DIVISION OF WATER MONITORING AND STANDARDS
BUREAU OF FRESHWATER AND BIOLOGICAL MONITORING
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Quality Assurance/Quality Control Project Plan
Lake Regional Monitoring Network

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Table of Contents

1.0 Project Name: Lake Regional Monitoring Network

2.0 Requesting Agency: United States Environmental Protection Agency Region 2

3.0 Date of Project: Initiated April 2021, Continuous monitoring

4.0 Project Fiscal Information: Job Number 33340000, Activity Code V4PC

5.0 Project Personnel: Emily Nering, USEPA – Project Officer
Muhammed Saeed, USEPA – Quality Assurance Officer
Johannus Franken, NJDEP BFBM – Project Manager
Brian Taylor, NJDEP BFBM – Project Data Manager

6.0 Special Training Needs/Certification

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

Safety training and safety requirements will comply with Bureau of Freshwater and Biological Monitoring's Field Work Health and Safety Plan (HASP) Version #2 August 2019 and any amendments due to COVID-19 safety guidelines.

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

7.0 Project Background

Discrete water quality data measurements represent a single fixed point in time. In a dynamic environment, such as lakes, a single data point fails to illustrate how a parameter(s) behaves over a specific period, how it may infer other water quality conditions and the potential impacts on aquatic life. Using continuous data collection devices, such as datasondes & loggers, for selected parameters in a waterbody can be observed over time resulting in a comprehensive picture detailing their behavior. Understanding this picture leads toward better decision making in assessing lake water quality.

The United States Environmental Protection Agency (U.S. EPA) is working with its regional offices, states, tribes, river basin commissions and other entities to establish Regional Monitoring Networks (RMNs) to detect climate change effects and other changes in condition of least disturbed (Stoddard et al. 2006), freshwater lakes. RMN surveys build on existing monitoring efforts, with the goal of collecting comparable data that can be pooled at a regional level. The need for RMNs stems from the lack of long-term, contemporaneous biological, thermal, and hydrologic data, particularly at minimally disturbed sites (Stoddard et al. 2006). High quality waters are being targeted because they are the standard against which other bioassessment sites or ecoregion-based water quality criteria (eg. nutrients) are compared. If those baselines are changing, regulators and policy makers need to understand the shift and how to account for it in decisions. Reference lakes selected New Jersey Department of Environmental Protection (NJDEP), Bureau of Freshwater and Biological Monitoring (BFBM) in conjunction with Bureau of Environmental Analysis, Restoration and Standards (BEARS)

will be 4 of at least 30 primary sites across the nation in the Lake Regional Monitoring Network (RMN).

The RMN will also help meet the data needs of BEARS in their assessments of the waters of the State detailed in the State's Integrated Report. The Integrated Report includes the "303(d) List of Water Quality Limited Waters" (303(d) List), which satisfies the Section 303(d) requirement to biennially produce a list of waters that are not meeting surface water quality standards (SWQS).

8.0 Project Description

Project will collect continuous water quality information for NJ reference lakes. Actual sampling sites in each lake will be determined during the first on-water site visit and will be selected based on morphometry, as determined by this on-site visit. At that time, each in-lake station will be recorded with a handheld Global Navigation Satellite System (GNSS, formerly known as Global Positioning System or GPS) and stored on the DEP GIS system. This will allow printing of aerial photography maps showing actual sample sites.

Four (4) reference lakes representing 4 of 5 Omernik Level III ecoregions within NJ (Northern Piedmont is not represented) will be continuously monitored annually to detect long-term trends. See Appendix A, List of Reference Lakes.

9.0 Project Objectives

EPA and collaborators have developed recommendations with the regional working groups on best practices for the collection of biological, thermal, hydrologic, physical habitat, and water chemistry data at RMN sites. These best practices, which are the basis of this Quality Assurance Project Plan (QAPP), are described in detail in two EPA reports (EPA 2014, EPA 2016). The best practices are intended to increase the comparability of data being collected at RMN sites, improve our ability to detect long-term trends by minimizing biases and variability, and to ensure that the data are of sufficient quality.

Data collected from RMN sites will serve many purposes, including documenting current conditions at high quality sites and tracking changes at these sites over time. These data will provide important information on whether benchmarks are shifting over time, and if so, whether these changes are associated with changing thermal and hydrologic conditions. RMN data from high quality sites can also be used for the Clean Water Act Section 305(b) assessments as well as 303(d) Program, since protection planning priorities will be incorporated into the reporting cycles and may also be used for other state and EPA programs.

Other potential short and long-term uses of data being collected from RMN sites include:

- Quantifying natural variability
- Informing criteria development or refinement (e.g., defining natural conditions)
- Detecting temporal trends in biological, thermal, hydrologic, habitat, and water chemistry data
- Detecting trends attributable to individual and multiple stressors.
- Investigating relationships between biological, thermal, and hydrologic data
- Testing hypotheses and predictive models related to future species distributions and thermal and hydrologic conditions

- Exploring ecosystem responses and recovery from extreme weather events (e.g., season drought, prolonged precipitation, severe temperatures, etc.)

