

PASSAIC RIVER NITRATE TRACKDOWN AND CHARACTERIZATION PROJECT

2018 QUALITY ASSURANCE PROJECT PLAN



*New Jersey Department of Environmental Protection;
Bureau of Freshwater and Biological Monitoring and
Bureau of Marine Water Monitoring*

**New Jersey Department of Environmental Protection
Water Monitoring and Standards Element
Bureau of Freshwater and Biological Monitoring
P.O. Box -420, Mail Code 35-01
Trenton, New Jersey 08625**

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1.0 Project Name: Passaic River Nitrate Track-down and Characterization Project

2.0 Project Requested by: NJDEP; Division of Water Supply and Geoscience and Water Resource Management (Assistant Commissioner's Office)

3.0 Date of Project: June, 2018 – October, 2018*

*This quality assurance plan also addresses samples that were collected in September and October of 2017

4.0 Project Fiscal Information: Job # TBD Activity Code TBD

5.0 Project Management

5.1 Project/Task Organization

5.1.1 Management Responsibilities

5.1.1.1 Office of Quality Assurance

Marc Ferko, Quality Assurance Officer

The Quality Assurance (QA) officer is responsible for the final approval of the Quality Assurance Project Plan (QAPP).

5.1.1.2 Bureau of Water Resources and Geoscience

Steven Domber, Project Manager

Project Manager is responsible for overall implementation of the project including: communicating objectives, coordination with internal and external agencies, identifying funding sources, final review of the summary data analysis, and submitting summary to management.

5.1.1.3 Bureau of Freshwater and Biological Monitoring, and Bureau of Marine Water Monitoring

Chris Kunz and Bob Schuster, BFBM and BMWM Field Coordinators

BFBM and BMWM Field Coordinators are responsible for obtaining and maintaining appropriate equipment, overseeing data collection, implementing the appropriate QAPP and SOP's, and ensuring the appropriate sampling, handling, and custody procedures as explained in the QAPP and SOP's are followed. Field coordinators are also responsible for coordination with the laboratory in terms of obtaining proper sample collection bottles and delivering samples on time and per laboratory's SOPs (on file with OQA and available upon request). Field coordinators are also responsible for coordinating with Compliance and Enforcement staff in terms of providing sample containers for effluent sampling and receiving and delivering samples to the laboratory.

5.1.1.4 Bureau of Marine Water Monitoring

Eric Ernst, Laboratory Supervisor

The Laboratory Supervisor is responsible for ensuring proper analytical methods for this project are used, conducts audits of laboratory activities, validates laboratory data before final certification, and ensures that corrective action is properly implemented and documented. The laboratory supervisor is also responsible for compiling data in a format conducive for data management (ultimately in a format that can be uploaded to the State's official database (WQDE) and eventually to USEPA's database (STORET)).

5.1.1.5 Bureau of Water Resources and Geoscience and Bureau of Environmental Analysis Restoration and Standards

Steven Domber and Biswarup Guha, Data Analysis Coordinators

Data Analysis Supervisors are responsible for the coordination of analysis and summarization of the data. Coordinators will ensure that analysis and summaries are provided to the Passaic Nitrate Workgroup, for review, discussion and decision making. Data summaries, graphs and or maps will be provided to the Workgroup in an easily accessible and readable format.

5.1.1.6 Bureau of Freshwater and Biological Monitoring

Chris Kunz and Leigh Lager, Data Managers

Data Managers are responsible for ensuring all data collected meets data management requirements and is provided to data management staff in the necessary format and will ensure data is uploaded to the appropriate databases.

6.0 Special Training Needs/Certification

All staff participating in this project will be trained in the proper collection techniques as outlined in the "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/> >.

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

The BMWM Leeds Point Laboratory is certified (lab #01179) for dissolved oxygen, temperature, pH, conductance, turbidity, total nitrogen, total phosphorus, orthophosphate, nitrate nitrite, nitrite, TSS, and ammonia.

7.0 Project Background

In September 2017, nitrate concentrations as reported through USGS' real-time water quality monitor at Passaic River below Pompton River at Two Bridges (USGS

station ID 01389005) appeared to be much higher than previously observed. Nitrate concentrations reported in 2017 (late summer) were between 6 and 8 mg/L whereas in previous years, concentrations were typically 3 to 4 mg/L during the same time (late summer when stream flows are usually at their lowest point). The current NJ drinking water Maximum Contaminant Level (MCL) the freshwater surface water quality standard for nitrate are both 10 mg/L. As presented on the map in Attachment E, there is at least one drinking water intake used by Passaic Valley Water Commission (PVWC) downstream of the USGS water quality monitor (Passaic River below Pompton River at Two Bridges; USGS station ID 01389005).

The Passaic River Basin is an effluent-dominated system where the majority of the point sources are located upstream of the several drinking water intakes. Analysis of available in-stream data for nitrate suggested that, generally, nitrate levels increased from the headwaters to the location at Two Bridges. There are eighteen wastewater treatment plants along the Passaic, Whippany and Rockaway Rivers upstream of Two Bridges. There are also five major potable water supply intakes on the Passaic River including the PVWC intake, located downstream of the Two Bridges area, and North Jersey District Water Supply Commission(NJDWS)/PVWC Intakes, located on the Pompton River close to the confluence with the Passaic River near Two Bridges.

Because of the concern of a drinking water intake being potentially impacted by high concentrations of nitrate, a Workgroup was formed, comprised of many NJDEP programs (BFBM, BMWM, NJGWS, DWQ, BEARS and Compliance and Enforcement), to determine the best courses of action to investigate and possibly address the high concentrations observed.

8.0 Project Description

For calendar year 2018, the Passaic Nitrate Trackdown and Characterization Project will monitor water quality at a number of stations throughout the Passaic River watershed, upstream of the PVWC intake at Little Falls. The number of stations and parameters of interest may vary depending on data review as the project progresses, but for 2018, the initial focus will be on six in-stream monitoring locations and the effluent at eight wastewater treatment plants in the watershed that are closest to the main drinking water intake at Little Falls. These are labeled as being priority 1 on Attachment A1. Two additional locations (labeled priority 2 on the same attachment) and possibly other stations will be added later. Priority 1 stations were identified as being the most important in terms of an initial assessment and characterization of nitrate concentrations and loadings in this area of the Passaic River. Revisions to the project will be informed by monitoring activities as the project progresses; any changes will be approved by the Workgroup and the QAPP will be amended accordingly.

In 2017, samples were collected several times in late summer and early fall. Sample timing was influenced by nitrate concentrations observed at USGS' real-time water

quality monitor at Passaic River below Pompton River at Two Bridges (USGS station ID 01389005). Sampling occurred after elevated nitrate concentrations were observed. A list of stations sampled in 2017 is included in Attachment A2 and a list of parameters from 2017 is included in Attachment B2.

9.0 Project Objectives

The project objective is to collect in-stream water quality samples that will help identify potential anthropogenic or natural sources of nitrate loads which impact the PVWC intake at Little Falls. This will help inform decision makers on the best courses of action to effectively address the sources thereby reducing nitrate levels in Passaic River at the drinking water intakes.

10.0 Monitoring Network Design

Water Quality Stations (2018): Initially, eight in-stream monitoring locations and eight wastewater treatment plants were identified (see attachment A1) by the workgroup. To address the diurnal variation reported by the USGS sensor at Two Bridges and to acknowledge the time taken by the discharges from the upstream wastewater treatment plant to reach the PVWC intake at Little Falls (could be several hours to several days depending on the proximity of the wastewater treatment plant to the intake and the flow conditions), continuous or semi-continuous measurements spanning at least 24 hours are ideal. The initial selection of sampling locations, frequency and methods were primarily driven by availability of ISCO samplers which allow semi-continuous measurements over a specific period. The initial selection of the eight in-stream monitoring locations, which were chosen from a list of stations used for the Non-Tidal Passaic River Basin Nutrient TMDL (Omni Environmental, 2007), to provide additional data at these locations to help update, calibrate and validate the model for nitrate. Additionally, these monitoring stations were chosen such that they were located downstream of the eight wastewater treatment facilities contributing to the nitrate concentrations/loads at Little Falls. Initially, the focus will be on six stations due to limitations in relation to available equipment. The nature of this project will require changes to the frequency and location of the sample collection based on review of the data being collected. Any such changes to this project will be approved by the workgroup and the QAPP will be amended accordingly. A map of the site locations is included as Attachment E.

