checked annually.

6.4 Dissolved Oxygen Meter

Primary Meter: Eureka Manta+30 will be used. Meters will be calibrated daily prior to sample collection using the air calibration chamber in water method.

Backup Meter: YSI 650 MDS with 6820 V2 logger will be used. Meters will be calibrated daily prior to sample collections using the air calibration chamber in water method.

6.5 Turbidity Meter

Meter: Eureka Manta+30 will be used. Meters will be calibrated daily prior to sample collection using 0 NTU and 1000 NTU.

Backup Meter: YSI 650 MDS with 6820 V2 logger will be used. Meters will be calibrated daily prior to sample collections.

6.6 Maintenance of Calibration Records

Staff will maintain records of instrument calibrations, repairs, and maintenance in the "Water Quality Field Instrument Calibration Log," and will report any abuse or neglect of equipment or calibration schedules to the Project Officer.

6.7 Preventative Maintenance

6.7.1 Conductivity–dip cell
Staff will wash the conductivity cell with distilled water and river water. The cell will be shaken dry and stored.

6.7.2 pH–combination electrode
The electrode will be stored according to operating manual instructions.

6.7.3 Dissolved oxygen meter
Meters will be stored according to operating manual instructions.

6.7.4 Churn splitter
SRBC staff will churn with distilled water and river water before collecting a sample at each site. SRBC staff also will rinse and scrub the churn splitter with Liquinox detergent and rinse with tap water then distilled water prior to each sampling day.

6.8 Backup Instruments and Equipment

Backup instruments and equipment also will be maintained, as described above.

7.0 DOCUMENTATION, DATA REDUCTION, AND REPORTING

A complete flow chart for data collection through data submission is listed in Appendix D. Samples collected in the field will be labeled at the time of collection. PADEP sample bottles are labeled with a seven-digit identification number, sampling date, and time. The seven-digit identification number consists of a four-digit collector identification number and a three-digit sample number. This identification information also is recorded on a laboratory submission sheet. One form is submitted with each set of samples and also includes an analysis code that designates the laboratory analyses to be conducted. Laboratory results from PADEP will be received by electronic transfer. ALS Environmental will submit electronic copies of data from New York.

All project data will be entered into the SRBC computer-data files. On completion of data entry, they will be retrieved, and visually checked by project personnel to insure that data were entered correctly. The data will be served on SRBC's web site (www.srbc.net). New York data will be submitted by SRBC through the CBPO's Data Upload and Evaluation Tool (DUET). All parameters will be reported in mg/L.

Prior to sample collection each year, SRBC and PADEP will provide the CBPO with an updated set of the metadata spreadsheets addressing the upcoming field collection period including any anticipated changes in personnel, parameters, and/or methods. The spreadsheets include 1) Expected Parameters & Stations, 2) Points of Contact, and 3) Methods/MDLs.

8.0 DATA ANALYSIS

The new model Weighted Regression on Time Discharge and Season (WRTDS) are used to calculate loads, flow normalized loads, and flow normalized concentrations (FNC) and for trend analysis (Hirsch and De Cicco, 2015). Trends in flow are calculated using Seasonal Kendall tests in Microsoft Excel.

9.0 INTERNAL QUALITY-CONTROL CHECKS

SRBC personnel will receive results of analyses, and will submit copies of the analyses and "primary printouts" to project personnel. Personnel will review results for accuracy and acceptability within five to ten days after receipt, using their analytical experience and knowledge of water quality of streams in the basin. The data will be verified by comparing values with ranges of values from prior sampling and by review of data plots.

If an error in an analysis is detected or suspected, the questionable value will be noted and a rerun will be requested. Rerun data will be reviewed by the project personnel, and appropriate changes will be made in the computer files. If results of field-split duplicate samples are different but are within quality assurance specifications, the average of the two values will be reported.

10.0 ANALYTICAL PROCEDURES

Pennsylvania samples will be analyzed by the PADEP Laboratory. New York samples will be analyzed by ALS Environmental. The methods used by the laboratory are listed in Table 1. Laboratory quality assurance procedures, including use of standard reference materials, are documented in the specific lab's Standard Operating Procedures.

11.0 PERFORMANCE AND SYSTEM AUDITS

11.1 Laboratory

Analytical and quality assurance procedures for each laboratory are detailed in the labs' Quality Assurance Plan. Duplicate samples will be submitted to the PADEP, ALS, and USGS laboratories by the field personnel, as directed above. The total number of quality assurance samples submitted will be at least 10 percent of the samples analyzed. The appropriate Quality Assurance Officer and Project Officer will review results for necessary action. Any problems, which cannot be resolved by SRBC personnel, will be deferred to the PADEP BCR Project Officer for solution.

Chesapeake Bay Tributary Split Samples (Blue Plains) are delivered to PADEP Lab, and the results are compared to other Bay laboratories. USGS nutrient reference samples are analyzed once or twice a year.

11.2 Field

Field personnel will be subjected to performance audits for pH and specific conductance. The USGS Water Science Center in New Cumberland will schedule audits annually using standard samples provided by the USGS Central Lab. Results will be verified by the USGS Central Lab. The SRBC Project Officer is responsible for verifying that all field personnel are competent in the collection techniques before participation in any fieldwork. Any unsatisfactory results will be cause for a repeat audit, at the discretion of the Project Officer.

11.3 System Audit

This audit is made by the appropriate agency Quality Assurance Officer as a qualitative and quantitative inspection and review of the total measurement system. Audits include reviews of the following:

11.3.1 Organization and responsibility--Is the quality-control organization operational? Are quality-control and system audits properly made and documented?

11.3.2 Data collection--Are written data collection procedures available and followed? Are personnel completing all record forms and identification labels?

11.3.3 Sample collection--Are written sample collection procedures available and followed? Do personnel use the required containers? Are containers clean to prevent contamination?

11.3.4 Sample analysis--Are written analysis procedures available and followed?

11.3.5 Human errors--Are data checks made and actions taken to control human errors? Is the program of pass-fail checks for operations in use? Does checking show that the desired quality assurance level is met?

11.3.6 Measurement comparisons--Are results from measurements-comparison testing reviewed and used?

The role of audits in the overall measurement program is one of verification. While audits do not improve data quality, if all work is correctly performed, they do provide assurance that the work prescribed for the measurement program has been conducted properly. A summary of all audit results will be submitted to SRBC and PADEP BCR, and will include the following: the purpose of the audit; personnel audited; activities audited; tests observed; documents and data reviewed; work performance and errors in procedures observed; corrective actions recommended and a deadline for completion of corrective actions; and a provision for verification of completion of corrective actions.

2016 USGS/USEPA/SRBC Audit

A system audit was completed on April 26 and 27, 2016. Audit specifics are included in Appendices E and F. The results of the audit were incorporated into the current QAPP including updates in sample collection gear and procedure. Additionally, a coordinated USGS, PADEP, SRBC workshop was conducted on September 26, 2016, with both office and field portions to insure that all personnel are current with regard to the new equipment and protocols.

12.0 PREVENTIVE MAINTENANCE

All lab equipment will be maintained as specified in each lab's individual Quality Assurance and Work Plans.

The appropriate Quality Assurance Officer will keep maintenance records of all equipment and calibration procedures. The Project Officer will review these records periodically.

All field equipment will be maintained as described in Section 6.0.

13.0 ROUTINE PROCEDURES FOR DATA PRECISION, ACCURACY, AND COMPLETENESS

Assessment of data precision and accuracy for the monitoring program will consist of collecting and analyzing duplicate, field-split duplicate, and blank samples.

The purpose of these quality assurance practices is to check the precision of the laboratories that provide water analyses and data for the program's use and to verify that the laboratories are producing comparable results. These criteria will be evaluated in terms of the standard deviation(s) and the coefficient of variation (cv) for each of the constituents analyzed. The number of QA samples is described in Section 3.3.

All data will be verified and submitted to the USEPA CBPO according to procedures established in the latest Data Submission Guidelines and Water Quality Data Management Plan.

Load calculations will be made using an established method that is consistent with the methods used by the Harrisburg division of USGS, SRBC, and USGS in Maryland and approved by the CBPO Integrated Analysis Workgroup.

14.0 CORRECTIVE ACTION

Corrective action is taken immediately upon discovery of a problem. Project personnel will interact constantly to coordinate project activities. Additionally, meetings with personnel from all agencies will be held at the discretion of the PADEP BCR Project Officer. Data and data-collection activities are discussed constantly and evaluated. Corrective action is taken immediately by the appropriate agency Project Officer, if evaluation indicates action is necessary. Laboratory corrective action is the responsibility of the Lab Quality Assurance Officer. Any issues that cannot be resolved by the Lab Officer and the SRBC Officer, will be referred to the PADEP BCR Project Officer or his/her supervisor for action.

15.0 REPORTS

Quarterly reports will be submitted by SRBC to the PADEP BCR Project Officer. These quarterly reports will include a description of activities completed during the quarter, as well as any problems encountered. Data analysis results will be summarized. A description of activities planned for the next quarter also will be included.

A quarterly report will be submitted to USEPA, CBPO Project Officer by the PADEP BCR Project Officer as part of the quarterly grant report.

A final report also will be submitted by SRBC annually that summarizes the results to the PADEP BCR Project Officer.

For the enhanced Group B sites and trends work, a semi-annual progress report and final report will be completed and submitted to the CBPO.

16.0 REFERENCES

Brown, E., M.W. Skougstad, and M. Fishman. 1970. Methods for Collection and Analysis of Water Samples for Dissolved Minerals and Gases. U.S. Geological Survey Techniques of Water Resources Investigation, Book 5, Chapter A1.

