Quality Assurance Project Plan
Canandaigua Lake Monitoring Program

May 2019

Canandaigua Lake Watershed Council and Ontario County

Prepared by:

Name: **Kevin Olvany and Kim McGarry**
Agency: **Canandaigua Lake Watershed Council**
Address: **205 Saltonstall Street, Canandaigua, NY 14424**
Phone: **(585) 396-3630**
Email: **Kevin.olvany@canandaiguanewyork.gov**

QAPP Update Log

Prepared/Revised By:	Date:	Revision No:	Summary of Changes:
Kevin Olvany	May 17, 2019	0	original

This document was prepared to provide a quality assurance/quality control framework for water quality data collected from the FLLOWPA Program. This document guides NYSDEC employees who manage this program to ensure that the data collected are of suitable quality to meet minimum NYSDEC QA criteria so that data may be used to augment NYSDEC data sets. Separate QAPP documents are produced by each Project Manager and must satisfy the requirements of this document. All questions and comments concerning this document should be forwarded to Aimee Clinkhammer, Division of Water, Finger Lakes Watershed Hub, NYS Department of Environmental Conservation, 615 Erie Blvd West, Syracuse, NY 13204.

This document has been prepared according to the United States Environmental Protection Agency publication EPA Requirements for Quality Assurance Project Plans dated March 2001 (QA/R-5).

Introduction/Abstract

This Quality Assurance Project Plan has been prepared to meet the Quality Assurance/Quality Control requirements for the Canandaigua Lake Monitoring Program. This project is a continuation of a long-term monitoring program that has been conducted for the last 20+ years to assess the health of the lake over time. Our monitoring program also periodically expands to include parameters that address new and emerging threats to the lake.

This document was prepared to provide a quality assurance/quality control framework for FLLOWPA projects. This document guides the FLLOWPA Project Manager and key personnel to ensure that the quality assurance documentation is of sufficient quality to meet minimum NYSDEC QA criteria to support data usability determinations by the end users. This QAPP documents the project goals and objectives, standard operating procedures, sampling methods, data review and evaluation procedures, and QC methods that will be used in the data collection process.

A. Project Management

A1. Approval Signatures

sign here

Project Manager **Kevin Olvany, Canandaigua Lake Watershed Council**	**Date**

sign here

FLLOWPA Coordinator, Kristy LaManche **Finger Lakes Lake Ontario Watershed Protection Alliance**	**Date**

sign here

FLLOWPA Program Manager, Aimee Clinkhammer, Division of Water, Finger Lakes Watershed Hub, NYSDEC	**Date**

sign here

FLLOWPA Quality Assurance Manager, Anthony Prestigiacomo, Division of Water, Finger Lakes Watershed Hub, NYSDEC	**Date**

sign here

Laboratory Manager **David Prichard, Life Science Laboratories, Inc.**	**Date**

This QAPP will be ***accepted*** by NYSDEC Division of Water, Quality Assurance Officer (QAO) or their designee before work will begin on this project.

A2. Table of Contents

A3. Distribution List

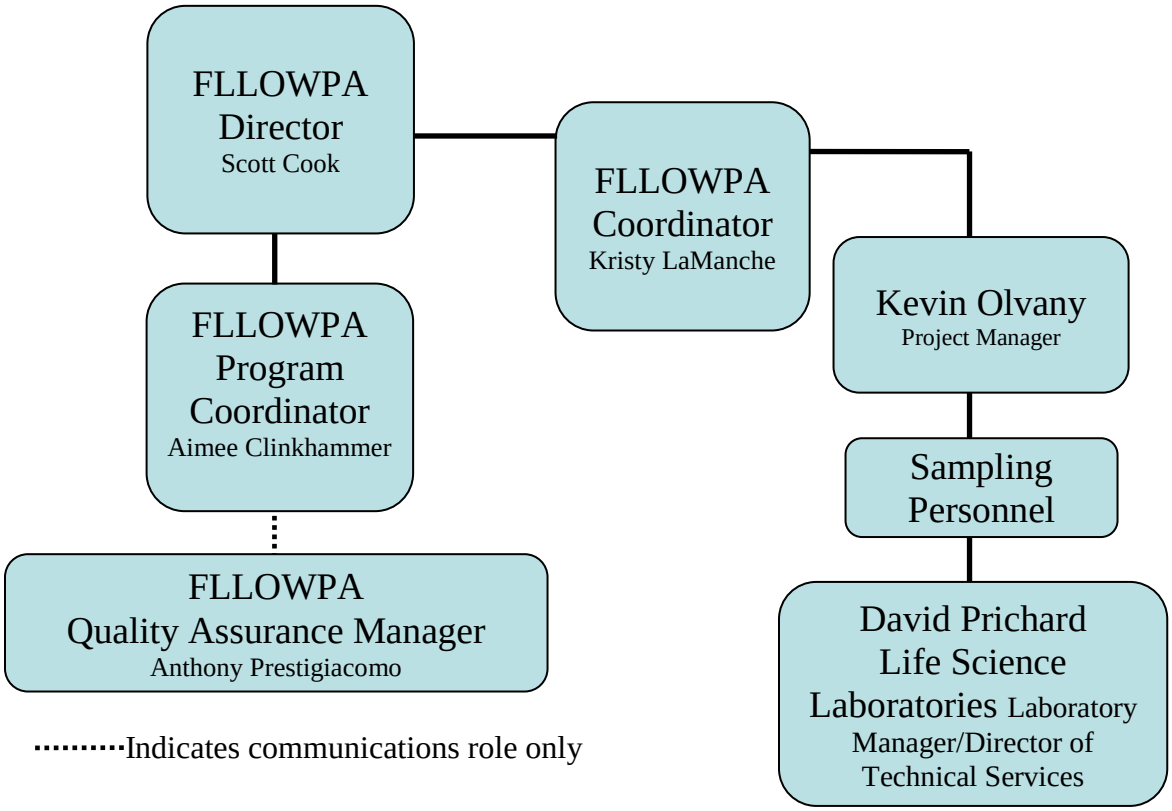
The following individuals must receive a copy of the ***accepted*** QAPP to complete their role in this project. Copies will be distributed electronically, and all sampling personnel will keep a hard copy in sampling vehicles. Project planning involved data users and technical staff. Changes to planning and project documents will receive technical and management review by the Project Manager.

Title	Name	Organization	Email	
FLLOWPA Coordinator (FC)	Kristy LaManche	FLLOWPA		Electronic
Project Manager (PM)	Kevin Olvany	Canandaigua Lake Watershed Council	Kevin.olvany@canandaiguanewyork.gov	Hardcopy/electronic
Additional key personnel:	Patricia Thompson	Finger Lakes Community College	Patricia.thompson@flcc.edu	Hardcopy/electronic
	Lisa Cleckner	Finger Lakes Institute	cleckner@hws.edu	Hardcopy/electronic
	Kimberly McGarry	Canandaigua Lake Watershed Council	kmcgarry@canandaiguanewyork.gov	Electronic
Laboratory Manager/Director of Technical Services	David Prichard	Life Science Laboratories, Inc (ELAP # 10248)	pricharddj@lsl-inc.com	Hardcopy/electronic
FLLOWPA Program Manager (NFPM)	Aimee Clinkhammer	NYSDEC	aimee.clinkhammer@dec.ny.gov	Electronic
FLLOWPA Program Director (NFPD)	Scott Cook	NYSDEC	scott.cook@dec.ny.gov	Electronic
FLLOWPA Quality Assurance Manager (QAM)	Anthony Prestigiacomo	NYSDEC	anthony.prestigiacomo@dec.ny.gov	Electronic
NYSDEC Quality Assurance Officer	Rose Ann Garry	NYSDEC	roseann.garry@dec.ny.gov	Electronic

A4. Program Management / Organization

The following outline describes the responsibilities and roles of staff who actively participate in this project and its oversight:

Figure 1. Organization Chart



New York State Department of Environmental Conservation

Aimee Clinkhammer
Title/Affiliation: FLLOWPA Program Coordinator (PM)
Address: 615 Erie Blvd West, Syracuse, NY 13204
Phone No.: (315) 426-7507
E-mail: aimee.clinkhammer@dec.ny.gov
Responsibilities:

- develop the FLLOWPA Quality Assurance Management Plan (QAMP) with the FLLOWPA QAM.
- provide relevant SOPs and training materials to FLLOWPA participants
- review water quality and quality control data results for adherence to project QAPPs in coordination with the FLLOWPA QAM.
- work with FLLOWPA PD and QAM and FLLOWPA Coordinator to conduct DEC program reviews and implement modifications
- disseminate FLLOWPA data sets to NYSDEC Water Assessment and Implementation Section for use in Consolidated Assessment Listing Methodology (CALM) and Priority Waterbody List/Waterbody Inventory (PWL/WI) evaluation

Scott Cook
Title/Affiliation: FLLOWPA Program Director (PD)
Address: 615 Erie Blvd West, Syracuse, NY 13204
Phone No.: (315) 426-7502
E-mail: scott.cook@dec.ny.gov
Responsibilities:

- oversee Program Administration
- review FLLOWPA Member County Workplans
- manage Quality Assurance and Quality Control Measures

Anthony Prestigiacomo
Title/Affiliation: FLLOWPA Quality Assurance Manager (QAM)
Address: 615 Erie Blvd West, Syracuse, NY 13204
Phone No.: (315) 426-7452
E-mail: anthony.prestigiacomo@dec.ny.gov
Responsibilities:

- provide technical assistance to FNPM and FNPD in reviewing and approving QAPPs
- provide technical guidance on the approval of member county workplans and amendments

Lewis McCaffrey
Title/Affiliation: NYSDEC Technical Coordinator
Address: 615 Erie Blvd West, Syracuse, NY 13204

Phone No.: (315) 426-7514
E-mail: lewis.mccaffrey@dec.ny.gov
Responsibilities:
- provide technical guidance on the approval of member county workplans and amendments