10.0 Monitoring Network Design

Deer Park Pond, Hands Mill Pond, Mashipacong Pond and Mount Misery Lake were selected for the RMN because they are monitored as reference lakes for the NJ Ambient Lake Monitoring Network. See Appendix B, Project Information Tables and Maps. Multiple sampling events were performed annually at all reference lakes from 2015 through 2019. Deer Park Pond was also sampled in 2005 and 2010 and Mount Misery Lake was sampled in 2006 and 2011. These lakes are intended to be minimally disturbed by human activity and preferably in an area protected from human-induced changes. The lakes were selected using the following criteria:

Manmade or natural lakes:

- ≥5 acres in surface area
- 1-meter depth minimum
- Surrounding land use <20% Urban + Agricultural
- < 2% impervious cover
- No discharges into lake
- No regulated discharges upstream of lake inlet.

Shoreline Characteristics (if available):

- Trees/Shrub > 75%
- Lawns/grasses < 25%
- Bare ground < 5%
- Shoreline anthropogenic disturbance (shoreline modifications/development) < 5%

Most of the lake shorelines and watersheds are protected by NJDEP State Parks and Forests-, Fish and Wildlife-, and/or conservation non-profit-managed lands so they have low potential for future disturbance.

These four waterbodies, along with another four reference lakes (Great Gorge Lake, Green Turtle Pond, Silver Lake and Watchu Pond), will also be monitored once each year during the July 24 through August 7 timeframe as part of the Ambient Lake Monitoring Network (ALMN). This timeframe coincides with the United States Environmental Protection Agency (U.S. EPA) Lake RMN timeframe for discrete monitoring. Water column measurements will be collected along with a suite of laboratory analysis parameters. This effort is covered under a NJDEP Lake Monitoring Networks QAPP.

11.0 Sampling Procedures

11.1 Continuous Sensors

Water temperature, dissolved oxygen (DO) and water level measurements will be collected at each of the four lakes, as resources permit. Water temperature is the highest priority parameter, followed by DO, then water level. Water temperature sensors are deployed year-round. Dissolved oxygen (DO) and water level sensors are being deployed year-round or seasonally, depending on the type of installation and logistical constraints. These sensors will be installed on a vertical profile sensor array (array). The arrays are assembled

by installing sensors, at fixed depths, on a line that is vertically suspended by a buoy and attached to the lake bottom using an anchor system.

11.2 Equipment for vertical profile sensor arrays

11.2.1 Logger selection

Water temperature. Sensors must have a minimum accuracy of ±0.5°C and capture the full range of temperatures that are expected to occur at each lake. The Onset HOBO proV2, which can withstand being frozen into the ice, will be used for this project.

Dissolved oxygen. Sensors must have a minimum accuracy of ±0.2 mg/L up to 8 mg/L and ±0.5 mg/L from 8 to 20 mg/L and capture the full range of DO concentrations that are expected to occur in the lakes. The PME miniDOT sensors will be used for this project.

Water level. Sensor accuracy will vary based on the selected depth range of the transducer. Sensors with the smallest depth range that capture the maximum expected range of water levels are selected because they have the highest accuracy. Accuracy is calculated as a percentage of the "full scale" (depth range) of the sensor. The sensors must have a minimum accuracy of ±0.05% Full Scale (typical); ±0.1% Full scale (maximum) and be non-vented. One transducer is installed in the water and one is installed on land (the on-land sensor accounts for changes in barometric pressure). The Onset HOBO U-20 series water level sensors will be used for this project. In addition to the sensors, lake gauges are installed, or reference marks are established, to allow for instantaneous readings in the field, which are used to verify the sensor readings and correct sensor drift.

See Appendix C, Sensor Specifications for loggers used in this network.

11.2.2 Logger configuration and calibration

All sensors are configured to record measurements at intervals of 60 minutes or less. Sensors should be configured to:

- Record on the hour (xx:00)
- Record in consistent units (temperature - degrees Celsius; DO – mg/L; water level – meter)
- Record in military time
- Record in local standard time (e.g., UTC-5 for sites in the Eastern Time zone) instead of daylight savings time.

11.2.3 Logger Calibration

Calibration of the loggers will take place as close to the deployment time as possible. Calibration issues or failures will be evident when performing Winkler for DO or check against the NIST thermometer for temperature.

Dissolved Oxygen: Calibration of the Dissolved Oxygen logger 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 5 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. Dissolved oxygen will be checked against a Winkler titration before deployment. Differences greater than 0.3 mg/l 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 0.3°C require recalibration.

Temperature/pressure loggers do not require calibration. However, both parameters are checked before deployment to ensure proper functioning.

- For Temperature, loggers are submersed in a bucket of water and checked against a certified NIST thermometer. Temperature differences greater than 1.5 requires the Logger removed from use.
  Pressure loggers will be checked against YSI Pro DSS built-in barometer to ensure proper reading.

11.2.3 Logger Deployment

The sensors are attached to the fixed vertical profile sensor arrays, which are located at the deep point in the lake. Sensors are deployed in the same locations over time to minimize the chances of detecting false trends related to movement of the sensor. If the sensor(s) must be moved, this is noted on the field forms.