Chesapeake Bay Program. 2013. "Interim Guidance for Nontidal Network WY 2013 Field Blank and Duplicate Sample Collection." March 12, 2013. URL: http://www.chesapeakebay.net/channel_files/19326/ntn_wy2013_qc_sample_guide-3-12-13_app-d.pdf.

Chesapeake Bay Program. 2008. "Chapter V, Nontidal Water Quality Monitoring," Final Draft, Rev. 0, November 18, 2008. URL: http://archive.chesapeakebay.net/pubs/subcommittee/msc/amqawg/Chapter%205%20Nov%2008%20Final.pdf.

Cohn, T.A., L.L DeLong, E.J. Gilroy, R.M. Hirsch, and D.E Wells. 1989. Estimating Constituent Loads. Water Resources Research, 25(5), pp. 937-942.

Guy, H.P. and V.W. Norman. 1969. Field Methods for Measurement of Fluvial Sediment. U.S. Geological Survey Techniques of Water Resources Investigation, Book 3, Chapter C2 and Book 5, Chapter C1.

Hirsch, R.M. L.A. and De Cicco. 2015. User guide to Exploration and Graphics for RivEr Trends (EGRET) and dataRetrieval: R packages for hydrologic data (version 2.0, February 2015): U.S. Geological Survey Techniques and Methods book 4, chap. A10, 93 p., http://dx.doi.org/10.3133/tm4A10.

Langland, M.J., J.D. Bloomquist, L.A. Sprague, and R.E. Edwards. 1999. Summary of Trends and Status for Flow, Nutrients, Sediments at selected Nontidal Sites, Chesapeake Bay Basin, 1985-99. U.S. Geological Survey (Open-File Report 01-73), 20 pp.

Schertz, T.L., R.B. Alexander, and D.J. Ohe. 1991. The computer program EStimate TREND (ESTREND), a system for the detection of trends in water quality data: U.S. Geological Survey Water-Resources Investigations Report 91-4040, 63 pp.

U.S. Geological Survey. 2006. Collection of water samples (ver. 2.0): U.S. Geological Survey Techniques of Water-Resources Investigations, book 9, chap. A4. Accessed 2/6/12. http://pubs.water.usgs.gov/twri9A4/.

APPENDIX A

LOCATION DATA

TABLE A1. USGS GAGE NUMBERS AND LATITUDE AND LONGITUDE OF SAMPLING SITES

Existing SRBC sites (Group A sites)	Gage #	Latitude	Longitude
Susquehanna River at Towanda, Pa. (James Street Bridge)	01531500	41°47'27"	76°26'40"
Susquehanna River at Danville, Pa.	01540500	40°57'29"	76°37'10"
Susquehanna River at Lewisburg, Pa.	01553500	40°58'05"	76°52'25"
Juniata River at Newport, Pa.	01567000	40°28'42"	77°07'46"
Susquehanna River at Marietta, Pa. (Rt. 30 Bridge)	01576000	40°02'08"	75°31'23"
Conestoga River at Conestoga, Pa.	01576754	39°56'20"	76°23'15"
Enhanced Sites (Group B sites)		**Latitude**	**Longitude**
Susquehanna River at Smithboro, N.Y.	01515000	42°02'02"	76°24'02"
Cohocton River near Campbell, N.Y.	01529500	42°15'09"	77°13'01"
Chemung River at Chemung, N.Y.	01531000	42°00'10"	76°38'06"
Susquehanna River at Conklin, N.Y.	01503000	42°02'07"	75°48'12"
Unadilla River at Rockdale, N.Y.	01502500	42°22'40"	75°24'23"
Susquehanna River near Wilkes-Barre, Pa.	01536500	41°15'03"	75°52'52"
West Branch Susquehanna River near Jersey Shore, Pa.	01549760	41°12'08"	77°15'05"
Penns Creek at Penns Creek, Pa.	01555000	40°52'00"	77°02'55"
Bald Eagle Creek near Castanea, Pa.	01548085	41°07'36"	77°25'60"
Shermans Creek near Dromgold, Pa.	01568000	40°20'46"	77°11'31"
Conodoguinet Creek near Hogestown, Pa.	01570000	40°15'08"	77°01'17"
Swatara Creek near Hershey, Pa.	01573560	40°17'54"	76°40'05"
West Conewago Creek near Manchester, Pa.	01574000	40°04'56"	76°43'13"
Pequea Creek near Martic Forge, Pa.	01576787	39°53'53"	76°20'32"
West Branch Susquehanna River near Karthaus, Pa.	01542500	41°07'03"	78°06'33"
Raystown Branch Juniata River at Saxton, Pa.	01562000	40°12'57"	78°15'56"
Octoraro Creek at Richardsmere, Md.	01578475	39°41'25"	76°07'41"
East Mahantango Creek near Dalmatia, Pa.	01555500	40°36'40"	76°54'44"
Paxton Creek near Penbrook, Pa.	01571000	40°18'30"	76°51'00"
Kishacoquillas Creek near Reedsville, Pa.	01565000	40°39'17"	77°35'00"

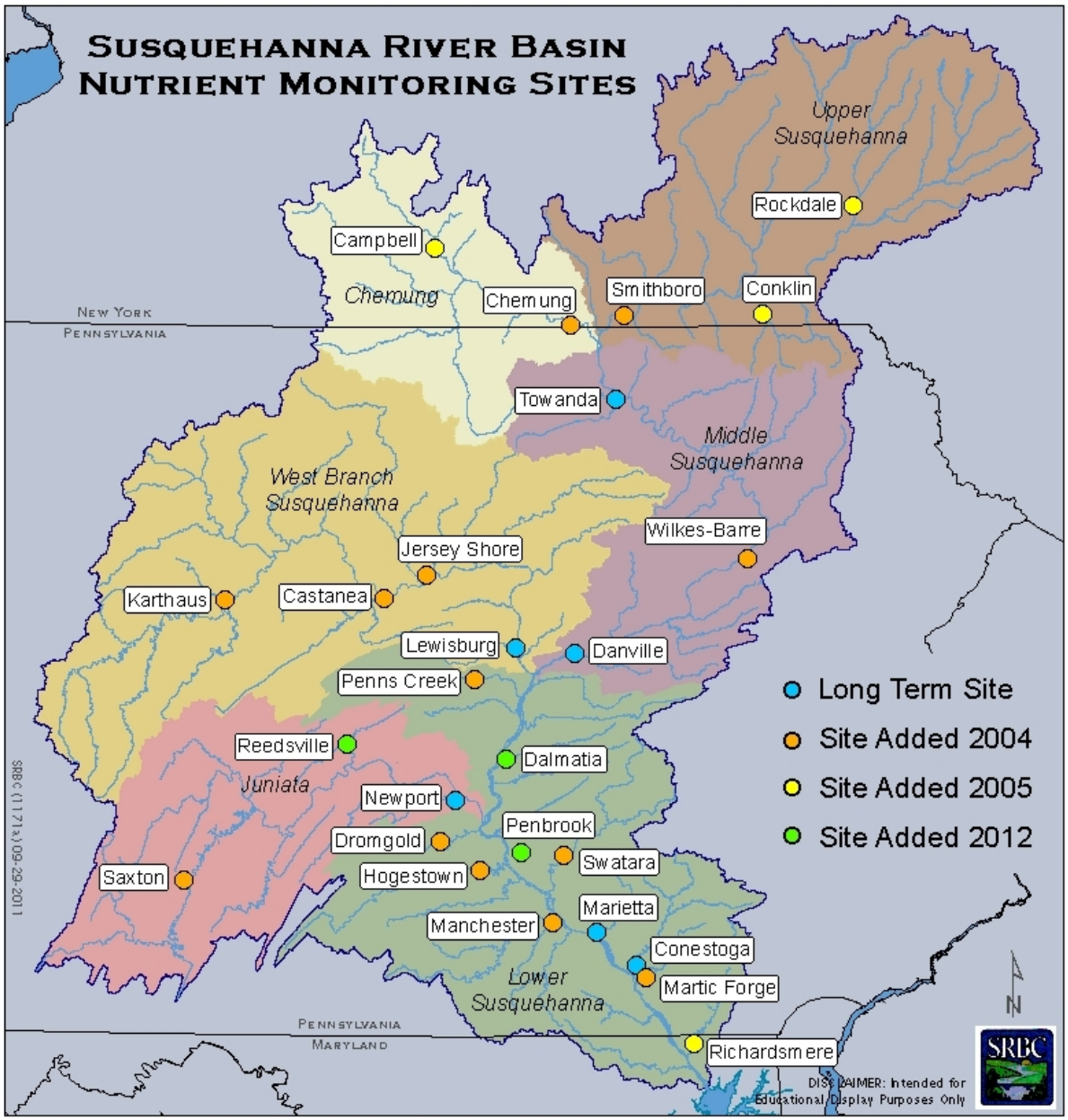


Figure A1. Sampling Site Locations

APPENDIX B

SRBC SUSPENDED SEDIMENT STANDARD OPERATING PROCEDURE

STANDARD OPERATING PROCEDURE (SOP) FOR SUSPENDED SEDIMENT CONCENTRATION (SSC)

Susquehanna River Basin Commission
4423 North Front Street
Harrisburg, PA 17110-1788
Phone (717) 238-0423
Fax (717) 238-2436

Manager, Monitoring & Protection
Name James P. Shallenberger Signature _____ Date_____i

QA Officer
Name James P. Shallenberger Signature _____ Date_____i

Author
Name Kevin H. McGonigal Signature _____ Date_____i

Review	Date	Description of Revision /Comment	Signature
1	2/5/2015	Initial Release	

TABLE OF CONTENTS

I. OVERVIEW & PURPOSE

The following standard operating procedure has been developed in order to provide Susquehanna River Basin Commission (SRBC) staff with information necessary to perform suspended sediment concentration analysis at the SRBC laboratory located at 4423 North Front Street.

