New Jersey Department of Environmental Protection
Water Resources Management
Water Monitoring and Standards
Bureau of Freshwater and Biological Monitoring

Work/Quality Assurance Project Plan

Stream Monitoring for Effects on Water Quality by Road Salt Application

2018-2019

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1.0 Project Name : Stream Monitoring for Effects on Water Quality by Road Salt Application; 2018-2019

2.0 Project Requested by :
NJDEP, Bureau of Freshwater and Biological Monitoring

3.0 Date of Project :
2018-2019

4.0 Project Fiscal Information: Job Number 33340000, Activity Code V38A

5.0 Project Officer :
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7.0 Special Training Needs/Certification

Assistants to the project will be trained in the operation and use of all sampling equipment. The training will entail calibration methods, deployment techniques and data retrieval from the equipment. The Project Officer or designee will be responsible for any necessary training.

BFBM is certified by the Office of Quality Assurance (certified lab ID # 11896) for the following parameters during field work for this project: temperature, pH, conductance, dissolved oxygen (DO), turbidity.

8.0 Project Description :

8.1 Objective

Through continuous year-round monitoring, develop a specific conductance database that will examine critical high winter specific conductance levels, the duration of elevated levels, and comparisons to baseline levels and normal fluctuations throughout the year in a variety of New Jersey's non-tidal, freshwater streams. Historical specific conductance data obtained through discrete sampling shows that during winter months (December to March), levels of specific conductance in non-tidal freshwater streams increase significantly during and after significant snowfall events. This suggests that road salt application may be impacting water quality in these streams, but little is known about the duration or maximum values of these elevated levels.

Studies have shown (i.e. Increasing chloride in rivers of the conterminous U.S. and linkages to potential corrosivity and lead action level exceedances in drinking water, USGS, 2018, Water Pollution and Associated Effects of Street Salting,

USEPA, EPA-R2-73-257, May 1973 and Estimating Concentrations of Road-Salt Constituents in Highway-Runoff from Measurements of Specific Conductance, USGS Water Resources Investigation Report 99-4077, 1999) significant transfer of total dissolved solids and chloride from impervious surfaces (e.g. road ways and parking lots) to adjacent water bodies after winter snowfall events. This transfer can be evident in specific conductance measurements, since specific conductance is sometimes used as a surrogate measurement of total dissolved solids and chloride.

Because the melting of snow after snowfall events is somewhat unpredictable, it is difficult to deploy staff to take targeted, discrete total dissolved solids and chloride samples. The use of data loggers should provide additional insight into scheduling such discrete sampling events.

Data obtained through this project will allow for more in-depth assessment of specific conductance data as it relates to winter precipitation/snow events. In addition, data will assist in the determination of site-specific relationships between specific conductance, chloride and total dissolved solids. Information on these relationships may inform as to the determining factors influencing surface water chloride and TDS levels. Finally, data will be evaluated against geographic information system (GIS) coverages. Road miles will be broken down into State, county, municipal, or privately/commercially owned categories within each drainage basin to potentially determine proportional impacts from road salting operations. Due to the range of variation in stream type, ground water / surface water interactions and adjacent land uses; a statewide database of continuous specific conductance data of this kind will require years to develop. The data collected for this project will build on the Bureau's previous work (2011-2016). In addition, the United States Geological Survey maintains a limited number of stations where continuous specific conductance is recorded. This information can also be used to evaluate some of the objectives of this project.

8.2 Data Usage

Project data will be used to assess levels of specific conductance in relation to winter precipitation/snow events. By developing a database which exhibits winter maximum values, staff (BFBM and BEARS) can assess whether or not the application of road salt before, during and after snowfall events and below freezing temperatures, has a significant impact on water quality. Data will also be used to assess the severity of potential impacts from distinct road deicing entities (State, county municipal and private/commercial). That information can then be used to inform and develop specific education and outreach materials in terms of best practices to minimize impacts of road de-icing. The Bureau of Freshwater and Biological Monitoring (BFBM) and the Bureau of Environmental Analysis and Restoration (BEARS) will also review data to determine if additional study or a modification of the study is necessary to effectively assess impacts of road salt operations on stream water quality.

8.3 Monitoring Design

Specific conductance data loggers are deployed year-round in targeted non-tidal, freshwater streams (See Site List Attachment A, Table 1), which are expected (based on historical discrete sample data) to exhibit elevated levels of specific conductance in winter months (December – March).

Discrete samples for total dissolved solids and chloride will also be collected at least six times annually (January, March, May, July, September, November) during data logger deployment. Samples will be collected as grab samples and submitted to a certified laboratory (New Jersey Department of Health; NJDOH).