The array is accurately georeferenced by recording global navigation satellite system (GNSS, commonly known as GPS) coordinates (latitude and longitude) at the exact site where the line is deployed. The coordinates are recorded in decimal degrees, using the NAD83 datum, and processed according to NJDEP mapping standards. . The accuracy of the coordinates is verified in the office or laboratory with Geographic Information System [GIS] software or Google Earth. If GPS coordinates are not available on-site, the sensor location is marked on a map and the coordinates are determined later using desktop software. Descriptive notes and photographs of specific and easily identifiable visual markers in the lake or along the shoreline (such as large trees or large stable boulders) are taken.

Field crews will use either field notebook or field data sheet to document array deployment. The exact time at which the array is correctly positioned in the water must be recorded so that observations recorded before that time can later be removed during data processing (Section IV).

<u>Water Temperature Sensors</u>
The number and spacing of water temperature sensors is driven by the lake mixing pattern, depth of the lake and resource constraints. The table below provides recommendations on spacing of sensors under different levels of effort (minimum to best) in lakes with different mixing patterns (stratified vs. polymictic).

Mixing pattern	Level of effort	Recommendations
Stratified	Minimum	Two sensors: one positioned ~1-m below the surface and the other ~1-m above the bottom
	Best	In the epi- and metalimnion (top and middle layers, respectively), space the sensors 1-m apart. In the hypolimnion (bottom layer), space the sensors at geometrically increasing intervals (1, 2, 3, 4 then 5 m intervals to the bottom).
	In-between "minimum" and "best"	If you can obtain more than two temperature sensors but not enough to deploy sensors throughout the water column, position sensors ~1-m below the surface, ~1-m above the bottom and concentrate the others in the area where the thermocline is most likely to occur
Polymictic (year-round mixing)	Minimum	One temperature sensor on one instrument line; ideally the sensor is positioned > 0.5 m off the bottom and >1 m below the surface
	Best	Two instrument lines, with one temperature sensor per line, ideally positioned > 0.5 m off the bottom and >1 m below the surface.

Dissolved Oxygen Sensors

Due to the higher cost of the DO sensors, one to two DO sensors will be deployed. If only one can be deployed, it is placed in the bottom layer (or more specifically, 1-m above the bottom). If a second DO sensor is deployed, it is placed in the top layer (1-m below the surface). If more than two DO sensors are deployed, field crew will use best professional judgement to decide on the most suitable placement.

Water Level Non-Vented Pressure Transducers

One in-water sensor is attached near the bottom of the instrument line (which minimizes sensor movement if the line sways). The on-land pressure transducer is placed at a height of 2 meters, or approximately 6 feet, off the ground. The location of the on-land sensor in relation to the in-water sensor remains constant throughout the period of data collection. If the lake shoreline/riparian zone is forested, the on-land sensor is mounted to a tree that is: 1) nearest the in-water sensor; and 2) large enough to support the sensor. The sensor is attached to the tree's north side, out of direct sunlight. Efforts are made to minimize the amount of other vegetation near the sensor. If a suitable tree is not available, the sensor is attached to the north side of an existing or constructed stable structure (e.g., fence post). Efforts are made to hide the sensor from view to reduce the chance of vandalism. If feasible, equipment should be labeled with the organization name and contact information in case it is located by outside entities.

Upon deployment, a top-to-bottom profile will be collected at the array station for optical dissolved oxygen (ODO), pH, chlorophyll a, phycocyanin, specific conductance, and water temperature and depth. Readings for these parameters will be collected as stated below.

All stations require a reading at 0.1 meter below surface and determined sample depth.
Stations with total depths ≤ 1.0 meters require readings at half of the total depth.
Stations with total depths < 3.0 meters require readings at 0.5-meter intervals.
Stations with total depths ≥ 3.0 meters require readings at 1.0-meter intervals.
Stations with total depths > 1.0 meters require a reading at 0.5 meters above the bottom.

Readings and sample depths will not necessarily be recorded at whole numbers due to the high accuracy (±0.04m for 30-meter cables and ±0.004m for 10-meter cables) of the depth sensor used.

Total depth and interval/sample depth will be determined using a YSI Pro DSS. The YSI Pro DSS is a multi-parameter water quality system that combines depth, temperature, pH, conductance, ODO, phycocyanin, and chlorophyll a, probes into one meter that is submersible to the desired depth in the lake. The YSI Pro DSS is also equipped with a Total Algae Sensor which measures phycocyanin and chlorophyll a. Turbidity will be measured from the sampled depth using a Hach 2100Q Turbidity meter.

11.2.4 Logger Retrieval and Maintenance

After the initial deployment, sites are visited as frequently as possible to check the condition of the sensors, gather data for mid-deployment accuracy checks and offload data. More frequent site visits help ensure the longevity of the sensors and data quality. Records of these checks are kept in field notebooks or on field data sheets. Maintenance checks include:

- Looking for signs of movement, physical damage, vandalism, or other disturbance, particularly after high winds and periods of ice cover. If movement of the instrument line occurs, the line is re-secured and re-documented by recording new GPS coordinates, etc. Any changes are noted on the field form. If the instrument line is constantly shifting, an alternative location will be considered.
- Checking the battery life of the sensors.
- Replacing the DO sensor cap, if needed.
- Ensuring that the bottom sensor is not in contact with the bottom substrate. If there are signs that this has occurred, this is noted on the field form, the sensor is cleaned, and depth is adjusted upwards.
- Removing anything that could bias the measurements. This includes cleaning algae from the sensors, which can cause fouling and inaccurate readings. Sensor manuals are consulted for specific instructions on cleaning and maintenance.
- Ensuring that there is no sag in the line from water level fluctuations.
- Ensuring that moisture is not affecting the on-land non-vented pressure transducer. If the sensor is placed in a PVC canister/radiation shield, sometimes moisture collects in the bottom of the canister, which affects the accuracy of the barometric pressure measurements.
- If a lake gauge is installed, cleaning the gauge with a scrub brush (especially during the summer months) so that the gage can be accurately read. Rust marks are painted over with enamel paint to improve durability.

