Quality Assurance Project Plan (QAPP) for

Buckeye Lake Monitoring
2018

Division of Surface Water
Central District Office

Buckeye Lake Monitoring Station, 2017

Division of Surface Water
April 18, 2018

Quality Assurance Project Plan (QAPP) for

Buckeye Lake Monitoring 2018

Ohio EPA Division of Surface Water (DSW)

April 2018

Prepared by
State of Ohio Environmental Protection Agency

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SECTION A – PROJECT MANAGEMENT

A1 - Quality Assurance Project Plan for Buckeye Lake Monitoring (2018)

Brian W Hall ______________________ Date: 5/7/2018

Tiffani Kavalec, Chief or Brian Hall, Assistant Chief, DSW

______________________________ Date: 5/3/2018

Marianne Piekutowski, Assessment and Monitoring Section Manager

Jeffrey P. Bohne ______________________ Date: 5/7/18

Jeff Bohne, Inland Lakes Coordinator

Jeffrey W. Reynolds ______________________ Date: 5/3/18

Jeff Reynolds, Ohio EPA Quality Assurance Coordinator

______________________________ Date: 5/2/2018

Michael Gallaway, CDO-DSW Manager

Jeffrey Lewis ______________________ Date: 4/20/18

Jeffrey Lewis, CDO-DSW Water Quality Supervisor

______________________________ Date: 4/20/18

Chloe Welch, CDO-DSW Ohio EPA Field Staff

This document, Quality Assurance Project Plan (QAPP), contains elements of the overall project management, data generation and acquisition, information management, assessment and oversight, and data validation and usability for the Ohio EPA Inland Lakes Program. The complete QAPP includes this document as well as other references, which includes the Inland Lakes Field Procedures Manuals. Together, these items comprise the integrated set of QAPP documents. All project cooperators should follow these guidelines. Mention of trade names or commercial products in this document does not constitute endorsement or recommendation for use.

A2 - Table of Contents

A3 – Distribution List and Lake Contacts

This QAPP, which includes the associated manuals and guidelines, will be distributed to the following internal staff and Management:
(This QAPP will also be made available publicly on Ohio EPA's Inland Lakes Web Page).

A3.1 - *Table 1. Ohio EPA Central Office Staff*

Name/Title	Contact E-mail	Phone
Brian Hall, DSW Assistant Chief	brian.hall@epa.ohio.gov	614-644-2001
Marianne Piekutowski, Assessment and Modeling Section Manager	Marianne.Piekutowski@epa.ohio.gov	614-644-2876
Keith Orr, Assessment and Modeling Supervisor	Keith.Orr@epa.ohio.gov	614-644-2885
Jeff Bohne, Inland Lakes Coordinator	Jeffrey.Bohne@epa.ohio.gov	614-728-3841
Jeff Reynolds, Quality Assurance Coordinator	Jeffrey.Reynolds@epa.ohio.gov	614-705-1011
Jennifer Kraft, DES, Asst. Chief	Jennifer.Kraft@epa.ohio.gov	614-644-3020

A3.2 - *Table 2. Ohio EPA Central District Office Staff*

Name/Title	Contact E-mail	Phone
Michael Gallaway, CDO-DSW Manager	Michael.Gallaway@epa.ohio.gov	614-728-3843
Jeffrey Lewis, CDO-DSW Water Quality Supervisor	Jeffrey.Lewis@epa.ohio.gov	614-466-2657
Chloe Welch, Field Staff	Chloe.Welch@epa.ohio.gov	614-728-3852

A3.3 - *Table 3. Other Interested Parties*

Organization (contact name)	Telephone Number
OHIO DNR – Buckeye Lake State Park Manager (Jason Wesley)	(740) 467-2690

A4 – Project/Task Organization and Communication

A4.1 - Table 4. Roles & Responsibilities

Individual(s) Assigned:	Responsible for:	Authorized to:
Chief or Asst. Chief	Allocate resources, project implementation, resolve disputes.	Resolve disputes, suggest changes and edits, approve needed resources, approve overall project and QAPP.
Mari Piekutowski, Assessment and Modeling Section Manager	Staff assignment, signatures, payments, and reporting. Coordinate with Inland Lakes Coordinator regarding modeling and lake needs.	Review documents and reports; suggest changes and edits.
Keith Orr, Modeling Supervisor	Technical advisor for sonde continuous monitoring station, Sutron data hosting contract contact.	Provide assistance regarding sonde station and assure proper equipment and supplies available for station.
Jeff Bohne, Environmental Supervisor	Coordinate sample schedule, maintain statewide communications with districts, ensure consistency in sampling procedures, coordinate training efforts, track data output and deliver appropriate reporting of results.	Coordinate all functions and activities related to inland lake monitoring in order to develop and maintain an effective Inland Lakes Program.
Jeff Reynolds, Quality Assurance Officer	QA/QC input to document development. Prepare documents and reports.	Review documents and reports; suggest changes and edits. Sign off on completed QAPPs.
Michael Gallaway, CDO-DSW Manager	Project manager, staff assignment, backup crew member, signatures, payments, data evaluation and reporting.	Review documents and reports; suggest changes and edits; obtain approvals and signatures;
Jennifer Kraft, DES Assistant Chief	Overseeing completion of chemical sample analysis and data delivery for project samples.	Review documents and reports; suggest changes and edits (related to DES content).
Study Team:		
Jeffrey Lewis, District Water Quality Supervisor	Study plan coordinator, logistics, sampling coordinator, backup crew leader, track project progress and report to management.	Assure proper equipment and supplies available, manage sampling schedule, coordinate study planning, lead sampling crews as needed.
Chloe Welch, District Water Quality Staff	Sampling/field crew leader; field and lab data management, data QA/QC, review, and verification, database population and transmission. Assist with project planning and coordinate lake access.	Prepare documents and reports. Schedule field activities and lead sampling crews as needed.