Water Quality Stations (2017): Forty-four monitoring stations were identified (see Attachment A2) and all were monitored by collection of discrete samples at least one time during the project. A subset of these forty-four locations were sampled repeatedly because of their overall relevance to the project (i.e. Passaic River at Two Bridges). The number of stations, the parameters of interest and how often each site was sampled, was variable and was informed by monitoring activities as the project

progressed. Data from these efforts will be available as outlined in Section 20.0 of this plan (Final Reporting of Data). A list of these stations and parameters is included in Attachment A2.

Continuous Monitoring Stations (2018): As noted above, the number of continuous monitoring stations, and parameters sampled and analyzed will be determined by the workgroup as needed and as subsequent sampling efforts provide additional information. To date, the locations that have been discussed are located near the confluence of the Passaic and Rockaway Rivers. Other options such as continuous measurements using sensors or the SYSTEWA W.I.Z. probe are under consideration and the Department is in the process of acquiring them. Once these instruments are acquired and validated for use, the workgroup will determine their inclusion in this project based on the data collected in the interim.

11.0 Sampling Procedures

11.1 General Procedures:

2018:

Sample collection from auto samplers, continuous water quality monitors and wastewater treatment plants will occur every two weeks. The collection of samples by NJDEP from wastewater treatment plants will only occur during the month of June. Beginning July 1st, the wastewater treatment plants will be collecting and providing their own data on a more frequent basis and the Workgroup will rely on that data for analysis. Significant rain events (greater than 0.5 inches over a twenty-four-hour period the day before deployment of sondes and auto samplers) will be avoided unless deemed necessary by the Workgroup. Auto samplers will be deployed to collect discrete samples every two hours over a forty-eight-hour period. Water quality sondes will collect data every fifteen minutes over the same forty-eight-hour period. In addition, composite samples (twenty-four-hour composite) will be obtained from the sewage treatment plants using their auto sampling equipment and SOPs. A list of parameters to be collected is included in Attachment B1.

Sample bottles for analytical parameters will be provided by the New Jersey certified laboratory. Sample volume and container type are as described in the respective laboratory's "Quality Manual" and/ or SOP, approved by the Office of Quality Assurance (OQA). BFBM and BMWM staff will be responsible for obtaining water quality samples and data from stream locations. NJDEP, Compliance and Enforcement staff will be responsible for obtaining water quality samples from sewage treatment plants.

Additional data on daily effluent flow to represent the sampling period at wastewater treatment plants and daily water diversions by drinking water purveyors will be compiled and provided by Compliance and Enforcement and Bureau of Water Resources and Geoscience.

Although two week intervals for sampling is being targeted initially, the Workgroup agreed that the schedule needs to be flexible in terms of avoiding or targeting certain conditions to help with analysis (e.g. long, dry periods with very low stream flow may be beneficial and so sampling will need to adjust to those types of situations).

2017:

Sampling frequencies for selected field and laboratory analyzed parameters were on an as needed basis depending on nitrate levels as reported through USGS' real-time water quality monitor at Passaic River below Pompton River at Two Bridges (USGS station ID 01389005). Sample bottles for analytical parameters were provided by the New Jersey certified laboratory. Sample volume and container type were as described in the respective laboratory's "Quality Manual" and/ or SOP, approved by the Office of Quality Assurance (OQA). BFBM was responsible for all water quality sample and data collection.

11.2 Cleaning Sample Equipment: Because the possibility of contamination of samples, all sampling devices used to collect water quality samples for the parameters listed will be cleaned as thoroughly as possible between each use using a 1% solution of lab detergent (Liquinox) and Deionized (PICO) water, followed by a thorough rinse with deionized (PICO) water. All equipment cleaning will be performed at BFBM or BMWM laboratories. Parameter specific cleaning (e.g. the need for acid-rinsing or other special bottle and equipment preparation) is outlined in the laboratory's (BMWM) SOP (on file with OQA and available upon request).

11.3 Field Precautions for Invasive Species: To prevent the potential spread of nuisance or invasive organisms such as *Didymosphenia* sp. From stream to stream, all nets, waders, etc. will be decontaminated in the field between sites by spraying with a commercial antibacterial spray and rinsing with tap water. Also, the use of felt-soled waders will be avoided.

11.4 Analytical Sampling Procedures and Parameters:

2018:

The collection of water quality samples will be accomplished using ISCO Automatic Samplers, programmed to collect water samples at 2-hour intervals for 48 hrs. Rough start time will be at 7 am Tuesday mornings, and collect samples for 48 hours. Composite nitrate nitrite samples over 24 hours, from the WWTPs will be collected starting on Wednesday morning and ending on Thursday mornings during the month of June. All samples will be kept on Ice and delivered to the Leeds Point Lab for sample separation and preservation (table below).

Org	Parameter	Prep	Code	Method	Container	Holding Time
NJDEP BFBM	Turbidity	U	Turb	SM 2130 B-11	50mL centrifuge tube	48 hours
	Total Suspended Solids	U	TSS	USGS I-3765-85	500mL Amber HDPE	7 days
NJDEP Leeds Point Lab	Chlorophyll a	U	Chla	SM 10200-H 1+2		
	Total Nitrogen	U	TN	USGS I-4650-03	50mL centrifuge tube	28 days, Frozen, -20°C
	Total Phosphorus	U	TP	USGS I-4650-03		
	Nitrate + Nitrite	U	NO3	EPA 353.4		
	Orthophosphate	U	PO4	EPA 365.5		
	Ammonia	U	NH3	350.1 MOD	50mL centrifuge tube	14 days, <4°C

Field readings for analyze immediately parameters (dissolved oxygen, pH, specific conductance, water temperature, air temperature and turbidity) will be made at each site during each sampling event. The chemical and field parameters are listed in Attachment B1.

2017:

All samples were collected as center of flow, grab samples in accordance with the “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/> >.

All samples were kept on Ice and delivered to the Leeds Point Lab for sample separation and preservation (table below).

Field readings for analyze immediately parameters (dissolved oxygen, pH, specific conductance, water temperature, air temperature and turbidity) were made at each site during each sampling event. The chemical and field parameters are listed Attachment B2.

11.5 Continuous Monitoring and Sampling Procedures:

Continuous monitors will be deployed based upon availability. ISCO auto samplers will be used for discrete sampling.

11.5.1 Deployment

Auto Samplers

Deployment of ISCO Auto Samplers will be done by securing the sample intake strainer and line to a 20-foot piece of aluminum angle. The angle will be spiked to the bottom of the stream as far out in stream as possible. The other end of the angle will be secured to the ground. A fully charged marine battery will power the sampler. The sampler will be programmed for collection by setting a time delay that is up to 999 minutes, to make sure samples are collected at the same time from all stations. All samplers will be checked for sample volume prior to deployment. ISCO auto samplers will be secured using locks and cables or chains to a nearby tree or other structure on the stream bank to prevent movement and tampering

Continuous Water Quality Sondes

Datasondes or data loggers will be checked against another calibrated Datasonde unit or field meter at deployment for possible drift. This duplicate analysis will be in a standard bucket filled with a grab sample of stream water. Compared values which differ by 10% or more may indicate a problem with the probe and will be identified in the data report. All values are to be recorded and retained in a file or bound notebook. The following steps will be performed.

- Place datasondes in the grab sample bucket.
- Wait for 5 minutes to elapse to allow sensors to acclimate.
- Record readings from both units for Temperature (Temp), Specific Conductivity(SC), Dissolved Oxygen in mg/L (D.O.) Dissolved Oxygen saturation (D.O. %), pH and Turbidity (NTU)

11.5.2 Retrieval

Datasondes or data loggers will be checked against another calibrated Datasonde or field meter at retrieval. This duplicate analysis will be done in a standard bucket filled with a grab sample of stream water. Compared values which differ by 10% or more may indicate a problem with the probe and will be identified in the data report. All values are to be recorded and retained in a file or bound notebook. Follow the steps below

- Removed deployed unit from the water. **Do not** clean the probes of the deployed unit.
- Place datasondes in the grab sample bucket.
- Wait for 5 minutes to elapse allow sensors to equilibrate.
- Record values from both units for Temp, SC, D.O. D.O. %, pH and NTU.
- Remove the datasondes. Clean/rinse the probe heads of the deployed unit with Deionized Lab Pure water.
- Placed the cleaned deployed unit back in the bucket.
- Wait for 5 minutes to elapse to allow sensors to equilibrate.
- Record values from both units for Temp, SC, D.O., D.O.%, pH and NTU.