- Taking photos and locational data to document any changes to the monitoring location (particularly those that could influence readings).

Upon retrieval, a top-to-bottom profile will be collected at the array station as described in 11.2.3 Logger Deployment.

11.3 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. Field data will be recorded utilizing the NJDEP Continuous Monitoring form or approved Field Book.

12.0 Data Quality/Quality Control Requirements

All Loggers used in the project will be calibrated per manufacturer's specifications. Calibrations will be recorded for each parameter in the designated NJDEP field form, approved field notebook or stored digitally via a function of manufacturer-provided software, when available.

Collected data will be screened for errors and noted in the generated file of the site measured.

13.0 Sampling Schedule

Temperature/pressure and dissolved oxygen loggers will be deployed year-round for 30-minute intervals. Monitoring of network sites is intended to be performed for a minimum of 10 years. Network sites may be amended via attachments to this QAPP

14.0 Resource Needs

To complete this network as described, at least two full-time staff are required. This will allow for Calibration, Deployment, Retrieval, Data Quality assurance and Control.

15.0 Quality Assurance

All measurements will be collected using YSI ProDSS, HOBO and PME miniDOT loggers.

All meters & loggers used will be inspected prior to deployment. Meters and loggers will be serviced, maintained, and calibrated per manufacturer's specifications.

Calibration of the loggers will take place as close to the deployment time as possible. Calibration issues or failures will be indicated by error messages in the software during calibration.

Dissolved Oxygen: Calibration of the PME miniDOT logger will be verified by 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 at least 30 minutes shall elapse before verification takes place to allow temperature and oxygen to equilibrate. The sensor is then checked for 100% saturation using the current barometric pressure. Dissolved oxygen will be checked against a Winkler titration before deployment. Differences greater than 0.3 mg/l will require factory recalibration which has a recommended interval of one year.

Temperature: Temperature will be checked against a NIST certified thermometer on a quarterly basis. Temperature differences between the standard and measured reading exceeding 0.3°C require recalibration.

Temperature/Pressure Loggers do not require calibration. However, both parameters are checked before deployment to ensure proper functioning.

- For Temperature, loggers are submersed in a bucket of water and checked against a certified NIST thermometer. Temperature differences greater than 1.5 requires the Logger removed from use.
- Pressure loggers are checked against a zero standard (open air) to ensure proper reading. If pressure loggers read values greater than zero in open air, the logger is removed from use.

16.0 Data Validation

Once the data has been downloaded, it will be screened by the Project Officer. Usability of the dataset will be determined by checks for drift, errors present (if any) and their extent. Loggers deployed in the field will be checked for drift at both time of deployment and retrieval. This check will consist of using a multimeter alongside the logger and comparing readings between the two units. Temperature Sensors will be checked against a NIST certified thermometer before, during and after deployment for drift.

R scripts and procedures are being developed for the data review, each organization will retain, store, and back up their original raw continuous data files. Once the scripts and procedures have been developed, organizations will receive detailed instructions and training on how to review (and if necessary, correct) the data, and will be asked to submit their reviewed and corrected continuous data to the EPA Regional Coordinator on a on a schedule that is agreed upon by the Organization and the EPA Regional Coordinator.

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

Parameter	**Minimum**	**Maximum**
Temperature	0.3° C	1.5° C
Dissolved Oxygen	0.3 mg/l	1.5 mg/l or 25%
Pressure	±0.05% of FS*; 0.5cm (0.015ft)	±0.1% of FS*; 1.0cm (0.03ft)

*FS-Full Scale; Accuracy is calculated as a percentage of the “full scale” (depth range) of the sensor. The typical depth range of the sensors used in this project will be 30 feet, unless otherwise noted.

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

Should the difference exceed the Maximum range, then the data for that parameter will not be reported. Reasons for any omissions will be added to the data record for future use. Once the

comparison check is completed, the data will be screened for errors. Sources of errors can be attributed to the following:

1. Non-lake 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).

Once the drift check is completed, data from the unit will be downloaded and validated. The data is processed through a public domain R Script that examines the data for expected Range values and Spikes.

For the Range test the process compares the value to a range expected set for each parameter. The range is based on historical data for fresh water lakes.

Parameter	**Warning Range**	**Validation Range**
Dissolved Oxygen (mg/l)	0.08 to 13.00	0.00 to 30.00
Dissolved Oxygen % saturation	0.7 to 130	0 to 200
Water Temperature (℃)	1.0 to 35.0	0.0 to 40.0
Pressure (kPa)	1.0 to 125	0.3 to 225

Values that are outside of these expected ranges will be flagged and examined to determine validity.

For the Spiking test**,** the process compares the values to an unlikely interval difference, for each parameter for 15- or 30-minute intervals.