Rose Ann Garry
Title/Affiliation: Quality Assurance Officer (QAO), NYSDEC Division of Water Standards and Analytical Support Section
Address: 625 Broadway, Albany, New York 12233-0001
Phone No.: (518) 402 - 8159
E-mail: roseann.garry@dec.ny.gov
Responsibilities:
- oversee Division of Water Quality Assurance activities, and is not subject to the authority of any persons connected to the project, provide expertise regarding analytical and QA/QC Issues
- review the QAMP to verify that those elements outlined in the EPA Requirements for QA Project Plans (QA/R-5) are successfully discussed

Finger Lakes-Lake Ontario Watershed Alliance (FLLOWPA)

Kristy LaManche
Title/Affiliation: FLLOWPA Coordinator (FC)
Address: Water Resources Board, Oswego County Soil and Water Conservation District; 3105 NY-3, Fulton, NY 13069
Phone No.: (315) 673-7148
E-mail: klama3481@gmail.com
Responsibilities:
- Coordinate participation logistics of FLLOWPA member counties
- Review and keep record of all submitted QAPPs from member counties
- Review data and usability submissions from FLLOWPA partners, submit FLLOWPA data to FLLOWPA Program Coordinator

Canandaigua Lake Watershed Council

Kevin Olvany
Title/Affiliation: Project manager and Watershed Program Manager at the Canandaigua Lake Watershed Council
Address: 205 Saltonstall Street, Canandaigua, NY 14424
Phone No.: (585) 396-3630
E-mail: Kevin.olvany@canandaiguanewyork.gov
Responsibilities:
- planning, coordination, and oversight of the project including sampling strategy and overall monitoring network design, including sampling site location, parameter selection, and sampling frequency
- supervision of field samplers including occasional and appropriate program reviews and implement modifications to enhance monitoring effort as necessary

- coordinate sampling logistics (including paperwork) between sampling staff and the analytic laboratories

Patricia Thompson

Title/Affiliation: Instructor of Environmental Conservation at Finger Lakes Community College
Address: 3325 Marvin Sands Road, Canandaigua, NY 14424
Phone No.: (585) 785-1645
E-mail: Patricia.thompson@flcc.edu
Responsibilities:

- receive and maintain all equipment, supplies, and materials; contact the Project Manager to report equipment breakage, supplies shortages, or other problems and deliver samples to analytical laboratory
- collect all water quality and field data in accordance with sampling design and approved methods
- conduct chlorophyll *a* analysis according to methodology

Lisa Cleckner

Title/Affiliation: FLI Director, Finger Lakes Institute
Address: 601 South Main Street, Geneva, NY 14456
Phone No.: (315) 781-4381
E-mail: cleckner@hws.edu
Responsibilities:

- oversees field technicians collecting field data using the Fluoroprobe
- ensures all data is collected in accordance with sampling design and approved methods

Life Science Laboratories, Inc

David Prichard

Title/Affiliation: Laboratory Manager, **Director of Technical Services, Life Science Laboratories, Inc., NYSDOH ELAP certification number 10248**
Address: 5854 Butternut Drive, East Syracuse, NY 13057
Phone No.: (315) 445-1900
E-mail: pricharddj@lsl-inc.com
Responsibilities: maintenance of NYS DOHELAP certification and all associated activities (NY Laboratory ID No. **10248**; EPA Laboratory Code NY01042)

- oversee laboratory analyses and for quality control requirements, procedures and completing required documentation
- oversight of all laboratory staff and their activities
- routine laboratory data reporting of analytical results

A5. Background – Description of Problem

The goal of Canandaigua Lake Monitoring Project is to provide an annual assessment and long-term analysis of the lake's health. The project is a continuation of our long-term monitoring program that has been conducted on the lake for the last 20+ years. Our program consists of monthly sampling from spring

through fall at 6 locations on the lake representing various lake conditions- 2 in mid-lake open water areas, 2 in the near shore area near tributaries and 2 in the near shore area further from the influence of tributaries. We focus on key indicators of lake health, including temperature, dissolved oxygen, pH, conductivity, Secchi disk depth, chlorophyll *a*, and nutrients. This long-term dataset has been key to evaluating potential causes of harmful algae blooms, impacts of land use change on water quality, and the influence of invasive species on lake health. The data is also used to inform the public and local municipal officials on the overall water quality of the lake and is used to conjunction with the 2014 Comprehensive Update to the Canandaigua Lake Watershed Management Plan to identify potential water quality projects.

Canandaigua Lake experienced its first large harmful algae bloom in 2015 and has had blooms of varying degree in every subsequent year. Our monitoring program has expanded to better understand harmful algae dynamics on the lake and potential causes of blooms. In 2018, the lake monitoring program expanded to include additional near shore samples for nutrient analysis to assess the role of nutrients on harmful algae blooms. We also began collecting blue green algae cell counts in the open water areas using a YSI probe as an early indicator for potential blooms. Beginning in 2019, the Finger Lakes Institute will partner with the Canandaigua Lake Watershed Council to monitor blue green algae concentrations throughout the water column using a Fluoroprobe. The Watershed Council also plans to purchase a bbe AlgaeTorch in 2019 to further monitor harmful algae dynamics. Recent research across the Finger Lakes has shown the potential influence of seiches on harmful algae, so we plan to install a thermistor array in 2019 to continuously monitor the temperature profile in the lake. Our monitoring program will continue to monitor harmful algae and potential contributing factors to aid in understanding causes and potential solutions.

The primary objectives of this sampling project are to:

1. Satisfy quality assurance requirements through the completion of this QAPP and the adherence to NYSDEC ***accepted*** sampling methods, sample handling, and data management protocols. This will allow the resulting data to be used for multiple purposes within and external to the NYSDEC.
2. Provide assessment and quantification of water quality conditions, based on the collection of sufficient data and information in the lake.

The secondary objectives of this sampling project are to:

1. Collect coincident field measurements, such as temperature, conductivity, pH, dissolved oxygen and blue green algae cell counts, to provide additional data for lake assessment.

A6. Project/Task Description

Our monitoring program will continue to assess lake health through our 6 long-term monitoring sites. These sites were selected 20+ years ago to intentionally represent a range of conditions on the lake, including mid-lake open water conditions (DR and SP), near shore conditions associated the mouths of tributaries (WR and FB), and near shore conditions further from the influence of tributaries (VV and HP). Through these 6 monitoring locations, we have incorporated some replication while sample collection is still logistically feasible. Monitoring at these 6 sites contributes additional data to the long-term dataset to analyze trends in water quality and assess overall lake health.

Lake monitoring will be conducted one day each month to capture general seasonal variations in lake water quality, typically from May to October but with the option to include April and November. Whenever possible, lake monitoring will be conducted during clear weather conditions and from mid- to late morning to reduce time of day as a variable.

Over the last 3 to 4 years, our northeast near shore site (FB-2) showed consistent elevated phosphorus levels. To further analyze in-lake factors contributing to blue green algae blooms, ten additional near-shore samples were taken in 2018 and analyzed for phosphorus to see if elevated phosphorus levels are observed elsewhere. We will continue this program in 2019. However, near shore sampling locations may be amended to reflect current lake conditions or concerns by watershed staff. These extra near shore samples will be collected during the summer months in conjunction with the long-term monitoring program.

Samples will be collected through a partnership between the Canandaigua Lake Watershed Council and Finger Lakes Community College, who have been involved in the lake monitoring program for 20+ years. Sites to be sampled are listed in Table 1, with the schedule provided in Table 2. Chemistry samples and field data will be collected, documented, handled, and shipped to an NYSDOH ELAP-certified laboratory for analysis as per the "Quality Assurance Management Plan for the Finger Lakes-Lake Ontario Watershed Protection Alliance (FLLOWPA)" in Table 1. Samples will be analyzed for chlorophyll *a*, which is not a certified parameter, by Finger Lakes Community College. In addition, a Yellow Springs Instrument 6920V2 water quality sonde and a 650 data logger will be utilized for in-situ monitoring at the open water sites for dissolved oxygen, temperature, water pH, conductivity, % oxygen saturation, and blue green algae cell count.

The monitoring program has expanded in recent years due to the emergence of harmful algae blooms on the lake. Beginning in 2019, the Watershed Council and Association are partnering with the Finger Lakes Institute to field monitor harmful algae concentrations using a Fluoroprobe. The Watershed Council also plans to purchase a bbe AlgaeTorch to further increase monitoring of harmful algae dynamics. The Fluoroprobe and AlgaeTorch both have the ability to collect profile data and use the same technology, so these instruments will be used in combination to collect data at various depths to better understand harmful algae dynamics throughout the water column. This monitoring will take place throughout the lake, but an emphasis will be placed on water depths and locations correlated with private water supply intakes. The baseline plan is to collect data on a weekly basis during the late summer and early fall, with additional work by the AlgaeTorch. However, the exact dates, frequency and locations for in-lake Fluoroprobe and AlgaeTorch monitoring will reflect current conditions and concerns based on the Watershed Program Manager's assessment. The Fluoroprobe and AlgaeTorch will be calibrated, maintained and utilized per the manufacturer's instructions.

Recent research has shown the potential influence of seiches on harmful algae blooms. In 2019, we will begin collecting continuous temperature profile data using a thermistor array developed by Karl Hanafin of Intelilake.com. It will monitor temperature at 1-meter intervals from the bottom of the lake to

approximately 5 meters below the water surface at 15 minute intervals. We are working with a shoreline property owner with a logistically feasible site (needs a power source and wifi on the shoreline and appropriate shoreline depth) located approximately 100 yards south of the City's Water Treatment Plant. The thermistor array will be installed in approximately 75 to 80 feet of water depth approximately 800 to 900 feet from shore. The thermistor array will be anchored to the bottom of the lake, so the depth from the surface will fluctuate with the minor summer changes (< 1-foot range) in lake level.

Sites to be sampled are listed in Table 1, with the schedule provided in Table 2.