Sites were selected with input from the Bureau of Environmental Analysis, Restoration and Standards. Sites were specifically targeted for the following reasons:

1. Sites were targeted within HUC14s that had high TDS and/or chloride readings. Because there may be human health concerns associated with high chlorides, nine of the sites also have surface water intakes within or just downstream of the HUC 14.
2. Canoe Brook was selected for a second year because recent data continues to exhibit elevated values and will help determine whether having 2 continuous years of data is helpful, or if one year is sufficient.
3. Back Creek and Crystal Creek are sites that were sampled for the Regional Targeted Water Quality Network during the Lower Delaware round. Both sites repeatedly had high specific conductance readings and were added to get a better understanding of why we are seeing high readings at these sites.

8.4 Monitoring Methods/Frequency

Locating data loggers in free flowing areas will ensure that data loggers record data which is representative of stream flow (i.e. not in impounded areas or areas where flow is impeded by debris or adjacent structures). Data loggers will be secured to the stream bottom using stainless steel cable, the units positioned approximately six inches off the bottom. Units will also be placed in deeper areas of the stream, to reduce the possibility of the unit being frozen in ice.

Data loggers will be deployed year-round. Specific conductance measurements will be recorded every 0.5 hrs to monitor general trends and brief, but potentially significant changes in specific conductance.

Discrete grab samples for total dissolved solids and chloride will be collected six times annually during data logger deployment. In addition, analyze immediately parameters will be measured on site at the time of sample collection.

9.0 Data Quality Requirements

Data Loggers

Data will be collected using ONSET HOBO Conductivity Data Loggers (model #s 024-001 and U24-002). The data loggers will be deployed and utilized in accordance with the manufacturer's instructions. Additional information is available at manufacturer's website
http://www.onsetcomp.com/products/data-loggers/conductivity-and-salinity

Prior to deployment and immediately following deployment, data loggers will be checked with a conductance standard to ensure readings are within manufacturer's stated accuracy. The standard used to verify readings will be certified traceable to NIST Aqueous Electrolytic Standard Reference Solution 3193 (750 uS/cm @ 25.0 ^{o}C , since this will be the approximate expected conductivity at selected stations). To verify data quality side by side specific conductance readings will be made with a specific conductance meter probe that has been calibrated according to manufacturer's instructions at the time of data logger deployment and when data loggers are retrieved. Specific conductance measurements from the data logger will not be accepted if comparative measurements are not within the stated accuracy of the method, which is +/- 1 %. Below are the manufacturers stated accuracies for the units being deployed.

	U24-001	U24-002 & U24-002C
Range	0-10,000 uS/cm	100-65,000 uS/cm
Accuracy		
Low Range:	0 – 2,500 uS/cm	100 – 55,000 uS/cm
	3% or 5 uS/cm	3% or 50 uS/cm
	Whichever is greater	Whichever is greater
Full Range:	0 – 10,000 uS/cm	100 – 65, 000 uS/cm
	3% or 20 uS/cm	up to 5%

Data handling is accomplished by downloading specific conductance measurements using HOBO unit software (HOBOware)directly to an Excel Spreadsheet, then into a DEP database. Automated data handling eliminates transcription errors associated with manual data entry.

Field Measurements of Analyze Immediately Parameters

The Bureau of Freshwater and Biological Monitoring is certified by DEP's Office of Quality Assurance for specific conductance, pH, dissolved oxygen, water temperature and turbidity measurements.
All pH meters, dissolved oxygen meters, conductivity meters and thermometers shall be operated and maintained according to the "Regulations Governing the Certification of Laboratories and Environmental Measurements", N.J.A.C. 7:18. BFBM is certified by the Office of Quality Assurance (certified lab ID # 11896) for all parameters listed below:

Temperature, pH, Conductance and DO are measured using a Hach model # HQ40D. The Hach HQ40D is a multi-parameter water quality system that combines temperature, pH, conductance, and luminescent dissolved oxygen (LDO) probes into one meter.
Temperature: The probe is calibrated with a NIST certified thermometer on a quarterly basis. Records of the calibration shall be maintained by the BFBM.
pH: The probe is calibrated on a daily basis per the manufacturer recommendations. The pH meter is calibrated each day of use, including calibration with three standard pH buffers bracketing the value to be measured. After calibration, a standard buffer with pH within the calibration range shall be measured without any control adjustments to check the calibration. When the pH meter is in use for longer than a 3 hour period, the pH of the third buffer shall be checked once every three hours. If the pH differs by more than 0.2 pH units from the standard buffer value, the meter shall be recalibrated. Records of all calibrations and calibration checks shall be maintained in the field log.
Conductance: The probe is calibrated on a daily basis per the manufacturer recommendations. The probe is calibrated each day of use with a certified standard which corresponds to the expected range of the values to be measured. Records of all calibrations and calibration checks shall be maintained in the field log.
DO: A Winkler check is performed on a weekly basis and the meter (Hach HQ40D) is barometrically compensated and checked at each sampling site. Records of all calibrations and calibration checks shall be maintained in the field log.
Turbidity: HACH Model 2100Q turbidimeter is calibrated once a month per manufacturer recommendations. The meter is then checked with certified standards for accuracy within the calibration range during each day of use. Records of all calibrations and calibration checks shall be maintained in the field log.
Flow: Discharge measurements will be made at each station (where applicable) during each sampling event using BFBM standard operating procedures (Attachment C) or United States Geological Survey procedures http://training.usgs.gov/TEL/Nolan/SWProcedures/Index.html. Several sites have USGS flow gages present, flow information will be taken from the gage instead of the Flow Tracker at these sites.

Other Parameters:
Barometer: Thommen TX Mechanical Barometer. Measured for LDO meter compensation only. Not used for project's data objectives.
Ambient Air Temperature: Measured for general information purposes only. Not used for project's data objectives.

Relevant Documents
Bureau of Water Monitoring Certified SOP, for field measurements and calibrations.
NJDEP Field Sampling Procedures Manual (2005).

NJAC 7:18 - Regulations Governing the Certification of Laboratories and Environmental Measurements.

Discrete samples for total dissolved solids and chloride

Total dissolved solids and dissolved chloride samples will be collected as per "NJDEP Field Sampling Procedures Manual," August 2005; the document available online at the NJDEP's webpage, <http://www.state.nj.us/dep/srp/guidance/fspm/ >. The chemical and field parameters that will be collected as part of this project are listed in Attachment A. Tables 4 and 5

Laboratory Analysis

Analytical samples will be delivered to the NJ Dept. of Health (DOH certification # 11036) and testing will be done by a method for which the laboratory has certification (Attachement A, Table 6). Quality control procedures (including required calibrations and quality control procedures required by regulation or by the method) shall be defined in the laboratory's Quality Manual (QM) or Standard Operating Procedures (SOPs). The QM and SOPs must be approved by the NJDEP Office of Quality Assurance (OQA).
The reporting levels listed in Attachment A. Table 6 are **required** for this project.

Sample Containers: Sample containers shall be dedicated, single-use. Sample containers shall be provided by the DOH certified laboratory.

Sample Retention: All samples must be retained by the laboratory until such time that the BFBM approves the reported results or holding times expire.

Chain of Custody: Chain of custody forms are required for all samples forwarded to a NJ certified laboratory for testing. Information to be recorded includes all information required by N.J.A.C. 7:18-5.6(d) and 8.5(c).

Resource Needs: Approximately 0.5 FTEs will be required for this project.

10.0 Data Validation

The Project Officer and/or the Supervisor are responsible for all initial data validation. If apparent anomalous data is suspected (e.g. dissolved values larger than total values; field blank values larger than ambient values), the Project Officer and/or the Supervisor will review the sampling procedures with the field sampler to make sure the proper collection and preservation procedures were followed. The field sampler, Project Officer and/or the Supervisor may perform further water quality logic tests on the suspect data, as described in the U.S. Geological Survey Open File Report 02/383; 2003, entitled, *"Methods For Quality Assurance Review of Water Quality Data in New Jersey."*

Preliminary analytical data will be available to BFBM, from the laboratory employed for this project, to the Project Officer, within 21 calendar days from receipt of sample. A report in electronic format (i.e. data feed) will be provided to the Project Officer within 28 days from receipt of the sample.
If any laboratory analyzed data is suspect, the NJ certified laboratory (NJDOH) will be contacted. An internal review of their laboratory procedures and/or calculations used in the analysis of the suspect sample, with special emphasis on transcription of data to assure that no transposition of figures occurred will be conducted. The NJ certified laboratory will be asked to check on equipment calibration. They may be further requested to reanalyze the retained portion of the sample. If no problems are found in the analytical laboratory procedures, the data may then be compared to any historical data that might have been collected at the same site prior to the most recent sampling event to see if similar anomalies might have been found previously. The suspect data may also be compared to literature values or standard analytical treatises to verify whether or not the results are within the limits of accuracy of the test method.