Parameter	**Unlikely Interval Difference (15 or 30 minute interval) +/-**
Dissolved Oxygen (mg/l)	2

Dissolved Oxygen % saturation	20
pH	0.50
Specific Conductance (uS/cm)	5,000
Temperature (℃)	1.5
Turbidity (NTU)	2500

Flagged data values by this test will be examined to determine validity. Spikes determined to be the result of 'Noise', Fouling or Hardware malfunctions will be truncated from the data set.

Temperature sensors will follow the same parameter criteria & data review that is used for datasondes.

The Project Officer and the Supervisor are responsible for all initial data validation. If apparent anomalous data is present, the Project Officer and/or the Supervisor will review the sampling procedures with the field sampler to make sure the proper calibration and placement procedures were followed.

If no problems are found in the procedures, the data may then be compared to any historical data that might have been collected at the same site prior to the most recent sampling event to see if similar anomalies might have been found previously. The suspect data may also be compared to literature values or standard analytical treatises to verify whether the results are within the limits of accuracy of the test method.

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 a review of the data, as it relates to the objectives(s) and data accuracy required in this project.

17.0 Data Storage

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

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

All raw data records shall be retained on a local server at BFBM for the lifetime of the project and maintained for a period of no less than five years.

18.0 Performance System Audits

Any staff participating in any function of the program may be subjected to a Performance Review by the Project Officer for the purposes of Quality Control. All data generated for the program is also subject to Quality Control review by the Project Officer or Supervisor.

19.0 Data Reporting

Data generated by the project will be uploaded to the Rutgers Website for reporting once it has been validated and passed Quality Assurance protocols. Preliminary data will not be uploaded for reporting.

20.0 Assessment, Oversight, and Response

The Project Officer will be responsible for the oversight of all activities relating to the Continuous Monitoring project. The QA 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.

Appendix A
List of Reference Lakes

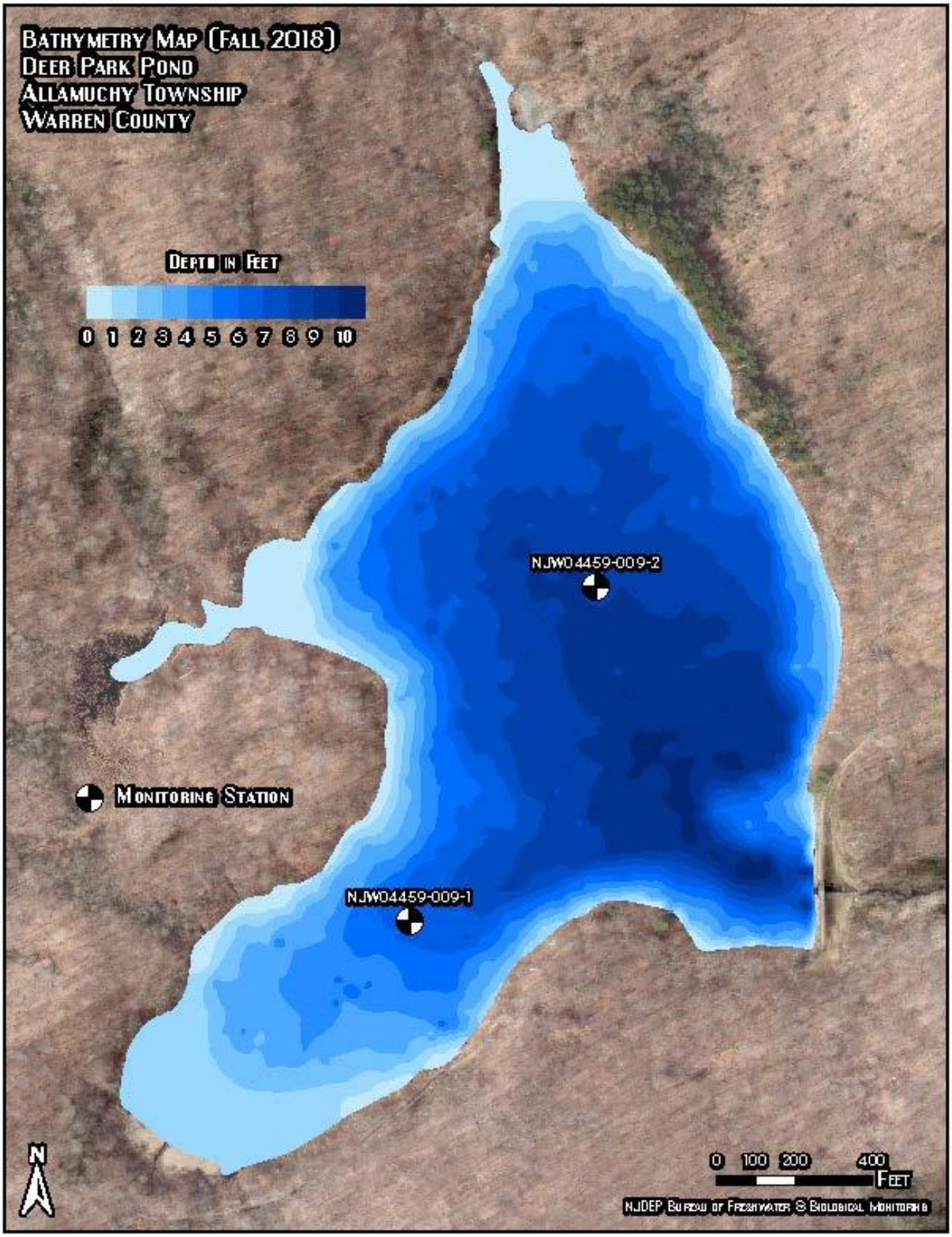
Site ID	GNIS Name	County	Municipality
NJW04459-058	Mount Misery Lake	Burlington	Pemberton Twp
NJW04459-352	Hands Mill Pond	Cumberland	Maurice River Twp
NJW04459-339	Mashipacong Pond	Sussex	Montague Twp
NJW04459-009	Deer Park Pond	Warren	Allamuchy Twp