After measurement time has been achieved the datasondes will be retrieved and the data will be downloaded. Downloaded data will be screened for errors then exported into an excel spread sheet to be supplied to BEARS and the BFBM's data team.

All Datasondes used in the project will be calibrated according to manufacturer's specifications. Calibrations will be recorded for each parameter in a designated logbook. Collected data will be screened for errors and noted in the excel file to the site measured. Calibration metadata will be stored in a dedicated field book and held for QA purposes. Dataset verification and validation will be discussed in the *Data Validation* section of this document.

11.5.3 Non-Direct Measurement (Secondary Data)

Secondary data such as Calibration records, Weather, Site Location, Site Conditions and Issues will be recorded for each site prior to deployment and at retrieval. A digital picture of the location will be taken at deployment and retrieval. Field data will be recorded in a bound notebook or on a form retained in a local file.

11.5.4 Deployment Requirements

For a successful monitoring event to be completed, a protocol concerning deployment must be followed. The protocol is broken down into the following steps:

1. Deployment locations will be located with a global positioning system (GPS) if not placed at an established site with previous locational information.

2. Datasonde units must be completely submerged in flowing water. Center flow channel stream placement is optimum.
3. Sample intakes for auto samplers must be away from the bank, in a flowing section of the river or stream and in the water column off the bottom to prevent being buried by sediment or pumping sediment or bottom material into the sample container.
4. Sensor cluster of the datasondes should be aimed downstream to prevent scouring of the probe heads.
5. All units must be secured via a cable and lock, affixed to a tree or similar fixture on the stream bank.
6. A site sketch of the unit's placement in a stream must be drawn for retrieval by other BFBM or BMWM personnel if necessary.
7. Steps should be taken to conceal the unit should the location have foot traffic by non-DEP personnel to prevent tampering.

12.0 Data Quality/Quality Control Requirements

12.1 Sampling Locations: Sampling locations will be established using an approved global positioning system (GPS) device (Trimble Geo Explorer 3 or newer model). Subsequently, all sampling locations will be verified by sampling staff during each sampling event using a GPS device.

12.2 Testing by BFBM

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. (BFBM Standardized Analytical Method for Temperature, 2017; AM007.1293, Rev, 2, August 2017)

pH: The probe is calibrated daily per the manufacturer recommendations. The pH meter is calibrated each day of use, including calibration with two 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. **(BFBM Standardized Analytical Method for Determining pH by the Electrometric Method, 2017; AM005.0315, Rev. 2, August 2017)**

Conductance: The probe is calibrated daily 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. **(BFBM Standardized Analytical Method for Specific Conductance 2017, AM008.1293, Rev. 2, August 2017)**

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. **(BFBM Standard Analytical Method for Dissolved Oxygen by the Luminescence Measurement of Dissolved Oxygen (LDO), 2017; AM008.0713a, Rev. 1, August 2017)**

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. **(BFBM Standard Operating Procedure for Field Turbidity Measurement, 2017; AM009.0614, Rev. 2, August 2017)**

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

NJDEP Field Sampling Procedures Manual (2005).
NJAC 7:18 – Regulations Governing the Certification of Laboratories and Environmental Measurements.

12.3 Additional Testing performed by a NJ Certified Laboratory

Analytical samples delivered to a NJ certified laboratory, testing will be done by a method for which the laboratory has certification (New Jersey DEP Leeds Point Laboratory; laboratory certification number 01179). 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 or Standard Operating Procedures (SOPs). The QM and SOPs must be approved by the OQA.

13.0 Sampling Schedule

Sampling frequencies for selected laboratory analyzed parameters and field parameters will be determined by the Workgroup based on data review as the project progresses.

2018: See attachment D. for proposed schedule, but in general deployments of auto samplers, continuous water quality sondes and sample collection at wastewater treatment plants will occur every two weeks, beginning the week of June 11th, 2018 (sewage treatment plant sampling limited to the month of June only). Schedule subject to change based on stream conditions (e.g. avoiding periods after significant precipitation events when conditions are unsafe for sampling)

2017: Sampling occurred several times in late summer/early fall of 2017.

14.0 Resource Allocation: To complete this project as described, at least four full-time staff are required. This will allow for physical/ chemical and continuous monitoring sample collection, and data quality assurance and control.

15.0 Quality Assurance

15.1 Sampling Locations: All sampling locations will be established and verified during each sampling visit using global positioning system (GPS) device.

15.2 Laboratory Analysis: All physical/ chemical parameters will be analyzed by a qualified New Jersey certified laboratory (Bureau of Marine Water

Monitoring, Leeds Point Laboratory). Any laboratory used for this project shall be certified by NJDEP's OQA for the requested parameters. The reporting levels listed in Attachment G are **required** for this project.

15.3 Sample Containers: Sample containers shall be dedicated, single-use or cleaned as per the laboratory's SOP. Sample containers shall be provided by the NJ certified laboratory.

15.4 Sample Retention: All samples must be retained for the duration of each analyte's respective holding time.

15.5 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 8.5I. A copy of the chain of custody form for this project is included as Attachment F.

15.6 Sample Blanks/Replicates: To ensure no contamination from the equipment, each sampler intake line will be cleaned at the laboratory and rinsed with di-ionized water (DIW). After rinsing, di-ionized water will be run through the lines and collected and analyzed as blanks. A subset of acid washed bottles will also be filled with DIW and analyzed as blanks.

15.7 Continuous Monitoring Parameters:

All measurements will be collected using YSI 6600, 6920 and EXO series datasondes or ONSET U22 or U24 series data loggers. Sensor specifications can be found in Attachment C.

All datasondes and/or data loggers used will be inspected prior to deployment. Units will be serviced, maintained and calibrated according to manufacturer's specifications. D.O. Sensor membranes (if applicable) will be inspected for bubbles or wrinkles and be replaced accordingly. pH sensor bulbs will be inspected for scratches and replaced if necessary. Specific Conductivity sensors will be inspected and cleared of any residue (if any). Turbidity sensors will be inspected and wiper assembly verified as functional.

Calibration of the datasondes and/or data loggers will take place 1 to 3 days in advance of the deployment. YSI 6600, 6920 and EXO series datasondes

feature calibration checks to ensure sensors remain properly calibrated. Calibration issues or failures will be indicated by error messages in the software during calibration.

Dissolved Oxygen: Calibration of the Optical Dissolved Oxygen Sensor will be done using the 1-point air saturation method. This method utilizes a container of water that is continuously sparged with oxygen from an air pump. A period of 10 minutes shall elapse before calibration takes place to allow temperature and oxygen to equilibrate. The sensor is then calibrated to 100% saturation using the current barometric pressure. The rapid pulse DO sensors report a statistic (DO Charge) that indicates if the probe is operating successfully. Ranges below 25 or exceeding 75 indicate sensor failure. Dissolved oxygen will be checked against a Winkler titration before and after deployment. Differences greater than 0.3 mg/l will require recalibration.

pH: pH sensors will be calibrated via a two-point calibration check. The pH standards used will be 4 and 10. Calibration will be checked against a pH value of 7 to determine accuracy. pH sensors will report 'Out of Range' errors should sensor output exceeds the normal range. Differences between the standard and measured reading ± 0.1 SU for pH will require recalibration.

Specific Conductivity: Specific Conductivity sensors will be calibrated via a one-point calibration check against a standard of 1.412 mS/cm. Conductivity sensors will report 'Out of Range' errors should sensor output exceeds the normal range. Differences between the standard and measured reading exceeding 1% will require recalibration.

Turbidity: Turbidity sensors will be calibrated via a two-point calibration check. The sensors will be calibrated against a 0 NTU solution and a 100 NTU solution. Turbidity sensors will report 'Out of Range' should the defined calibration range be exceeded. Differences between the standard and measured reading exceeding 2 NTU will require recalibration.

Temperature: Temperature will be checked against a NIST certified thermometer on a quarterly basis. Temperature differences between the standard and measured reading exceeding 0.1°C require recalibration.