For continuous monitoring of conductivity and water temperature, once the data has been downloaded, it will be screened by the Project Officer. Usability of the dataset will be determined by checks for Drift, errors present (if any) and their extent. Data loggers deployed in the field will be checked for Drift at both time of deployment and retrieval. This check will consist of using another meter alongside the first and comparing readings between the two units

For the Drift check, the difference between the two units will be measured and checked against the following parameter criteria:

Parameter	**Minimum**	**Maximum**
Temperature	0.1° C	1.5° C
Specific Conductivity	1%	25%

Should the difference found to be below the Minimum criteria threshold, then the data will be reported as is.

Should the difference fall between the Minimum and Maximum values, the data will then be reported with a qualifier, modifying the value listed via a plus/minus percentage or unit(s).

Should the difference exceed the Maximum range, then the data for that parameter will be deleted. Once the comparison check is completed, the data will be screened for errors. Sources of errors can be attributed to the following:

1. Non-stream conditions readings (open air, data outside realistic ranges)
2. Hardware failure
3. Tampering by non DEP personnel (causing non stream readings)
4. Fouling.

Errors involving loss of data (i.e. out of water) will be truncated from the dataset. Errors that involved hardware failure and fouling will result in the truncation of data from the moment of failure to the point of normal operation (if any).

If no obvious problems are found after these reviews, the complete data set will be reported with the suspect data identified as such. The BFBM will then conduct its own review of the data, as it relates to the objectives(s) and data accuracy required in this project.

11.0 Data Storage

Continuous Data:

Continuous specific conductance data from data loggers will be stored in NJDEP's DWM&S Continuous Data Monitoring Program's website (http://njdep.rutgers.edu/continuous/). Graphical representations of the data will be stored internally in BFBM databases/spreadsheets.

Precipitation Data

Daily precipitation data collected by the National Oceanic and Atmospheric Administration
(http://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/quality-controlled-local-climatological-data-qclcd)
is available to assess the amount of precipitation and more specifically, snowfall. BFBM staff will download applicable data and store locally in order to compare with continuous and analytical data.

Field and Laboratory Analyses

Analytical data for grab samples submitted to laboratory and data from analyze immediately parameters will be entered into New Jersey's Water Quality Data Exchange (WQDE) and USEPA STORET Data Warehouse and will be accessible through the USEPA and the National Water Quality Monitoring Council's Water Quality Portal by June of the following year it is received from the analytical laboratory. The data will be entered with the Project ID "SALT". All raw data

records shall be maintained for a period of no less than five years. See Attachment A for Data Management information.

12.0 Performance System Audits

All NJ certified laboratories used are subject to audits and to the requirements of the OQA Laboratory Certification Program as well as internal performance evaluations. The OQA will be notified of field monitoring schedules for possible audits.

13.0 Data Reporting

Continuous Data

All continuous data will be downloaded and processed through the device's dedicated software. Once the data has been downloaded and validated, it will then be exported into an Excel spread sheet format for storage and reporting.

Continuous Monitoring data will be stored on a local server at BFBM and at the Division of Water Monitoring & Standards Continuous Data Monitoring website hosted by Rutgers University. The website for this is located at http://njdep.rutgers.edu/continuous/

Laboratory and Field Data

Final analytical data will be reported to BFBM, from the laboratory employed for this project, in the form of electronic and/ or hard copies of the lab sheets; or in a tabulated form within 40 calendar days from receipt of sample. All data shall be reported in a complete and concise fashion and shall meet the reporting requirements of NJAC 7:18. Routine quality control results must be retained on file for review by the BFBM and the OQA.

Final data and evaluations will be available to the NJDEP Bureau of Environmental Analyses, Restoration and Standards for use in the generation of the biennial New Jersey Integrated Water Quality and Assessment Report [305(b) and 303(d)].

14.0 Corrective Action / Assessment, Oversight, and Response

The Project Officer will be responsible for the oversight of all activities relating to this project. The Project Officer will assess field collection functions and make corrections when necessary to maintain the data accuracy as defined in this plan. If any changes or modifications are made to this plan regarding data collection, as it relates to the objectives(s) and data accuracy required in this project, all original signees of the QAPP will be notified.

Attachment A:
DATA MANAGEMENT TABLES

For Data Management purposes, Water Chemistry is defined as parameters analyzed by a lab; Field measurements are defined as analyze immediately parameters.