A5 – Problem Definition/Background

Buckeye Lake basin is owned by Ohio State Parks (ODNR) and drains approximately 45 square miles (28,340 acres). Buckeye Lake receives little, if any drainage from the northwest since there is a diked barrier along the shore, sending surface waters to the South Fork of the Licking River. Thus, almost all the flow into Buckeye Lake originates from the northeast, west and south sides of the lake. Much of the input drainage flows over land used primarily for agricultural purposes. A large percentage of agricultural activity in the Buckeye Lake basin involves row-crop production with limited farm animal production.

The margin of the lake is contained within 2,363 acres or 36.25 miles of shoreline during normal summer pool according to the Ohio DNR records. Much of the northern shoreline was utilized to hold back water during construction of the original reservoir for canal transport purposes dating back to 1825. An outlet structure was placed in the Village of Buckeye Lake and discharges to Wasteweir Run (also referred to locally as Mingo Run). An emergency spillway (un-gated weir) was constructed in 1993 to alleviate the dam wall of hydraulic pressure and to provide an optional outlet during major storm events. This emergency outlet is located on the north bank near Seller's Point.

Since late 2014, Ohio DNR has been managing water levels on Buckeye Lake to allow the construction of a new 4.1-mile dam. Initially water levels were held about 3 feet below normal summer pool at winter draw down level (885.5 feet above mean sea level) to allow for work to reinforce the existing dam. In the summer of 2016, this work was completed and water levels were adjusted to returned to 890.5 feet above mean sea level (approximately 1 foot below normal summer pool) for the remainder of the project during the summer recreation season. Water quality monitoring during the project is essential for lake management purposes. The project is estimated to be completed in late fall 2019.

Previous Ohio EPA monitoring on Buckeye Lake has been performed from 2008-2009, and 2011-2017.

The purpose of the Buckeye Lake Monitoring QAPP is to establish the type and quality of data needed to provide necessary information to continue tracking the condition of Buckeye Lake, to describe the methods for collecting and assessing those data and to identify specific QA and QC measures that will be utilized during lake sampling efforts.

A6 – Project/Task Description

A6.1 - Continued Monitoring

The primary tasks for this study are to set up a monitoring station at a fixed location on Buckeye Lake to collect continuous water chemistry data, and to collect periodic water quality data via boat sampling at three additional lake locations during the summer of 2018. These two tasks serve as a means to continue to monitor water quality trends in the system throughout ODNR's dam reconstruction project. A general description of each of the water quality parameters that will be used to evaluate trends, as well as expected ranges for the system based on previous data collected at Buckeye Lake, is described in sections A.6.2.1.1 through A.6.2.1.7.

A6.2.1 - Lake Water Quality Indicators

A6.2.1.1 - Dissolved oxygen

Dissolved oxygen (DO) is oxygen that is dissolved in the water column and is essential for the survival of aquatic organisms. The amount of DO soluble in water is inversely proportional to temperature. Buckeye Lake experiences regular DO swings between 6 mg/L and 10 mg/L, based on data from the 2017 continuous monitoring station. In general, prolonged DO levels less than 2.0 mg/L at Buckeye Lake may result in stressful conditions for fish (and result in fish mortality). Similarly, large DO swings (greater than 15 mg/L) may also be an indicator of potential problems for fish survival.

A6.2.1.2 – Chlorophyll-a

Nutrient loading is a concept that suggests there is a relationship between the amount of nutrients entering a lake and its response to that nutrient load. Chlorophyll-*a* is a quantifiable index that expresses this relationship. Buckeye Lake chlorophyll-*a* levels over 100 µg/L are not uncommon for this eutrophic lake system and are indicative of hypereutrophic conditions in the lake. It is important to consider that high chlorophyll-*a* levels may indicate future HAB concerns. Because the chlorophyll-*a* (green pigment) is an indicator of algae growth, and the system is often dominated by cyanobacteria growth in the warm summer months, much of the chlorophyll-*a* pigment at Buckeye Lake correlates to increased HAB presence.

Chlorophyll-*a* can also be used to determine Trophic State Index (TSI), a measure of a lake's trophic status along a continuum of productivity expressed in different stages of lake eutrophy. In general, a lake that lacks nutrients and associated productivity is considered to be oligotrophic (chl. A TSI < 50). Lakes that carry an abundance of nutrients and are very productive are considered eutrophic or even hyper-eutrophic in some cases (chl. a TSI > 75). Lakes in between are considered mesotrophic. The TSI has importance in that it can help prioritize corrective measures and assist in determining what type of restoration methods are appropriate to be used on restorable, impaired lakes.

A6.2.1.3 - Ammonia-N

Problems with ammonia (NH_4-N) typically arise because under anaerobic conditions it is an end product of the decomposition of organic matter. With the increasing use of nitrogen for lawn fertilizer and food production, sources of ammonia have increased in the water column of lakes exponentially. Studies have shown that certain cyanobacteria growth rates correlate positively with ammonia. However, the main reason ammonia is used as an indicator is because of its toxicity to aquatic life. In general, Buckeye Lake has low levels of ammonia throughout the summer months that are usually below detection levels, or, if detectable, below 0.1 mg/L. The average 2017 concentration of ammonia at all three stations on Buckeye Lake was non-detect.

A6.2.1.4 - pH

pH is a measure of how acidic/basic the lake water is. Elevated pH levels can be associated with high levels of photosynthesis common in extremely productive lakes like Buckeye Lake. Here surface pH levels are regularly elevated, and fluctuate between 8.0 and 10.0 S.U. In 2017, Buckeye Lake had a median pH value of 8.76, and a maximum of 9.92 at the continuous monitoring station. Buckeye Lake profile pH values in the vicinity of Cranberry Bog (Station L-1) can be near neutral (e.g. 7.5) due to the influence of the bog (acidic) and lower photosynthetic activity deeper in the water column.