Table 1. Proposed Sampling Locations, Justifications, and Data collection

Site Code	Sampling Location	GPS Coordinates		Sample Justification	Field Measurements	Water Chemistry[1]
		North	West			
WR	West River	42.670	-77.359	Long term sampling location in the lake near the mouth of a significant tributary, West River To assess the impact of the largest subwatershed on lake quality		nutrients - grab sample at 2 m; chlorophyll *a* - vertically integrated sample
FB	Fall Brook	42.870	-77.258	Long term sampling location in the lake near the mouth of a significant tributary, Fall Brook To assess the impact of a significant tributary on lake quality		nutrients - grab sample at 2 m; chlorophyll *a* - vertically integrated sample
VV	Vine Valley	42.723	-77.329	Long term sampling location in the near shore area further from the influence of tributaries To assess general shoreline conditions		nutrients - grab sample at 2 m; chlorophyll *a* - vertically integrated sample
HP	Hope Point	42.843	-77.280	Long term sampling location in the near shore area further from the influence of tributaries		nutrients - grab sample at 2 m;

				To assess general shoreline conditions		chlorophyll *a* - vertically integrated sample
SP	Seneca Point	42.741	-77.331	Long term sampling location in mid-lake open water To assess open water conditions and understand extent of vertical water quality variability and lake stratification	Multiprobe - Collect at 1 m intervals from surface to 15 m (or lower if necessary), then 5 m intervals from 15 m to the maximum potential depth of 55 m - dissolved oxygen, temperature, conductivity, % oxygen saturation, blue green algae cell count Secchi depth	nutrients - grab sample at 2, 25 & 50 m; chlorophyll *a* - vertically integrated sample
DR	Deep Run	42.819	-77.273	Long term sampling location in mid-lake open water To assess open water conditions and understand extent of vertical water quality variability and lake stratification	Multiprobe - Collect at 1 m intervals from surface to 15 m (or lower if necessary), then 5 m intervals from 15 m to the maximum potential depth of 55 m - dissolved oxygen, temperature, conductivity, % oxygen saturation, blue green algae cell count Secchi depth	nutrients - grab sample at 2, 25 & 50 m; chlorophyll a - vertically integrated sample
See map of potential locations	Near shore areas – exact locations will be determined based on conditions			To assess nutrient concentrations in the near shore area to determine if elevated concentrations are found along the shoreline and could potentially contribute to harmful algae blooms		nutrients - grab sample at 2 m

	~ 100 yards south of the City's Water Treatment Plant			To assess temperature dynamics in the water column, including thermocline depth and seiches	Thermistor array from lake bottom to ~15 feet below lake surface	
	To be determined based on lake conditions			To assess harmful algae dynamics throughout the water column	Fluoroprobe and AlgaeTorch profile	

The Project Manager and partners have experience performing all required field data collection procedures and will ensure that all Sampling Personnel are trained in the skills needed to complete this project. For more information, see Section A8.

Table 2: Project Schedule

Task	**Anticipated Completion Date**
QAPP Completion and Approval	May initially- every 5 years after 2019 or as the monitoring program changes
Sample Collection Commencement	Data collection for this project will begin after only the final approval of this Quality Assurance Project Plan. Anticipate sampling in late May 2019 to continue long term dataset
Sample Collection End	December 10 each year
Data and Final Report Submitted	February 1 each year

The FLLOWPA Program provides approximately $10,000 towards lake and tributary monitoring on Canandaigua Lake. The Canandaigua Lake Watershed Council, along with additional funding sources, also provide financial support to the monitoring program. The Canandaigua Lake Watershed Council also provides significant staff time towards the monitoring program.

A7. Quality Objectives and Criteria

The overall quality assurance objective is to develop and implement field and sampling procedures that are of known and documented quality. The contract lab, **Life Science Laboratory, Inc., NYSDOH ELAP Certification Number 10248** has developed and implemented quality control procedures on laboratory samples for certified parameters that will be applied to this study. Data Quality Objectives (DQOs; Table 3) are used as qualitative and quantitative descriptors in interpreting the degree of acceptability or utility of data. The DQOs listed are sufficient to confirm that the type and quality of data being used in this project

are obtained and will support project validation/verification (Section D). While unforeseen now, any limitations on the use of the data collected as part of this project will be identified and documented.

These data quality requirements are consistent with those used in other water quality monitoring programs conducted by the NYSDEC, other state agencies and non-government partners, and are consistent with requirements provided by USEPA. These also satisfy the data requirements associated with the state water quality standards, 6 NYCRR Part 703.

Table 3: Data Quality Objectives and Assessments

Data Quality Objective (DQOs)	**Description**	**Assessment (calculation)**	**Acceptability Criteria**
Precision	the degree in which two measurements agree	Relative Percent Difference (RPD)	**RPD ≤ 20%**
Accuracy/bias	the degree of agreement between a sample and a true value or an accepted reference	1. Field blanks 2. Matrix spikes (MS) 3. Laboratory control samples (LCS)	**All FB samples ≤ LOQ**
Representativeness	degree to which samples accurately and precisely represent environmental conditions	1. Site selection criteria used matches project goals. 2. Relative Percent Difference (RPD).	**RPD ≤ 20%**
Completeness	the number of valid measurements taken from the number of total measurements taken in the entire project	verified from data sampling plan, data deliverables and completed COC	**Completeness ≥ 90 %**
Comparability	confidence with which one set of data can be compared to another	comparison of two data sets	Adherence to QAPP and standard analytical methods, holding times, consistent detection limits, common units and consistent rules for reporting

Data Quality Objective (DQOs)	Description	Assessment (calculation)	Acceptability Criteria
Detection/ Quantification	Levels of Detection (LOD) and quantification (LOQ) for a specific method and matrix	For methods with no published detection limit, Laboratory calculated LOD/LOQ are used.	Acceptable criteria can be found in 2016 EPA Method detection limit procedure, revision 2.

Section B5 describe DQO calculation procedures.

A8 Training Requirements/Certifications

The Program Manager will ensure that all individuals involved with the project receive and are familiar with this QAPP and to the relevant standard operating procedures, to ensure proper adherence to sampling procedures prior to the start of work. The Program Manager and professionals from FLCC and FLI have extensive experience with sampling and field data collection. They have been collecting lake data for many years and do not require any additional training to continue this project.

Training is the responsibility of the Project Manager and is required for all new field staff involved in the current project to ensure the proper collection and handling of samples. Training of field staff will include a review of sampling methodology by the Project Manager or appropriate professional. Training of individuals employed by contract laboratories for processing water samples is the responsibility of the contract laboratories and must be done according to their procedures.

Effective communication will be critical, to discuss any problems that arise with sampling procedures or equipment. In order to solve problems during the sampling season, the Project Manager will contact the NYSDEC FLLOWPA Program Coordinator, Aimee Clinkhammer through email (aimme.clinkhammer@dec.ny.gov). Communication will be conducted as needed, to make sure equipment is performing properly and to discuss any other issues.

Health and Safety

Safety is more important than the task. If for any reason conditions at the monitoring site are considered unsafe as determined by the field staff, sampling will be suspended, and the staff will leave the site. The following points should be considered when collecting samples.

Cautions

1. Staff will provide the Project Manager adequate notice of sampling times and contact information (i.e., cell phone numbers of samplers),
2. Always work with at least one partner,
3. Never boat in unsafe conditions,
4. Be aware of other boaters or people recreating on the lake,
5. Wear and maintain personal protective equipment (PPE) to prevent hypothermia, heat exhaustion, sunstroke, drowning, insect bites, or other dangers,

6. Never eat and/or drink when collecting and handling samples,
7. Always wash hands before and after collecting and handling samples,
8. Cover all personal cuts and abrasions before sampling,
9. Be fully aware of all lines of communication that address emergency and safety situations.

A9. Documentation and Records

FLLOWPA Project QAPP

- This QAPP must be ***accepted*** by all parties listed on the Approval page before work may begin. ***Accepted*** QAPPs are added as electronic pdf documents to workplans,
- ***Accepted*** QAPPs may be updated to reflect changes in the project. The revised QAPP must have a new version # recorded, approved and sent to all individuals on the distribution list,
- Any changes to a Project QAPP after it is finalized are approved are recorded as a new version #.

Site Locations and Codes

Sample sites selected for this project by the Project Manager and Finger Lakes Community College include the 6 long-term sites on Canandaigua Lake where monitoring has been conducted for the last 20+ years. Additional near shore sites will be monitored during the summer months for nutrients and their locations will be selected by the Project Manager based on water quality concerns and current conditions on Canandaigua Lake. The Fluoroprobe and AlgeTorch sampling sites will be based on current conditions and will be selected by the Project Manager and FLI staff. The thermistor array will be installed approximately 100 yards south of the City's Water Treatment Plant where electricity and wifi are available on shore and in an area with 75 to 80 feet of water depth. Individual sites and justifications are presented in Table 1. The analytes to be determined from samples taken at these sites are those needed to further the project objectives.

Site Codes must follow the following format:

for example, a sample collected on June 1, 2019 from Deep Lake in Niagara county:

(e.g., 20190601_FONTA_Deep-WS)

yyyymmdd_Fcccc_sssss-WS

yyyy	four-digit year
mm	two-digit month
dd	two-digit day
F	abbreviation for FLLOWPA
cccc	four letter abbreviation for County
sssss	five letter code for Site name
WS	indicates a water sample
QC	Quality Control sample-duplicate
B	Blank

Analytical Laboratory Results for Water

A record of the sample collection will be kept on laboratory Chain of Custody (CoC) forms which will be completed during sample collection and relinquished to the laboratory upon sample submittal. CoCs contain all information required to reconstruct the origination of each sample. Data packages from the contract lab will be delivered to the Project Manager, in accordance with the requirements of this QAPP and the contract laboratory's standard operating procedure. As per requirements, the "official" laboratory data reports to project partners will be in electronic form (submitted as a PDF). Data will be transcribed to Excel and both pdfs and Excel formats will be submitted to FLLOWPA and NYSDEC. Laboratory data reports will include all analyses, calibration, lab QC, and any corrective actions. An example of a CoC is provided in the Appendix. Complete data packages are required to provide data validation capability. Data packages are delivered to the FLLOWPA Coordinator.