Table 1. Monitoring Locations

Station ID(WQDE compliant and referenced)	Waterbody/Location	Latitude-dd	Longitude-dd	County	Site exists in WQDE already?	Surface Water Intake Present?	Location Type
01379525	Canoe Brook on Parsonage Hill Rd	40.748988	-74.336539	Essex	YES	YES	River/stream
AN0231C	Slough Brook at Parsonage Hill Rd	40.759011	-74.349365	Essex	YES	YES	River/stream
01389785	Molly Ann Brook at Paterson	40.921111	-74.193611	Passaic	YES	YES	River/stream
01391500	Saddle River at Lodi	40.890278	-74.080556	Bergen	YES	NO	River/stream
AN0192	Rahway River at Northfield Ave	40.769598	-74.283289	Essex	YES	YES	River/stream
01395000	Rahway River at Rahway	40.618889	-74.283333	Union	YES	YES	River/stream
01396023	SB Rahway River at Colonia	40.577222	-74.306944	Middlesex	YES	YES	River/stream
01407760	Jumping Brook	40.203333	-74.065833	Monmouth	YES	YES	River/stream
01398000	Neshanic River at Reaville	40.473333	-74.827778	Hunterdon	YES	NO	River/stream
01460530	Delaware and Raritan Ca at Griggstown	40.438056	-74.614167	Somerset	YES	YES	River/stream
01402000	Millstone River at Blackwells Mills	40.475000	-74.575833	Somerset	YES	YES	River/stream
01408152	Metedecond River near Laurelton	40.078763	-74.156729	Ocean	YES	UPSTREAM	River/stream
01464523	Back Creek at Yardville	40.191980	-74.665278	Mercer	YES	NO	River/stream
0146453250	Crystal Creek near Mansfield Square	40.113092	-74.722778	Burlington	YES	NO	River/stream

Table 2. Sample Types

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection	Habitat	Metrics	Indices
01379525	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
AN0231C	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01389785	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01391500	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
AN0192	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01395000	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01396023	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01407760	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01398000	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01460530	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01402000	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01408152	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
01464523	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
0146453250	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO

Table 3. Partner Information

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection
01379525	DEP	DEP	DEP	DEP	No	No	No
AN0231C	DEP	DEP	DEP	DEP	No	No	No
01389785	DEP	DEP	DEP	DEP	No	No	No
01391500	DEP	GAUGE	DEP	DEP	No	No	No
AN0192	DEP	DEP	DEP	DEP	No	No	No
01395000	DEP	GAUGE	DEP	DEP	No	No	No
01396023	DEP	DEP	DEP	DEP	No	No	No
01407760	DEP	DEP	DEP	DEP	No	No	No
01398000	DEP	GAUGE	DEP	DEP	No	No	No
01460530	DEP	DEP	DEP	DEP	No	No	No
01402000	DEP	GAUGE	DEP	DEP	No	No	No
01408152	DEP	DEP	DEP	DEP	No	No	No
01464523	DEP	DEP	DEP	DEP	No	No	No
0146453250	DEP	DEP	DEP	DEP	No	No	No

Table 4. Field Parameters

Field Name	**WQDE Name**	**Media**	**Units**
DO	Dissolved oxygen (DO)	Water	mg/l
Water Temp	Temperature, Water	Water	deg C
Spec Cond	Specific conductance	Water	uS/cm
pH	pH	Water	None
Flow	Flow	Water	cfs
Barometric Pressure	Barometric Pressure	Air	mmHg
DO Sat	Dissolved oxygen saturation	Water	%
Temperature, air	Temperature, air	Air	deg C

Table 5. Laboratory Parameters

Analysis (lab name)	EPA Characteristic Name	Result Sample Fraction	Result Measure Unit	Result Value Type	Sample Collection Type	Sample Collection Equipment
NEW JERSEY DEPARTMENT OF HEALTH - 11036	Chloride	Total	mg/l	Actual	Grab	Water Sampler (Other) Water Sampler (Other)
NEW JERSEY DEPARTMENT OF HEALTH - 11036	Total dissolved solids	Total	mg/l	Actual	Grab	Water Sampler (Other) Water Sampler (Other)

Table 6. Laboratory Analytical Methods and Detection Limits Table 7. Data Inventory Supplement

Parameter	Laboratory	Lab Number	Method	Method ID Context	Lower Reporting Limit	units	Method Detection Limit	units	Upper Reporting Limit (MPN/100 ml)	units	Holding Time	Preservative
Chloride	NEW JERSEY DEPARTMENT OF HEALTH - 11036		4500-CL(E)	APHA	2.5	mg/l	0.113				28 days	Ice to 4 deg C
Total dissolved solids	NEW JERSEY DEPARTMENT OF HEALTH - 11036		2540-C	APHA	1	mg/l	1				7 days	Ice to 4 deg C