16.0 Data Validation

Laboratory Analyzed Data:

The Project Officer, Data Manager and the Laboratory Supervisor are responsible for all initial data validation. If apparent anomalous data is suspected the Project Officer and/or the Laboratory Supervisor will review the sampling procedures with the field sampler to make sure the proper collection and preservation procedures were followed. Additionally, for nutrient parameters (particularly Ammonia, TKN, Nitrate + Nitrite and Phosphorus), 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.”*

If the data is still suspect, the NJ certified laboratory 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. (Samples are to be retained by the laboratory for the duration of each analytes respective holding time.) 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 if the results are within the limits of accuracy of the test method.

Continuous Monitoring Data:

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

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

<u>Parameter</u>	<u>Minimum</u>	<u>Maximum</u>
Temperature	.1° C	1.5° C

Specific Conductivity	1%	25%
pH	0.1	1.5
Dissolved Oxygen	.3 mg/l	1.5 mg/l or 25%
Turbidity	2 NTU or 5%	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)
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.

17.0 Data Storage

Data will be stored locally in electronic format (MS Access or MS Excel). Water quality data from in-stream monitoring locations will be entered in New Jersey's Water Quality Data Exchange (WQDE) and USEPA STORET Data Warehouse by

June of the following year it is received from the analytical laboratory. All raw data records shall be maintained for a period of no less than five years. Continuous water quality data will be available through NJDEP's DWM&S Continuous Data Monitoring Program's website (<http://njdep.rutgers.edu/continuous/>). Data analyzed in the field and laboratory will be accessible through the USEPA's STORET database (<https://www.epa.gov/waterdata/water-quality-data-wqx> , and the National Water Monitoring Council's Water Quality Portal (<https://www.waterqualitydata.us/>).

Data obtained and analyzed from wastewater treatment plants will be provided for review/analysis purposes only.

18.0 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.

19.0 Data Reporting

19.1 Preliminary Reporting of Data

Preliminary analytical data will be reported to BFBM and BFBM, from the laboratory employed for this project, in either electronic format or by verbal communication to the Project Officer, within 21 calendar days from receipt of sample. Samples which yield results considered anomalous by the Project Officer and/ or Laboratory Supervisor will be validated as specified in section 16.0, Data Validation, before the holding time of the retained sample is expired. If the results remain suspect after an internal review of the laboratory procedures, calculations, and/or on transcription of data has been conducted, then the sample shall be reanalyzed by the laboratory using the retained portion of the sample. This reanalysis shall be performed within the parameter holding time.

20.0 Final Reporting of Data

Continuous Data

Continuous water quality data will be available through NJDEP's DWM&S Continuous Data Monitoring Program's website (

<http://njdep.rutgers.edu/continuous/>) within 6 months of completion of the project.

Analytical 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.

Data analyzed in the field and laboratory for in-stream monitoring locations will be accessible through the USEPA's STORET database (<https://www.epa.gov/waterdata/water-quality-data-wqx> , and the National Water Monitoring Council's Water Quality Portal (<https://www.waterqualitydata.us/>).

Data obtained and analyzed from wastewater treatment plants will be provided for review/analysis purposes only.

21.0 Data Analysis

The larger Workgroup is in the process of developing a smaller technical workgroup that will be responsible for preliminary data analysis. This data analysis workgroup will develop materials and summaries of data collected within two weeks of receiving data from the laboratory. Those materials and summaries will then be shared with the larger workgroup for further assessment and decision making. The data analysis workgroup will be comprised on one representative from each of the major parties involved in the development of this project (DWSG, BEARS, BFBM, BMWWM, DWQ and C&E).

The primary goal of the analysis will be to identify hotspots for nitrate, better understand the changes in nitrate concentrations in the stream from upstream to the downstream PVWC intake and possible sources which are potentially impacting the concentrations at the PVWC intake. The relative impact of the confounding factors impacting the nitrate concentrations will be evaluated. Additionally, the analysis will help the workgroup determine future sampling locations which may result in amendment of this QAPP.

BEARS will prepare an "R" and "RShiny" based application which will display the reported data graphically and spatially in maps. This application will include other relevant data such as the data from USGS sensor, rainfall, flow etc. to facilitate analyses of the data so that multiple staff can evaluate the data simultaneously. A data workgroup will be set up to analyze the data individually

and collectively; the conclusions will be reported to the nitrate workgroup at DEP for making decisions pertaining to the evolution of this investigative study.

22.0 Assessment, Oversight, and Response

See Section 5.0 (Project Management) for detailed list of responsibilities regarding this project.

22.0 Corrective Action

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 A1: 2018 Monitoring Stations

In-Stream Monitoring Locations

Station ID	Station Name	TMDL ID	Comment*	Priority
01382000	Passaic River at Two Bridges	PA-7		1
01389000	Pompton River at Two Bridges	POM-3		1
BFBM000288	Rockaway River on Bloomfield Avenue, Montville	RO-2		1
01381800	Whippany River at Pine Brook	WI-3	Move downstream to Whippany R at Pine Brook gage	1
01381900	Passaic River at Pine Brook	PA-6	Move upstream to Passaic R at Pine Brook gage	1
01379580	Passaic River at Eagle Rock Avenue	PA-5		1
01389400	Passaic River	PA-8		2
BFBM000287	Passaic River	PA-4	Move upstream to Shepard Kollock Park	2

- See detailed QAPP tables on Attachment G for exact GPS coordinates

Wastewater Treatment Plant Stations

Sewage Treatment Plant Name	Facility ID
Parsippany-Troy Hills	NJ0024970
Rockaway Valley	NJ0022349
Two Bridges	NJ0029386
Molitor	NJ0024937
Hanover	NJ0024902
Livingston	NJ0024511
Wayne Mountainview	NJ0028002
Caldwell	NJ0020427

Attachment A2: 2017 Monitoring Locations

Station ID	Name	County	Sample ID	Lat	Long
01389110	Passaic River at Rt 46	PASSAIC	P1	40.892679	-74.265787
01382000	Passaic River at Two Bridges Rd above USGS Sensor/Pompton Rvr	ESSEX	P2	40.8972	-74.272901
01389000	Pompton River at Two Bridges	MORRIS	P3	40.897988	-74.272446
BFBM000261	Passaic River at Bloomfield Ave	ESSEX	P4	40.858534	-74.319071
AN0251	Rockaway River at Greenbank Dr	MORRIS	P5	40.899436	-74.387854
01381800	Whippany River at end of Edwards Rd	MORRIS	P6	40.8453	-74.347099
BFBM000262	Rockaway River above Par Troy discharge	MORRIS	P7	40.847011	-74.342089
BFBM000263	ParTroy Discharge at Discharge	MORRIS	P8	40.846353	-74.341931
01379580	Passaic River at Eagle Rock Ave	ESSEX	P9	40.827714	-74.334905
BFBM000264	Rockaway River below discharge/mixing point of Morris County STP	MORRIS	P10	40.845633	-74.340614
01381940	Passaic River at Horseneck Rd (County 626)	ESSEX	P11	40.882115	-74.340056
AN0274A	Passaic River off of Willard Lane (Dr) below Compost Facility	ESSEX	P12	40.900886	-74.336463
BFBM000265	Passaic River at Union Ave (County 646), PVWC Intake Canal	PASSAIC	P13	40.884512	-74.23247
BFBM000266	Passaic River Trib at Two Bridges Rd	MORRIS	P14	40.899619	-74.278721
BFBM000267	Passaic River Trib at Lane Rd	ESSEX	P15	40.896334	-74.279806
BFBM000268	Passaic River Trib off Marginal Rd	ESSEX	P16	40.895934	-74.29449
BFBM000269	Passaic River above Two Bridges site	ESSEX	P17	40.897944	-74.279522
BFBM000270	Passaic River In Great Piece Meadows	MORRIS	P18	40.905851	-74.297163
BFBM000271	Passaic River Downstream of Golf Course	MORRIS	P19	40.903419	-74.317013
BFBM000272	Pompton River above p3 01389000	MORRIS	P20	40.900161	-74.272504
BFBM000275	Pompton River off Fairfield Rd above STP	PASSAIC	P21	40.906004	-74.26655
BFBM000276	Passaic River at Great Piece Meadows Preserve P22	ESSEX	P22	40.906506	-74.330962
BFBM000277	Passaic River at Great Piece Meadows Preserve P23	ESSEX	P23	40.906606	-74.328303
BFBM000278	Passaic River at Great Piece Meadows Preserve P24	ESSEX	P24	40.905726	-74.326559
BFBM000279	Passaic River at Great Piece Meadows Preserve P25	MORRIS	P25	40.908713	-74.325925
BFBM000280	Passaic River at Great Piece Meadows Preserve P26	MORRIS	P26	40.907054	-74.321782
BFBM000281	Passaic River at Great Piece Meadows Preserve P27	ESSEX	P27	40.906454	-74.31885
BFBM000282	Passaic River at Great Piece Meadows Preserve P28	MORRIS	P28	40.904782	-74.308786
BFBM000283	Passaic River at Great Piece Meadows Preserve P29	MORRIS	P29	40.906903	-74.304189
BFBM000284	Passaic River at Great Piece Meadows Preserve P30	ESSEX	P30	40.899391	-74.289104
BFBM000285	Passaic River at Great Piece Meadows Preserve P31	MORRIS	P31	40.899634	-74.283144
BFBM000273	Loantaka Brook off Fanok Rd	MORRIS	S1	40.778287	-74.464763
BFBM000274	Loantaka Brook below Woodland STP	MORRIS	S2	40.772099	-74.462712
01379010	Passaic River at Velley Rd	SOMERSET	S3	40.664779	-74.529694
AN0226	Dead River off Somerville/Hunter Rd	SOMERSET	S4	40.659291	-74.593192
01379200	Dead River at King George Rd	SOMERSET	S5	40.649729	-74.524202
AN0228	Passaic River off of Warren Ave	MORRIS	S6	40.661195	-74.493915
BFBM000203	Passaic River at Central Ave	UNION	S7	40.701896	-74.426615
01379504	Passaic River at Summit Ave	UNION	S8	40.734313	-74.377515
AN0231A	Passaic River at Passaic Ave	ESSEX	S9	40.755788	-74.361336
01379570	Passaic River at Rt 10	ESSEX	S10	40.800541	-74.359042
BFBM000169	Whippany River at Lake Valley Rd	MORRIS	S11	40.812571	-74.497329
01381500	Whippany River off East Hanover Ave	MORRIS	S12	40.8062	-74.455902
01381515	Whippany River at South Jefferson Rd	MORRIS	S13	40.819588	-74.440272