Field Results

Field data generated in this project will be recorded on field sheets. Within 72 hours of completion of the sampling day, Finger Lakes Community College will transfer field data into spreadsheets featuring the long-term dataset. The field data will be relinquished to the Project Manager as requested during the field season. At the end of the field season, Finger Lakes Community College will provide the Watershed Council with an electronic version of the long-term dataset, including the current field season and documentation of field comments.

Field data collected on the Fluoroprobe must be downloaded onto a computer. Finger Lakes Institute will download data within 24 hours of data collection and will transfer field notes into an electronic format. The output files will be relinquished to the Project Manager as requested. An electronic copy of the fluoroprobe output will be stored at the Watershed Council. The AlgaeTorch data will be downloaded by the Watershed Council within 24 hours of data collection and will be stored at the Watershed Council.

Thermistor array data must be downloaded onto a computer. The Watershed Council will store output files and will transfer any field notes into an electronic format.

Report format/information

All results will be summarized in a final report to be prepared by the Project Manager, Finger Lakes Community College and Finger Lakes Institute in the form of a powerpoint presentation. The final report will include all field and laboratory QA/QC results analyzed during this study. An evaluation of how QA/QC objectives were or were not met will be included in the final report. The final report will include a summary and discussion of analytical results for those parameters included in Tables 4. The final report will be made available electronically to the Project Quality Assurance Officer for independent review to ensure data meet stated (and acceptable) quality requirements. Hard copies of this report will be made available upon request.

Document/record control

The Project Manager is responsible for preparation, maintenance, updates, and distribution of this QAPP. The FLLOWPA Coordinator has ultimate responsibility for all changes to records and documents whether

handwritten or electronic. Field documents and laboratory COCs will be recorded in indelible ink **immediately after sample collection**, and changes to such data records will be made by drawing a single line through the error and initialed by the responsible person. At the end of the project, all field and laboratory results generated as part of tasks listed in Section A6 will be reported to the Project Manager for dissemination to various stakeholders and partners. Other technical memoranda may be written and distributed as needed during the project (typically transmitted to project partners by e-mail). All deliverables for this project (for example: summary report, PowerPoint presentation, data report) will be submitted in electronic format to project partners).

Storage of project information
Field data collected will be entered into Excel workbooks and stored on the Project Manager's computer. All hardcopies of field documents will be stored at the organization responsible for collecting data, which includes the Watershed Council, Finger Lakes Community College, and Finger Lakes Institute. Hardcopy laboratory records will be put into project notebooks at the Canandaigua Lake Watershed Council. All field data and laboratory data and reports and electronic data will remain secure on password protected computer for **at least five years** after the completion of the project. If hardcopy documents must be destroyed, disposition will be by shredding. The Project Manager and the FLLOWPA Coordinator shall retain copies of all management reports, memoranda, and all correspondence between NYSDEC as identified in Section A4. Records of written correspondence, internal notes, e-mails and communications between the team members and other project members will be kept for a **minimum of five years** as required by the project reporting requirements.

This QAPP is an FLLOWPA controlled-document. Revised releases will be made known by an increment in revision number. After approval by the appropriate persons, the revised QAPP will be sent to each person on the distribution list. The Project Manager is responsible for preparation, maintenance, updates, and distribution of this QAPP. Data generated through FLLOWPA must be reviewed and consented by NYSDEC prior to its distribution or publication. Interim data may be presented to the public prior to NYSDEC consent during the field season in response to water quality inquiries from the public or for educational purposes but must be qualified as interim.

B. Data Generation and Acquisition

B1. Sampling Process / Experimental Design

This project will collect data at 6 long-term sampling sites representing a range of lake conditions, including open water, near shores areas associated with tributaries, and near shore areas further from the influence of tributaries. These sites have been monitored for 20+ years and continuation at these sites is essential for understanding long-term trends in water quality and assessing lake health. Sampling will occur monthly from May through October, with the possibility to include April and November based on lake conditions.

At all of the 6 long-term sampling locations, we will collect a grab sample for nutrients at 2 meters using a Van Dorn sampler and a vertically integrated sample through the photic zone for chlorophyll *a* using flexible tubing. The open water sites will have additional grab samples for nutrients at 25 meters and 50

meters using the Van Dorn sampler. In addition, a Yellow Springs Instrument 6920V2 water quality sonde and a 650 data logger are utilized for in-situ monitoring at the open water sites for dissolved oxygen, temperature, water pH, conductivity, specific conductance, % oxygen saturation, and blue green algae cell count. The YSI data will be collected at 1-meter intervals from the surface to 15 meters (or lower if the thermocline drops below 15 meters), and then at 5-meter intervals from 15 meters to the maximum potential depth of 55 meters.

This project will also collect samples at additional near shore sites to further understand nutrient dynamics that may contribute to harmful algae blooms. The extra near shore samples will be collected as part of the monthly sampling program during summer months based on lake conditions. The samples will include grab samples collected with a Van Dorn sampler at 2 meter depth and analyzed for nutrients.

Samples for laboratory analyses at select locations and depths (Table 1) will be collected with a Van Dorn sampler at the designated locations over the project interval (Table 2). Chemistry samples that are deemed critical (quantitative) analyses are presented in Section B4 (Table 4). Field QC samples will be discussed further in Section B5.

To further understand harmful algae dynamics, a Fluoroprobe and AlgaeTorch will be utilized to collect harmful algae profile data. The basic plan is to collect data weekly with the Fluoroprobe from late summer through early fall and to collect additional data using the AlgaeTorch. However, the exact dates, locations and frequency will be based on lake conditions. Because harmful algae concentrates and disperses quickly, site locations will be selected to represent a range of conditions, such as worst case scenario dense blooms to dots in the water column. The monitoring will occur at numerous locations and depths throughout the lake. The monitoring will also focus on water depths and locations that correlate with private water intakes to better understand potential risk to private water supplies.

Recent research has shown that seiches and lake temperature dynamics may influence harmful algae blooms. A thermistor array will be installed in the lake at approximately 75 to 80 feet of water depth to capture these dynamics. The thermistor array will collect temperature data every meter from the bottom of the lake to approximately 5 meters below the lake surface. The thermistor array is anchored to the bottom of the lake, so the exact distance below the surface will change with the minor fluctuations in lake level. Temperature will be collected at approximately 15 minute increments. The data will be available in real-time, as it will be sent via wifi to Karl Hanafin's website and will be accessed by the Watershed Council.

B2. Sampling Methods

Sampling methods for water chemistry collections and field measurements are consistent with standard water quality investigation techniques. The specific methods used for this project are discussed below.

Bottle Preparation and Labeling

Pre-cleaned bottles will be provided by the contract laboratory prior to each sampling event. These bottles will be stored in a cooler in a location free from dust, water, or other potential contamination. Sample

bottles will be waterproof, legible, and labeled in permanent marker or indelible ink with information required to properly identify the sample location (yyyymmdd_Fcccc_sssss-WS). Minimum information to be provided with allow the sample to be paired with its record on the event Chain of Custody.

Bottle Labeling

1. Sample ID (yyyymmdd_Fcccc_sssss-WS)
2. Sampling time (in military time) rounded to the nearest 10-minute mark,
3. Analytes to be measured,
4. Apply the label to the sample bottle, not to the sample bottle cap

Water Sample Collection

Samples will be collected in an accurate, representative, and consistent manner following standard water quality investigation techniques. Chemistry samples will be collected at 2 meter depth, with additional samples at 25 and 50 meter depths in the open water monitoring sites. Field equipment will be maintained as per NYSDEC SOPs 211-19 "Use, Calibration, Maintenance and Storage of multi-probe meters used to measure water quality parameters" and 103-19 "Equipment Decontamination/Cleaning". A summary of the methods used for this project are provided below.

The following steps should be followed for all types of samples prior to sample collection: (1) verify what, if any, field processing requirements are needed for the constituents to be analyzed, (2) assemble and collect equipment necessary for sample collection, handling and transport, (3) prepare documentation (COC, field sheets) pertaining to sample collection, handling, and transport, (4) pre-label collection bottles and sample bottles if applicable, (5) establish and maintain a clean working area if applicable, and (6) rinse with ambient water prior to sample collection any collection equipment (e.g., Kemmerer).

Sample Collection, General

1. **This QAPP must be *accepted*** before the start of the Project,
2. Sampling personnel must wear new, clean gloves at each sampling location. If gloves become contaminated, they must be replaced,
3. Verify sampling location with GPS or maps. Any deviations from the designated sampling locations or protocol will be made on the field document sheets,

Equipment Blank Sample Collection

To collect an equipment blank, the sampler uses laboratory grade deionized water sent from the laboratory through all the steps and equipment required to collect a water column chemistry sample.

1. Rinse the sampling device with deionized clean water
2. Fill the sampling device with deionized clean water
3. Uncap the Equipment Blank bottle(s)
4. Pour directly from the device into the sample bottle.
5. Place in cooler on ice and handle in a manner consistent with samples.

Sample Collection, Direct Grab (NYSDEC SOP#203-19, Section 12.3- Discrete Sampling with Kemmerer Bottles pg. 11)

1. Using a properly decontaminated Van Dorn sampler, set the pre-calibrated sampling device so that the sampling end stoppers are positioned away from the sampling tube, allowing the sampled substance to easily pass through the tube.
2. Lower the sampling device to the pre-determined depth. Surface samples are collected at a depth of 2 meters. In the open water sites, samples are also taken at 25 meters and 50 meters below the surface, which is as close to the bottom as possible with equipment. Avoid bottom disturbance to prevent sediment introduction into the sample. Any samples with visible suspended sediment must be discarded and the sample must be recollected, unless visual observations of the sampling environment indicate high ambient turbidity.
3. When the Van Dorn sampler is at the required depth, send down the messenger to close the sampling device.
4. Retrieve the sampler and discharge the first 10 to 20 mL of sample to clear any potential contamination on the valve and, if not already fully decontaminated, the compositing container. If suspended sediment is visible in the sample and not in the ambient environment prior to collecting the same, the sample will be discarded and re-collected.
5. Transfer the remaining sample to the appropriate container(s).
6. Record the sample information in the field notebook.
7. The duplicate will be collected in a manner consistent with the parent sample collection (Section B5).