The SOP has been adopted from Guy, 1969*. Adherence to the SOPs will ensure that conformance to technical and quality system requirements are met regardless of personnel changes and that consistent, high-quality data are collected.

II. PROCEDURAL SECTION

A. Scope & Applicability

1. This SOP is intended to provide specific procedures involved in suspended sediment concentration analysis to be conducted in the laboratory at Susquehanna River Basin Commission.

B. Summary of Method

1. Filtration method outlined in Guy (1969)*

C. Definitions

1. SSC – Suspended Sediment Concentration

D. Health & Safety Warnings

1. Caution when working with crucibles and sediment bottles to avoid broken glass.

E. Interferences

1. Potential interferences include contaminated containers and materials, large pieces of debris or gravel on the filter paper, which need to be removed prior to measurement.

F. Personnel Qualifications/Responsibilities

1. Individuals new to this procedure will work with experienced staff to gain familiarity with equipment and procedures.

G. Equipment and Supplies

1. Pyrex Gooch coarse fritted disc crucibles
2. Whatman glass microfiber 32 mm Filters
3. Desiccator
4. Forceps
5. Gravity Convection Oven
6. Dishwasher for sediment bottles
7. Vacuum/filtration system (Air Admiral Vacuum pump)
8. Water Bottle
9. Scales
   OHAUS E4000 –weighing sediment bottles
   Mettler AE240 –weighing crucibles
10. Tongs

H. Procedure

Use tongs during all procedures involving crucibles after cooked in the oven.

Sediment sample processing procedure

1. Clean Crucibles in water
2. Air dry and add filter paper
3. Into oven for 24 hours at 105* degrees
4. Out of oven into desiccator for 24 hours (using tongs)
5. Weigh each crucible (handle with tongs)
6. Weigh sediment sample (record Tare and Gross)
7. Record information (site, date, time, etc.)
8. Record crucible number to be used
9. Pour sediment sample into crucible (rinse bottle with DI to insure all sediment collected)
10. Use forceps to remove any large pieces of organic matter and/or gravel.
11. Crucibles into oven for 24 hours at 105* degrees
12. Out of oven into desiccator for 24 hours (tongs)
13. Weigh sample (tongs)
14. Crucibles to sink

Scale Calibration procedure

1. Turn scale on and allow 30 minutes before step 2
2. Hold bar down until calibration mode is reached
3. Wait until 100 g is requested then slide lever on right side backward
4. Wait until 0 g is requested then slide lever on right side forward
5. After calibration place crucible in center and close door. Allow several seconds for reading dot goes off on LED display before recording value.

I. Data and Records Management

1. Suspended sediment concentration is calculated using the following equation:

$$\frac{(A - B) \times 1{,}000{,}000}{C}$$

A = Weight of crucible plus filtered sediment in grams
B = Weight of crucible plus filter paper (tare) in grams
C = Weight of entire sample minus container tare weight in grams
Results in ppm equivalent to mg/L

2. Data entry form used in laboratory to be transferred to excel
3. Records stored electronically
4. Excel Spreadsheet used for calculations
5. Data entry forms listed in section four.

* As per ASTM Method D 3977-97, the oven temperature recommendation is 105 degrees. The SRBC method for oven temperature was changed from 110 degrees to 105 degrees based on USEPA recommendation on 2/27/2015 (ASTM, 1999).

III. REFERENCES

ASTM. 1999. D 3977-97, Standard Test Method for Determining Sediment Concentration in Water Samples, Annual Book of Standards, Water and Environmental Technology, 1999, Volume 11.02, pp. 389-394.

Guy, H.P. and V.W. Norman. 1969. *Field methods for measurement of fluvial sediment.* U.S. Geological Survey Techniques of Water Resources Investigation, Book 3, Chapter C2 and Book 5, Chapter C1.

U.S. Environmental Protection Agency. 2007. *Guidance for Preparing Standard Operating Procedures (SOPs) (QA/G-6)*, EPA/600/B-07/001, Office of Environmental Information, Washington, D.C.

IV. DATA ENTRY AND CALCULATION FORM EXCERPTS AND EXAMPLE

Sediment Concentration Data Entry Sheet					
Station	Example				
Date	1/1/2015				
Time	1500				
Gross Sample	738				
Tare Sample	234				
Cruc. #	1				

Crucible Weights Data Entry		
Cruc #	Used	Clean
1	23.235	23.20
2		
3		
4		
5		

SEDIMENT CONCENTRATION CALCULATION SHEET											
SITE		Example									
DATE	|	1/1/2015									
TIME	|	1500									
GAGE HT.	|										
GROSS SAMP	|	738									
TARE SAMP	|	234									
NET SAMPLE	|	504	0	0	0	0	0	0	0	0	0
----------	|										
CRUC. #	|	1									
GROSS WT	|	23.235									
TARE WT	|	23.2									
NET WEIGHT	|	0.0350	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
----------	|										
*1000000	|	35000	0	0	0	0	0	0	0	0	0
CONC. PPM	|	69									

APPENDIX C

FORMS

Field notes data entry page

SAMPLE # _____
DATE _____
TIME _____
pH _____
COND. _____
TEMP. _____
D.O. _____
TURB _____
GAGE HT _____
Field Notes:

COLLECTOR_____
SONDE ID _____
Check if:
____ **WQ in churn**
____ **Alt location**
____ **Storm**
____ **Routine**
____ **Routine Storm Impacted**

Calibration Log Book Entry Page

Date:		Employee Name:			
Time:		Sonde Type and Serial Number:			
Calibration					
Function	Temp. of Standard	Value of Standard	Initial Reading	Calibrated to	Comments
Specific conductance ≥1,000 µS/cm					Zero Check □Pass □Fail; Value =
pH calibrated (7)					
pH mv for pH 7 solution					Range 0 ± 50 mv
pH calibrated (10/4)					
pH mv for pH10 pH mv for pH 4					Range: -130 to -230 mv Range: 130 to 230 mv
Dissolved Oxygen (% Sat)					
Optional Sensors (include parameter: turbidity, etc.)					
DATA NEEDED FOR DISSOLVED OXYGEN CALIBRATION					
Altitude (A) = _____feet above msl			Barometric pressure_____mm hg		

3800-FM-WSFR0121 8/2009

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Sample Submission Sheet

PA DEP Bureau of Laboratories

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER STANDARDS AND FACILITY REGULATION

# of Unpreserved Bottles:		
Tests	# of bottles	Fixative
Metals		HNO3
Phenols		H2SO4
CN		NaOH
NA/K		HNO3
Spl. Inorg/Nutrients		H2SO4

Organic Bottles Submitted			
Bottle	Test	# of bottles	Fixative
40mL VOA amber	TOC		H2SO4
40mL VOA amber	DOC		H2SO4
1 L amber			
500 mL amber			
Other:	Bacteria		Pre-cl'd
Other:			

LAB USE ONLY

Lab Number:

Date Received:

Received By:

Temp. ≤ 6°C

Collector ID | **Sequence No.** | **Date Collected** (MM, DD, YY) | **Time Collected** (HH MM)

Reason Code | **Cost Center Code** | **Program Code** 0 0 0 1 | **STD Analysis Code**

Matrix Code | **Residual Chlorine** Yes No | **pH less than 2.0** Yes No | **Legal Seal Number:**

Legal Seal Intact: Y N

Additional Analysis

How Shipped:
- ☐ US Cargo
- ☒ Hand Delivered
- ☐ Other _____

Collectors Name: (printed) Kevin McGonigal

Phone: 238-0426 X 105

Relinquished By: (signature) _____

Date: _____

Station Number (WQN0###)

W Q N 0

Station Name _____

Sampling Location _____

Stream Name _____

Stream Code | River Mile Index

Latitude (DMS) | Longitude (DMS)

FIELD RESULTS:

Temp.(°c)	(00010)	
pH (units)	(00405)	
D.O. (mg/l)	(00300)	
Sp. Cond. (µmhos)	(00094)	
Gage (ft)	(00065)	
Flow (cfs)	(00061)	
Secchi Disk	(00078)	

Comments:

One Copy of This Sheet Goes To: a) 625 Broadway, 4th Floor, Albany, New York 12233-3502
b) With sample to contract lab c) Retain for your records

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

CONTRACT LAB SAMPLE INFORMATION SHEET

Print Legibly

Clear Form

CAUTION (check if applicable)

☐ Lab personnel are expected to use caution when handling DEC samples, however, please use special caution when handling this sample since it is believed to contain significant concentrations of hazardous and/or toxic material(s).