Attachment B1: 2018 Parameters

Field/Analyze Immediately Parameters

Parameter	Units	Streams?	WWTPs?
Water Temperature	°C	Yes	Yes
Dissolved Oxygen (concentration)	Mg/L	Yes	Yes
Dissolved Oxygen (saturation)	%	Yes	No
pH	SU	Yes	Yes
Specific Conductance	uS/cm	Yes	No
Turbidity	NTU	Yes	No
Air Temperature	°C	Yes	NA
Barometric Pressure	mmHg	Yes	NA
Effluent Flow	MGD	NA	Yes

Laboratory Parameters

Parameter	Units	Streams?	WWTPs
Total Suspended Solids	Mg/L	Yes	No
Chlorophyll a	Mg/L	Yes	No
Total Nitrogen	Mg/L	Yes	No
Nitrite-Nitrate	Mg/L	Yes	Yes
Ammonia	Mg/L	Yes	No
Total Phosphorus	Mg/L	Yes	No
Ortho Phosphate	Mg/L	Yes	No

Attachment B2: 2017 Parameters

Field/Analyze Immediately Parameters

Parameter	Units
Water Temperature	°C
Dissolved Oxygen (concentration)	Mg/L
Dissolved Oxygen (saturation)	%
pH	SU
Specific Conductance	uS/cm
Turbidity	NTU
Air Temperature	°C
Barometric Pressure	mmHg

Laboratory Parameters

Parameter	Units
Total Nitrogen	Mg/L
Nitrite-Nitrate	Mg/L
Ammonia	Mg/L
Total Phosphorus	Mg/L
Ortho Phosphate	Mg/L

Attachment C: Sensor Specifications

<u>Logger/Probe Type</u>	<u>Manufacturer</u>	<u>Model #</u>	<u>Range</u>	<u>Resolution</u>	<u>Accuracy</u>
Temperature Logger	Onset	U22-001	- 40 to 50 ^o C	0.02 °C at 25°C	+/- 0.21 from 0 to 50 C
pH	YSI	6 series	0-14 units	0.01 units	+/-0.2 units
pH	YSI	EXO	0-14 units	0.01 units	+/- 0.1 units within 10 DEGREES C,+/-0.2 units
D.O. optical	YSI	6150	0-50 mg/l	0.01 mg/l	0-20 mg/l +/- 1% of the reading or +/- 0.1 mg/l w
D.O. optical	YSI	EXO	0-50 mg/l	0.01 mg/l	0-20 mg/l +/- 1% of the reading or +/- 0.1 mg/l w
Turbidity	YSI	6163	0-1000 NTU	0.1 NTU	+/- 5% reading or 2 NTU (Whichever is greater)
Turbidity	YSI	EXO	0-4000 FNU	0-999 FNU: .01 FNU, 1000-4000 FNU: .1 FNU	0-999 FNU: +/-2% of reading (whichever greater)
Conductivity	YSI	6560	0-100 mS/cm	0.001 mS/cm to 0.1 mS/cm (Range dependent)	+/- 0.5 % of reading +0.001 mS/cm
Conductivity	YSI	EXO	0 to 200 mS/cm	0.001 mS/cm to 0.1 mS/cm (Range dependent)	0-100 mS/cm:.001, 100-200 mS/cm: +/- 1%
Temperature	YSI	6560	-5 to 45 °C	0.01 ° C	+/- .15 °C
Temperature	YSI	EXO	-5 to 45 °C	.001 ° C	-5 to 35 C : +/- .01; 35-50 C +/- .05 C

Attachment D: Proposed Monitoring Schedule Every Two Weeks Beginning Week of June 11th.

Instream Sampling : 6 initial locations using ISCO samplers

Sampling Locations: RO2, PA5, WI3, PA7, PO3, Passaic River @ Pine Brook (USGS 01381900 Lat 40°51'45", long 74°19'18")

There is initial installation time for all ISCO locations, approximately a half day per location. Set up can take place at anytime prior to agreed upon start date for sampling schedule.

Samples taken once every two weeks. ISCO's will collect samples once every 2 hours for a total of 24 samples over a 48 hours period. Initial 6 sampling locations will generate 144 total samples every two weeks.

Field measurements : pH, DO, DO Saturation, Water Temperature, Specific Conductivity

Lab measurements: Total Nitrogen, Ammonia Nitrogen (NH3-N), Nitrate+Nitrite, Total Phosphorus (TP), Chlorophyll-a, Total Suspended Solids (TSS), Turbidity

Setup 1	Setup 2	Setup 3	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
			Deploy	Deploy	Sample	Sample	Retrieve									
			Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21	Day 22	Day 23	Day 24	Day 25	Day 26	Day 27	Day 28
			Deploy	Deploy	Sample	Sample	Retrieve									

STP Effluent Sampling : 8 locations using samples from each plants compositor

STP's Sampled: Caldwell, Hanover, Livingston, Molitor, Parsippany-Troy Hills, Rockaway Valley Regional, Two Bridges, Wayne Twp

No physical setup required, but coordination and scheduling with each plant is necessary. Schedule of sampling days provided in advance to STPs. Samples collected the first day of instream sampling. STP sampling day will dictate instream sampling period.
Do we need to provide bottles to plants ahead of time? Or can C&E collect sample when they arrive.