Water Transparency Measurements with a Secchi Disk (NYSDEC SOP#203-19, Section 12.10- Water Transparency Measurements with a Secchi Disk pg. 16)

1. A Secchi disk is used to measure water transparency as a surrogate for turbidity in ponded waters. Water clarity can be determined if measured transparency exceeds the water depth at the sampling site and if there is sufficient sunlight to illuminate the water column above the lowered disk.
2. Sampling procedures are as follows:
3. Lower the disk over the shady side of the boat until the disk just disappears from site. Record this depth to the nearest 0.1 meter.
4. Lower the disk one meter below the depth recorded in step 12.10.2.1. Raise the disk until the disk reappears in sight, and record to the nearest 0.1 meter. If this measurement varies from the first measurement by more than 0.5 meters or 10% of the depth in step 12.10.2.1, whichever is greater, repeat step 12.10.2.1 and this step.
5. Determine the reported Secchi disk transparency by computing the average of steps 12.10.2.1 and 12.10.2.2.

Collection of Field Parameters

Field data collection

1. Yellow Springs Instrument 6920V2 water quality sonde and a 650 data logger are utilized for in-situ monitoring at the open water sites for dissolved oxygen, temperature, water pH, conductivity, % oxygen saturation, and blue green algae cell count.
2. Lower probe to as deep as it will go (up to 55 meters.)
3. Allow probe to stabilize.
4. Record parameters at each depth on field data sheet, allowing probe to stabilize between each reading.

Fluoroprobe and AlgaeTorch

1. The Fluoroprobe and AlgaeTorch automatically collects data when in water. The probe will be slowly lowered through the water column to collect data at each sampling site.
2. The Fluoroprobe and AlgaeTorch will be used to analyze general dynamics through the water column in a variety of conditions from dense surface blooms to just visible dots. We will collect data from the surface through the thermocline.
3. To analyze the potential risks to private water supplies, the Fluoroprobe and AlageTorch will collect data at the approximate depth of private intakes and locations of private water supplies.

Thermistor Array

1. Data will automatically be collected at approximately 15 minute increments. When the battery gets low, it will automatically change the frequency to every 30 minutes. The unit will attempt to connect to the wifi 10 times. If it cannot connect, the data will not be collected.

Preparation of data collection instruments

The YSI multiprobe will be calibrated, maintained and deployed according to the manufacturer's instructions by Finger Lakes Community College. The Fluoroprobe will be calibrated, maintained and deployed according to the manufacturer's instructions by Finger Lakes Institute. The thermistor array will be installed, maintained and deployed according to the manufacturer's instructions by the Watershed Council.

All field instruments will be calibrated, maintained and deployed as per NYSDEC SOP 211-19 "Use, Calibration, Maintenance and Storage of multi-probe meters used to measure water quality parameters".

B3. Sample Handling / Custody Procedures

Sample handling and custody procedures for this project will be conducted in a manner described by NYSDEC SOP 101-19 "Sample Handling, Transport, and Chain-of-Custody" is summarized below.

Sample Handling and Storage

1. Samples will be filled in accordance to the procedures described in Section B2,
2. Samples requiring preservation will be preserved according to the appropriate method (Table 4),

3. After collection, CoCs will be completed. Upon completion, samples will be packed in ice in a clean cooler and stored dark ≤6 °C in the field and then transferred to a refrigerated cooler until delivery to the contract lab,
4. Samples will be delivered to the contract laboratory within the standard method's allowable holding time.

Chain of Custody and Laboratory Submission
A COC must be filled out immediately after sample collection and must accompany the sample from collection through analysis and reporting. A sample is considered to be in custody when: (1) it is secured or kept in a safe area to prevent tampering, or (2) it is in one's actual physical possession or view. As few people as possible should handle the sample(s) prior to receipt by laboratory personnel. Whenever sample(s) is/are transferred from one individual's possession to another individual's, the chain-of-custody record form must be signed and dated to record the transfer. Whenever sample(s) is/are transferred to a common carrier, the shipper's copy of the shipping documents should be retained as part of the chain of custody documentation.

COCs are completely and legibly completed by the FLLOWPA participants. Upon arrival at the laboratory, the COC is signed by the laboratory manager. These forms are used to establish an intact continuous record of the physical possession, storage and disposal of collected samples and aliquots. The COC follows each sample that comes into the laboratory for analysis. This is necessary to preserve the traceability of samples and identify individuals who physically handled individual samples through the life cycle of the sample. The sample delivery person should retain a copy of the chain-of-custody record as these will become part of the permanent record and submit the copy to the Project Manager. The chain of custody and laboratory submission form must contain the name, address, and telephone number of the sample collector and should always accompany the sample(s) during transport.

Data Entry QA procedures
Entering hand-written field data into the Excel spreadsheets will be completed by the Project Manager, Finger Lakes Community College or Finger Lakes Institute within 72 hours of collection. The Excel spreadsheet will be a continuous record created to include data organized into columns and rows and will contain all pertinent information from the field documentation including: (1) sample date and time, (2) sample location and ID, (3) site conditions and notes, and (4) other field notes. Data will be verified by double checking electronic copies with original field documents. Any suspected errors will be discussed with samplers.

B4. Analytical Methods
Analytical methods for both field and laboratory analyses are listed in Table 4. Samples will be analyzed at **Life Science Laboratories, Inc (ELAP ID 10248) for all certified parameters.** Chlorophyll *a* samples, which is not a certified parameter, are processed at Finger Lakes Community College's facility using the following procedure:

Samples are stored on ice in a cooler in a one liter plastic dark bottle and are processed the same day they are collected. Samples are filtered using a vacuum flask and filter apparatus fitted with a 0.8 um filter. Filters are dissolved in 10 mL of 90% alkaline acetone in combination with maceration using a glass stir rod. Samples are processed using a PerkinElmer UV/VIS Spectrometer, Lambda XLS unit set to a wavelength of 663 nm. The machine is zeroed before analyzing each sample using a cuvette filled with acetone as a blank.

All final analytical results including QC results will be provided to the Project Manager upon completion of the project by **February 1**.

B5. Quality Control

An integral part of sample quality is the collection of representative samples, those that accurately describe the characteristics of the waterbody being studied. Collected samples must accurately represent the waterbody and be unaffected by collection procedures, sample preservation, or sample handling. The analytical laboratory is responsible for maintaining internal quality control as a part of their quality assurance and lab QC analyses will be performed on aliquots of the parent sample bottle. Sample results comparability is maintained by use of established site selection, sampling, and analytical methods. To ensure that sampling standards are being met**, blanks and field duplicate samples** are collected as part of water chemistry sampling protocols.

Table 4: Parameters, analytical specifications, QA/QC requirements, and laboratories processing samples.

						Calibration				
	Parameter	***Laboratory***	***Method***	***Precision***	***Accuracy***	***Initial***	***Ongoing***	***Blanks***	***Method Detection Limit***	***Reporting Limit***
Field	*Water Temperature*	*In-situ*	*YSI multiprobe*	*0.01 deg C*	*±0.15 deg C*	*Factory set*			*- 5 to 50 deg C*	
	Conductivity	*In-situ*	*YSI multiprobe*	*0.001 to 0.1 mS/cm*	*±0.5% of reading +0.001 mS/cm*	*1 day before deployment*			*0 to 100 mS/cm*	
	pH	*In-situ*	*YSI multiprobe*	*0.01 5unit*	*±0.2*	*1 day before deployment*			*0 to 14*	
	% oxygen saturation	*In-situ*	*YSI multiprobe*	*0.1%*	*±1% of reading or air saturation*	*1 day before deployment*			*0 to 500%*	
	Dissolved oxygen	*In-situ*	*YSI multiprobe*	*0.01 mg/L*	*±0.1 mg/L or 1% or reading*	*1 day before deployment*			*0 to 50 mg/L*	
	Blue-green algae phycocyanin	*In-situ*	*YSI multiprobe*	*1 cell/mL or 0.1 RFU*		*1 day before deployment (zero): annually with Rhodamine dye*			*0 to 280,000 cells/mL; 0 to 100 RFU*	*~220 cells*
	Blue green algae concentration	*In-situ*	*Fluoroprobe*	*0.01 µg/L chlorophyll-a*	*0.01 µg/L chlorophyll-a*	*Factory set*			*0 to 200 µg/L chlorophyll-a*	*200 µg/L chlorophyll-a*
	Water temperature	*In-situ*	*Thermistor array*		*For temp range 0˚C to 30˚C in the mode we are*					

					using without calibration. 3sigma: +0.16˚C/-0.05˚C					
Analytical	*Chlorophyll a*	*Finger Lakes Community College*	*Alkaline acetone method (Wetzel and Likens 1991)*	*± 1 nm*	*± 2 nm*	*Automatic when turned on*		*Before each sample is analyzed*	*1100 nm*	*190-1100 nm*

The table below outlines parameters, analytical specifications, QA/QC requirements from Life Science Laboratories.