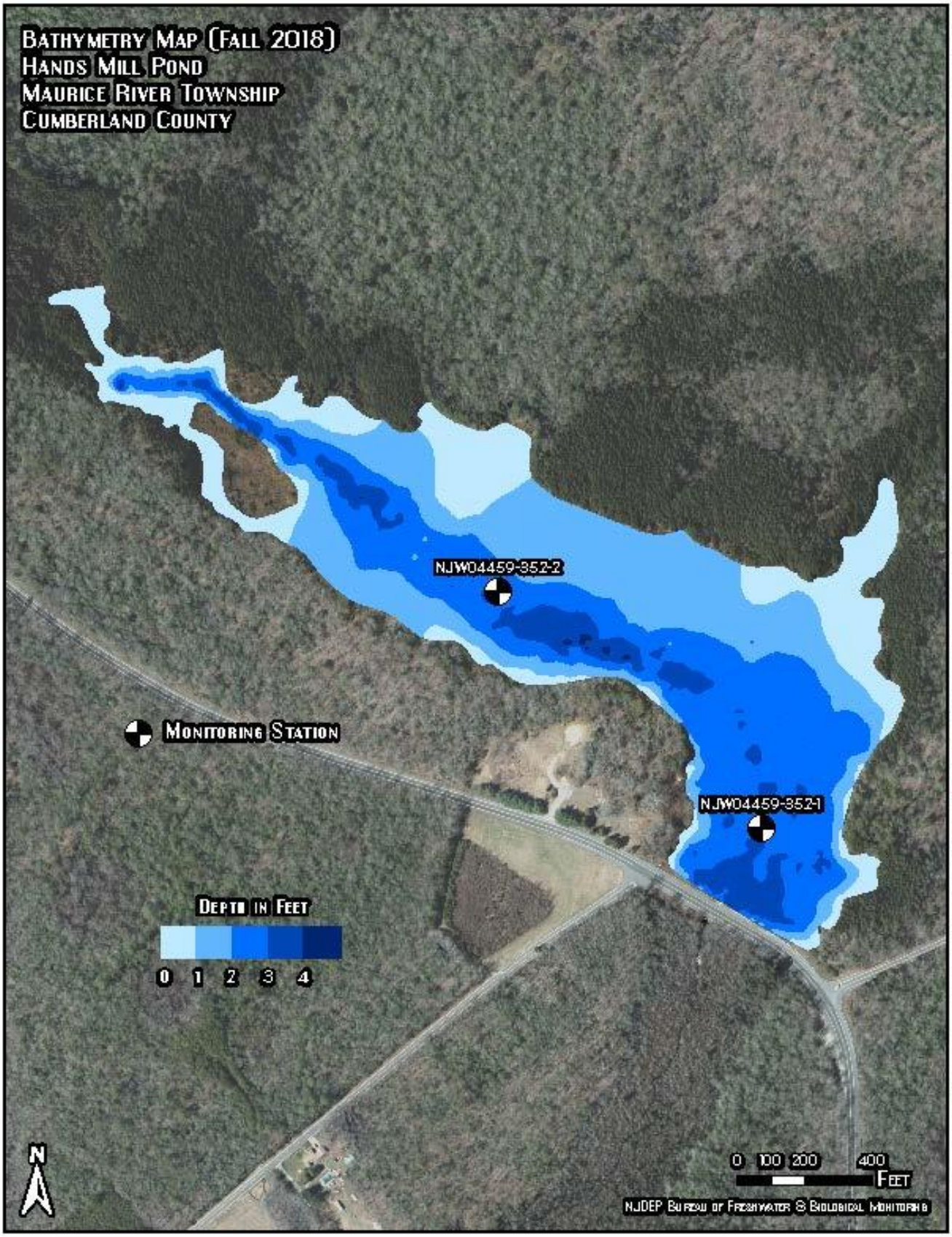
Appendix B
Project Information Tables & Maps

Provisional Site List

Site ID	GNIS Name	Monitoring	Latitude	Longitude
NJW04459-058	Mount Misery Lake (vertical profile sensor array)	Temperature, Dissolved Oxygen, water level	*	*
NJW04459-058	Mount Misery Lake (on land sensor)	Temperature, pressure	*	*
NJW04459-352	Hands Mill Pond	Temperature, Dissolved Oxygen, water level	39.2430964	-74.9016459
NJW04459-352	Hands Mill Pond	Temperature, pressure	39.243387	-74.902295
NJW04459-339	Mashipacong Pond	Temperature, Dissolved Oxygen, water level	*	*
NJW04459-339	Mashipacong Pond	Temperature, pressure	*	*
NJW04459-009	Deer Park Pond	Temperature, Dissolved Oxygen, water level	40.904653	-74.793841
NJW04459-009	Deer Park Pond	Temperature, pressure	Need coordinates	Need coordinates