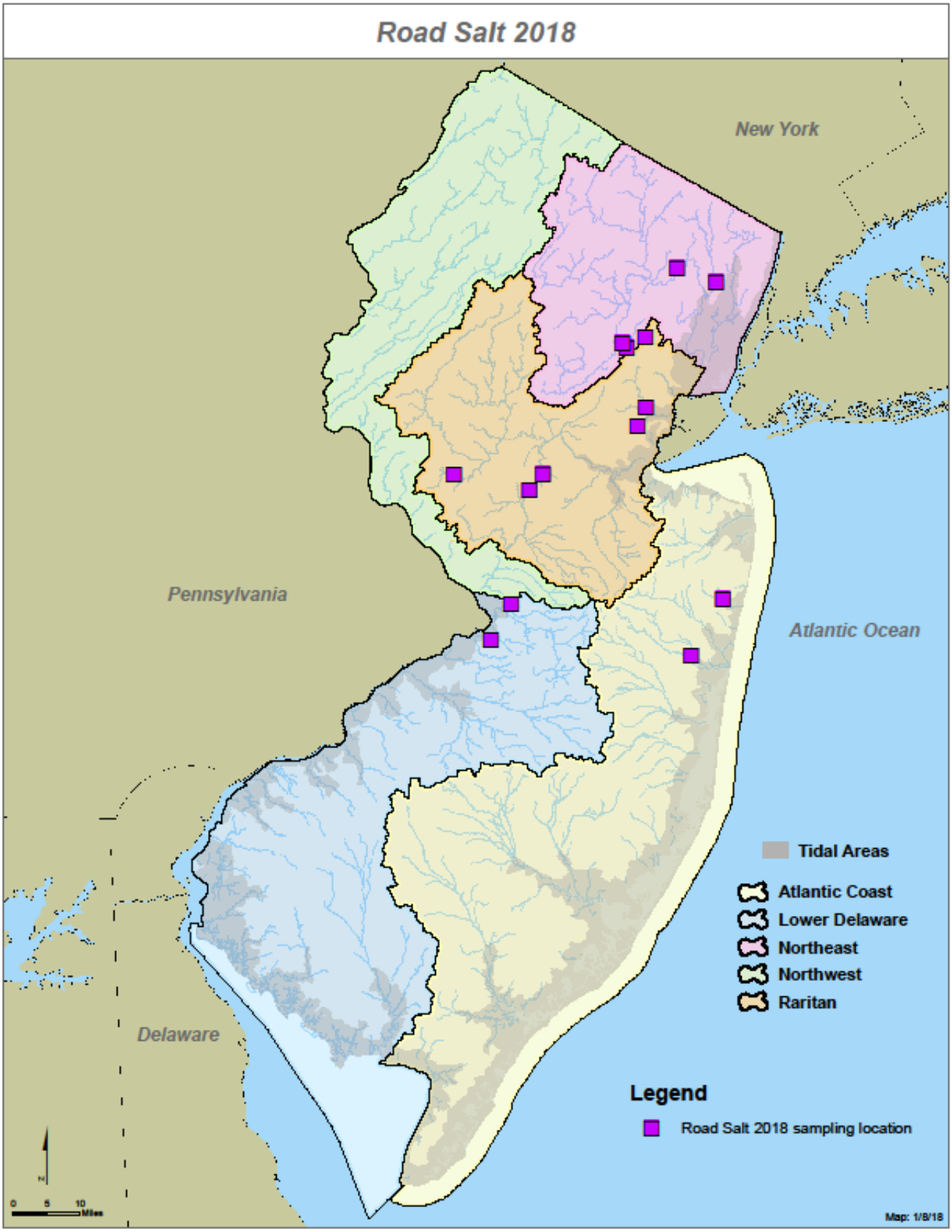
Table 7. Data Inventory Supplement

Geographic Regions	Statewide
Counties	Essex, Passaic, Bergen, Union, Middlesex, Monmouth, Hunterdon, Somerset, Ocean, Mercer, Burlington
Dates	1/1/2018-1/31/2019
Status	Future/Planned
Sample Frequency	Other
Seasons Sampled	Spring, Summer, Fall, Winter
Waterbody Type	River/Stream
Salinity Category	Fresh
Tidal Influence	Non-tidal
Project Description	Through continuous year-round monitoring, develop a specific conductance database that will examine critical high winter specific conductance levels and the duration of elevated levels in a variety of New Jersey's non-tidal, freshwater streams. Historical specific conductance data obtained through discrete sampling shows that during winter months (December to March), levels of specific conductance in non-tidal freshwater streams increase significantly during and after significant snowfall events. This
Parameters analyzed type	Chemical/Physical (Conventionals)