A6.2.1.5 - Transparency

The measure of transparency, or light penetration through the water column, is conducted using a Secchi disk. The Secchi reading is influenced by absorption characteristics of the water and of the dissolved and particulate matter in the water column. Associations have been made between primary productivity (algae) and Secchi transparency. Secchi transparency is regularly low in Buckeye Lake, averaging 0.23 meters across data from all stations during monitoring years 2014-2017. The average Secchi transparency in 2017 was only 0.196 meters. Low readings are likely caused by high primary productivity that is known to occur at Buckeye Lake, as well as turbidity in the water column due to boat traffic in shallow waters that agitate bottom sediments.

A6.2.1.6 - Total phosphorus (TP)

As compared to other nutrients (carbon, hydrogen, nitrogen and sulfur), phosphorus is least abundant and thus tends to limit biological activity. However, TP plays a major role in biological metabolism and is the primary cause of nutrient enrichment. At Buckeye Lake, TP fluctuated between 0.012 and 0.721 mg/L across all monitoring stations between 2014 and 2016. The mean from this period was 0.19 mg/L.

A6.2.1.7 - Total nitrogen (TN)

Nitrogen is an abundant element on the earth's surface and it occurs in fresh waters in numerous forms. Total nitrogen is the sum of total Kjeldahl nitrogen (ammonia, organic and reduced nitrogen) and nitrate-nitrite, all reactive forms of nitrogen. Total inorganic nitrogen (ammonia and nitrate-nitrite) is also an indicator of nutrient enrichment. At Buckeye Lake, TN fluctuated between 1.12 and 5.885 mg/L at the L-1 station between 2014 and 2016. The mean from this period was 2.68 mg/L.

A6.4.1.2 - HABs

The State of Ohio Harmful Algal Bloom Response Strategy for Recreational Waters (2016) identifies numeric thresholds for cyanotoxins as indicators and advisory recommendations for recreational waters. Ohio currently has a standard based on numeric thresholds for microcystins, anatoxin-a, cylindrospermopsin and saxitoxin presence during the recreation season, which spans from June to September. The monitoring and posting of this information is a shared effort involving Ohio EPA, the Ohio Department of Natural Resources (Ohio DNR) and the Ohio Department of Health, and is available at the Beachguard webpage. Ohio EPA will perform cyanotoxin monitoring (microcystins only) during each of the eight scheduled lake sampling events in 2018 at each of the three identified monitoring stations.

A6.5 - Other Consideration for Lake Assessments

A6.5.1 - Planktonic Analysis of Lakes

Phytoplankton populations have shown a general pattern of seasonal succession related to environmental factors such as light, temperature and nutrient load in lakes. A disruption of this pattern and dominance by certain genera may indicate impairment due to eutrophication of the system and can also be used to help define the trophic status of the lake being studied. Water samples are collected according to the methodology described the Inland Lakes Sampling Procedures Manual, preserved and stored until they are shipped to BSA Environmental Services for analysis. Samples are identified and enumerated using the methodology described in Appendix 4. Certain cyanobacteria species produce cyanotoxins that can be harmful to humans if consumed or through dermal contact. By identifying and enumerating phytoplankton, Ohio EPA provides valuable information to PWS operators and lake managers about the presence and concentrations of certain toxin producing cyanobacteria.

A6.6.2 - Sediment

Because the study is focused on nutrient enrichment in the water column, sediment will not be collected during 2018. Further, some sediment samples have been recently collected during part of the 2016 sampling effort.

A6.5.3 - Organic Constituents

Sampling for organic water quality compounds are not part of the focus for this particular study.

A6.5.4 - Water Column Profiles

In order to reveal water column conditions, measurements of temperature (°C), dissolved oxygen concentration (mg/L) and percent saturation (%), pH (SU), specific conductivity (µS/cm), chlorophyll-*a* (RFU) and blue green algae-phycocyanin (RFU) will be collected from the water column at the locations of chemistry grab samples and at roughly 0.5-m depths in-between. These “profile” measurements will be collected at the three designated locations in the lake (see Appendix 1). The information gathered by these measurements provides a basis for scientific assessment of lake condition and can be used to expose certain lake problems. For example, profile data has historically revealed the extent of dissolved oxygen depletion over the summer in several Ohio lakes. Combined with data on water transparency (Secchi depth) and algal pigment (chlorophyll-*a*), these data will be used to calculate the lake's trophic state index (TSI), which is a quantitative, objective measure of the current state of the lake based on eutrophication (Ohio EPA, Ohio Water Resource Inventory Volume 3: Ohio's Public Lakes, Ponds, & Reservoirs, 1996).

A lake profile at each sampling station will be performed using a YSI® multi-parameter EXO-2 sonde. The readings are recorded manually on the Ohio EPA Lake Profile Data Sheet. Data is then entered manually into a Microsoft Excel spreadsheet, where it will be stored for future import to Sample Master®, a Lab Information Management System used by DES. Lab data is added after the results are approved by the DES QAO. The data is then imported into the Ecological Assessment and Analysis Application (EA3), a database manager used by DSW.

A6.5.5 – Sonde Continuous Monitoring Station

Physical water quality will be continuously measured in the lake using one YSI® multi-parameter EXO-2 sonde secured inside a flow through tube mounted to a wooden piling, powered by a solar charged battery. This site is designated as the "Sonde Station". The unit is expected to be installed in the beginning of May and will take measurements near the surface. The unit activates every 30 minutes and measures depth (m), temperature (°C), pH (SU), conductivity (µS/cm), dissolved oxygen concentration (mg/L) and percent saturation (%), specific conductivity (µS/cm), chlorophyll-a (RFU) and blue green algae-phycocyanin (RFU). Data is transmitted via telemetry and managed on a website provided by the manufacturer (www.hydrometcloud.com). Data will be routinely monitored for accuracy. The sonde will be exchanged every three weeks with a clean and calibrated sonde of identical make/model and sensor configuration (see Attachment 4).

