

# **Barnegat Bay Long Term Ambient Monitoring Program**

**New Jersey Department of Environmental Protection**

**Water Monitoring and Standards**

**July 2018**



**QUALITY ASSURANCE SAMPLING PLAN**  
**Barnegat Bay Watershed, WMA 13**

Project Officer 1:

Patricia Ingelido 8/14/18  
Signature Date  
Patricia Ingelido, Environmental Specialist 4  
Bureau of Environmental Analysis, Restoration and Standards  
Water Monitoring and Standards

NJDEP:

Chris Kunz 8/24/18  
Signature Date  
Chris Kunz, Environmental Specialist 4  
Bureau of Freshwater & Biological Monitoring  
Water Monitoring and Standards

NJDEP:

Robert Schuster 8/20/18  
Signature Date  
Bob Schuster, Bureau Chief  
Bureau of Marine Water Monitoring  
Water Monitoring and Standards

Lab:

Eric Ernst 8/15/18  
Signature Date  
Eric Ernst, Environmental Specialist 3  
Bureau of Marine Water Monitoring  
Water Monitoring and Standards

Data Manager:

Julie Nguyen 8/15/18  
Signature Date  
Julie Nguyen, Environmental Specialist 3  
Bureau of Marine Water Monitoring  
Water Monitoring and Standards

NJDEP: Quality Assurance Officer

Deb Waller 9/19/18  
Signature Date  
Deb Waller, Research Scientist 1  
Office of Quality Assurance

Reviewed by:

Bruce Friedman 9/10/18  
Signature Date  
Bruce Friedman, Director  
Water Monitoring and Standards



1. **Project Name:** Barnegat Bay Long Term Ambient Monitoring Program
2. **Requesting Agency:** NJDEP, Water Monitoring and Standards
3. **Date of Project Requested:** June, 2018
4. **Date of Project Initiation:** July, 2018
5. **Project Officer:** Bruce Friedman, Director, WM&S,
6. **Project Duration:** July 2018 thru June 2023
7. **Special Training Needs/Certification**

This project utilizes the assistance of several partners to conduct sample collection and field analysis. Approval of project partners will be performed annually by the Office of Quality Assurance. The Project Officer (OQA) or designee will be responsible for providing any necessary training and facilitating the project approval process with OQA.

## 8. Project Description

### 8.1. Background: Barnegat Bay Ambient Water Monitoring Project

On June 6, 2011, DEP and its partners launched this comprehensive ambient monitoring project that measured both water quality and water quantity in ways never done before in the Bay. The Department had enlisted numerous Partners, including local and county governments, State and Federal agencies, a science high school, a university and other organizations to assist the Department in sampling and sample analysis. Water quality was measured with grab samples taken at 12 streams which enter the Bay, as well as at 14 locations within the Bay. Water flow into the Bay was measured at 12 streams, and water flows into and out of the Bay at the three inlets from the Atlantic Ocean. Also, water circulation within the Bay was measured at 3 locations. Continuous monitoring (at select locations), intensive summer season monitoring, continuous temperature monitoring around the Oyster Creek facility, sediment monitoring and a survey to map the bottom of the Bay (i.e. bathymetric survey) was carried out. On a given sampling day, the Department and its Partners sample water quality and measure flow at both stream and bay locations. The continuous and intensive monitoring components complemented the discrete sampling to capture the full range of daily, tidal and seasonal variations.

This project was conducted in three phases, over a 2 year period, which included 3 intensive events. While the development of the water quality and hydrodynamics models continues, the monitoring project was successfully concluded on June 30, 2013.

In July of 2013 Phase 1 of the Barnegat Bay Long Term Ambient Monitoring Program commenced. The purpose of the new program was to monitor the on-going quality of the bay and those tributaries with the most significant impacts/loadings to the bay, as well as different land uses.

October 4<sup>th</sup> 2017, the Department released the Barnegat Bay Restoration Enhancement and Protection Strategy (REP Strategy). <http://www.nj.gov/dep/barnegatbay/docs/BarnBay-REPS.pdf>

This strategy is built upon the data, modeling results and research generated by the Barnegat Bay 10-point Plan that was announced in 2010. DEP is building upon the accomplishments of the 10-point plan, by identifying restoration, enhancement and protections actions as part of the BB REP Strategy, with the continued goal of improving the ecological health of Barnegat Bay and its watershed. A major component of the REP strategy is Assessment and Effectiveness Monitoring. Science is the backbone of the strategy and monitoring is needed throughout the process to assess conditions and determine the efficacy of actions taken. Continuation of the Barnegat Bay Watershed Long-Term Water Quality Monitoring Program is an action item identified in the BB REP Strategy.

## **8.2 Objective and Coverage: Barnegat Bay Long Term Ambient Monitoring Program**

Building on the success of the completed monitoring projects, the purpose of this new program is to continue to monitor on-going quality of the bay and those tributaries with the most significant impacts/loadings to the bay. This monitoring program will commence in July 2018.

The goals of the program are to:

1. Capture changes in water quality in the Barnegat Bay watershed over time.
2. Document changes resulting from restoration actions taken as part of the Barnegat Bay Restoration Enhancement and Protection Strategy, including actions guided by the water quality and hydrodynamic models underdevelopment, as well as other restoration actions.
3. Document changes in water quality related to the decommissioning of Oyster Creek Nuclear Generating Station which is schedule to occur in November 2018
4. Data will also be used for assessment purposes as part of the Integrated Water Quality Monitoring and Assessment Report process.
5. Superstorm Sandy: On October 25, 2012, Superstorm Sandy directly hit the New Jersey coast including Barnegat Bay. While the damage and some of the impacts are evident, it will be years before the full impact of the storm on the Bay are known. This long term monitoring program will help capture those changes that impact water quality over time. To be able to better characterize the normal fluctuations in water quality so that we can have a better definition of the uncertainty surrounding any given water quality measurement.
6. To provide water quality data that can be referenced to the biological research, which is occurring concurrently.
7. Interpretation of the narrative nutrient criteria requires water quality data to be collected at the same time as biological studies.