CHECK THE BOX PRECEDING THE REQUESTED ANALYSIS

PRIORITY POLLUTANTS (Water and Wastewater Title 40 Part 136)—SPDES

☐ 1. 13PP Metals	☐ 10. Sulfate	☐ 19. Halogenated Volatiles (USEPA 601 GC)
☐ 2. Cyanide	☐ 11. Reactive Phosphorus	☐ 20. Aromatic Volatiles (USEPA 602 GC)
☐ 3. BOD	☑ 12. Total Phosphorus	☐ 21. Volatiles (USEPA 624 GC/MS)
☐ 4. CBOD	☑ 13. Nitrate/Nitrite	☐ 22. Low-Level Volatiles (USEPA 524.2 GC/MS)
☐ 5. COD	☑ 14. Ammonia	☐ 23. Acids/Base/Neutrals (USEPA 625 GC/MS)
☐ 6. pH	☐ 15. TKN	☐ 24. Pesticides/PCBs (USEPA 608 GC)
☐ 7. Settleable Solids	☐ 16. Total Phenols	☐ 25. PCBs at 0.065 µg/L (USEPA 608 GC)
☐ 8. Total Solids	☑ 17. TOC	☐ 26. PCBs congener method (1668A HRGC/HRMS)
☑ 9. TSS	☐ 18. Oil/Grease	☑ 27. Other TPO4, DPO4, TN, DN

CONTRACT LABORATORY PROTOCOLS

☐ 28. (ALL) - Water - Includes 29-33	☐ 35. (ALL) - Soil/Sediments - Includes 36-40
☐ 29. Base/Neutral/Acid (B/N/A) Water (GC/MS)	☐ 36. Base/Neutral/Acid (B/N/A) Soil/Sediments (GC/MS)
☐ 30. Volatile Organic Analysis (VOA) Water (GC/MS)	☐ 37. Volatile Organic Analysis (VOA) Soil/Sediments (GC/MS)
☐ 31. Pesticides/PCBs Water (GC/MS)	☐ 38. Pesticides/PCBs Soil/Sediments (GC)
☐ 32. 23 Metals in Water	☐ 39. 23 Metals in Soil/Sediments
☐ 33. Cyanide in Water	☐ 40. Cyanide in Soil/Sediments
☐ 34. Dioxin - Water (1613B GC/MS)	☐ 41. Doixin - Soil/Sediments (1613B GC/MS)
☐ 42. Other _____	

HAZARDOUS WASTES/RCRA ANALYSIS SW-846

☐ 43. EP Toxicity	☐ 48. EP Toxicity (Metals Only)	☐ 53. BNA (USEPA 8270 GC/MS)
☐ 44. Corrosivity	☐ 49. TCLP (Metals Only)	☐ 54. Pesticides (USEPA 8081GC/ECD)
☐ 45. Ignitability	☐ 50. Metals—17 Hazardous	☐ 55. PCBs (USEPA 8082 GC/ECD)
☐ 46. Reactivity	☐ 51. Percent Solids	☐ 56. Dioxin (USEPA 8280 GC/MS)
☐ 47. TCLP	☐ 52. VOA (USEPA 8260 GC/MS)	☐ 57. Other _____

MUNICIPAL SLUDGE

☐ 58. RS-01 ☐ 59. RS-02 ☐ 60. Other _____

COLLECTED BY:	TELEPHONE NUMBER: (717) 476-7206	REGION NO.:

CONTRACT LABORATORY: Columbia Analytical Services	COUNTY:	SAMPLING DATE:	MILITARY TIME:

SAMPLE MATRIX:

☐ Air ☐ Soil/Sediment ☐ Groundwater ☑ Surface Water ☐ Wastewater ☐ Other _____

CASE NO.	SDG NO.	SAMPLE NO.	CHECK FOR MS/MD	TYPE OF SAMPLE
			☐ This Sample	☐ Grab ☑ Composite ☐ Term _____

☐ Check if there will be more samples with this SDG sent in this calendar week.

SAMPLING POINT:

Report via Category B, unless checked ☐

Check if field duplicate ☐ | Outfall Number

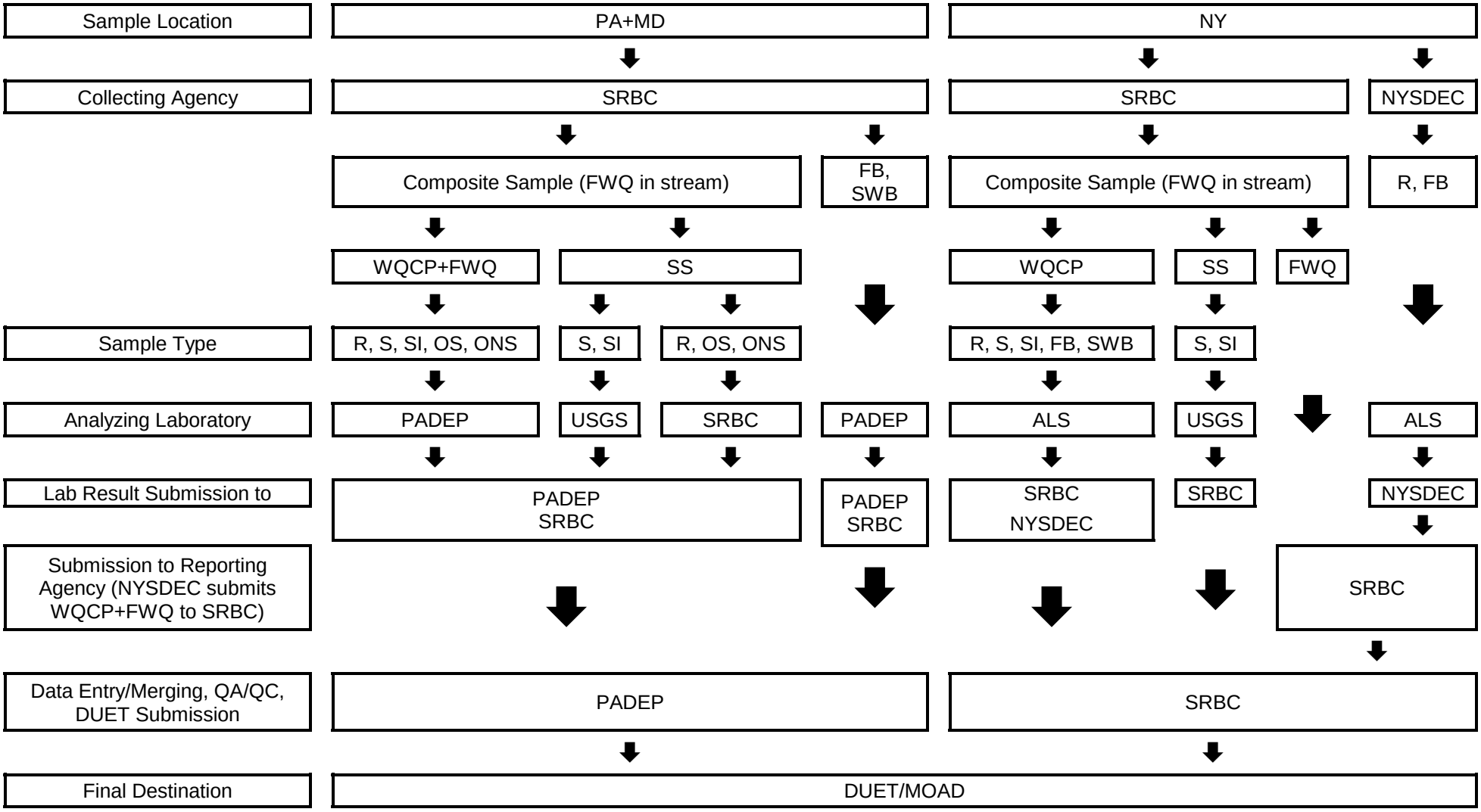
Check if sampling is part of inspection ☐

FLOW: _____ GPD _____ MGD

SPDES NUMBER/REGISTRY NUMBER

APPENDIX D

DATA COLLECTION and SUBMISSION FLOW CHART



Acronyms:
R-Routine, SI-Storm Impacted, S-Storm, OS-Other Storm, ONS-Other NonStorm, FB-Field Blank, SWB-Source Water Blank, SS-Suspended Sediment, WQCP-Water Quality Chemical Parameters, FWQ-Field Water Quality, QA/QC-Quality Assurance/Quality Check, ALS-ALS Environmental, NYSDEC-New York State Department of Environmental Conservation, PADEP-Pa Department of Environmental Protection, USGS-United States Geological Survey, SRBC-Susquehanna River Basin Commission, DUET-Data Upload and Evaluation Tool, MOAD-Mother of all Databases

APPENDIX E

APRIL 26-27 USGS/USEPA/SRBC AUDIT

Technical Systems Assessment of Susquehanna River Basin Commission Chesapeake Bay Nontidal WQ Monitoring Program

Final Report, June 10, 2016

Background

An on-site, technical systems assessment, i.e., audit, of the field procedures used by Susquehanna River Basin Commission (SRBC) Chesapeake Bay Nontidal Water Quality (WQ) Monitoring Program was conducted April 26-27, 2016. The purpose of the assessment was to review SRBC sampling procedures for conformance with Chesapeake Bay Program (CBP) guidance. The audit team included Mary Ellen Ley, CBP QA Coordinator; Brenda Majedi, USGS Hydrologic Technician, and Doug Chambers, USGS WQ Specialist. A concurrent assessment was done for the USGS PA WSC NTN program, the results of which are contained in separate report.

SRBC's Nontidal WQ Network monitoring is funded by the EPA Chesapeake Bay Program Office and the Pennsylvania Department of Environmental Protection (PADEP). SRBC field staff presently monitor 21 Pennsylvania Water Quality Network (WQN) stations. Staff are responsible for collecting water samples and transporting them to the PADEP Bureau of Laboratories for nutrient analyses. Suspended sediment (SSC) samples collected during storm events are sent to the USGS Kentucky Sediment Laboratory and the routine (monthly) SSC samples are analyzed in-house by SRBC staff.

The audit team met April 26 with all Pennsylvania Nontidal Network agencies to review the organization and responsibilities of each agency, sampling schedules, procedures, equipment, quality controls, training, data review and data reporting procedures. Day 1 participants included:

- PADEP – Justin Lorson
- SRBC – Tyler Shenk, Kevin McGonigal, and Matt Elsasser
- USGSPA WSC – Lee Eicholtz, Heather Eggleston, Mike Langland and Drew Reif

On April 27, the team observed Kevin McGonigal sampling at two SRBC stations – the Susquehanna River at Marietta (WQN 0201) and the Conestoga R. at Conestoga, PA (WQN 0273).