	Analytical				Calibration						
Parameter	***Laboratory***	***Method***	***Precision Limit (freq=per 20 samples)***	***LCS Accuracy Limit (freq=per 20 samples)***	***Calibration Frequency***	***Initial ICV Accuracy Limit (freq=per day)***	***Ongoing CCV Accuracy Limit (freq=per 10 samples)***	***ICB/CCB Limit (freq=per 10 samples)***	***Method Blank Limit (freq=per 20 samples)***	***Method Detection Limit***	***LOQ Reporting Limit***
Low Level Phosphorus, Total	*Life Science Laboratories*	*EPA 365.3*	*20 RPD*	*+/-10%*	*1*	*+/-10%*	*+/-10%*	*<0.002 mg/l*	*<0.002 mg/l*	*n/a*	*0.002 mg/l*
Low Level Phosphorus, Dissolved	*Life Science Laboratories*	*EPA 365.3*	*20 RPD*	*+/-10%*	*1*	*+/-10%*	*+/-10%*	*<0.002 mg/l*	*<0.002 mg/l*	*n/a*	*0.002 mg/l*
Ammonia	*Life Science Laboratories*	EPA 350.1 Rev.2.0	*20 RPD*	*+/-10%*	2	*+/-10%*	*+/-10%*	*<0.2 mg/l*	*<0.2 mg/l*	*n/a*	*<0.2 mg/l*
TKN	*Life Science Laboratories*	EPA 351.2 Rev.2.0	*20 RPD*	*+/-10%*	2	*+/-10%*	*+/-10%*	*<0.2 mg/l*	*<0.2 mg/l*	*n/a*	*<0.2 mg/l*
Nitrate	*Life Science Laboratories*	EPA 300.0 Rev.2.1	*20 RPD*	*+/-10%*	3	*+/-10%*	*+/-10%*	*<0.05 mg/l*	*<0.05 mg/l*	*n/a*	*0.05 mg/l*
Nitrite	*Life Science Laboratories*	EPA 300.0 Rev.2.1	*20 RPD*	*+/-10%*	3	*+/-10%*	*+/-10%*	*<0.05 mg/l*	*<0.05 mg/l*	*n/a*	*0.05 mg/l*

1 = Calibration is done Annually, or when ICV starts failing

2 = Calibration is done Daily, or when ICV starts failing

3 = Calibration is done Quarterly, or when ICV starts failing

4 = Balance is calibrated Daily, before use.

RPD = Relative Percent Difference
LCS = Laboratory Control sample (Blank Spike)
ICV = Initial Calibration Verification
CCV = Continuing Calibration Verification
ICB/CCB = Initial and Continuing Calibration Blanks

LOQ = Limit of Quantitation (We will not be reporting any results below this value)

Blanks and Duplicates
Field blanks and field duplicates will be collected at a frequency of one sample per sampling trip for nutrient analysis and at a rate of 10% of the total number of samples for all other analyses and are analyzed for the same nutrients as the project samples (Table 4 will be used to assess adherence to DQOs (Table 3).

A. Precision
Precision can be defined as the relative uncertainty about a given measurement and is determined by replicate analyses. Duplicate samples will be collected at a frequency corresponding to one per sampling trip for nutrient analysis and at a rate of 10% of the total number of samples for all other analyses. ***The DQO for precision is ≤ 20% RPD on duplicate samples. Any sample violating this DQO will be investigated to determine the reason for violation.***

B. Accuracy
Accuracy can be defined as the absolute uncertainty about the true value. Acceptability of sample results will be based upon the accuracy criteria detailed in Table 3. Blank samples are collected to measure the amount of contaminant concentration introduced because of sampling related activity. ***The DQO for accuracy is that all FB less than the LOQ. Any FB ≥ LOQ must be flagged as questionable.***

Matrix Spike and duplicate matrix spike samples are collected along with regular water quality samples and spiked in the analytic laboratory with a known concentration of analyte. The samples are then analyzed to determine the accuracy (percent recovery) of the analytic results for a given matrix. Matrix spike and duplicate matrix spike samples will be collected at a frequency corresponding to five percent (5%) per batch consisting of multiple laboratory client's samples.

D. Representativeness
Representativeness in water column samples is attained by selection of proper sampling equipment to obtain an integrated sample of water from a cross section of the waterbody, as well as from different depths. ***The DQO for representativeness is ≤ 20% RPD on duplicate samples. Any sample violating this DQO will be investigated to determine the reason for violation.***

E. Completeness
Completeness can be defined as the percentage of acceptable data necessary to accomplish the study objectives. Due to the high cost of sample analysis and the limited number of samples to be collected, it is important that staff strictly adhere to all QA criteria to accomplish the survey objectives. ***The DQO for completeness is 90% successful analysis and reporting.***

F. Comparability
Comparability is the confidence with which one set of data can be compared to another. It is achieved by adherence to this QAPP and standard analytical methods, holding times, consistent detection limits, common units and consistent rules for reporting.

G. Detection and quantifications
LOD (Level of Detection)– for a specific method and matrix, minimum concentration an analyte can be determined to be significantly different from a blank. LOQ (Level of Quantification)– concentration level above which values are associated with a high degree of confidence.

Data anomalies
Occasionally data may be collected that appears to be erroneous. The first step is to verify that there was not a transcription, data entry, calculation, or cut and paste error. This can be accomplished by going back to the source documents (e.g., field sheets or laboratory bench sheets) and verifying against the original data. It is possible that a data point is an outlier and should be excluded from further analyses; this will be noted in the spreadsheet/database record. It is also possible that the observation is an outlier but is correct (for instance an exceptionally high turbidity reading may be the result of a record rain storm) but is still correct. In this instance, the analyst will use their best judgement as to how to present the data

If a sample was not collected in the field or run in the laboratory, then there will be missing data in the database. This type of error is handled by placing a note in the comment field on the field sheet (if it was a field error) or in the database comment field if it was related to a lost sample in the laboratory. In both cases, a brief explanation of why the sample was lost will be made.

B6. Instrument/Equipment Testing, Inspection, and Maintenance

Numerous pieces of field equipment will be used on this project. The owner of each piece of equipment will be responsible for its proper operation and function, including:

- Yellow Springs Instrument 6920V2 water quality sonde and a 650 data logger (Finger Lakes Community College)
- Van Dorn sampler (Finger Lakes Community College)
- Integrated water column sampler – flexible tubing (Finger Lakes Community College)
- Fluoroprobe (Finger Lakes Institute)
- AlgaeTorch (Watershed Council – to be purchased in 2019)
- Thermistor array (Watershed Council)

Field instruments and equipment testing, inspection and maintenance will be performed in this program as per NYSDEC SOP #103-19, "Equipment Decontamination/Cleaning" and per the manufacturer's instructions. All calibration and maintenance records will be maintained by the Project Manager or equipment owner and will made in indelible ink and kept in a project notebook. Any deviations from standard operating procedures will be noted and included in the final report and all records will be made available upon request.

Storage
All sampling bottles and equipment related to sampling will be stored and maintained by sampling staff so that the results obtained from their use will not be questioned. Prior to use, all equipment will be checked to ensure good operating conditions and cleanliness. After sampling, has been completed, the equipment will be cleaned

(as described below) and kept ready for use. Manufacturer's specifications will be followed in carrying out routine maintenance.

Cleaning
All sampling equipment (buckets, churn, sampler, etc.) will be well cleaned with a distilled (de-ionized) water wash before and after each day's use. At each sampling station, field equipment will be rinsed with ambient water before a sample is collected and lab equipment is rinsed with distilled water after sampling is completed so equipment will be ready for use at the next monitoring location. The equipment may be washed every two weeks using a nutrient free detergent and water scrub followed by a distilled water rinse as needed. Whenever equipment is cleaned with a phosphate free detergent a notation is made in the equipment's log book.

B7. Instrument/Equipment Calibration and Frequency

Calibration of equipment will be done at according to manufacturer's recommendations (all field equipment used can be found in the Appendix) and NYSDEC SOPs 211-19 "Use, Calibration, Maintenance and Storage of multi-probe meters used to measure water quality parameters" and 103-19 "Equipment Decontamination/Cleaning". All calibration results will be recorded in a bound log book. The YSI multiprobe is calibrated the day prior to sampling following the manufacturer's protocol. Briefly, this entails a 2-point calibration for pH using a 4 and 10 buffer solution. The dissolved oxygen probe is calibrated using a calibration cup at 100% saturation. The conductivity probe is calibrated with a YSI standard of 10,000 um/cm concentration. The blue green algae probe is calibrated to 0 and to a rhodamine dye annually. The YSI multiprobe is maintained according to the manufacturer's recommendations. This includes replacing the optical DO membrane assembly on the YSI Optical DO sensor annually. All calibration results for the FluoroProbe are stored in the Finger Lakes Institute Water Quality laboratory. The FluoroProbe is operated and maintained according to the manufacturer's recommendations and uses a factory set calibration as listed in the bbe FluoroProbe User Manual Version 2.6 E2, October 2017 (bbe Moldaenke GmbH, Preetzer Chaussee177, 24222 Schwentinental, Germany, +49 (0) 431/380 400). Maintenance and calibration is performed on the FluoroProbe by the manufacturer every 2 years. Ongoing maintenance by FLI includes regular cleaning of FluoroProbe windows and unit, inspection of all torque points within the unit, greasing of unit connection port, and inspection of unit for signs of physical damage. The AlgaeTorch will be maintained, calibrated and operated by the Watershed Council according to the manufacturer's recommendations. Deficiencies in calibration and maintenance of all equipment are resolved on a case by case basis. The actual maintenance, calibration, and log keeping of all equipment work performed upon it is the responsibility of the Project Manager.

Laboratories conducting analyses should maintain appropriate service contracts for laboratory instruments and perform routine instrument maintenance at intervals suggested by the manufacturer or by internal laboratory SOP.

B8. Inspection/Acceptance of Supplies and Consumables

The Project Manager will inspect supplies and consumables upon arrival of new materials and immediately before their use in the field or laboratory. For newly arrived supplies and consumables all materials must be in their original packaging and free of noticeable damages. For materials already obtained and ready for use, no

noticeable defects will be allowed. The Project Manager is responsible for ensuring the quality of all supplies and consumables.

B9. Non-Direct Measurements

This program will not utilize secondary data.

B10. Data Management

The Project Manager, Finger Lakes Community College and Finger Lakes Institute will be responsible for entering all field information into Excel spreadsheets. The Project Manager will also receive electronic data packets from the analytical laboratory via email and review for completeness and accuracy. Hard copies of field forms or lab results will be kept in a secure location in the Project Manager's, Finger Lakes Community College's or Finger Lakes Institute's office. Electronic copies of data will be stored on the Project Manager's password protected work computer.