Table 8. Data Management Supplement

QAPP network path file location?	V:\LUM\BFBM\Bfbm\Quality Assurance Plans\Calendar Year 2018 QAPPS\Roadsalt2018	ex. V:\LUM\BFBM\Bfbm\Quality Assurance Plans\Calendar Year 2015 QAPPs
Where will data be recorded in field (media)	Paper	ex. Paper/tablet/phone/etc
If on tablets or phones, will download at office occur or will you connect wirelessly?	NA	
If on tablets or phones, who will do the download?	NA	Name of person
If data collected electronically, where will it be stored?		ex. Excel file in V:\LUM\BFBM\Bfbm\, or access database in V:\LUM\BFBM\biomon
Format to be received from Lab	LIMS	For every lab used, must provide description (excel in x format, or txt or something set from lims)
Method of receipt from lab/s		ftp/link/dropbox/email attachment, etc
Personnel receiving outside lab data	Carol O'Donnel-Kee	
Is data expected to go to WQDE/STORET?	Yes	yes/no (if no, why not?)
Data manager - (Bureau and Name)	BFBM Leigh Lager	IT staff who will handle the data

Attachment B



ATTACHMENT C:
Standard Operating Procedures; Discharge Measurement

Standard Operating Procedure for Making Discharge Measurements in Wadable, Non-tidal, Freshwater Streams with a Handheld Acoustic Doppler Velocimeter (ADV)

With additional guidance from the United States Geological Survey, the New Jersey Department of Environmental Protection Bureau of Fresh Water and Biological Monitoring (NJ DEP/BFBM) adopted the Standard Operating Procedures from the manufacturer for using a handheld ADV and the United States Geological Survey Field manual.

Field Manual for United States Geological Survey:
http://training.usgs.gov/TEL/Nolan/SWProcedures/Index.html

I. Diagnostic Test Before Use – Before any sampling run, or quarterly, a system diagnostics test called a "beam check" should be performed in a lab environment. A beam check should show that signal amplitude plots from each probe are roughly the same, and should show noticeable peaks for "sample volume', "boundary reflection" and "noise level". If not, it is possible the probe(s) may be damaged. A complete description of "beam check" can be found in the manual. Should the meter fail the beam check, it will be removed from service and sent back to the manufacturer for repair.

II. Site Selection - In order to ensure that quality discharge measurements are made, it is important to select a location which minimizes the amount of interference and error during the measurement. Ideally, the location should be at a section of stream which is as straight as possible. If possible, avoid bends in the stream and areas of dead water. A general rule of thumb is that a transect location should be a distance (upstream and downstream) of 2X the width of the stream from any type of control, such as a riffle or pool or incoming tributary. Flow at the location should be as close to being laminar as possible. Once the location is selected, any moveable obstructions (small rocks, tree branches, macrophytes) should be removed from the transect.

III. Setting up a tagline - A tagline consisting of a tape measure will be set up perpendicular to the stream flow. The tape measure units should be in feet with sub-increments in 10ths of a foot. It is important that the line is taught and secure. Once established, a stream width will be determined from wetted edge to wetted edge. For the purpose of uniformity, the left edge of water will be determined by looking downstream.

IV. Measuring discharge - Measuring discharge involves wading across the stream/ river while taking measurements of water depth and velocity at different locations (based on ISO/USGS procedures) along a transect. By combining this information, the total discharge can be calculated.

A. Preparation

1. Divide the river cross-section into a number of stations appropriate for its width. According to the United States Geological Survey, 25-30 stations will give a representative measurement. There is a limitation however for streams <8.25 feet wide. The meter's probes measure at a distance of 4 inches from the probe face. Increments less than 4 inches (0.3 feet) will result in overlapping measurements. In these cases, it is acceptable to have as many increments as the stream width will allow. Below is a chart that can be used to determine how many increments to use for streams less than 8.25'

Stream Width	Number of Increments
8’	23
7.5’	21
7’	20
6.5’	18
6’	17
5.5’	15
5’	14
4.5’	12
4’	11
3.5’	9
3’	7
2.5’	6
2'	5
1.5’	3
1’	2
<1’	1

These are general guidelines and actual on-site conditions will determine how many increments can be done for a given stream. It should also be noted that the meter is incapable of measuring flows at a depth less than 3”, so increments at those depths may need to be omitted.

2. The starting edge is then established. The meter automatically defaults to left edge (descending bank or facing downstream), so it is advisable to begin on the left edge. If it is not possible, then the operator must change the starting edge to right (see manual).
   The operator must then establish the increments that will be used to measure velocity for the given stream width. For example if the stream is 26 feet width, the increment is 1.04 feet (26/25). This will give the operator the minimum required number of stations (25).
3. Facing upstream, orient the hand held ADV perpendicular to the tagline Velocity data is recorded once per second for the entire averaging time (40 seconds), and then averaged to compute the mean velocity. Quality control data is also reviewed and displayed; you will be alerted to any unexpected values. If the velocity measurement is found to be unsatisfactory, you should repeat the measurement.
4. During the entire measurement, the probe’s X-axis must be maintained perpendicular to the tag line. The probe should be held away from underwater obstacles that may disturb the flow. Do not turn the hand held ADV into the direction of flow, as it will automatically account for flow direction when making discharge measurements.