Summary of Day 1 discussion

1. The number and frequency of SRBC NTN WQ sample collection was excellent in WY 2015. The number of routine samples per station was monthly, with a few exceptions due to ice cover. The number of storm samples was eight or more per station, when counting the "other storms". Baseflow, i.e., "other non-storm" samples are omitted from the following percentages:

    - 97% completion for routine samples (actual R+RSI/Expected = 245/252)

- 98% completion for storm samples (actual S/Expected = 164/168)

2. Routine sampling is scheduled for the 12th day of each month, ± 4 days. The decision to use an isokinetic sampler is determined on-site, and based on professional judgement.

3. SRBC and USGS have done side-by-side comparisons of data collected from the modified DH-48 and the DH-95 and determined that the modified DH-48 produced comparable results under the conditions sampled.

4. Decisions to collect storm samples are based on predictions from the Mid-Atlantic River Forecast Center www.weather.gov/marfc. Two samples are collected per storm event, on different days, with the first collection on the rising limb, close to the peak discharge, and the second on the falling limb. The goal is to sample one storm event per station per quarter.

5. Field Duplicates reported to CBP – Two duplicates are required per station per year, capped at 24. That means the 21 stations should be duplicated at least once and at least 3 stations duplicated twice.
   - In WY 2015, SRBC reported 39 replicates to the CBP, from all sample types. Two storm samples had field duplicates, and included SSC.
   - In WY 2015, the following stations did not have a field duplicate reported to the CBP: WQN 0204, WQN 0210, WQN 0223, WQN 0226, WQN 0229, and WQN 0302.

6. Field Blanks (FBs) reported to CBP – One blank per station per year is required.
   - In WY 2015, the expected number of field blanks is 21, with 9 reported (43%).
   - Each of the 9 FBs were from different stations. Source water blanks are also collected.
   - A mix of blanks from different event types were done (routine, storm, etc.).
   - Field blanks were not reported for SSC.
   - Omni Water is used to prepare blanks. FBs go to a commercial laboratory (ALS) to achieve a lower detection limits than the PADEP lab.

7. Field meter calibration is checked in the SRBC lab each day of sampling. Field measurements are not always taken if conditions are unsafe, or alternatively, staff take the measurements from a sampled container of water.

8. SRBC staff were originally trained by USGS PA Water Science Center staff in the procedures developed for the Pennsylvania WQ Network. Kevin McGonigal attended the 2004 CBP training for Nontidal Network sampling and is responsible for training the 5 sampling teams. USGS PA staff provide technical assistance as needed. Kevin is a regular member of the CBP workgroups for Integrated Monitoring Networks and the Data Integrity Workgroups.

9. Data are managed jointly by PADEP and SRBC. Field recorded measurements including DO, pH, temperature, specific conductivity, and turbidity are recorded on the laboratory chain of custody sheets that accompany the samples. Lab and field data are merged by PADEP.

Summary of Findings – Day 2 Site Visits

Susquehanna River at Marietta: Michael (Josh) Lookenbill, PADEP WQ Monitoring Section Chief, participated in the Day 2 site visits. Samples were collected by Kevin McGonigal from the downstream side of the concrete Rt. 462 "Veterans Memorial" Bridge, approximately 1.25 miles long, between Wrightsville and Columbia, PA. The sampled section was wide and shallow (deepest point approximately 8 feet) with uniformly low velocity, and less than the 1.5 ft/s required for using an isokinetic sampler. The stream velocity was estimated visually and informed by knowledge of site conditions. A non-isokinetic sample was collected using a modified DH-48 sampler with the nozzle removed. The modified sampler is a DH-48 sampler with a tail fin and a hanger for suspension, fitted with a removable 0.5 L glass sample bottle. Samples were collected at 11 approximately equidistant verticals across the bridge. Some verticals were adjusted slightly to avoid piers or mid-channel bars. Leather work gloves were worn throughout the sampling. Samples were composited in an 8-L polyethylene churn. The churn was not bagged nor in a churn carrier. At each sampling point the churn was set unprotected on the ground. The churn lid was opened at each site to pour in the sample the sample. The sampler bottle was not swirled to re-suspend any sediment in the sample from each vertical. There was constant, moderate vehicle traffic on the bridge which could contaminate the water placed in an unprotected churn.

The sample was processed on the tail gate of a pick-up truck on the road side. The truck had a topper and the sample processing area was partly shielded from the elements by the topper's upper door. Unfiltered samples were dispensed from the churn first. It was pointed out to Kevin that the water had to be churned at least ten times before dispensing the first sample. To prepare samples for dissolved parameters, water was pumped through a plate-filter using a peristaltic pump and plastic tubing into clean, labeled sample bottles. Acid preservatives were added from a 500-mL bottle using a syringe. After processing, the samples were placed on ice for later delivery to the analytical laboratory.

Conestoga River at Conestoga: Samples were collected by Kevin McGonigal from the downstream side of River Road Bridge near Safe Harbor, PA. The sampled section was fairly uniform with a maximum depth of approximate 3.5 ft. Doug estimated that the mean velocity of the stream exceeded 1.5 ft/s, and recommended that an isokinetic sample be collected. This was accomplished using by adding a nozzle to the modified DH-48 sampler. SRBC sampling staff have selected a 5/16-inch nozzle as the standard for isokinetic sampling. Kevin did not have the transit rate and volume guidelines for using an isokinetic sampler that are specified in the USGS National Field Manual (NFM). Kevin and Doug discussed the application of a uniform transit rate at each of the verticals. Kevin used a transit rate of 0.3 ft/s, appropriate for the maximum depth and mean stream velocity at the site. At this transit rate and stream velocity the modified DH-48 sampler was not stable in the vertical and "swam" erratically.

Samples were collected at five points across the stream section. Kevin stated that he was using a "flow-weighted" EWI method. Vertical locations at all sites were previously established either at equal distance locations, at sites where flow and depth were uniform, or "flow weighted," where

flow and/or depth were not uniform or where hydrology changes due to storm events and debris occurred (as had occurred at Conestoga). At these sites, professional judgment was used to re-locate and/or add verticals to insure the collection of a representative sample. New locations are maintained unless additional alterations to the hydrology occur. All other aspects of sample collection were similar to those used at the Susquehanna River at Marietta. The sample was processed using the same protocols as had been observed at the Susquehanna River site.

Observations and concerns

The techniques used by SRBC depart significantly from those stated in the CBP Non-Tidal monitoring guidance and the USGS National Field Manual.

The number of sampling points may be insufficient to constitute a EWI or EDI. The Chesapeake Bay Program requires a minimum of 5 EWI samples for streams between 100-250 feet wide, and an assessment of the cross-sectional variability using field measurements to determine if additional increments are needed. The USGS NFM recommends a minimum of 10 EWI verticals for streams greater than 5 foot in width.

Rinse water for the sampler and churn should be collected at the deepest, fastest section, the thalweg, to determine the transit rate applicable to all increments. If a table of stage vs. mean velocity is not available, estimate the velocity using wading rod and stopwatch or other means to estimate velocity.

Greater attention should be paid to churn rinsing. Most of the rinse water should go through the spigot and any remnant swirled and poured out the top.

The sampler bottle was not swirled to ensure complete transfer of sediment to churn. The churn did not have the funnel-top modification.

More care should be given to safeguarding the sample from contamination. Bagging the churn and opening the bag to pour in the sample will protect the sample. Additionally, given the length of the bridge at the Susquehanna River at Marietta, there is a significant opportunity for the sample to warm during the summer. Consider using a churn carrier or cooler to protect the sample. A foldable garden or yard cart will make carrying the sampling equipment much easier.

The modified DH-48 is inadequate for collecting isokinetic samples. It is not heavy enough and "swims" erratically at appropriate transit rates. Under higher flows, the sampler may not reach the bottom layers of the water column where heavier suspended sediment particles occur.

Processing samples on the tail gate of a pick-up truck is inadequate for protecting the sample from contamination. Had there been more precipitation on the day of the field audit, it would have been very difficult to prevent contamination.

The plate filters are likely to result in clogging at higher TSS concentrations. The use of capsule filters is recommended. A new capsule filter for each site eliminates the need to clean the filter holder between sites.

Requirements and Recommendations

1. **Sampling Equipment**
    a. Discontinue the use of the modified DH-48 for the collection of Chesapeake Bay Nontidal WQ Network samples.

    b. When isokinetic conditions exist, use the sampler appropriate for the depth and flow conditions. The DH-81, DH-95 or D-95 samplers are examples of appropriate samplers, but the field staff should consult Table 5.2 in the *CBP Nontidal WQ Monitoring*, or the USGS Open File Report 2005-1087 for applications.

    c. A crane and a reel will be necessary to lower and raise the heavier DH-95 or D-95 samplers from bridges into the channels.

    d. Submit data and a description (stage, parameters, etc.) of the side-by-side comparison study done with USGS-PA staff that established the equivalency of the modified DH-48 and the DH-95.

    e. When the new equipment is obtained, collect additional side-by-side samples to estimate the bias, if any, between data collected from the modified DH-48 and the DH-95 samplers. This should be done at each station, over a range of flow conditions.