Data and supporting documentation from contract laboratories will be reported electronically to FLLOWPA in a complete data document either on CD or via a link to the laboratory secure data repository. The data documents include summaries of data validation conducted by the analytical laboratory. Inconsistencies in the data files are flagged for review and correction by the Project Manager. Once the sample collection information (station, date, time, parameter) has been verified, the water quality result values are reviewed. Values are compared against assessment criteria, including established parameter-specific limits. If reported values exceed the established limit, the result is flagged for further investigation.

Investigation of laboratory values may result in confirmation of the results by the analytical laboratory, comparison of the value against other results from the same site, inserting an appropriate data qualifier, and/or accepting the value without qualification.

Laboratory analytical data will be delivered electronically and hard copy to the NYSDEC Project Manager. Electronic data will be in a form of a .csv file importable to an Excel spreadsheet containing the validated laboratory data. A data narrative including analyst comments, and explanation of qualifiers and a listing of methods that are NELAC accredited are also required to be provided by the analytical reporting laboratory or organization. All reports, records and data are to be sent to the Project Manager. Data generated through FLLOWPA must be reviewed and consented by NYSDEC prior to its distribution or publication. Interim data may be presented to the public prior to NYSDEC consent during the field season in response to water quality inquiries from the public or for educational purposes but must be qualified as interim. After the final submission of reports and datasets to the NYSDEC, FLLOWPA Project Managers will manage their data in accordance with FLLOWPA requirements.

C. Assessment and Oversight

Each FLLOWPA project will be audited at two stages: (1) QAPP and workplan development and (2) the FC and/or FNPM will audit 10% of projects each year.

C1. Assessment and Response Actions

The Project Manager will thoroughly brief project implementation staff before and after beginning their respective implementation tasks, to identify emerging/unanticipated problems and take corrective action, if necessary. Also, contract laboratory staff will notify the Project Manager of any unanticipated problems that may arise during this project and any corrective actions taken will be documented.

Corrective Action

The Project Manager will thoroughly brief project implementation staff before and after beginning their respective implementation tasks, to identify emerging/unanticipated problems and take corrective action, if necessary. Also, contract laboratory staff will notify the Project Manager of any unanticipated problems that may arise during this project and any corrective actions taken will be documented.

C2. Reports to Management

The Project Manager will perform a data validation review on each chemical matrix for this project. This evaluation together with the analysis of the completeness, precision, and accuracy of the program will provide a level of confidence to the data set and to the interpretations and conclusions drawn from the data.

A final report in powerpoint will be coordinated by the Project Manager which will contain a summary of the data collected including an Excel spreadsheet with data and quality objective metrics (e.g., precision, accuracy, etc.). The report will present observations, draw conclusions, identify data gaps, and describe any limitations in the way the data may be used based on QC results and stated DQOs. No other reporting is required for this project. NYSDEC will store electronic copies of project information including data as per the NYSDEC records retention policy.

Table 5. Project QA Status Reports

Type of Report	Frequency	Preparer	Recipients
QAPP	Once, before primary data collection begins	**Canandaigua Lake Watershed Council, Project Manager**	**All recipients of original QAPP**
Final Project Report including all data generated in project	Once, upon completion	**Canandaigua Lake Watershed Council and Finger Lakes Community College**	**Finger Lakes Community College, FLLOWPA, Ontario County, Finger Lakes Institute**

D. DATA REVIEW AND EVALUATION

D1. Data Review, Verification and Validation

This QAPP shall govern the operation of the project always. Each responsible party listed in Section A4 shall adhere to the procedural requirements of the QAPP and ensure that subordinate personnel do likewise. Data will not be published in any form until the validation review is completed.

All the responsible persons listed in Section A4 shall participate in the review of the QAPP. The Project Manager is responsible for determining that data is of adequate quality to support this project. The project will be modified as directed by the Project Manager. The Project Manager shall be responsible for the implementation of changes to the project and shall document the effective date of all changes made. Any significant changes will be noted in the next progress report and shall be considered an amendment to the QAPP. All verification and validation methods will be noted in the analysis provided in the final project report.

D2. Verification and Validation Methods

Data results generated by this program will be reviewed at three separate stages. First, analytical laboratory staff follows specific laboratory protocols to assure the quality and validity of the data. Second, the Program Manager will review data results during the processing of the electronic data files including checking deliverables against the original COCs. This review includes confirmation of suspect values and the possible qualification of data results. For the third stage, the Project Manager will perform a data validation review and will evaluate the completeness, precision, and accuracy for the Program (below).

25% of the data will be verified and validated by the Project Manager to determine its validity prior to use and distribution. Data for each of the parameters will be compared with the detection limits and precision/accuracy data provided in Section B5; the analytical laboratory performs these comparisons on results that they generate. Those data not meeting the previously identified criteria for precision, accuracy and blank values (Section A6-A7) will be re-analyzed where possible or flagged if additional sample material is not available. An indication as to why flagged data did not meet the minimum QA criteria will be provided. If data validity cannot be verified, these data will be qualified in the database. An indication as to why qualified data did not meet the minimum QA criteria will be provided. This information will be noted in the final QA/QC report.

D3. Evaluating Data in Terms of User Needs

This section of the QAPP addresses issues of whether data collected during field sampling meet data quality objectives in Section B5 and Table 4. Each data type is reviewed for adequacy in terms of precision, accuracy, representativeness, completeness and comparability by appropriate the Project Manager and Project Quality Assurance Officer.

Reconciliation with use Requirements

As noted in Section C, uncertainty in the data allowed for use in the monitoring programs end product will be limited to that found acceptable in the data verification and validation process. This section of the QAPP addresses issues of whether data collected during field sampling meet data quality objectives.

Meeting and reporting needs of your project

This section of the QAPP addresses issues of whether data collected during field sampling meet data quality objectives. The Project Manager will document all analyses and assumptions as necessary in project related memos. If any data type fails to meet the data quality objectives outlined in Table 4 or Section B5, the reasons for failure will be determined by the Project Manager and will be included in the final report. Any data type that fails a data quality objective will be flagged and documented in the datafile or any accompanying report. The Project Manager will document all analyses and assumptions as necessary in project related memos.

Mathematical and statistical methods
Acceptable levels of data validation and verification are presented in Section B5.

Approach to managing unusable data
It is expected that data collected as part of this project will meet the requirements for usability. Data that do not meet requirements for precision, accuracy, completeness or comparability will be carefully evaluated by the Project Manager (in consultation with the contract lab or NYSDEC staff if necessary) for deviations from laboratory and accepted paradigms. If warranted these data will be removed from the data set, by the Project Manager, with appropriate comments regarding decision process for removal.

Reporting
After the above QC calculations and examinations have been performed for all media, the results will be summarized in a final report. The QA/QC section of the final report will include a discussion and summary of the DQOs observed during the study. Any restrictions or limitations on the data will be linked with the dataset and indicated in any documentation resulting from the data. Project reports will be approved by the Project Manager and FLLOWPA Coordinator prior to distribution.

References

NYSDEC. 2019 Quality Assurance Management Plan for the Finger Lakes-Lake Ontario Watershed Protection Alliance (FLLOWPA), Division of Water, New York State Department of Environmental Conservation, 615 Erie Blvd West, Syracuse, New York.

NYSDEC. June 2019. Standard Operating Procedure: Collection of Lake Water Quality Samples, NYSDEC SOP #203-19. Division of Water, New York State Department of Environmental Conservation, 625 Broadway, Albany, New York.

NYSDEC. April 2019. Calibration, Maintenance and Storage of multiprobe meters used to measure water quality parameters. NYSDEC SOP #211-19. Division of Water, New York State Department of Environmental Conservation, 625 Broadway, Albany, New York.

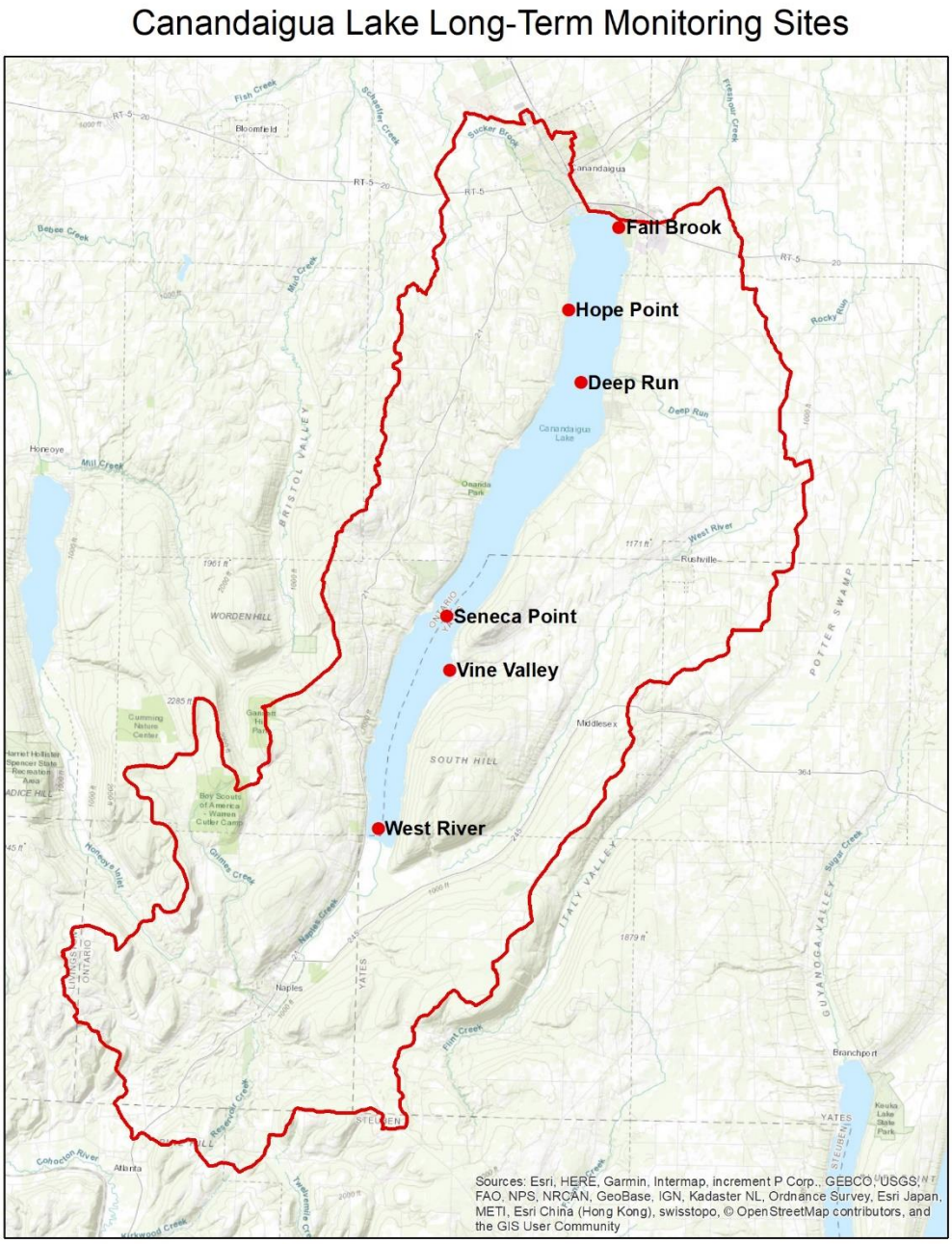
NYSDEC. March 2019. Standard Operating Procedure: Sample Handling, Transport, and Chain of Custody, NYSDEC SOP #101-19. Division of Water, New York State Department of Environmental Conservation, 625 Broadway, Albany, New York.