# Sampling Network and Design Rationale

## 9.1 Continuous in-situ water quality monitoring

Continuous monitoring multi-parameter probes will be deployed at the proposed monitoring sites in the Barnegat Bay. Table 1 specifies the list of parameters, frequency of collection and the number of sites for each phase of sampling. Table 2 identifies the bay sampling locations and Figure 1 shows the location of all proposed sampling sites.

**Table 1: Continuous Monitoring Plan: Monitoring Parameters and Frequency of Collection**

| <b>Continuous Monitoring Plan*</b>                                                |                                                                                                                                              |                        |                                                                                                                                                                                                                                                                         |                                |
|-----------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
| <b>Bay</b>                                                                        |                                                                                                                                              |                        |                                                                                                                                                                                                                                                                         |                                |
| <b>Sampling Stations</b>                                                          | <b>Sampling Type</b>                                                                                                                         | <b>Sampling Matrix</b> | <b>Parameters</b>                                                                                                                                                                                                                                                       | <b>Frequency</b>               |
| 4 buoy locations and 1 fixed station, as identified in Table 2 and Figure 1 below | Continuous monitoring probes at mid depth <sup>1</sup> using 4 buoy-located devices and 1 device housed within a fixed station (Mantoloking) | Aqueous                | Dissolved Oxygen concentration (DO), pH, Temperature, Turbidity <sup>3</sup> , Conductivity, Salinity <sup>2</sup> , Chlorophyll-a <sup>3</sup> ; (possible deployment of NO <sub>3</sub> <sup>3</sup> probe at Mantoloking using a buoy provided by USGS) <sup>3</sup> | Measurements every 15 minutes. |
| <b>Tributary</b>                                                                  |                                                                                                                                              |                        |                                                                                                                                                                                                                                                                         |                                |
| <b>Sampling Stations</b>                                                          | <b>Sampling Type</b>                                                                                                                         | <b>Sampling Matrix</b> | <b>Parameters</b>                                                                                                                                                                                                                                                       | <b>Frequency</b>               |
| Toms River near Toms River (USGS 01408500)                                        | probes located within the existing gauging station                                                                                           | Aqueous                | Dissolved Oxygen concentration (DO), pH, Temperature, Turbidity <sup>3</sup> , Conductivity, Nitrate/Nitrite <sup>3</sup>                                                                                                                                               | Measurements every 15 minutes. |

\*Separate QAPPs have been developed for the Department's continuous monitoring efforts and will be added to this document as an editorial revision.

<sup>1</sup> Sampling sites where depth is greater than 12 feet, two samples will be taken at 1/3 and 2/3 depth.

<sup>2</sup> Salinity to be calculated from conductivity.

<sup>3</sup> Requires the use of a NJ Certified laboratory.

## **9.2-Grab Water Quality Sampling**

Grab samples will be collected once per month (Monday through Thursday) leaving at least 2 weeks between sampling events, at the Barnegat Bay locations listed on Table 2 and additionally at tributary sites listed on Table 3. Locations are shown in Figure 1. Samples will be collected in accordance with approved field sampling procedures and analyzed in certified laboratories. The water quality parameters to be sampled are those listed in Table 6.

All water quality grab samples will be collected following procedures found in “NJDEP Field Sampling Procedures Manual, August 2005”. Sampling locations have been marked and verified with GPS. In addition NJDEP staff and project partners will utilize detailed site sketches to locate the sampling location on the first and subsequent visits. The freshwater tributary locations samples will be collected as center of flow grab samples. At tributary locations greater than 20 ft. wide, specific conductance measurements were made along a transect and it was determined that at all locations in the stream are well mixed and that a center of flow grab sample would be representative of the water quality at that location. Because the water depth at the tributary monitoring locations is never greater than 12 ft., samples will be collected at a depth of 1 ft. If the water depth is less than 1 foot, samples will be collected at mid-water level. Bay water quality samples will be taken as surface grab samples.

All sample containers are being supplied by the DEP and only these sample containers can be used for the project. All sample containers must be transported on ice in coolers to preserve the integrity of the samples and maintain sample temperature at greater than freezing and less than 6°C. Necessary preservatives will be added at Leeds Point Lab,

### **Field Parameters**

Field parameters, pH, water temperature, dissolved oxygen and specific conductance, will be measured on site. Collected turbidity samples will be measured at a project field station by staff certified for turbidity measurements. At each sampling location, parameters requiring immediate analysis (i.e. pH, specific conductance, salinity (calculated from specific conductance), and dissolved oxygen,) will be taken using handheld meters or multi parameter sensors. The turbidity sample may be as a field measurement from the meter by BFBM staff or at the Bureau of Marine Water Monitoring Laboratory, Leeds Point