2. **Sampling Procedures**
    a. Measure equal-width increments (EWIs) as specified in the *USGS National Field Manual for the Collection of Water-Quality Data.* (Incorporated by reference in *CBP Nontidal WQ Monitoring*, Section B.2.2.)

    b. Check the cross-sectional variability of field measurements from individual verticals to ensure the number of EWIs is sufficient - see #7 below for details. (Section 4.5)

    c. On the day of sampling, obtain an accurate measure of velocity to determine if an isokinetic sampler is needed. For each station, construct a table of stage vs. mean velocity and use real-time information to select the appropriate sampler and nozzle. (Section B.1.10)

    d. Predetermine the vertical transit rate at the deepest, fastest increment of the cross-section. (Sections B.2.7 – B.2.9) The downward and upward transit rates must be the same.

    e. Do not allow the rope attached to the sample-collection device to contact the ground; instead, put it in a clean bag, or cooler.

f. Protect the churn splitter while filling using a plastic bag, churn carrier or cooler. Thoroughly rinse the churn with stream water – through the spigot, inside of churn, etc.

g. Wear powderless, non-contaminating gloves (e.g., nitrile) when handling the sampler bottle and pouring EWI water into the churn.

h. Swirl to mix the water in the sampler bottle before pouring into the churn to ensure complete transfer of sediment. Consider using a funnel-top modification to the churn.

3. **Subsampling and Processing**
   a. Use clean-hands / dirty hands protocols. (Section B.4.3) Process samples in a better protected area such as the inside of a van.

   b. Pre-mix the composited sample by churning for about 10 strokes (Section B.4.7) and continue churning while subsampling. (Section B.4.8) Churn at a constant rate of 9 inches per second. (Section B.4.6 – B.4.7) Do not break the surface of the water while churning. (Section B.4.5)

   c. Use capsule filters for preparing filtered samples. Use a new filter at each station and rinse in the field with 2 L of DI water and a small amount of sample to prevent clogging.

   d. Wear powderless, non-contaminating gloves (e.g., nitrile) when handling all equipment used for sample processing, in order to minimize contamination.

4. **Field Parameters**
   a. Turbidity is listed as a field measurement in the SRBC QAPP, (Table 1). There were no turbidity values reported to the CBP from the SRBC WQN sites; only New York stations.

   b. Turbidity meter calibration must be checked each day of use, not monthly as stated in the QAPP.

   c. When dissolved oxygen and temperature are measured in a container instead of *in-situ*, report these values to the CBP with the appropriate method codes (_F02).

5. **Field Blanks and Duplicates**
   a. Send nutrient field blanks to the PADEP laboratory and SSC field blanks to both sediment laboratories. Field blanks must be treated exactly the same as regular samples, which includes the analytical procedures. (Section B.6.1.1)

   b. Collect field duplicates from each of the 21 WQN stations at least once. Three of the stations need to have a second duplicates to bring the total to 24 per year. *CBP*

Nontidal WQ Monitoring, (Table 5-A.2)

6. **Suspended Sediment Analysis**

   The SRBC Sediment Laboratory must participate twice a year in the USGS Sediment Laboratory Quality Assurance Project for suspended sediment concentration (SSC). Further information is available at: https://bqs.usgs.gov/slqa/index.html

7. **Training**

   Ensure that field personnel are trained in the use of applicable USGS sampling techniques and equipment required for the CBP Nontidal Network. Staff need to better understand the meaning of each sampling technique and how to determine the conditions for their correct use. Specifically, the meanings of equal-width increment (EWI), equal-discharge increment (EDI), and multiple verticals need to be reinforced. Concepts such as how the transit rate is used and how the appropriate isokinetic sampler and nozzle size is determined and the importance of these sampling considerations needs to be reinforced.

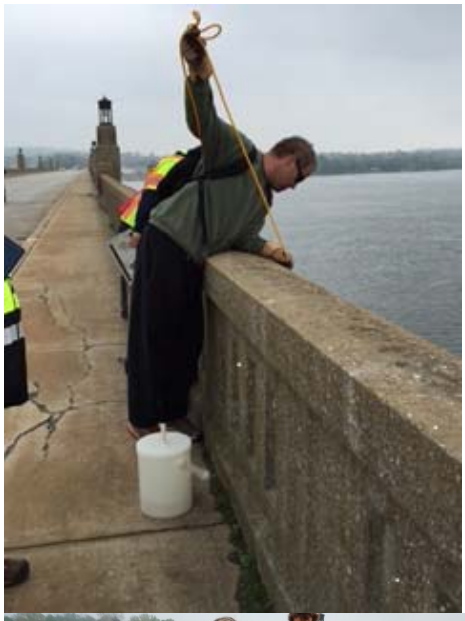
8. To determine if the number of depth-integrated EWIs adequately represent the vertical and horizontal water-quality gradients within the cross-section, over a range of flow conditions:

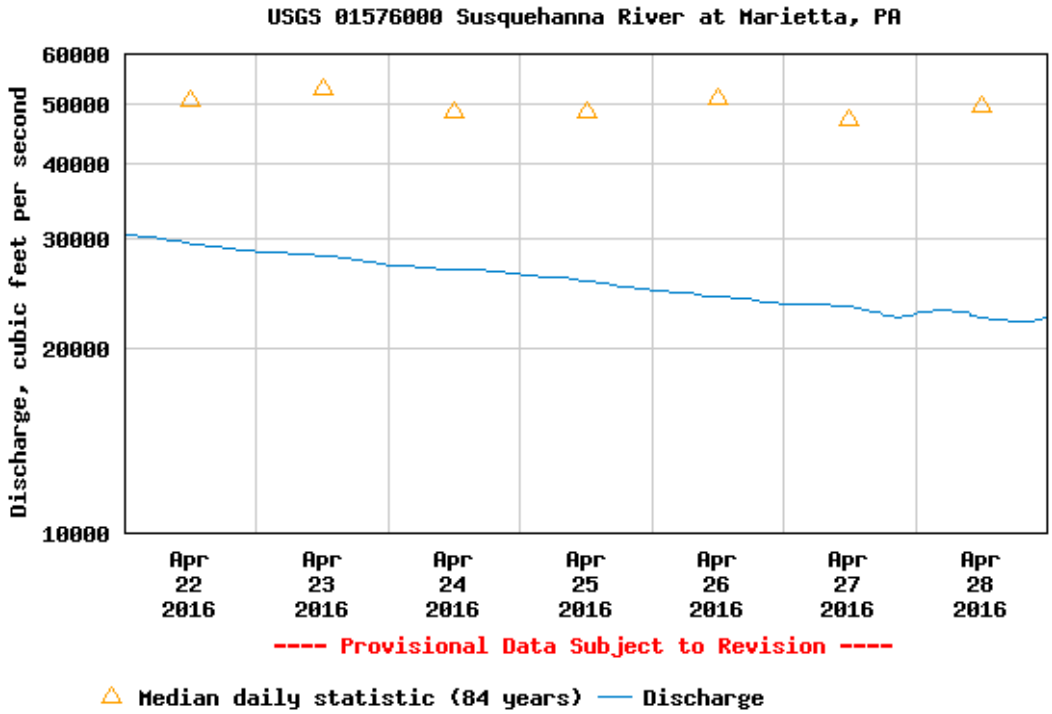
   a. Analyze individual depth-integrated samples collected along the stream cross section for suspended sediment concentration, total phosphorus and ortho-phosphate,

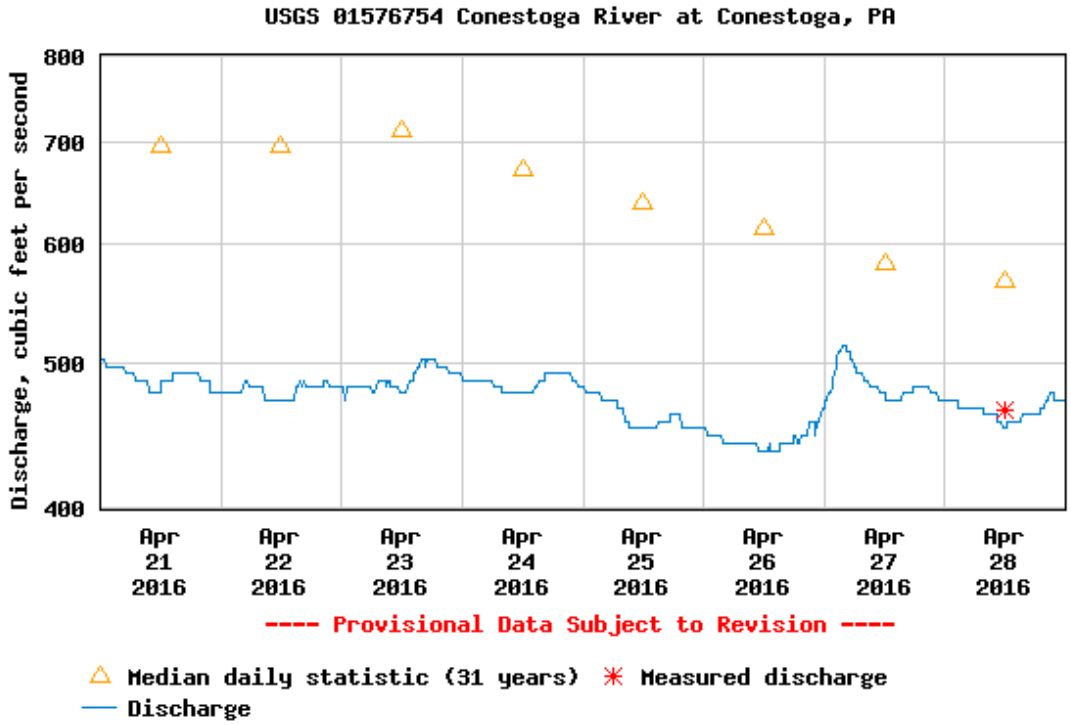
   b. Assess the cross-sectional variability of turbidity, specific conductance, water temperature, dissolved oxygen and pH, and

   c. Estimate the variability of constituents across the channel and increase the number of EWIs if the variability is significant. Further guidance on “significant” is to be determined by a CBP workgroup.