A6.5.6 - *Sampling Template DQOs*

Analytes on the Buckeye Lake DES template(s) have been compared to DES minimum detection limits (MDLs) and reporting limits (RLs) to verify that project numerical data quality objectives (DQOs) can be met. Additionally, DES has an agreement with DSW to provide advance warning for any reporting limits that they expect to change. Any special parameters will be addressed in the corresponding attached study plan. The ability of DES to meet numerical DQOs for those parameters added were individually verified and compared to DES limits by the Inland Lakes coordinator.

A7 – Quality Objectives and Criteria

A7.1 - Sampling Objectives

Specific study objectives at Buckeye lake include:

1) to assess the current water quality conditions in Buckeye Lake during the new dam construction,
2) to monitor the water quality trends in Buckeye Lake over time,
3) to collect real-time chlorophyll-*a* and blue green algae data to allow for future correlation with in-situ data and remote sensing products (satellite imagery),
4) to refine methods and procedures for continuous lake monitoring sonde deployment, and
5) to evaluate the general effectiveness of existing nutrient reduction practices in the watershed.

A7.2 - QC Performance criteria

Blanks and duplicate QC samples will be collected at rates consistent with Appendix IV of the DSW field manual (about 5% for the sum of field and equipment blanks and 5% for the sum of duplicates and replicates). The results of these will be evaluated using techniques and thresholds also described in the field sampling manual. Appendix IV – Data Management of that manual describes assessment methodology and acceptable thresholds for blanks, duplicates, and paired parameters. The district lakes coordinators will plan sampling to allow for collection of an appropriate number of QC samples. The division will also do an annual review of QC sampling rates, rates of blank detects, and duplicate sample qualification by parameter.

A8 – Special Training/Certification

All staff involved in collecting any type of environmental sample must complete training associated with that sampling method. Annual chemical sampling refresher training covers a rotating sequence of different methods, instruments, and other issues pertinent to field sampling. The most recent agency-wide lake sampling refresher training was held for all employees in April 2018.

A9 - Documents and Records

The Quality Assurance Project Plan (QAPP) will be posted on the Inland Lakes Web page. Any changes to the original QAPP will be updated and posted appropriately, and the "Lakes Group" will be notified.

DSW management will determine what specific project deliverables will be developed from the study. Deliverables may include updated watershed modeling, summary water quality report(s) and/or presentation of study findings.

The format for all data recording will be consistent with the requirements and procedures used for data validation and assessment described in this QAPP. Files generated according to applicable and attached standard operating procedures (such as raw data, results of QC checks, problems encountered, etc.) will be documented and reported to the study team.

A9.1 - *Document/record control*

The recording media for the project will be a combination of paper and electronic means to document site conditions. Data gathered using paper will be recorded using indelible ink, and changes to such data records will be made by drawing a single line through the error with an initial by the responsible person. Similar methods will be developed for electronic editing.

The Study Team Leader shall retain the most recent version of the QAPP and be responsible for distribution of the current version of the QAPP to the project team. Agency management and the QA will approve updates to the QAPP, as needed. The QA Officer shall retain copies of all management reports, memoranda, and all correspondence between team members identified in Section A.

A9.2 - Document storage

The Study Team Leader will maintain a central project file, which will act as a repository for all data collected or generated as part of this project. The project file will include both hardcopy and electronic data and will be stored at the Ohio EPA office. All files will be retained by Ohio EPA in accordance with established retainment schedules.

SECTION B – DATA GENERATION AND ACQUISITION

B1 - Sampling Design and Limitations

Sample design (including stations/locations) is based on previous Buckeye Lake studies and the Ohio EPA Inland Lakes Sampling protocol. Any deviation from these locations must be reviewed and approved by District staff.

In the event field and lake conditions (e.g. weather) interfere with planned sampling, the decision to cancel sampling or eliminate sites is up to the District staff/field crew. Safety is of primary importance. The decision to reschedule canceled sampling dates and missed locations (sites) will be up to the District staff.

Limitations on past sampling design included fluctuating (low) water levels that made boat navigation and access to lake stations periodically unsafe. Higher water levels are expected for the 2018 study. However, if low water levels impact boat navigation, the field crew can cancel or eliminate sites as described above.

B2 – Sampling Methods

B3.1 - Sampling Strategy for Determining Use attainment

The sampling strategy will focus on evaluating water quality conditions present in the epilimnion of Buckeye Lake. Key water quality parameters include (but are not limited to) total phosphorus, total nitrogen, chlorophyll-*a*, Secchi depth, microcystin, ammonia, dissolved oxygen, pH, total suspended solids, and total dissolved solids.

B3.2 - Sampling Protocols and Procedures

All field practices follow guidelines in the most recent Surface Water Field Sampling Manual (Ohio EPA, Surface Water Field Sampling Manual for Water Quality Parameters and Flows, 2018) and Inland Lakes Sampling Procedure (ILSPM) (Ohio EPA, Appendix I: Inland Lakes Sampling Procedure Manual, 2016) manuals. The current ILSPM will be superseded by any more current versions or addendums that are finalized prior to the first sampling event.