**To be determined on first site visit*


Bathymetry Map (Fall 2018)
Deer Park Pond
Allamuchy Township
Warren County
Depth in Feet
0 1 2 3 4 5 6 7 8 9 10
NJW04459-009-2
Monitoring Station
NJW04459-009-1
N
0 100 200 400
Feet
NJDEP Bureau of Freshwater & Biological Monitoring


Bathymetry Map (Fall 2018)
Hands Mill Pond
Maurice River Township
Cumberland County
NJW04459-352-2
NJW04459-352-1
Monitoring Station
Depth in Feet
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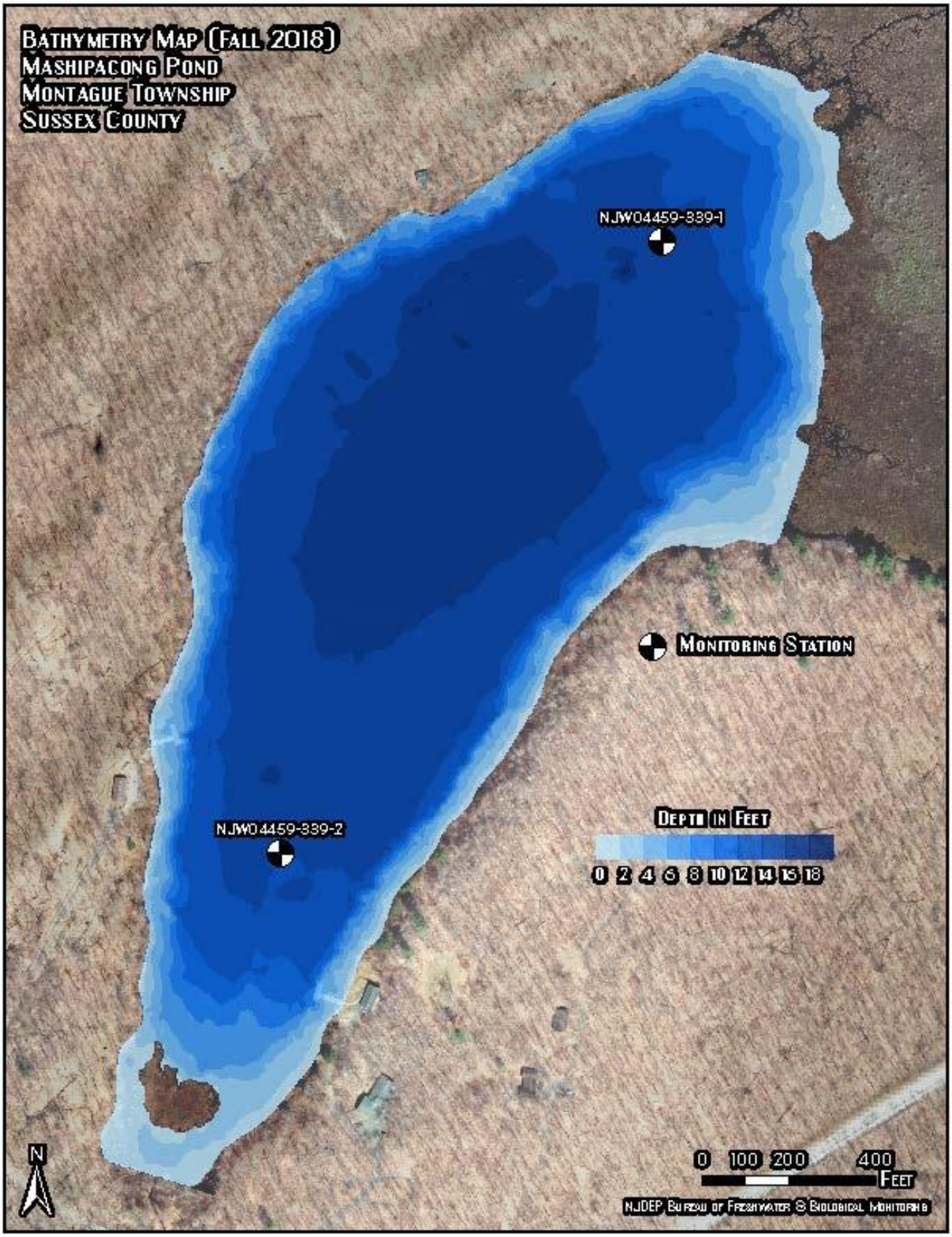
N
0 100 200 400
Feet
NJDEP Bureau of Freshwater & Biological Monitoring