**Table 2: List of monitoring sites within the Barnegat Bay**

| Station ID   | Site Description                                          | Type:<br>Grab/<br>Buoy/Fixed | Longitude  | Latitude   | Site Reference<br>ID | Site<br>Partner         |
|--------------|-----------------------------------------------------------|------------------------------|------------|------------|----------------------|-------------------------|
| 1403A        | Barnegat Bay at the Mouth of Metedeconk River             | G                            | 40.05373   | -74.09792  | BMWM1403A            | NJDEP BMW-M-Leeds Point |
| BB01 (1605A) | Barnegat Bay at Mantoloking                               | G,F                          | -74.054320 | 40.038320  | USGS-01408168        |                         |
| BB03 (1629B) | Barnegat Bay by Route 37 Bridge                           | G                            | -74.101530 | 39.9481700 | BMWM1629B            |                         |
| BB04a        | Barnegat Bay near the Mouth of Toms River                 | G,B                          | -74.14069  | 39.93289   | BMWM1502A            |                         |
| BB05a        | Barnegat Bay above Cedar Creek                            | G                            | 74.1094237 | 39.9157764 | DEPMODELSITE         |                         |
| BB06         | Barnegat Bay below Cedar Creek and above Forked River     | G                            | -74.102080 | 39.8526200 | BMWM1651D            |                         |
| BB07a        | Barnegat Bay below Oyster Creek and above Barnegat Inlet  | G,B                          | 74.1571172 | 39.8012861 | DEPMODELSITE         |                         |
| 1661A        | Forked River Mouth                                        | G                            | -74.162022 | 39.825040  | BMWM1661A            |                         |
| 1661F        | Barnegat Bay at Station 1661F                             | G                            | -74.1018   | 39.80984   | BMWM1661F            |                         |
| 1663A        | Oyster Creek Mouth                                        | G                            | -74.168436 | 39.811515  | BMWM1663F            |                         |
| BB08         | Barnegat Bay by Barnegat Inlet                            | G                            | -74.108014 | 39.7633528 | MU-Barnegat Inlet    |                         |
| BB09 (1674B) | Barnegat Bay below Barnegat Inlet and close to Long Beach | G,F                          | -74.147920 | 39.7426200 | BMWM1674B            |                         |
| 1707C        | Manahawkin Bay at Station 1707C                           | G                            | -74.2051   | 39.6404    | BMWM1707C            |                         |
| 1712         | Manahawkin Bay at Station 1712                            | G                            | -74.2701   | 39.61679   | BMWM1712             |                         |
| BB12         | Barnegat Bay in Little Egg Harbor                         | G                            | -74.268750 | 39.5815100 | BMWM1834A            |                         |
| 1826A        | Little Egg Harbor at Station 1826A                        | G                            | -74.2682   | 39.5354    | BMWM1826A            |                         |
| BB14         | Little Egg Harbor Inlet near Beach Haven Heights          | G,B                          | -74.297370 | 39.5112300 | BMWM1824B            |                         |

**Table 3: Tributary Sampling Locations**

| Station ID    | Site # | Description                                             | LAT       | LONG       | Flow-Measurement Type          | Flow Site Partner | Water Quality Site Partner |
|---------------|--------|---------------------------------------------------------|-----------|------------|--------------------------------|-------------------|----------------------------|
| 01408100      |        | North Branch Metedeconk River at Lakewood               | 40.109722 | -74.219167 | NA staff gage present          | NA                | NJDEP/BFBM                 |
| USGS-01408123 | BT01   | North Branch Metedeconk R near Laurelton                | 40.081648 | -74.151811 | Extrapolate from existing gage | NA                | Brick MUA                  |
| USGS-01408152 | BT02   | SB Metedeconk River near Laurelton (Chambers Bridge Rd) | 40.078763 | -74.156729 | Gage                           | USGS              | Brick MUA                  |
| 01408136      |        | South Branch Metedeconk River at Bennetts Mills         | 40.126667 | -74.277778 | NA                             | NA                | NJDEP/BFBM                 |
| 01408260      |        | Toms River near Van Hiseville                           | 40.109722 | -74.373611 | NA                             | NA                | NJDEP/BFBM                 |
| 010408492     |        | Ridgeway Brook at Route 70 near Lakehurst               | 40.020833 | -74.273611 | NA                             | NA                | NJDEP/BFBM                 |
| USGS-01408505 | BT03   | Toms River near Toms River                              | 39.976389 | -74.218333 | Gage                           | USGS              | NJDEP/BFBM                 |
| USGS-01408640 | BT04   | Wrangle Brook near South Toms River                     | 39.952854 | -74.218515 | Measure                        | NJDEP/BFBM        | NJDEP/BFBM                 |
| 01408830      |        | Cedar Creek at Cedar Crest                              | 39.897222 | -74.316389 | NA* staff gage present         | NA                | NJDEP/BFBM                 |
| USGS-01408950 | BT06a  | Cedar Creek (at RR)                                     | 39.871111 | -74.173889 | Gage1                          | USGS              | MATES                      |
| USGS-01409055 | BT07   | NB Forked R at Forked River                             | 39.836035 | -74.196013 | Measure                        | NJDEP/BFBM        | MATES                      |
| BFBM000166    | BT09   | South Br Forked River (upstream Rt 9 @ JCPL)            | 39.820380 | -74.203128 | Measure                        | NJDEP/BFBM        | NJDEP/BFBM                 |
| R14A          |        | Oyster Creek on S Main St. Bridge                       | 39.810990 | -74.199550 | NA                             | NJDEP/BFBM        | NJDEP/BFBM                 |
| R14B          |        | Forked River on S. Main St. Bridge                      | 39.819992 | -74.202464 | NA                             | NJDEP/BFBM        | NJDEP/BFBM                 |
| R14C          |        | Forked River on Beach Blvd. Bridge                      | 39.823209 | -74.187011 | NA                             | NJDEP/BFBM        | NJDEP/BFBM                 |
| BFBM000167    | BT10   | Oyster Creek (upstream Rt 9 @ JCPL)                     | 39.810584 | -74.204626 | Gage                           | USGS              | NJDEP/BFBM                 |
| USGS-01409210 | BT11   | Mill Ck at Manahawkin (Bay Avenue)                      | 39.695405 | -74.259527 | Gage (new)                     | USGS              | BBP                        |
| USGS-01409281 | BT12   | Westecunk Ck at Railroad Ave at West Ck                 | 39.640297 | -74.307970 | Measure                        | USGS              | BBP                        |