Monitoring will focus on evaluating chemical conditions near the surface and physical conditions in the water column. Samples will be taken from one historical location (L-1) and two recently established sites, one east (L-2) and one west (L-3), to represent impacts from western and southern drainage. The coordinates of the lake sampling sites and their station ID number are listed below. Sampling events will be conducted every three (3) weeks between May – September. Dates will be selected based on convenience for the field crew and sample load at the lab. Because the lake is relatively shallow and windswept, Buckeye Lake does not stratify. Water column samples will be collected from the surface, mid-column and 0.5 meters off the bottom of the lake and composited at L-1 and L-3, and just at mid-column at L-2 due to limited depth at this location.

B3.3 - Lake Sampling Locations

Station L-1 (300412)	39.93055° N. Latitude	82.46449° W. Longitude
Station L-2 (203886)	39.92930° N. Latitude	82.43960° W. Longitude
Station L-3 (301483)	39.1150° N. Latitude	82.50859° W. Longitude
Sonde Station	39.92592° N. Latitude	82.47022° W. Longitude

B3 – Sample Handling and Custody

DSW will use Sample Master® to enter information for sample labels and parameters needed for analysis. This system directly connects to the DES Laboratory Information Management System (LIMS) so that the same number can now be used to track a sample from creation of sample runs and labels through DES electronic delivery of data. Sample submission forms are no longer necessary with this new system. Sample labels are transferred via photocopier to label stock that is adhered to sampling containers. All samples will be handled securely in accordance with Ohio EPA Surface Water Field Sampling Manual from the time they are collected until they are delivered to DES.

B4 – Analytical Methods

The analytical methods to be used in this study are provided in Appendix 2 along with the containers, preservatives, holding times, and reporting limits. Analytical SOPs for individual parameters are available on the DES intranet site.

B5 – Instrument/Equipment Testing and Calibration, Inspection, and Maintenance

In most cases, the team leaders already have experience operating and maintaining sampling instruments and equipment. The YSI® EXO2 sonde will be calibrated in accordance with manufacturer's protocol for the equipment to be used. An individual log book is maintained for each multimeter probe. This log book contains the date of each calibration and standardized pertinent information proving that the device is within specifications. If any of the sonde parameters do not conform to the specifications provided in the standard protocol, the sonde or sensors will be repaired or another unit will be used until the sonde or sensors is/are repaired or replaced. The calibration readings and any repairs are entered into the log book along with any other pertinent information. Other equipment used will follow specifications provided in the water quality sampling procedures manual.

B6 – Inspection/Acceptance of Supplies and Consumables

Supplies and consumables will be inspected upon receipt by the field sampling teams. Nearly all of the supplies utilized for this project are maintained and used during the normal business operations of the Ohio EPA. The field team leaders will be responsible to ensure that all sample containers and all needed supplies and consumables are available in advance of all field work. It will be their responsibility to maintain and replenish stock with assistance from the Inland Lake Coordinator when needed. Consumable supplies include, but are not limited to: sample containers, acid preservatives, Lugol's iodine solution, ethyl alcohol, buffers, filters and miscellaneous supplies such as distilled water, disposable gloves, and towels. Field personnel will confirm that all reagents are within applicable shelf life.

B7 – Data Management

B9.1 - *EA3 and Sample Master®*

The data management process is shared by the Division of Surface Water (DSW) and Division of Environmental Services (DES). Data management for this project will adhere to the procedures outlined in Appendix IV of the Surface Water Field Sampling Manual: Data Management (Ohio EPA, Surface Water Field Sampling Manual for Water Quality Parameters and Flows, 2018). DSW uses a specially designed program called Ecological Assessment and Analysis Application (EA3) and DES uses a Lab Information Management System (LIMS) called Sample Master® for this purpose. These programs are linked together to allow the transfer of information back and forth between the two systems. EA3 software is used to assign a permanent six-digit station ID number to each sampling location and to create a project name to associate locations so data can subsequently be exported and assessed in groups.

Sample Master® is used to schedule and administer the samples that are submitted to DES for analysis. The sample collector logs into the system and places an order by selecting the appropriate project, stations to be sampled and test group(s) to be analyzed. The program creates a chain of custody form and container labels for each site. Samples for analysis of cyanotoxins are submitted using a separate test group to expedite release of the results so they can be posted on the Ohio EPA Harmful Algae Bloom webpage in a timely manner. Samples delivered to DES are logged with a scanner that reads the external ID bar code printed on the label. The samples are then assigned a lab ID number used to track them through the system.

Field measurements are collected instantaneously using a YSI® EXO2 sonde following the methods described in the ILSPM. Parameters will be recorded manually on a paper form and entered into Microsoft Excel and saved on a local or shared network. All agency files are ultimately backed up and housed in the State of Ohio Computer Center (SOCC).

Data files saved in Excel need to be transferred to a table in Sample Master® by the sample collector or delegated data manager. Field data recorded in paper form can also be manually entered into this table. Field and chemistry data from a site are ultimately paired together in this table based on the lab ID number assigned during the sample order process. Field and chemistry data tabulated in Sample Master® are eventually uploaded into EA3. Then, in EA3, the sample collector will review each data sheet for accuracy, validate field QC, add comments, and complete edits if necessary before approving the sheet. This data is then available for use in analysis and reporting.

Continuous monitoring data from the YSI® EXO2 sonde located at the Sonde Station will be continuously uploaded to the contractor's data web site via telemetry (www.hydrometcloud.com). This data will be downloaded periodically and managed electronically using a Microsoft Excel spreadsheet. The spreadsheet will be saved on the Agency CDO DSW data directory in the Buckeye Lake 2018 project folder. Appendix 3 contains an outline of operation and maintenance activities for the Sonde Station.

B9.2 - HAB Samples

Microcystin samples will be submitted under a different project order, separate from the other chemistry samples. This will expedite turnaround of the results. Algal analytical results are posted daily to the DDAGW HAB office and to other EPA officials to make them aware of any HAB presence statewide. The DDAGW HAB office will coordinate any notifications or response needed as specified in the State of Ohio Harmful Algal Bloom Response Strategy for Recreational Waters (2016).