B. Starting the discharge measurement

1. Turn the handheld ADV on. Press ENTER to display the Main Menu.
2. Press 1 to enter the Setup Parameters Menu. Sampling Volume YX Probe Coordinate System Graduated Tag Line Primary Flow Direction Mounting Pin
3 At the Setup Parameters Menu, review the current settings and change the values to meet the requirements. To change a displayed value, press the number next to the relevant parameter.
4. Press ENTER to display more menu options. For example:
5. Press 2 in the Setup Parameters Menu to change the Averaging Time.
   The defaults for these parameters are: Units: English, Averaging Time: 40 seconds, Mode: Discharge Salinity: 0.0 ppt
   (freshwater) Discharge Equation: Mid Section When you are finished,
6. Press 0 to return to the Main Menu.
7. Now press 2 to enter the System Functions Menu.

C. Field-testing the hand held ADV

1. Collect and verify temperature data (press 4).
2. Check battery voltage (press 5). If voltage is at 60% or below, then a battery change is required before proceeding.
3. Collect and verify raw data. Ideally, SNR (signal noise ratio) values should be >10 dB, but 4 dB is acceptable (press 6).
4. Verify the internal clock is correct (press 9).
5. When you are done, press 0 to return to the Main Menu.

D. Enter site information

1. Press 3 to Start Data Run and display the Data File Name Menu.
2. Press 1 and enter a file name. To enter text names, use the same method as mobile phones (e.g., press 2 four times for "C"; 2-A-B-C). Now press 9 to accept the name. At any time during data collection,
3. Press 8 (QC Menu) to enter supplemental data including gauge height, rated flow, and user comments.

E. Collect station data

1. In the Starting Edge screen, enter the location, depth, correction factor, and starting edge using the marked buttons on the keypad. Note that LEW/REW stands for Left/Right Edge Water.
2. Press Next Station to continue. Enter the location, depth, and method of measuring velocity (changed by pressing Method +/-).
3. When the station information is complete, and the probe is at the correct depth and Orientation, press the Measure button. An updating display will show the measured velocity and SNR values. Keep the probe as steady as possible.
4. On completion of the averaging time, a summary will be displayed. Press 1 to accept and go to the next station or depth, or
5. Press 2 to repeat this measurement. These steps will be repeated for all stations until End Section is pressed.

F. Ending the measurement

1. When End Section is pressed, the ending-edge information is displayed. Enter the information for this edge. The Previous Station and Next Station buttons can also be pressed to review completed stations.
2. Press Calc Discharge to compute the total cross-sectional discharge for all completed stations.
3. Press 0 to return to the Main Menu.

You must always return to the Main Menu to make sure that all data is saved.

V. Quality Assurance Procedures

To ensure accuracy, NJDEP/BFBM will follow manufactures instructions for determining probe/meter condition. This consists of a beam check and ping test. The beam check is performed in a lab quarterly. The ping test is done in stream on a daily basis. These tests ensure that the meter and probe are operating within the manufacturers guidelines. If either of these tests are failed, a discharge measurement will not be made with that particular meter and the meter will be sent back to the manufacturer for repair. NJDEP/BFBM has also developed a quality assurance check for utilizing the handheld ADV. Each staff member qualified for performing discharge measurements will be required to have a flow comparison check against the ADR at the Pequannock River (USGS# 01382500) a USGS real time gage reading quarterly

during their assigned visit. Any flow comparison at a USGS real-time station that is off more than 20% will be repeated. If the repeated measurement is still off by more than 20%, then that staff member will undergo additional training. After the comparison is completed a hard copy will be stored of both the samplers discharge measurement and the ADR flow rate.
All discharge measurements made that are placed into records should have the flow rate (cubic feet per second) and also be designated a rank which determines the quality of measurement.

NJDEP/BFBM rank the quality of stream flow measurements by summing the International Organization of Standardization and Statistical uncertainty levels located on the data file (.WAD).

Rank:		
	</= 5.0%	Very good
	> 5.0 and </= 10.0%	Good
	>10.0% and </= 20.0%	Fair
	> 20.0%	Poor

All ranks should be entered with the data on all lab analysis and field sheets..

All projects and staff using the handheld ADV should adhere to the Standard Operating Procedures listed.