1Gage for this station is located slightly upstream of the water quality sampling location at: Lat 39.87917 Long -74.1906

**Table 4: The Analytical Method**

| Org                   | Parameter                    | Matrix | Fraction       | Code  | Method             | Container            | Preservative     | Holding Time                  |
|-----------------------|------------------------------|--------|----------------|-------|--------------------|----------------------|------------------|-------------------------------|
| NJDEP<br>BFBM         | Turbidity                    | FwSw   | Unfiltered     | Turb  | SM 2130 B-11       | 50mL centrifuge tube | Ice, ≤6°C        | 48 hours                      |
| NJDEP Leeds Point Lab | Total Suspended Solids       | FwSw   | Non-filterable | TSS   | USGS I-3765-85     | Amber 500mL HDPE     | Ice, ≤6°C        | 7 days                        |
|                       | Chlorophyll a                | FwSw   | Non-filterable | Chla  | SM 10200-H 1+2 MOD |                      |                  |                               |
|                       | Total Nitrogen               | FwSw   | Unfiltered     | TN    | USGS I-4650-03     | 50mL centrifuge tube | Ice, ≤6°C        | 28 days, Frozen, -20°C        |
|                       | Total Phosphorus             | FwSw   | Unfiltered     | TP    | USGS I-4650-03     |                      |                  |                               |
|                       | Nitrate + Nitrite            | Fw Sw  | Unfiltered     | NO3   | EPA 353.4          |                      |                  |                               |
|                       | Orthophosphate               | Fw Sw  | Unfiltered     | PO4   | EPA 365.5          |                      |                  |                               |
|                       | Ammonia                      | Fw Sw  | Unfiltered     | NH3   | 350.1 MOD          | 50mL centrifuge tube | 2 ml 3.5% Phenol | 14 days, Ice ≤6°C<br>6 months |
|                       | Biogenic Silica              | FwSw   | Non-Filterable | BSi   | EPA 366.0 MOD      |                      |                  |                               |
|                       | Non-Purgeable Organic Carbon | FwSw   | Unfiltered     | NPO C | SM 5310 B          |                      |                  | 28 days                       |
|                       | Alkalinity                   | Sw     | Unfiltered     | Alk   | SM 2320 B-11       |                      |                  | 1 day                         |
|                       | Enterococci                  | Sw     | Non-filterable | ENT   | EPA 1600-14        | 250mL HDPE           | Ice, ≤10°C       | 8 hours                       |

### 9.3 -Flow monitoring

The locations of existing gages are presented in Table 5 and shown in Figure 1. At selected tributary locations where gages are absent, flow will be measured using hand held equipment such as SONTEK Flow Tracker (or equivalent). Flow measurement SOP is available in Flow Tracker Handheld ADV User's Manual (SonTek/YSI 2009 FlowTracker Handheld ADV User's Manual Firmware Version 3.7). Discharge measurements at higher stages that cannot be waded at the SB Metedeconk River at Chambers Bridge Road near Laurelton will be made from the bridge or a pulley system. A Teledyne RDI StreamPro Acoustic Doppler Current Profiler (ADCP) mounted to a tethered boat will be pulled across the stream from the downstream side of a bridge or on a pulley system from bank to bank (Gotvald and Oberg, 2009). A minimum of four transects are made across the channel. The ADCP transmits acoustic pings that record the velocity and depth of water. A Bluetooth wireless link from the ADCP transmits depth, distance and velocity data every second to a field computer. The field computer calculates the discharge for each transect. The discharge from the 4 transects are averaged. The USGS quality assurance plan for discharge measurements using ADCPs is published in Oberg and others, 2005. (Note: maintaining the existing gauging stations over the entire project term will depend on the availability of continuing funding.) References are available online at <http://pubs.er.usgs.gov/usgspubs/sir/sir20055183> and <http://pubs.er.usgs.gov/usgspubs/fs/fs20083096>.

**Table 5: Gauging Stations**

| <b>Station Description</b>                        | <b>Latitude</b> | <b>Longitude</b> | <b>Type</b>  |
|---------------------------------------------------|-----------------|------------------|--------------|
| Westecunk Creek at Stafford Forge NJ              | 39.666667       | -74.320278       | Tributary    |
| Cedar Creek at RR                                 | 39.879170       | -74.190600       | Tributary    |
| North Branch Metedeconk River near Lakewood NJ    | 40.091667       | -74.152500       | Tributary    |
| Point Pleasant Canal at Point Pleasant, NJ        | 40.070278       | -74.059722       | Outlet/Inlet |
| Barnegat Bay at Mantoloking Bridge at Mantoloking | 40.040000       | -74.057222       | In Bay       |
| Barnegat Bay at Route 37 Bridge near Bay Shore,   | 39.946111       | -74.103056       | In Bay       |
| Barnegat Inlet at Barnegat Light, NJ              | 39.766389       | -74.099167       | Outlet/Inlet |
| Barnegat Bay at Route 72 Bridge near Ship Bottom  | 39.663333       | -74.206944       | In Bay       |
| Little Egg Harbor Inlet near Beach Haven Heights  | 39.507500       | -74.307500       | Outlet/Inlet |
| Oyster Creek near Brookville, NJ                  | 39.798333       | -74.250556       | Tributary    |
| S.B. Metedeconk River near Lakewood, NJ           | 40.085833       | -74.185556       | Tributary    |
| Mill Creek at Manahawkin, NJ                      | 39.695278       | -74.260000       | Tributary    |