Photos of Sampling the Susquehanna River from the Veterans Memorial Bridge:




USGS 01576000 Susquehanna River at Marietta, PA
Discharge, cubic feet per second
60000
50000
40000
30000
20000
10000
Apr 22 2016
Apr 23 2016
Apr 24 2016
Apr 25 2016
Apr 26 2016
Apr 27 2016
Apr 28 2016
---- Provisional Data Subject to Revision ----
Median daily statistic (84 years)
Discharge


USGS 01576754 Conestoga River at Conestoga, PA
Discharge, cubic feet per second
800
700
600
500
400
Apr 21 2016
Apr 22 2016
Apr 23 2016
Apr 24 2016
Apr 25 2016
Apr 26 2016
Apr 27 2016
Apr 28 2016
---- Provisional Data Subject to Revision ----
Median daily statistic (31 years)
Measured discharge
Discharge

Appendix F

SRBC Individual Audit Responses

INDIVIDUAL RESPONSES TO USGS AUDIT REQUIREMENTS AND RECOMMENDATIONS

Requirements and Recommendations

1. **Sampling Equipment**
    a. Discontinue the use of the modified DH-48 for the collection of Chesapeake Bay Nontidal WQ Network samples.

    SRBC Response: Staff will discontinue use of the modified DH-48 samplers under isokinetic conditions but will continue to use the current DH-48 samplers under non-isokinetic conditions.

    b. When isokinetic conditions exist, use the sampler appropriate for the depth and flow conditions. The DH-81, DH-95 or D-95 samplers are examples of appropriate samplers, but the field staff should consult Table 5.2 in the *CBP Nontidal WQ Monitoring*, or the USGS Open File Report 2005-1087 for applications.

    SRBC Response: Staff will utilize DH-95 samplers under isokinetic conditions.

    c. A crane and a reel will be necessary to lower and raise the heavier DH-95 or D-95 samplers from bridges into the channels.

    SRBC Response: Bridge rigs will be included in equipment purchases.

    d. Submit data and a description (stage, parameters, etc.) of the side-by-side comparison study done with USGS-PA staff that established the equivalency of the modified DH-48 and the DH-95.

    SRBC Response: The side by side study conducted in 2005 is attached (appendix G of QAPP).

    e. When the new equipment is obtained, collect additional side-by-side samples to estimate the bias, if any, between data collected from the modified DH-48 and the DH-95 samplers. This should be done at each station, over a range of flow conditions.

    SRBC Response: Side by side comparison of methods will be conducted beginning in January 2017 and will consist of sampling at 25% of 2017 events. Specific site and frequency will be determined at a later date.

2. **Sampling Procedures**

a. Measure equal-width increments (EWIs) as specified in the *USGS National Field Manual for the Collection of Water-Quality Data.* (Incorporated by reference in *CBP Nontidal WQ Monitoring*, Section B.2.2.)

SRBC Response: Equal with increments will be established at all sites.

b. Check the cross-sectional variability of field measurements from individual verticals to ensure the number of EWIs is sufficient - see #7 below for details. (Section 4.5)

SRBC Response: Cross sectional variability of field measurements will be conducted. Additions and/or reductions of the number of verticals will not be made until the CBP defines "significant variation."

c. On the day of sampling, obtain an accurate measure of velocity to determine if an isokinetic sampler is needed. For each station, construct a table of stage vs. mean velocity and use real-time information to select the appropriate sampler and nozzle. (Section B.1.10)

SRBC Response: Recommendation will be implemented as requested.

d. Predetermine the vertical transit rate at the deepest, fastest increment of the cross-section. (Sections B.2.7 – B.2.9) The downward and upward transit rates must be the same.

SRBC Response: Recommendation will be implemented as requested.

e. Do not allow the rope attached to the sample-collection device to contact the ground; instead, put it in a clean bag, or cooler.

SRBC Response: Recommendation will be implemented as requested.

f. Protect the churn splitter while filling using a plastic bag, churn carrier or cooler. Thoroughly rinse the churn with stream water – through the spigot, inside of churn, etc.

SRBC Response: Recommendation will be implemented as requested.

g. Wear powderless, non-contaminating gloves (e.g., nitrile) when handling the sampler bottle and pouring EWI water into the churn.

SRBC Response: Recommendation will be implemented as requested.

h. Swirl to mix the water in the sampler bottle before pouring into the churn to ensure complete transfer of sediment. Consider using a funnel-top modification to the churn.

SRBC Response: Staff will swirl the bottles to ensure sediment transfer. Funnel-top modifications will not be used.

3. **Subsampling and Processing**

a. Use clean-hands / dirty hands protocols. (Section B.4.3) Process samples in a better protected area such as the inside of a van.

SRBC Response: Clean hands / dirty hands protocols will be implemented as feasible. Due to the lack of feasibility of purchasing vans for all teams, care will be taken to protect samples from outside contamination through some other means to be determined.

b. Pre-mix the composited sample by churning for about 10 strokes (Section B.4.7) and continue churning while subsampling. (Section B.4.8) Churn at a constant rate of 9 inches per second. (Section B.4.6 – B.4.7) Do not break the surface of the water while churning. (Section B.4.5)

SRBC Response: Recommendation will be implemented as requested.

c. Use capsule filters for preparing filtered samples. Use a new filter at each station and rinse in the field with 2 L of DI water and a small amount of sample to prevent clogging.

SRBC Response: Staff will rinse the filter with a small amount of DI water followed by a small amount of sample water to prevent clogging.

d. Wear powderless, non-contaminating gloves (e.g., nitrile) when handling all equipment used for sample processing, in order to minimize contamination.

SRBC Response: Recommendation will be implemented as requested.

4. **Field Parameters**

a. Turbidity is listed as a field measurement in the SRBC QAPP, (Table 1). There were no turbidity values reported to the CBP from the SRBC WQN sites; only New York stations.

SRBC Response: PADEP submits data for the PA sites. Turbidity data is included on the field lab sheets. PADEP has agreed to include turbidity measurements in annual submittals to DUET

b. Turbidity meter calibration must be checked each day of use, not monthly as stated in the QAPP.

SRBC Response: Recommendation will be implemented as requested.

c. When dissolved oxygen and temperature are measured in a container instead of *in-situ*, report these values to the CBP with the appropriate method codes (_F02).

SRBC Response: Recommendation will be implemented as requested.

5. **Field Blanks and Duplicates**

a. Send nutrient field blanks to the PADEP laboratory and SSC field blanks to both sediment laboratories. Field blanks must be treated exactly the same as regular samples, which includes the analytical procedures. (Section B.6.1.1)

SRBC Response: Recommendation will be implemented as requested.

b. Collect field duplicates from each of the 21 WQN stations at least once. Three of the stations need to have a second duplicates to bring the total to 24 per year. *CBP Nontidal WQ Monitoring*, (Table 5-A.2)

SRBC Response: Recommendation will be implemented as requested.

6. **Suspended Sediment Analysis**

The SRBC Sediment Laboratory must participate twice a year in the USGS Sediment Laboratory Quality Assurance Project for suspended sediment concentration (SSC). Further information is available at: https://bqs.usgs.gov/slqa/index.html

SRBC Response: Recommendation will be implemented as requested.

7. **Training**

Ensure that field personnel are trained in the use of applicable USGS sampling techniques and equipment required for the CBP Nontidal Network. Staff need to better understand the meaning of each sampling technique and how to determine the conditions for their correct use. Specifically, the meanings of equal-width increment (EWI), equal-discharge increment (EDI), and multiple verticals need to be reinforced. Concepts such as how the transit rate is used and how the appropriate isokinetic sampler and nozzle size is determined and the importance of these sampling considerations needs to be reinforced.

SRBC Response: Staff will participate in training to reinforce proper sampling procedures.

8. To determine if the number of depth-integrated EWIs adequately represent the vertical and horizontal water-quality gradients within the cross-section, over a range of flow conditions:

   d. Analyze individual depth-integrated samples collected along the stream cross section for suspended sediment concentration, total phosphorus and ortho-phosphate,

   SRBC Response: Parameters listed in section 8.b. will be used to determine cross sectional variability.

   e. Assess the cross-sectional variability of turbidity, specific conductance, water temperature, dissolved oxygen and pH, and

   SRBC Response: Recommendation will be implemented as requested.

   f. Estimate the variability of constituents across the channel and increase the number of EWIs if the variability is significant. Further guidance on "significant" is to be determined by a CBP workgroup.

   SRBC Response: Cross sectional variability of field measurements will be conducted. Changes to verticals will not be made until the CBP workgroup defines "significant variation."