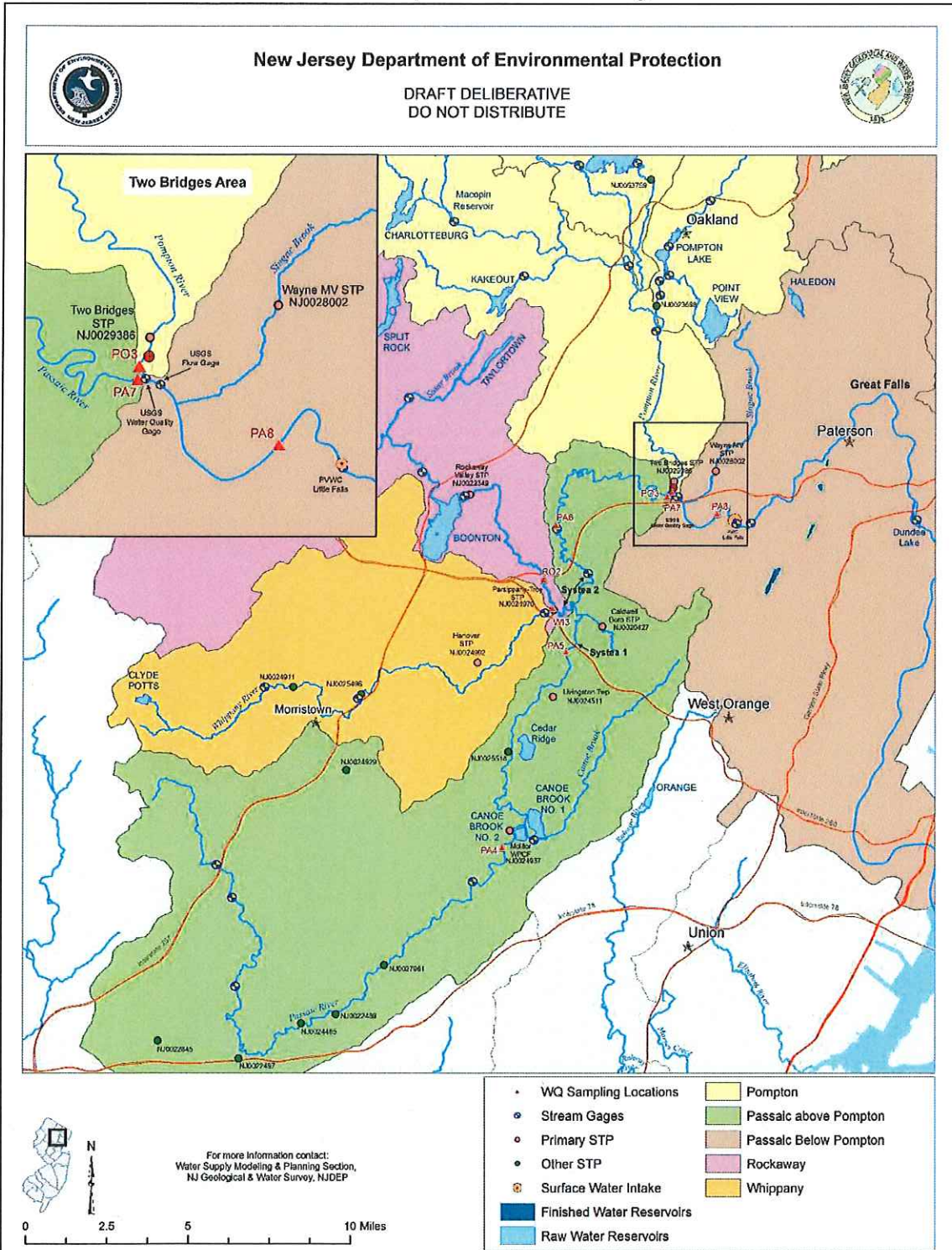
Samples taken from plant's compositor. One +24 hour grab sample per plant, total of 8 samples to be tested by lab every 2 weeks. DWQ/C&E to work out exact procedures.

Ice preservation only. Samples need to delivered to Leeds Point lab. Coordinate BFBM and C&E.

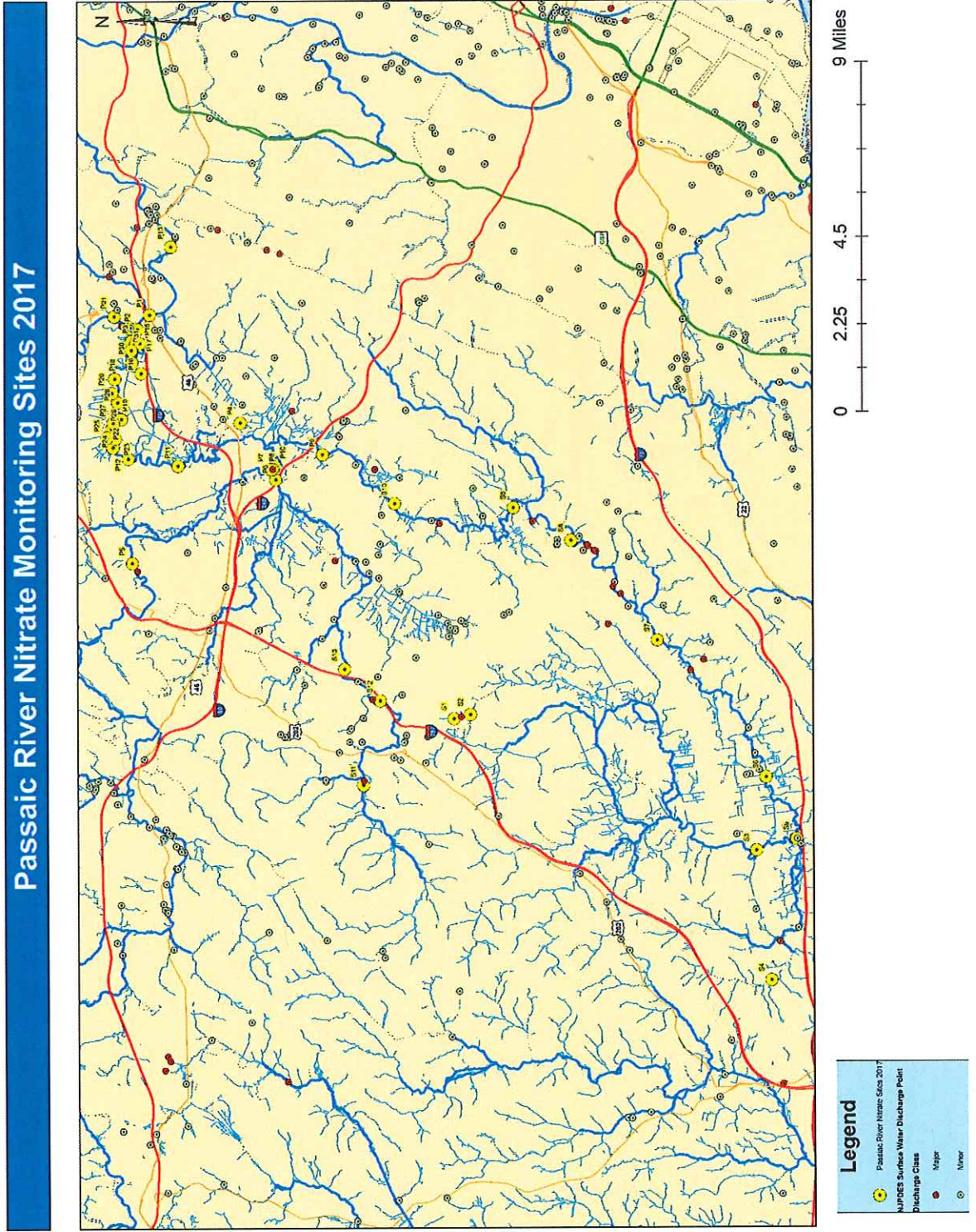
Field measurements: pH, DO, Water Temperature, Specific Conductivity. Is this possible?

			Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14
					Sample*											
			* May need to collect sample on morning of day 4 in order to collect day 3 effluent													
			Day 15	Day 16	Day 17	Day 18	Day 19	Day 20	Day 21	Day 22	Day 23	Day 24	Day 25	Day 26	Day 27	Day 28

Attachment E: Map of 2018 Monitoring Locations



Attachment E Continued: Map of 2017 Monitoring Locations



Attachment F: Chain of Custody Form

General Information						Lab Assigned
Site		Sample Collection	Start	End	Sample #s	
Sample Collector		Dates (mm/dd/yyyy)			Sample Type (circle one)	WWTP ISCO
Collector Organization		Times (hh:mm)				
Field Measurements					Notes	
Field Measurement Time (hh:mm)		Dissolved Oxygen (mg/L)				
Sample Depth (m)		Specific Conductance (uS/cm)				
Air Temp (deg C)		Salinity (ppt)				
Uncorrected Water Temperature (deg C)		pH				
Corrected Water Temperature (deg C)		Turbidity (NTU) / Time				
Dissolved Oxygen Saturation (%)		Effluent Flow (MGD)				
Waste Water Treatment Sample						
# of Bottles	Container	Matrix	Parameter	Fraction	Preservative	
1	HDPE, 1L	Freshwater	NO3+NO2	Unfiltered	Ice, 4 deg C	
ISCO Autosampler Samples						
# of Bottles	Container	Matrix	Parameter	Fraction	Preservative	
12	500mL ISCO Bottles	Freshwater	TSS, Chlorophyll a	Non-filterable	Ice, 4 deg C	
12	500mL ISCO Bottles	Freshwater	TN, TP, PO4, NO3+NO2, NH3	Unfiltered	Ice, 4 deg C	
Chain of Custody						
Container ID	Relinquished	Received	Date/Time		Reason	
Site-Day (ex.)			Date:	Time:		
01382000-1			Date:	Time:		
01382000-2			Date:	Time:		

Attachment G. Detailed QAPP Tables

QAPP Table Supplement; Data Inventory

Geographic Regions	Upper Passaic, Whippany & Rockaway
Counties	Somerset, Morris, Essex, Passaic
Dates	09/01/2017-12/31/2018
Status	In progress-discrete, In progress-continual
Sample Frequency	Other
Seasons Sampled	Spring, Summer, Fall, Winter
Waterbody Type	River/Stream
Salinity Category	Fresh
Tidal Influence	Non-tidal
Project Description	Through discrete monitoring and continuous monitoring, collect water quality data to evaluate nitrate concentrations and potential sources in the Passaic River watershed.
Parameters analyzed type	Chemical/Physical (Conventionals, Nutrients), Field and Continuous

QAPP Table Supplement; Data Management

QAPP network path file location?	V:\LUM\BFBM\Bfbm\Quality Assurance Plans\Calendar Year 2018 QAPPS\
Where will data be recorded in field (media)	Paper
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
If data collected electronically, where will it be stored?	http://njdep.marine.rutgers.edu/buoy/#data
Format to be received from Lab	Microsoft Excel
Method of receipt from lab/s	email attachment
Personnel receiving outside lab data	Chris Kunz
Is data expected to go to WQDE/STORET?	Yes. Continuous Data: http://njdep.marine.rutgers.edu/buoy/#data
Data manager - (Bureau and Name)	BFBM Leigh Lager

Table 1. Sampling Locations

Station ID(WQDE compliant and referenced)	Waterbody/Location	Latitude-dd	Longitude-dd	County	Site exists in WQDE already?	Location Type
01379010	Passaic River at Velley Rd	40.664779	-74.529694	SOMERSET	YES	River/stream
01379200	Dead River at King George Rd	40.649729	-74.524202	SOMERSET	YES	River/stream
01379504	Passaic River at Summit Ave	40.734313	-74.377515	UNION	YES	River/stream
01379570	Passaic River at Rt 10	40.800541	-74.359042	ESSEX	YES	River/stream
01379580	Passaic River at Eagle Rock Ave	40.827714	-74.334905	ESSEX	YES	River/stream
01381500	Whippany River off East Hanover Ave	40.8062	-74.455902	MORRIS	YES	River/stream
01381515	Whippany River at South Jefferson Rd	40.819588	-74.440272	MORRIS	YES	River/stream
01381800	Whippany River at end of Edwards Rd	40.8453	-74.347099	MORRIS	YES	River/stream
01381900 (PA-6)	Passaic River above Pine Brook gage	40.8625	-74.321667	MORRIS	YES	River/stream
01381940	Passaic River at Horseneck Rd (County 626)	40.882115	-74.340056	ESSEX	YES	River/stream
01382000	Passaic River at Two Bridges Rd above USGS Sensor/Pompton Rvr	40.8972	-74.272901	ESSEX	YES	River/stream
01389000	Pompton River at Two Bridges	40.897988	-74.272446	MORRIS	YES	River/stream
01389110	Passaic River at Rt 46	40.892679	-74.265787	PASSAIC	YES	River/stream
01389400 (PA-8)	Passaic River off of Route 23	40.887778	-74.246667	PASSAIC	YES	River/stream
AN0226	Dead River off Somerville/Hunter Rd	40.659291	-74.593192	SOMERSET	YES	River/stream
AN0228	Passaic River off of Warren Ave	40.661195	-74.493915	MORRIS	YES	River/stream
AN0231A	Passaic River at Passaic Ave	40.755788	-74.361336	ESSEX	YES	River/stream
AN0251	Rockaway River at Greenbank Dr	40.899436	-74.387854	MORRIS	YES	River/stream
AN0274A	Passaic River off of Willard Lane (Dr) below Compost Facility	40.900886	-74.336463	ESSEX	YES	River/stream
BFBM000169	Whippany River at Lake Valley Rd	40.812571	-74.497329	MORRIS	YES	River/stream
BFBM000203	Passaic River at Central Ave	40.701896	-74.426615	UNION	YES	River/stream
BFBM000261	Passaic River at Bloomfield Ave	40.858534	-74.319071	ESSEX	YES	River/stream
BFBM000262	Rockaway River above Par Troy discharge	40.847011	-74.342089	MORRIS	YES	River/stream
BFBM000263	Par Troy Discharge at Discharge	40.846353	-74.341931	MORRIS	YES	River/stream
BFBM000264	Rockaway River below discharge/mixing point of Morris County STP	40.845633	-74.340614	MORRIS	YES	River/stream
BFBM000265	Passaic River at Union Ave (County 646), PVWC Intake Canal	40.884512	-74.23247	PASSAIC	YES	River/stream
BFBM000266	Passaic River Trib at Two Bridges Rd	40.899619	-74.278721	MORRIS	YES	River/stream
BFBM000267	Passaic River Trib at Lane Rd	40.896334	-74.279806	ESSEX	YES	River/stream
BFBM000268	Passaic River Trib off Marginal Rd	40.895934	-74.29449	ESSEX	YES	River/stream
BFBM000269	Passaic River above Two Bridges site	40.897944	-74.279522	ESSEX	YES	River/stream
BFBM000270	Passaic River In Great Piece Meadows	40.905851	-74.297163	MORRIS	YES	River/stream
BFBM000271	Passaic River Downstream of Golf Course	40.903419	-74.317013	MORRIS	YES	River/stream
BFBM000272	Pompton River above p3 01389000	40.900161	-74.272504	MORRIS	YES	River/stream
BFBM000273	Loantaka Brook off Fanok Rd	40.778287	-74.464763	MORRIS	YES	River/stream
BFBM000274	Loantaka Brook below Woodland STP	40.772099	-74.462712	MORRIS	YES	River/stream
BFBM000275	Pompton River off Fairfield Rd above STP	40.906004	-74.26655	PASSAIC	YES	River/stream
BFBM000276	Passaic River at Great Piece Meadows Preserve P22	40.906506	-74.330962	ESSEX	YES	River/stream
BFBM000277	Passaic River at Great Piece Meadows Preserve P23	40.906606	-74.328303	ESSEX	YES	River/stream
BFBM000278	Passaic River at Great Piece Meadows Preserve P24	40.905726	-74.326559	ESSEX	YES	River/stream
BFBM000279	Passaic River at Great Piece Meadows Preserve P25	40.908713	-74.325925	MORRIS	YES	River/stream
BFBM000280	Passaic River at Great Piece Meadows Preserve P26	40.907054	-74.321782	MORRIS	YES	River/stream
BFBM000281	Passaic River at Great Piece Meadows Preserve P27	40.906454	-74.31885	ESSEX	YES	River/stream
BFBM000282	Passaic River at Great Piece Meadows Preserve P28	40.904782	-74.308786	MORRIS	YES	River/stream
BFBM000283	Passaic River at Great Piece Meadows Preserve P29	40.906903	-74.304189	MORRIS	YES	River/stream
BFBM000284	Passaic River at Great Piece Meadows Preserve P30	40.899391	-74.289104	ESSEX	YES	River/stream
BFBM000285	Passaic River at Great Piece Meadows Preserve P31	40.899634	-74.283144	MORRIS	YES	River/stream
BFBM000287 (PA-4)	Passaic River at Chatham	40.738	-74.3714	MORRIS	YES	River/stream
BFBM000288 (RO-2)	Rockaway River at Bloomfield Ave	40.8595	-74.3473	MORRIS	YES	River/stream