Bathymetry Map (Fall 2018)
Mashipacong Pond
Montague Township
Sussex County
NJW04459-339-1
Monitoring Station
NJW04459-339-2
Depth in Feet
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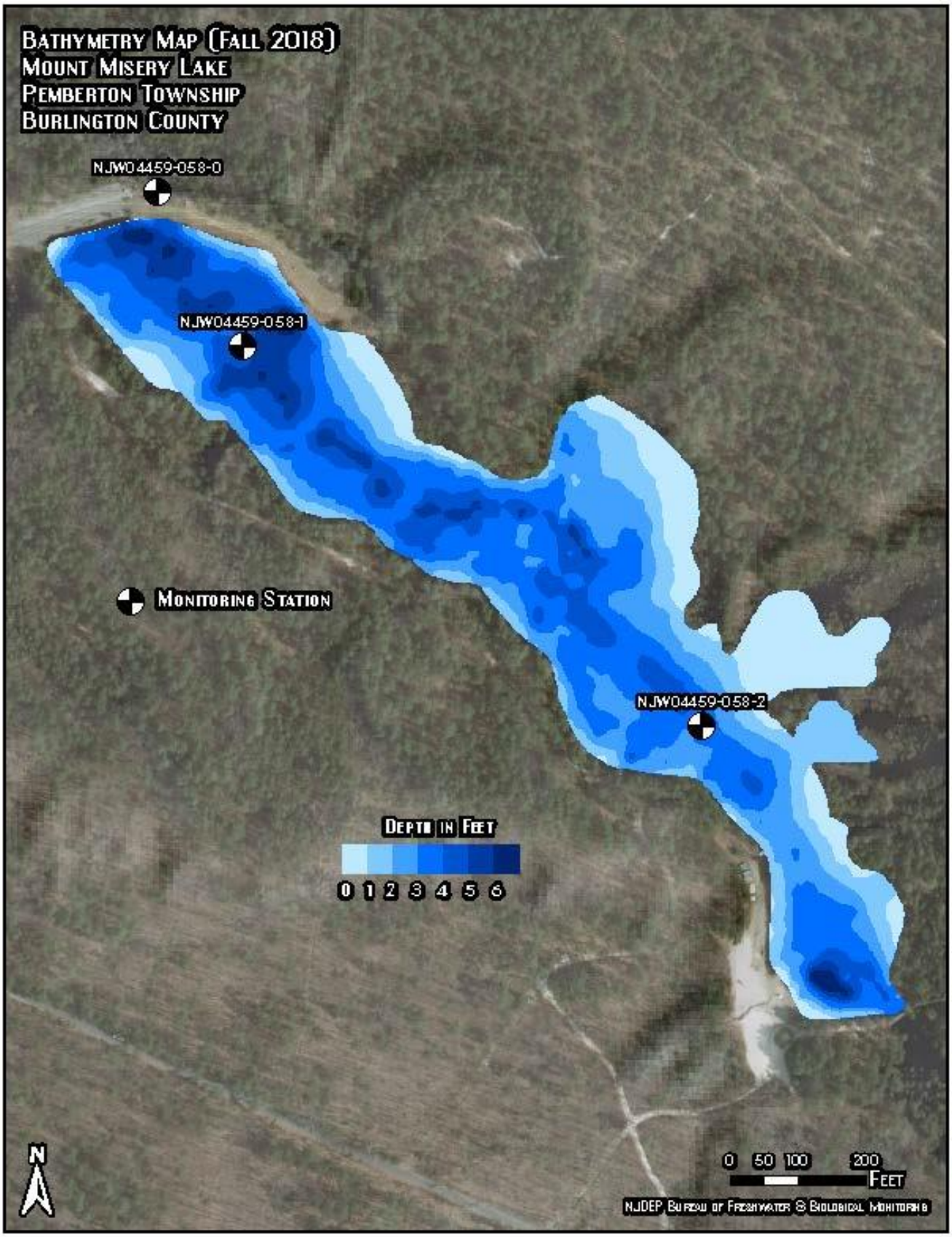
N
0 100 200 400
Feet
NJDEP Bureau of Freshwater & Biological Monitoring



Appendix C
Sensor Specifications

Logger Type	Manufacturer	Model Number	Range	Resolution	Accuracy
Water Temperature	Onset	U20L-01	-20° to 50°C	0.10° at 25°C	±0.44° C from 0° to 50°C
Water Level	Onset	U20L-01	0 to 9 m	<0.21 cm	±1.0 cm
Dissolved Oxygen	PME	MiniDOT	0 to 150% saturation	0.01 mg/L	±0.3 mg/L
Water Temperature	PME	MiniDOT	0 to 35°C	<0.01°C	±0.1°C
Air Temperature	Onset	U20L-01	-20° to 50°C	0.10° at 25°C	±0.44°C from 0° to 50°C
Air Pressure	Onset	U20L-01	0 to 207kPa 10 to 30 psia	<0.02 kPa <0.003 psi	±0.3% FS ±0.62 kPa ±0.09 psi

Appendix D
Data Management Table

QAPP network path file location?	V:\LUM\BFBM\Bfbm\Quality Assurance Plans\Calendar Year 2021 QAPPs
Where will data be recorded in field (media)	Field data sheet, YSI Pro DSS, Field Notebook
If on tablet or phone, will download occur at office or wirelessly?	N/A
If on tablets or phones, who will do the download?	N/A
If data collected electronically, where will it be stored?	DWMS/Rutgers Website
Format to be received from Lab	N/A
Method of receipt from lab/s	N/A
Personnel receiving outside lab data	N/A
Is data expected to go to WQDE/STORET?	No
Data manager - (Bureau and Name)	BFBM Leigh Lager