SECTION C - ASSESSMENT AND OVERSIGHT OF DATA COLLECTION

C1 – Sampling Assessments/Analysis and Response Actions

C1.1 - *Sampling Assessments*

Periodic assessment of field sites, field equipment, and laboratory equipment is necessary to ensure that sampling goes smoothly, and data obtained meets project needs. The assessments generally will focus on readiness and consistency of implementation but also seek continual improvement opportunities.

Daily assessments (for each day of project activities, as applicable) will include assessment of field equipment and supplies, laboratory equipment and supplies, completeness of the day's samples and associated field notes, future needs, etc.

C1.2 - *Response Actions*

Despite best preparations, assessments may find situations requiring corrective actions (CAs). Small day-to-day level assessment findings are often addressed by the individual(s) doing the assessment in the field or in the lab and are common enough to the process, so as to not necessitate a formal response. More significant problems will be brought to the attention of the district management and/or the lakes coordinator for discussion and resolution.

Laboratory personnel are aware that response may be necessary (many of these will result in changes to the analytical reporting via data qualifiers and comments) if:

- QC data are outside the warning or acceptable windows for precision and accuracy
- Blanks contain target analytes above acceptable levels
- Undesirable trends are detected in spike recoveries or RPD between duplicates
- There are unusual changes in detection limits
- Deficiencies are detected by the laboratory and or project QA officers during any internal or external audits or from the results of performance evaluation samples
- Inquiries concerning data quality are received

Corrective action implementation will be determined by the likelihood that the situation may affect the quality of the data. Field corrective actions will be brought to the attention of the study team for consideration as to their impact on the data, their potential interest to other sampling teams/subcontractors, and for future considerations for process improvement.

Lab corrective actions will follow regular laboratory procedures and SOPs. Any lab corrective action with the potential to affect data quality will be conveyed to the PI by the laboratory. The PI will evaluate if data requires any additional qualifiers and/or if it is usable for its originally intended purpose.

C1.3 - *Reporting and Resolution of Issues*

Any audits or other assessments that reveal findings of practice or procedure that do not conform to the written QAPP will be corrected as soon as possible. The Study Team and QA Officer will be notified regarding deviations.

C1.4 - *Data Completeness*

If the majority of the samples are collected using the methodology described above, useable data should be expected. Potential data gaps will be monitored as the project progresses and the project schedule will be revised to fill these gaps where they are determined to be significant or to potentially impact the fulfillment of project objectives.

C2 – Reports to Management

The Inland Lakes Coordinator will receive regular sampling updates from the District Water Quality Supervisor throughout the sampling season and will report to upper management during ensuing Senior Management Team meetings. Any large-scale problems that jeopardize completion of the project will lead to written reports and conferral with the lakes coordinator, other Central Office management, and possibly the division's Quality Assurance Coordinator.

SECTION D: DATA VALIDATION AND USABILITY

D1 – Data Review, Verification, and Validation

Data verification will be conducted by the Study Team with assistance from other DSW staff and from DDAGW staff when appropriate. This process will confirm that sample results received match up with samples submitted and parameters requested from the lab, and that any changes to sample labels made in the field have been revised by DES in the electronic system (otherwise the sampler will make the change if needed). The process will also result in summaries of any differences between initial sampling and methods planned in the QAPP and final results reported and available. Differences may result from samples not being collected (due to weather, scheduling, etc.), samples not being submitted (due to accidents like broken containers, or delays resulting in being past holding times, etc.), problems at the lab (methods changing, containers or equipment breaking), or other reasons. It is also possible that additional sampling would take place as a result of field observations/conditions. Documenting deviations from the QAPP is the responsibility of the project leader.

The Division of Environmental Services (DES) laboratory does the initial data review on all data. The Division of Environmental Services laboratory may qualify data based on laboratory QA/QC alone or with feedback from the sampler (regarding specific sampling procedures, variable sampling matrix, conditions, blank contamination, duplicate agreement, matrix spike recovery, *etc*.). DES points out potential QA/QC issues but leaves much of the final data qualification to the sampler/data user (supposing that data may be useable for some purposes and not for others). The data user can evaluate the data given their knowledge of sampling conditions, expected variability given location and matrix, data uses, *etc*.

D2 – Verification and Validation Methods

In addition to verifying data completeness, the Study Team will oversee data validation for the project which will include confirmation of sample holding times, proper preservatives, sample containers, analysis methods, QA/QC results (including assessment of results for blanks, spikes, duplicates, paired parameters), etc. This will also be an ongoing effort, concluding in a data validation summary to be included in the final report.

The Study Team will make final decisions regarding the validity and usability of the and will evaluate the sample collection, analysis, and data reporting processes to determine if the data is of sufficient quality to meet the project objectives. Data validation involves all procedures used to accept or reject data after collection and prior to use. These include screening, editing, verifying, and reviewing. Data validation procedures ensure that objectives for data precision and bias will be met, that data will be generated in accordance with the QAPP and SOPs, and that data are traceable and defensible.

The laboratory QA staff will conduct a systematic review of the analytical data for compliance with the established QC criteria using batch and sample QA/QC information including spike, duplicate, and blank results. All technical holding times will be reviewed, the laboratory analytical instrument performance will be evaluated, and results of initial and continuing calibration will be reviewed and evaluated.

Field QC sample results will be evaluated using recently clarified DSW procedures available in Appendix IV of the Surface Water Field Sampling Manual (Ohio EPA, Surface Water Field Sampling Manual for Water Quality Parameters and Flows, 2018).