Table 2. Sample Types

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological	Sediment	Bacteria Collection	Habitat	Metrics	Indices
					Sampling	Collection				
01379010	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
01379200	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
01379504	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
01379570	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
01379580	YES	TBD	YES	YES	NO	NO	NO	NO	NO	NO
01381500	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
01381515	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
01381800	YES	TBD	YES	YES	NO	NO	NO	NO	NO	NO
01381900 (PA-6)	YES	TBD	YES	YES	NO	NO	NO	NO	NO	NO
01381940	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
01382000	YES	TBD	YES	YES	NO	NO	NO	NO	NO	NO
01389000	YES	TBD	YES	YES	NO	NO	NO	NO	NO	NO
01389110	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
01389400 (PA-8)	YES	TBD	YES	YES	NO	NO	NO	NO	NO	NO
AN0226	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
AN0228	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
AN0231A	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
AN0251	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
AN0274A	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000169	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000203	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000261	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000262	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000263	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000264	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000265	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000266	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000267	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000268	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000269	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000270	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000271	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000272	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000273	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000274	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000275	YES	TBD	YES	TBD	NO	NO	NO	NO	NO	NO
BFBM000276	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000277	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000278	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000279	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000280	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000281	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000282	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000283	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000284	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000285	YES	TBD	TBD	TBD	NO	NO	NO	NO	NO	NO
BFBM000287 (PA-4)	YES	TBD	YES	YES	NO	NO	NO	NO	NO	NO
BFBM000288 (RO-2)	YES	TBD	YES	YES	NO	NO	NO	NO	NO	NO

Table 3. Sampling Partners

STATION ID	Field Msr/Obs	Flow	Water Chemistry	Continuous Monitoring	Biological Sampling	Sediment Collection	Bacteria Collection	Year Sampled
01379010	DEP	No	DEP	DEP	No	No	No	2017
01379200	DEP	No	DEP	DEP	No	No	No	2017
01379504	DEP	No	DEP	DEP	No	No	No	2017
01379570	DEP	No	DEP	DEP	No	No	No	2017
01381500	DEP	No	DEP	DEP	No	No	No	2017
01381515	DEP	No	DEP	DEP	No	No	No	2017
01381940	DEP	No	DEP	DEP	No	No	No	2017
01389110	DEP	No	DEP	DEP	No	No	No	2017
AN0226	DEP	No	DEP	DEP	No	No	No	2017
AN0228	DEP	No	DEP	DEP	No	No	No	2017
AN0231A	DEP	No	DEP	DEP	No	No	No	2017
AN0251	DEP	No	DEP	DEP	No	No	No	2017
AN0274A	DEP	No	DEP	DEP	No	No	No	2017
BFBM000169	DEP	No	DEP	DEP	No	No	No	2017
BFBM000203	DEP	No	DEP	DEP	No	No	No	2017
BFBM000261	DEP	No	DEP	DEP	No	No	No	2017
BFBM000262	DEP	No	DEP	DEP	No	No	No	2017
BFBM000263	DEP	No	DEP	DEP	No	No	No	2017
BFBM000264	DEP	No	DEP	DEP	No	No	No	2017
BFBM000265	DEP	No	DEP	DEP	No	No	No	2017
BFBM000266	DEP	No	DEP	DEP	No	No	No	2017
BFBM000267	DEP	No	DEP	DEP	No	No	No	2017
BFBM000268	DEP	No	DEP	DEP	No	No	No	2017
BFBM000269	DEP	No	DEP	DEP	No	No	No	2017
BFBM000270	DEP	No	DEP	DEP	No	No	No	2017
BFBM000271	DEP	No	DEP	DEP	No	No	No	2017
BFBM000272	DEP	No	DEP	DEP	No	No	No	2017
BFBM000273	DEP	No	DEP	DEP	No	No	No	2017
BFBM000274	DEP	No	DEP	DEP	No	No	No	2017
BFBM000275	DEP	No	DEP	DEP	No	No	No	2017
BFBM000276	DEP	No	DEP	DEP	No	No	No	2017
BFBM000277	DEP	No	DEP	DEP	No	No	No	2017
BFBM000278	DEP	No	DEP	DEP	No	No	No	2017
BFBM000279	DEP	No	DEP	DEP	No	No	No	2017
BFBM000280	DEP	No	DEP	DEP	No	No	No	2017
BFBM000281	DEP	No	DEP	DEP	No	No	No	2017
BFBM000282	DEP	No	DEP	DEP	No	No	No	2017
BFBM000283	DEP	No	DEP	DEP	No	No	No	2017
BFBM000284	DEP	No	DEP	DEP	No	No	No	2017
BFBM000285	DEP	No	DEP	DEP	No	No	No	2017
01381900 (PA-6)	DEP	No	DEP	DEP	No	No	No	2018
01389400 (PA-8)	DEP	No	DEP	DEP	No	No	No	2018
BFBM000287 (PA-4)	DEP	No	DEP	DEP	No	No	No	2018
BFBM000288 (RO-2)	DEP	No	DEP	DEP	No	No	No	2018
01379580	DEP	No	DEP	DEP	No	No	No	2017, 2018
01381800	DEP	No	DEP	DEP	No	No	No	2017, 2018
01382000	DEP	No	DEP	DEP	No	No	No	2017, 2018
01389000	DEP	No	DEP	DEP	No	No	No	2017, 2018

Table 4. Field Parameters

<u>Field Name</u>	<u>WQDE Name</u>	<u>Media</u>	<u>Units</u>
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
Turbidity	Turbidity	Water	NTU

Table 5. Laboratory Parameters

Analysis (lab name)	EPA Characteristic Name	Method Speciation Name	Result Sample Fraction	Result Measure Unit	Result Value Type	Sample Collection Type	Sample Collection Equipment
NUDEP LEEDS POINT LABORATORY - 01179	Ammonia-nitrogen	as N	Total	mg/l	Actual	Grab	Water Sampler (Other)
NUDEP LEEDS POINT LABORATORY - 01179	Nitrogen, Nitrite (NO2) + Nitrate (NO3) as N	as N	Total	mg/l	Actual	Grab	Water Sampler (Other)
NUDEP LEEDS POINT LABORATORY - 01179	Nitrogen	as N	Total	mg/l	Actual	Grab	Water Sampler (Other)
NUDEP LEEDS POINT LABORATORY - 01179	Orthophosphate	as P	Total	mg/l	Actual	Grab	Water Sampler (Other)
NUDEP LEEDS POINT LABORATORY - 01179	Phosphorus	as P	Total	mg/l	Actual	Grab	Water Sampler (Other)
NUDEP LEEDS POINT LABORATORY - 01179	Chlorophyll a		Total	mg/l	Actual	Grab	Water Sampler (Other)
NUDEP LEEDS POINT LABORATORY - 01179	Total suspended solids		Total	mg/l	Actual	Grab	Water Sampler (Other)

Table 6. Laboratory Analytical Methods and Reporting Limits

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
Ammonia (Total)	NIDEP LEEDS POINT LABORATORY - 01179		350.1	USEPA	0.01	mg/l	0.00476	mg/l			14 days	phenol to pH < 2, ice to 4 deg C
Nitrite plus Nitrate (NO2-NO3) (Total)	NIDEP LEEDS POINT LABORATORY - 01179		353.4 MOD*	USEPA	0.01	mg/l	0.00358	mg/l			28 days	ice to 4 deg C
Orthophosphate (Total)	NIDEP LEEDS POINT LABORATORY - 01179		365.5	USDOJ/USGS	0.005	mg/l	0.00378	mg/l			28 days	ice to 4 deg C
Phosphorus (Total)	NIDEP LEEDS POINT LABORATORY - 01179		1-4650-03	USDOJ/USGS	0.01	mg/l	0.00699	mg/l			28 days	ice to 4 deg C
Nitrogen (Total)	NIDEP LEEDS POINT LABORATORY - 01179		1-4650-03	USDOJ/USGS	0.1	mg/l	0.03797	mg/l			28 days	ice to 4 deg C
Chlorophyll a (Total)	NIDEP LEEDS POINT LABORATORY - 01179		10200-H	USDOJ/USGS	0.42	mg/l	NA	mg/l			7 days	ice to 4 deg C
Total Suspended (Total)	NIDEP LEEDS POINT LABORATORY - 01179		13765	USDOJ/USGS	1	mg/l	NA	mg/l			7 days	ice to 4 deg C
*Modified (alternative) USEPA method approved for water and wastewater.												