## 10. Data Usage

Water quality data sampled under this project will be used to identify assess water quality assessment and other purposes discussed in Section 7.2. All sampling procedures must be in conformance with NJDEP or USGS (URL <http://water.usgs.gov/owq/FieldManual/index.html>) field sampling procedures as well as other applicable guidance. If a method or procedure requires change and is not contained in Table 4, this information must be brought to the attention of the signatories of this QAPP through writing and needs approval prior to being used. Data sampled outside of this project plan which have been collected under an approved QAPP and analyzed in a New Jersey certified laboratory may also be utilized.

## 11. Reports

Data will be stored locally in electronic format (MS Access). All raw data records shall be maintained for a period of no less than five years. All water quality data collected, locations of final sampling sites, and related field notes should be entered in the New Jersey Water Quality Data Exchange (WQDE) and USEPA STORET Data Warehouse. Data quality assurance will occur at NJDEP Bureau of Marine using protocols found in USGS open file Report 02-383 "Methods for Quality Assurance Review of Water Quality Data in New Jersey".

## 12. Project area

Watershed project area covered under this project is the Barnegat Bay Watershed in WMA 13 (see Figure 1 for the spatial extent of the study). The GIS map provided identifies proposed monitoring locations, and approximate head of tide.

## 13. Data Representativeness

The same methods and techniques will be used by all field collection staff. Technical assessments in the field and laboratory audits performed by NJDEP's Office of Quality Assurance will ensure that all samples are collected and analyzed per the QAPP. Any deviations from the QAPP will be documented and will be resolved prior to the next sampling event

## 14. Data Validation

Method blank (lab), equipment blank, duplicate, and replicate samples will add approximately 10 percent more to the total number of samples collected. The sample data is validated using the QC data. The QC sample must fall between two standard deviations at the 95<sup>th</sup> percentile confidence level to be valid. All laboratory and field spikes must be within between 80-120 %. Water quality results will be assessed against available, historical water quality data from the locations monitored. Data will also be assessed using USGS Open-File Report 02-383 "Methods for Quality Assurance Review of Water-Quality Data in New Jersey ". That report provides information on standard ranges of specific parameters in New Jersey streams and standard relationships between specific parameters. All data collected will be provided to NJDEP and WM&S staff. They will perform the data validation process. Data that cannot be confirmed by these reviews or explained by circumstances (i.e. heavy rain, drought) or project QA data will be classified as questionable by NJDEP. In addition, quality assurance protocols will be used by Leeds Point and BFBM for the data validations under the supervision of a quality assurance officer.

## 15. Data Quality Requirements

### Field Quality Assurance and Quality Control

NJDEP and Partner groups field staff will be approved by DEP's Office of Quality Assurance for field measurements, which include: specific conductance/salinity (Wheatstone Bridge, SM 2510 B-11), dissolved oxygen (membrane electrode SM 4500-O G-11 or optical probe HACH 10360 or ASTM D888(09(C)), pH Electronic (SM 4500-H B-11 ) and temperature ( Thermometric SM 2550B-10). Project staff will follow manufacturer's manuals regarding calibration and operating procedures for specific meters. Results of daily pH calibrations, D.O. air calibrations, a DO Zero sample read, and specific conductance calibrations will be recorded on field calibration forms. Quarterly temperature ASTM-QC checks and weekly Winkler D.O. checks are also recorded. Turbidity samples will be analyzed at Leeds Point by NJDEP field staff who are certified for the measurement of turbidity (Nephelometric, SM 2130 B-11). The marine sample field quality control will consist of analyzing in the laboratory, the remaining sample not used for filtration for salinity; in addition, a dissolved oxygen Winkler titration sample will be collected at the time of sample collection and preserved immediately with manganous sulfate and alkaline-iodide-azide solutions. This data will be used to validate the data collected by the sondes in the field. The Winkler titration sample must be protected from the intrusion of atmospheric oxygen and needs to be analyzed prior to the validation for the salinity.

Leeds Point and/or BFBM Laboratory are certified to perform the parameters conducted for ambient water quality monitoring and will follow the Laboratory methods as outlined in Table 6. Any changes to the methods used must be pre-approved by the DEP before sample testing continues. 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 OQA.

The field meters or multi parameter meters will be calibrated using manufacturer specifications and the OQA requirements for accuracy and precision. Calibration and verification will be performed with the following:

#### **Temperature**

Temperature thermistors are factory calibrated. Thermistors must be checked against a National Institute of Standards and Technology (NIST)-certified/traceable thermometer on a quarterly basis, and an offset value will be applied to correct the reading or if drift is continuing to take place sonde/sensor will be

replaced. Any change will be noted in the calibration log and will be applied to all temperature measurements. Temperature units will be degrees Celsius (°C). On July 2, 2018, the temperature monitoring devices were calibrated by DEP personnel against a NIST certified thermometer. This calibration must be repeated quarterly thereafter through the duration of the program.