APPENDIX G

2005 USGS/SRBC Side by Side Collection Results

Table G1. Field Blank Results

Field Blank		USGS Sample 1	USGS Sample 2	SRBC Sample 1	SRBC Sample 2	USGS Ave	SRBC Ave	% Diff USGS SRBC	USGS % Diff dups
Code	Parameter								
01045A	Iron	20	20	20		20	20	0%	0%
410	alkalinity	1	1	1.6		1	1.6	38%	0%
945	Sulfate	1	1	1		1	1	0%	0%
1067A	Nickel	50	50	50		50	50	0%	0%
916A	Calcium T	0.046	0.03	1.944		0.038	1.944	98%	-53%
631A	Nox D	0.07	0.04	0.04		0.055	0.04	-38%	-75%
630A	Nox T	0.16	0.04	0.09		0.1	0.09	-11%	-300%
95	Conduct	1	1	1.13		1	1.13	12%	0%
665A	TP	0.01	0.01	0.01		0.01	0.01	0%	0%
671	DIP	0.01	0.01	0.01		0.01	0.01	0%	0%
70507	TIP	0.01	0.01	0.01		0.01	0.01	0%	0%
1042A	Copper T	10	10	10		10	10	0%	0%
608A	Ammonia D	0.12	0.12	0.1		0.12	0.1	-20%	0%
610	Ammonia T	0.11	0.11	0.09		0.11	0.09	-22%	0%
1105	Aluminum T	200	200	200		200	200	0%	0%
403	pH	6.5	6.5	7		6.5	7	7%	0%
600	TN	0.064	0.064	0.064		0.064	0.064	0%	0%
602	DN	0.064	0.064	0.064		0.064	0.064	0%	0%
1055	Manganese	10	10	10		10	10	0%	0%
1051	Lead	1	1	1		1	1	0%	0%
515	TDS	44	30	32		37	32	-16%	-47%
1092	Zinc	10	10	120		10	120	92%	0%
666	DP	0.01	0.01	0.01		0.01	0.01	0%	0%
530	TSS	2	2	2		2	2	0%	0%
680	TOC	0.5	0.5	0.5		0.5	0.5	0%	0%
927	Magnesium	0.025	0.01	0.059		0.0175	0.059	70%	-150%
900	Hardness	0	0	5		0	5	100%	0%

Table G2. Yellow Breeches USGS Gage #01571500 Results

Yellow Breeches		USGS Sample 1	USGS Sample 2	SRBC Sample 1	SRBC Sample 2	USGS Ave	SRBC Ave	% Diff USGS SRBC	USGS % Diff dups	SRBC % Diff dups
Code	Parameter									
01045A	Iron	394	374	434	452	384	443	13%	-5%	4%
410	alkalinity	91.6	93.4	92.4	93.4	92.5	92.9	0%	2%	1%
945	Sulfate	15.6	15.5	15.6	15.9	15.55	15.75	1%	-1%	2%
1067A	Nickel	50	50	50	50	50	50	0%	0%	0%
916A	Calcium T	32.4	31.5	31.8	31.7	31.95	31.75	-1%	-3%	0%
631A	Nox D	2.25	2.18	2.36	2.21	2.215	2.285	3%	-3%	-7%
630A	Nox T	2.15	2.18	2.38	2.31	2.165	2.345	8%	1%	-3%
95	Conduct	268	269	272	273	268.5	272.5	1%	0%	0%
665A	TP	0.036	0.033	0.031	0.03	0.0345	0.0305	-13%	-9%	-3%
671	DIP	0.011	0.013	0.011	0.01	0.012	0.0105	-14%	15%	-10%
70507	TIP	0.017	0.017	0.018	0.019	0.017	0.0185	8%	0%	5%
1042A	Copper T	10	10	10	10	10	10	0%	0%	0%
608A	Ammonia D	0.1	0.11	0.1	0.11	0.105	0.105	0%	9%	9%
610	Ammonia T	0.1	0.1	0.1	0.1	0.1	0.1	0%	0%	0%
1105	Aluminum T	294	298	379	378	296	378.5	22%	1%	0%
403	pH	8.1	8.1	8.1	8.1	8.1	8.1	0%	0%	0%
600	TN	2.31	2.35	2.43	2.42	2.33	2.425	4%	2%	0%
602	DN	2.33	2.33	2.34	2.37	2.33	2.355	1%	0%	1%
1055	Manganese	30	30	34	32	30	33	9%	0%	-6%
1051	Lead	1	1	1	1.1	1	1.05	5%	0%	9%
515	TDS	180	206	184	170	193	177	-9%	13%	-8%
1092	Zinc	11	10	54	57	10.5	55.5	81%	-10%	5%
666	DP	0.019	0.016	0.016	0.016	0.0175	0.016	-9%	-19%	0%
530	TSS	10	10	8	14	10	11	9%	0%	43%
680	TOC	1.56	1.53	1.54	1.64	1.545	1.59	3%	-2%	6%
927	Magnesium	9.34	8.86	8.69	8.71	9.1	8.7	-5%	-5%	0%
900	Hardness	119	115	115	115	117	115	-2%	-3%	0%

Table G3. Conodoguinet Creek USGS Gage #0157000 Results

Conodoguinet		USGS Sample 1	USGS Sample 2	SRBC Sample 1	SRBC Sample 2	USGS Ave	SRBC Ave	% Diff USGS SRBC	USGS % Diff dups	SRBC % Diff dups
Code	Parameter									
01045A	Iron	177	133	110	115	155	112.5	-38%	-33%	4%
410	alkalinity	155.2	155.2	156.6	155.2	155.2	155.9	0%	0%	-1%
945	Sulfate	20.9	21.1	21	21.1	21	21.05	0%	1%	0%
1067A	Nickel	50	50	50	50	50	50	0%	0%	0%
916A	Calcium T	61.7	58.6	61.9	62.6	60.15	62.25	3%	-5%	1%
631A	Nox D	4.59	4.62	4.58	4.37	4.605	4.475	-3%	1%	-5%
630A	Nox T	4.45	4.62	4.35	4.42	4.535	4.385	-3%	4%	2%
95	Conduct	417	418	418	419	417.5	418.5	0%	0%	0%
665A	TP	0.015	0.017	0.019	0.018	0.016	0.0185	14%	12%	-6%
671	DIP	0.01	0.01	0.01	0.01	0.01	0.01	0%	0%	0%
70507	TIP	0.011	0.01	0.01	0.01	0.0105	0.01	-5%	-10%	0%
1042A	Copper T	17	10	10	10	13.5	10	-35%	-70%	0%
608A	Ammonia D	0.1	0.1	0.1	0.09	0.1	0.095	-5%	0%	-11%
610	Ammonia T	0.1	0.1	0.1	0.09	0.1	0.095	-5%	0%	-11%
1105	Aluminum T	200	200	200	200	200	200	0%	0%	0%
403	pH	8.3	8.3	8.3	8.3	8.3	8.3	0%	0%	0%
600	TN	4.54	4.39	4.42	4.5	4.465	4.46	0%	-3%	2%
602	DN	4.62	4.54	4.5	4.52	4.58	4.51	-2%	-2%	0%
1055	Manganese	14	13	14	14	13.5	14	4%	-8%	0%
1051	Lead	1	1	1	1	1	1	0%	0%	0%
515	TDS	272	262	288	272	267	280	5%	-4%	-6%
1092	Zinc	18	10	62	60	14	61	77%	-80%	-3%
666	DP	0.011	0.011	0.011	0.01	0.011	0.0105	-5%	0%	-10%
530	TSS	6	6	2	2	6	2	-200%	0%	0%
680	TOC	1.46	1.52	1.59	1.62	1.49	1.605	7%	4%	2%
927	Magnesium	10.3	9.78	9.694	9.575	10.04	9.6345	-4%	-5%	-1%
900	Hardness	197	187	195	196	192	195.5	2%	-5%	1%

Table G4. Swatara Creek USGS Gage #01573560 Results

Swatara		USGS Sample 1	USGS Sample 2	SRBC Sample 1	SRBC Sample 2	USGS Ave	SRBC Ave	% Diff USGS SRBC	USGS % Diff dups	SRBC % Diff dups
Code	Parameter									
01045A	Iron	238	171	177	270	204.5	223.5	9%	-39%	34%
410	alkalinity	68.4	68.8	68.6	69	68.6	68.8	0%	1%	1%
945	Sulfate	28.1	28.3	27.8	28.6	28.2	28.2	0%	1%	3%
1067A	Nickel	50	50	50	50	50	50	0%	0%	0%
916A	Calcium T	27.4	28.7	31.1	32	28.05	31.55	11%	5%	3%
631A	Nox D	3.87	3.72	3.82	3.83	3.795	3.825	1%	-4%	0%
630A	Nox T	3.89	3.86	3.83	3.82	3.875	3.825	-1%	-1%	0%
95	Conduct	268	267	265	266	267.5	265.5	-1%	0%	0%
665A	TP	0.022	0.03	0.022	0.021	0.026	0.0215	-21%	27%	-5%
671	DIP	0.011	0.01	0.01	0.01	0.0105	0.01	-5%	-10%	0%
70507	TIP	0.015	0.015	0.015	0.015	0.015	0.015	0%	0%	0%
1042A	Copper T	10	10	10	10	10	10	0%	0%	0%
608A	Ammonia D	0.1	0.12	0.11	0.11	0.11	0.11	0%	17%	0%
610	Ammonia T	0.1	0.1	0.09	0.09	0.1	0.09	-11%	0%	0%
1105	Aluminum T	200	200	200	238	200	219	9%	0%	16%
403	pH	8	8	8.1	8	8	8.05	1%	0%	-1%
600	TN	3.78	3.78	3.75	3.84	3.78	3.795	0%	0%	2%
602	DN	3.91	3.82	3.77	3.84	3.865	3.805	-2%	-2%	2%
1055	Manganese	36	36	39	40	36	39.5	9%	0%	3%
1051	Lead	1	1	1.1	1	1	1.05	5%	0%	-10%
515	TDS	178	198	238	224	188	231	19%	10%	-6%
1092	Zinc	10	10	66	58	10	62	84%	0%	-14%
666	DP	0.014	0.013	0.014	0.014	0.0135	0.014	4%	-8%	0%
530	TSS	2	6	8	4	4	6	33%	67%	-100%
680	TOC	1.43	1.44	1.45	1.5	1.435	1.475	3%	1%	3%
927	Magnesium	8.05	8.4	8.227	8.71	8.225	8.4685	3%	4%	6%
900	Hardness	102	106	112	116	104	114	9%	4%	3%