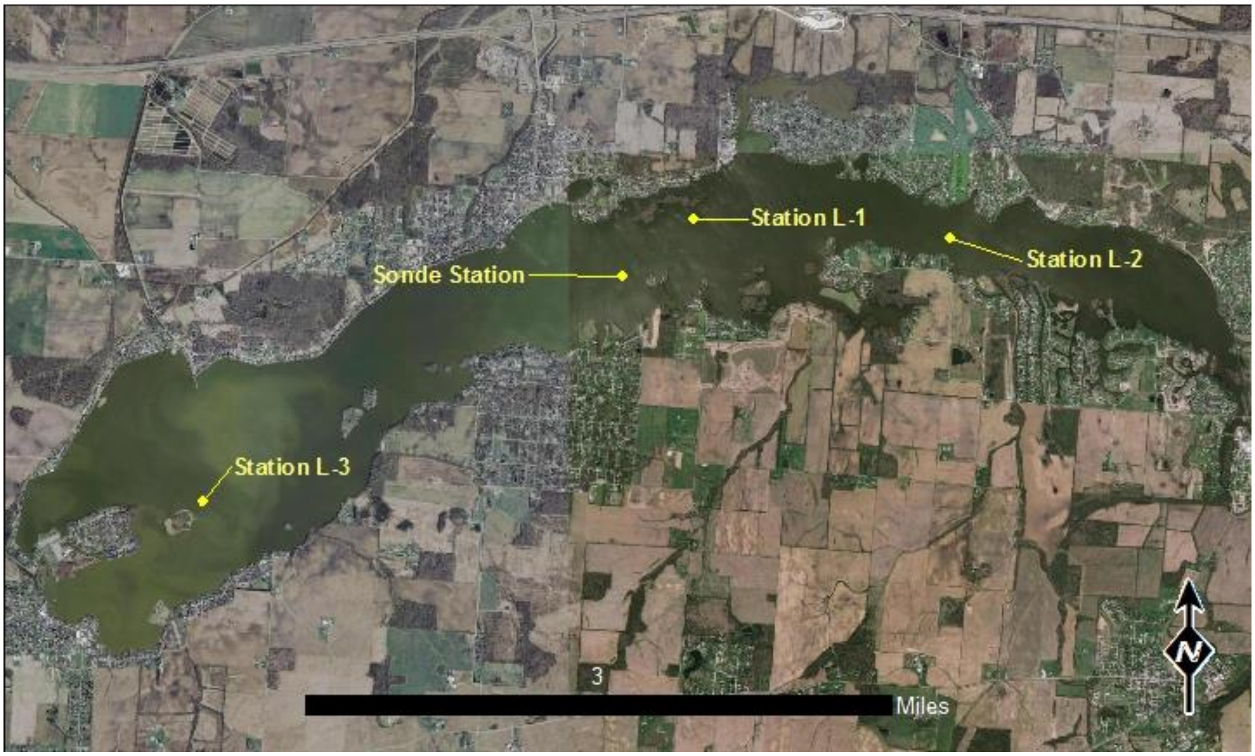
D3 – Reconciliation with User Requirements

Data qualifiers applied to sample results by DES at the lab and by samplers in the EA3 system will remain with the analytical results both in EA3 and in STORET/Water Quality Portal when the data is transferred to US EPA. This will reflect limitations of analytical results for current and future users of sampling data. Other anomalies will be recorded in the EA3 comments and/or field notes to be retained by DSW.

Issues related to data uncertainty, including any patterns of analytical or field QC uncertainties, will be assessed by samplers, other internal data users (DDAGW) and their management. Significant or persistent issues will be brought to the attention of the EA3 team, division QC personnel, and DES for further evaluation. This combination of personnel will assess how to best label affected data for storage in the database and how to eliminate or limit any similar problems going forward.

Appendix 1 – Buckeye Lake Monitoring Stations

Station Code	Location Description	Latitude	Longitude
300412	BUCKEYE LAKE L-1	39.93055	-82.46449
203886	BUCKEYE LAKE L-2	39.92930	-82.43960
301483	BUCKEYE LAKE L-3	39.1150	-82.50859
NA	Sonde Station	39.92592	-82.47022



Appendix 2 – Parameter Sampling List

Table 6. Key parameters for Buckeye Lake sampling with relative sampling information.

Parameter	Method	Reporting Limit	Container	Preservative	Holding Time (Max.)
Temperature	Field meter – YSI EXO2 sonde	0.1 °C	NA	NA	NA
Dissolved Oxygen		0.01 mg/L			
Dissolved Oxygen		0.10%			
pH		0.1 S.U.			
Specific Conductance		0.1 µS/cm			
Chlorophyll-*a*		0.1 RFU			
Blue green algae-phycocyanin		0.1 RFU			
Secchi Depth	Secchi disk	0.1 m			
Alkalinity	USEPA 310.1	5 mg/L	1 L LDPE	2 ml H_2SO_4	14 days
Ammonia-Nitrogen	USEPA 350.1	0.05 mg/L	1 L LDPE	2 ml H_2SO_4	28 days
Carbonate-Bicarbonate	SM 2320B	5 mg/L	1 L LDPE	2 ml H_2SO_4	14 days
Carbon, Total Organic	SM 5310B	2 mg/L	4 L LDPE	NP	28 days
CBOD20	OEPA 310.2	3 mg/L	4 L LPDE	NP	48 hours
Chloride	USEPA 325.1	5 mg/L	1 L LDPE	2 ml H_2SO_4	28 days
Nitrate	SM 4500-NO3-D	0.5 mg/L	1 L LDPE	2 ml H_2SO_4	28 days
Nitrite	USEPA 353.2	0.02 mg/L	1 L LDPE	2 ml H_2SO_4	48 hours
Nitrogen, Total Kjeldahl	USEPA 351.2	0.2 mg/L	1 L LDPE	2 ml H_2SO_4	28 days
Solids, Total Dissolved	SM 2540C	10 mg/L	4 L LPDE	NP	7 days
Solids, Total Suspended	SM 2540D	5 mg/L	4 L LPDE	NP	7 days
Sulfate	USEPA 375.2	5 mg/L	1 L LDPE	2 ml H_2SO_4	28 days
Total Phosphorus	USEPA 365.4	0.01 mg/L	1 L LDPE	2 ml H_2SO_4	28 days
Turbidity	OEPA 180.1	1.0 NTU	4 L LDPE	NP	48 hours
Chlorophyll-*a* (+ Pheophytin)	USEPA 445	0.05 mg/L	GC Glass Filter	NP	25 days
Microcystin	OEPA 701	250 mg/l	PETG	NP	5 days