### **Salinity/Specific Conductance**

Specific conductance is calibrated using a factory prepared conductivity standard with a value of 50 mS/cm or a 35 ppt salinity standard for the marine samples and 1.412 mS/cm for the fresh water locations, although alternative mS/cm solutions can be utilized as long as they are in the range of expected sample results. Specific conductance units will be uS/cm, Salinity will be expressed in parts per thousand (ppt). For sonde/sensor verification, another standard from a different source will be analyzed. The calibration must be checked in the measure mode with a standard. The required accuracy is that the calibration check data must be within 1% of the true value of the standard used to be acceptable for analysis. Duplicate testing is required daily or once every 20 samples tested.

### **Dissolved Oxygen**

Calibration of a DO meter at 100 percent oxygen saturation is made by adjusting the meter reading for air saturated with water vapor, as per the manufacturer's instructions. Sonde/Sensors will record both Dissolved Oxygen (DO) milligrams/liter (mg/l) and DO percent saturation (%). Samples for the Winkler titration will be collected at the marine water sites for sonde/sensor verification. Each week of use the DO meter must be verified against a Winkler titration procedure. The accuracy required between the reading from the DO meter and the results of the Winkler test must be within +/- 0.3 mg/L of each other to be acceptable. A DO Zero solution is read after every calibration. Duplicate testing is required daily or once every 20 samples tested.

### **pH**

A three point calibration is the preferred approach to a quality calibration using pH buffers at 4, 7, and 10, with a read of pH7 as a calibration check. All calibrations must meet the accuracy requirement of being within 0.05 s.u. of the true value of the buffer used to be considered acceptable. The required calibration check result must be within 0.10 s.u. of the true value of the buffer used. Every three hours of use the meter must be checked with the calibration check buffer and must be accurate to 0.2 s.u. of the true value to be considered acceptable for continued use. The field staff may also recalibrate the meter at each site as an alternative to the three hour calibration check requirement. All readings for pH must be made in standard units. Duplicate testing is required daily or once every 20 samples tested. Millivolt readings are also taken as a check of probe performance. For sonde/sensor verification, another certified pH buffer from a different source will be analyzed.

### **Turbidity**

Turbidity samples will be analyzed in the field or at the Leeds Point Laboratory using a Hach model 2100P turbidimeter. Calibration of the turbidity meter will be accomplished by a 4 point method using HACH produced microbead synthetic turbidity primary standards every 3 months. The calibration is checked against HACH Gelex secondary standards and deionized water (0NTU) each day of use. Turbidity units will be (NTU). Duplicate testing is required daily or once every 20 samples tested. A formazin standard or a standard from a different source will be analyzed for sonde/sensor verification.

**Table 6: Lab Methods**

| Lab         | Parameter                    | Matrix | Fraction       | Code | Lab Reporting Limit | Method                  | Holding Time |
|-------------|------------------------------|--------|----------------|------|---------------------|-------------------------|--------------|
| Leeds Point | Turbidity                    | FwSw   | Unfiltered     | Turb | 0.1 NTU             | SM 2130 B-11            | 48 hours     |
|             | Total Suspended Solids       | FwSw   | Non-Filterable | TSS  | 1.0 mg/l            | USGS I-3765-85          | 7 days       |
|             | Chlorophyll a                | FwSw   | Non-Filterable | Chla | 0.42 ug/l           | Modified SM 10200-H 1+2 | 24 hours     |
|             | Total Nitrogen               | FwSw   | Unfiltered     | TN   | 0.100 mg/l          | USGS I-4650-03          | 28 days      |
|             | Total Phosphorus             | FwSw   | Unfiltered     | TP   | 0.010 mg/l          | USGS I-4650-03          | 28 days      |
|             | Ammonia                      | FwSw   | Unfiltered     | NH3  | 0.010 mg/l          | 350.1 MOD               | 14 days      |
|             | Nitrate + Nitrite            | FwSw   | Unfiltered     | NO3  | 0.010 mg/l          | EPA 353.4               | 28 days      |
|             | Orthophosphate               | FwSw   | Unfiltered     | PO4  | 0.005 mg/l          | EPA 365.5               | 28 days      |
|             | Alkalinity                   | Sw     | Unfiltered     | Alk  | 1.0 mg/l            | SM 2320 B-11            | 1 day        |
|             | Biogenic Silica              | FwSw   | Non-Filterable | BSi  | 0.1mg/l             | EPA 366.0 MOD           | 6 months     |
|             | Non-Purgeable Organic Carbon | FwSw   | Unfiltered     | NPOC | 1.0 mg/l            | SM 5310 B               | 28 days      |
|             | Enterococci                  | Sw     | Non-Filterable | ENT  | 3 cfu/100mL         | EPA 1600-14             | 8 hours      |

## 16. Chain Of Custody

Chain of custody procedures will be instituted for this project. Chain of custody procedures will be employed until samples reach the appropriate laboratory. Once samples reach the laboratory the laboratories internal sample tracking procedures will be utilized. (See Appendix A for sample forms)