NYSDEC. March 2019. Standard Operating Procedure: Sampling Equipment Decontamination/Cleaning, NYSDEC SOP #103-19. Division of Water, New York State Department of Environmental Conservation, 625 Broadway, Albany, New York.

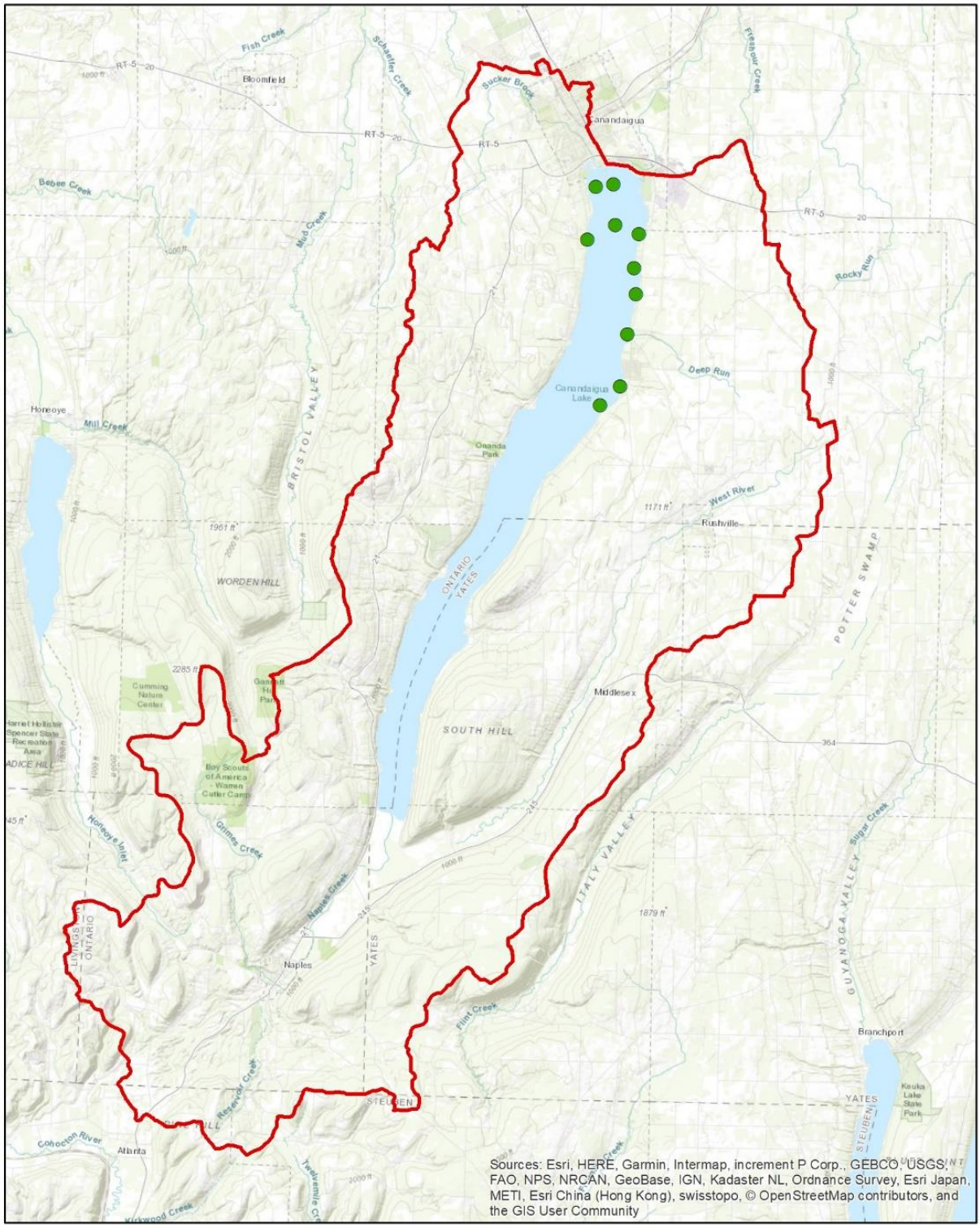
NYSDEC. May 2019. Standard Operating Procedure: Data Handling and Archival, NYSDEC SOP #102-11. Division of Water, New York State Department of Environmental Conservation, 625 Broadway, Albany, New York.

NYSDEC. May 2015. Consolidated Assessment and Listing Methodology. Division of Water, New York State Department of Environmental Conservation, 625 Broadway, Albany, New York.

Appendix 1. Maps of Site Locations



Canandaigua Lake Potential Summer Near-Shore Monitoring Sites



Appendix 2. Example Chain of Custody Forms

Life Science Laboratories, Inc.
5854 Butternut Drive
East Syracuse, NY 13057
Phone # (315) 445-1900 Telefax # (315) 445-1104

Chain of Custody Record

Client: _____ Phone # _____
Address: _____ Fax # _____
Email: _____
Authorization:

Contact Person:

LSL Project #:
Client's Site I.D.:
Client's Project I.D.:

LSL Sample Number	Client's Sample Identifications	Sample Date	Sample Time	Type grab	Type comp.	Matrix	Preserv. Added	Containers #	Containers size/type	Analyses	Free Cl (mg/L)	Pres. Check

Notes and Hazard identifications:

Custody Transfers	Date	Time
Sampled By: Received By:		
Relinquished By: Received By:		
Relinquished By: Received for Lab By:		

Shipment Method: Samples Received Intact: Y N

Appendix 3. Example Field Form

FIELD DATA FORM Recorder: _____

Water Body: Canandaigua Lake Station: _____ Date: _____

Time: _____ Air Temp (C): _____ Wind: _____ Sky: _____

Secchi Disk (m): _____ Substrate: _____ Total Depth (m): _____

Comments: _____

Total Depth	Temp. (C)	Conductivity (mS/cm)c	Specific Conductance (uS/cm)	pH	% oxygen saturation	D.O. (mg/L)	BGA Cell Count	Comments
55								
50								
45								
40								
35								
30								
25								
20								
15								
14								
13								
12								
11								

SHEET 1 of 2

1

FIELD DATA FORM

Recorder: _____

Water Body: Canandaigua Lake Station: _____ Date: _____

Time: _____ Air Temp (C): _____ Wind: _____ Sky: _____

Secchi Disk (m): _____ Substrate: _____ Total Depth (m): _____

Comments: _____

Total Depth	Temp. (C)	Conductivity (mS/cm)c	Specific Conductance (uS/cm)	pH	% oxygen saturation	D.O. (mg/L)	BGA Cell Count	Comments
10								
9								
8								
7								
6								
5								
4								
3								
2								
1								
0								

SHEET 2 of 2

2

Canandaigua Lake Field Sampling Checklist Date: _____

1. West River (time sampled: _____)
   - ☐ Integrated sample for chlorophyll
   - ☐ 2m Van Dorn sample

Site Notes:

2. Vine Valley (time sampled: _____)
   - ☐ Integrated sample for chlorophyll
   - ☐ 2m Van Dorn sample

Site Notes:

3. Seneca Point (time sampled: _____)
   - ☐ Secchi
   - ☐ Integrated sample for chlorophyll
   - ☐ 2m Van Dorn sample
   - ☐ 25 m Van Dorn sample
   - ☐ 50 m Van Dorn sample
   - ☐ YSI profile (1-15, 20 – 55 by 5's)

Site Notes:

4. Deep Run (time sampled: _____)
   - ☐ Secchi
   - ☐ Integrated sample for chlorophyll
   - ☐ 2m Van Dorn sample
   - ☐ 25 m Van Dorn sample
   - ☐ 50 m Van Dorn sample
   - ☐ YSI profile (1-15, 20 – 55 by 5's)

Site Notes:

5. Hope Point (time sampled: _____)
   - ☐ Integrated sample for chlorophyll
   - ☐ 2m Van Dorn sample

Site Notes:

6. Fall Brook (time sampled: _____)
   - ☐ Integrated sample for chlorophyll
   - ☐ 2m Van Dorn sample

Site Notes:

Appendix 4. Field Equipment Used in this Project

Equipment List:

Secchi Disk

Van Dorn Sampler – used for collecting all samples for nutrient analysis

Flexible tubing – used for collecting an integrated chlorophyll *a* sample

Yellow Springs Instrument 6920V2 water quality sonde with a 650 data logger equipped with ROX Optical Dissolved Oxygen Sensor, Blue Green Algae Phycocyanin Fluorescence Sensor, and Combo pH/ORP Field-replaceable 6-series probe

Fluoroprobe

AlgaeTorch

Thermistor array