Appendix 3 – Continuous Monitoring Station Protocol

Buckeye Lake General Protocol for Operation and Maintenance of Sonde at Continuous Monitoring Station (2018)

Daily Review of Continuous Monitoring Data via Telemetry and Website:

1. Staff will review data communication and water quality measurements at least once daily (Monday-Friday) via the station website.
2. During daily review staff will note battery (or power) status, data gaps, negative sensor readings, truncated sensor readings, station depth issues or other issues with data transmission and water quality measurements.
3. Staff will record or log any spurious sensor data for further evaluation (and deletion if necessary). If problems are identified a station field visit may be needed.

Maintenance Functions during Station Field Visits (Recommended frequency – every 3 weeks):

1. Inspect station for any signs of physical damage, vandalism or tampering.
2. With recently calibrated independent field sonde, observe and record readings next to the station sonde.
3. Remove station sonde from station. Record time of removal. Clean fixed station sonde deployment tube. Deploy the recently calibrated independent field sonde as the new station sonde. Record time of deployment.
4. Return old station sonde to lab.
5. In lab, perform a pre- and post-cleaning sonde check in air-saturated tap water. Record pre- and post-cleaning readings.
6. In lab, calibrate sonde after cleaning. Record calibration readings.
7. Prepare sonde for next station deployment.

Appendix 4 - BSA Phytoplankton Identification and Enumeration Methodology

BSA Environmental Services, INC. Lab Methodology
(Dr. John Beaver)

SAMPLING HANDLING, LOGGING, AND TRACKING

The chain-of-custody requirements for all laboratory operations for each sample (i.e., record keeping associated with sample acquisition, sample labeling, sample tracking to establish chain-of-custody, and shipping and packing) and laboratory analysis (i.e., laboratory coding, storage, check-out, and documentation of sample movement) will be fully documented. Samples will be stored in a refrigerated secure location in the laboratory restricted to authorized personnel. Samples will be preserved in Lugol's solution (1-2%) refrigerated immediately upon Receipt in the laboratory until analyses are performed. Dated and signed entries by appropriate personnel on all worksheets and logbooks will be required for data validation. The client will be informed of the presence and condition of all samples upon arrival at BSA.

PHYTOPLANKTON ANALYSES

Phytoplankton slides will be prepared using standard membrane filtration technique (McNabb, 1960). This technique will preserve cell structure and provide good resolution, allowing the samples to be examined at high magnifications. Samples will be thoroughly mixed as a part of the filtering process to ensure that the organisms will be evenly distributed.

A Leica DMLB compound microscope (100X, 200X, 400X, 630X, 1000X) will be used for enumerating filtered phytoplankton samples. The magnification used will depend upon the size of dominant taxa and presence of particulates. The goal is to count at multiple magnifications such that enumeration and identification of taxa which vary over several orders of magnitude in size is achieved. If a sample is dominated by cells or natural units below 10-20 µm, or when cells are fragile and difficult to identify, the majority of counting will be completed at 630X.

The abundance of common taxa will be estimated by random field counts. At least 300 natural units (colonies, filaments, unicells) will be enumerated to the lowest possible taxonomic level from each sample. In addition, an entire strip of the filter is counted at 630X and half of the filter is counted at 400X for any organisms missed during the random fields count to further ensure complete species detection.

Cell biovolumes of all identified phytoplankton taxa will be quantified on a per milliliter basis. Biovolumes will be estimated using formulae for solid geometric shapes that most closely match the cell shape (Hillebrand et al., 1999). Biovolume calculations will be based on measurements of 10 organisms per taxon for each sample where possible.

BSA has an extensive hard copy and digital reference library, which includes thousands of taxonomic references and keys. Our literature collection is continually expanding as new sources of information become available. In addition, BSA's location allows immediate access to several university libraries. Every effort will be made to use the most current taxa names, and any Rent changes in nomenclature will be noted.

QUALITY ASSURANCE/QUALITY CONTROL

The chain-of-custody requirements for all laboratory operations for each sample (broadly interpreted to include procedures for the preparation of reagents or supplies which become an integral part of the sample record keeping associated with sample acquisition, documentation of sample preservation, sample labeling, sample tracking to establish chain-of-custody, and shipping and packing) and laboratory analysis (i.e., laboratory coding, storage, check-out, and documentation of sample movement) will be fully documented. Samples will be stored in a secure location in the laboratory restricted to authorized personnel. Dated and signed entries by appropriate personnel on all worksheets and logbooks are required for data validation. Custody sheets accompanying samples delivered by the Government will be signed and returned, if applicable.

Data reporting must indicate data quality. Documentation of all samples will be traceable from the raw data to the final presentation in the final report. Data validation, reduction, and reporting requirements will include checking every entry into the electronic database against the raw data tabulated on the data log sheets.

DATA REPORTING

Microsoft Excel® spreadsheets, unless specified otherwise, will be used for all data reporting, and the appropriate sample information from the Chain of Custody will be included along with all data. Data reports will include taxonomic information, cell density (cells/ml), and biovolume measurements.

References

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