## 17. Corrective Action

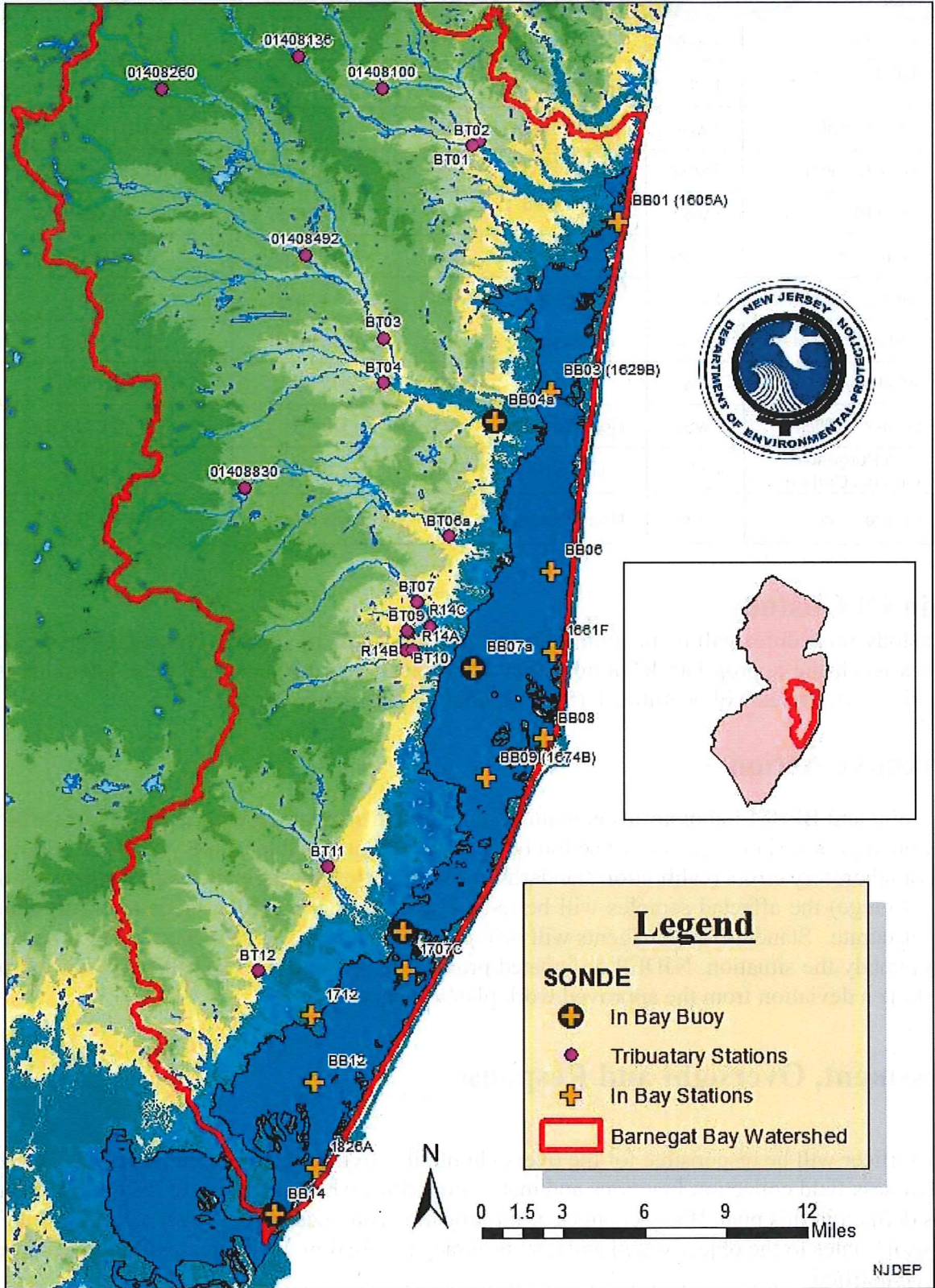
The Leeds Point and BFBM Laboratories is required to maintain standard operating procedures which outline specific action to pursue should corrective action be necessary. If acceptable results cannot be obtained due to: either field or laboratory errors (calibration standards, proficiency testing samples, blanks, spikes, or duplicates falling out of range) the affected samples will be re-analyzed and steps will be taken to ensure that the data produced is accurate. Standards and reagents will be replaced, equipment will be checked, or other action, will be taken to remedy the situation. NJDEP designated project officers and the NJDEP QAO will be notified in writing anytime a deviation from the approved work plan has occurred.

## 18. 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.

Figure 1: Barnegat Bay sampling sites

# Barnegat Bay Long Term Ambient Monitoring Program



# Appendix A: Sample Chain of Custody Form

Barnegat Bay Long-Term Ambient Monitoring Program Chain of Custody Form (July 2018)

| General Information                                          |                            |                           |                                                              |                          | Lab Only                                                      |            |
|--------------------------------------------------------------|----------------------------|---------------------------|--------------------------------------------------------------|--------------------------|---------------------------------------------------------------|------------|
| Site Name                                                    |                            | Site Description          |                                                              | Sample #                 |                                                               |            |
| Sample Collection Date (mm/dd/yyyy)                          |                            | Sample Collector          |                                                              | Sample Type (circle one) | Sample Blank Replicate                                        |            |
| Sample Collection Time (hh:mm)                               |                            | Collector Organization    |                                                              |                          |                                                               |            |
| Field Measurements/Observations                              |                            |                           |                                                              |                          |                                                               |            |
|                                                              | Surface                    | Bottom (Bay samples only) |                                                              | Surface                  | Bottom (Bay samples only)                                     | Site Notes |
| Field Measurement Time (hh:mm)                               |                            |                           | Specific Conductance (uS/cm)                                 |                          |                                                               |            |
| Sample Depth (ft)                                            |                            |                           | Salinity (ppt)                                               |                          |                                                               |            |
| Uncorrected Water Temperature (deg C)                        |                            |                           | pH                                                           |                          |                                                               |            |
| Corrected Water Temperature (deg C)                          |                            |                           | Turbidity (NTU)                                              |                          |                                                               |            |
| Dissolved Oxygen Saturation (%)                              |                            |                           | Air Temperature (deg C)                                      |                          |                                                               |            |
| Dissolved Oxygen (mg/L)                                      |                            |                           | Barometric Pressure (mmHg)                                   |                          |                                                               |            |
| Raw Sample                                                   |                            |                           |                                                              |                          |                                                               |            |
| Container ID                                                 | Container                  | Matrix                    | Parameter                                                    | Fraction                 | Preservative                                                  |            |
|                                                              | Amber HDPE, 500 mL         | Freshwater/Saltwater      | Chlorophyll a                                                | Non-filterable           | Ice, <6°C                                                     |            |
|                                                              | HDPE, 1L                   | Freshwater/Saltwater      | TSS, NH3, NO3, PO4, TN, TP, Turbidity, NPOC, BSi, Alkalinity | Total                    | Ice, <6°C                                                     |            |
|                                                              | HDPE, 250mL                | Saltwater                 | Enterococci                                                  | Non-filterable           | Ice, <6°C                                                     |            |
| NJDEP Leeds Point Laboratory (NJ Lab Certification #: 01179) |                            |                           |                                                              |                          |                                                               |            |
|                                                              | Container                  | Matrix                    | Parameter                                                    | Fraction                 | Preservative                                                  |            |
|                                                              | Amber HDPE, 500 mL         | Freshwater/Saltwater      | Chlorophyll a                                                | Non-filterable           | Ice, <6°C                                                     |            |
|                                                              | HDPE, 1L                   | Freshwater/Saltwater      | TSS                                                          | Non-filterable           | Ice, <6°C                                                     |            |
|                                                              | 50 mL HDPE centrifuge tube | Freshwater/Saltwater      | TN, TP, NO3, PO4                                             | Total                    | Ice, Frozen                                                   |            |
|                                                              | 50 mL HDPE centrifuge tube | Freshwater/Saltwater      | NH3                                                          | Total                    | 2 ml 3.5% Phenol, <6°C                                        |            |
|                                                              | 50 mL HDPE centrifuge tube | Freshwater/Saltwater      | BSi                                                          | Total                    | Ice, <6°C                                                     |            |
|                                                              | HDPE, 125 mL               | Freshwater/Saltwater      | NPOC                                                         | Total                    | conc H2SO4 pH<2, <6°C                                         |            |
|                                                              | 50 mL HDPE centrifuge tube | Freshwater/Saltwater      | Turbidity                                                    | Total                    | Ice, <6°C                                                     |            |
|                                                              | HDPE, 250 mL               | Saltwater                 | Alkalinity                                                   | Total                    | Ice, <6°C                                                     |            |
|                                                              | HDPE, 250 mL               | Saltwater                 | Enterococci                                                  | Non-filterable           | Ice, <6°C                                                     |            |
| Chain of Custody                                             |                            |                           |                                                              |                          |                                                               |            |
| Container ID                                                 | Relinquished               | Received                  | Date/Time                                                    |                          | Reason                                                        |            |
|                                                              |                            |                           | Date:                                                        | Time:                    | Sample drop off at LEEDS                                      |            |
|                                                              |                            |                           | Date:                                                        | Time:                    | Placement in coolers for lab transfer (runner signs received) |            |
|                                                              |                            |                           | Date:                                                        | Time:                    | Transfer to lab for analysis                                  |            |

Revision 5, January 2018

## Appendix B: Example Field Calibration

### Field Calibration Record-Barnegat Bay Monitoring Project

#### pH Meter Calibration

Required Accuracy:  $\pm 0.05$  standard units (su) of the true value for the calibration buffers used,  $\pm 0.10$  for the mid-range calibration check buffer. The temperature of the buffers must be recorded (if available).

| <u>Buffer</u> | <u>Temp</u> | <u>"As Found" Meter Reading</u> | <u>Set Meter Reading</u> | <u>Time</u> | <u>Date</u> | <u>Tech</u> |
|---------------|-------------|---------------------------------|--------------------------|-------------|-------------|-------------|
|---------------|-------------|---------------------------------|--------------------------|-------------|-------------|-------------|

|      |  |  |  |  |  |  |
|------|--|--|--|--|--|--|
| 4.00 |  |  |  |  |  |  |
|------|--|--|--|--|--|--|

|      |  |  |  |  |  |  |
|------|--|--|--|--|--|--|
| 7.00 |  |  |  |  |  |  |
|------|--|--|--|--|--|--|

|       |  |  |  |  |  |  |
|-------|--|--|--|--|--|--|
| 10.00 |  |  |  |  |  |  |
|-------|--|--|--|--|--|--|

Buffer used for Calibration Check: \_\_\_\_\_ Temp of Buffer: \_\_\_\_\_

Calibration Check Buffer result (performed in measure mode): \_\_\_\_\_

Time of Calibration Check and Tech: \_\_\_\_\_

#### Conductivity Meter Calibration

Required Accuracy: Within 1% of the true value for the standard used.

Meter is calibrated according to manufacturer's instructions. Standard check is required each day of use.

mS/cm Standard used for Calibration Check (performed in measure mode): \_\_\_\_\_

Date of Calibration Check: \_\_\_\_\_

Tech: \_\_\_\_\_

#### DO Meter Calibration

Meters are to be calibrated each day of use against air or water saturated air.

Meters also require a Winkler test each week of testing.

Required Accuracy between the Winkler titration and meter:  $\pm 0.3$  mg/L

Normality of Titrant (from container of sodium thiosulfate): \_\_\_\_\_

Beginning mls: \_\_\_\_\_

Ending mls: \_\_\_\_\_

Change in mls: \_\_\_\_\_

DO reading from Meter for the sample used for Winkler: \_\_\_\_\_

Tech: \_\_\_\_\_

Date: \_\_\_\_\_

#### Temperature Calibration

Thermometer calibrations must be performed on a quarterly basis prior to use for any sampling events. Records of the calibration will be retained.