Ohio Environmental Protection Agency

Quality Assurance Project Plan for Lake Erie Monitoring

Division of Surface Water
Northeast and Northwest District Offices

March 2021

Quality Assurance Project Plan for Lake Erie Monitoring

Lucas, Ottawa, Sandusky, Erie,
Lorain, Cuyahoga and Ashtabula Counties

March 2021

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Section A – Project Management

A1 – Title of Plan and Approval — Quality Assurance Project Plan for Lake Erie Monitoring

Brian W Hall — Date: 4/13/2021
Chief or Assistant Chief

Date: 3/30/2021
Mari Piekutowski, Modeling Manager

Bill Zawiski — Date: 3-29-21
Bill Zawiski, NEDO Water Quality Supervisor

John Weaver — Date: 03/26/2021
John Weaver, Interim NWDO Water Quality Supervisor

Victoria Houser — Date: 03/29/21
Vacant, Ohio EPA Quality Assurance Coordinator

This 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 Lake Erie monitoring program. The complete QAPP includes this document and its associated study plan as well as references to other manuals, which together 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

This QAPP will be distributed to the following division management and staff, saved on the DSW Lake Erie Programs collaboration site and posted on the following webpages: DSW Lake Erie Programs; Surface Water (DSW); Environmental Services (DES); and Drinking and Ground Waters (DDAGW).

Table 1 — Distribution List.

Name/Title	Contact Email/Phone	
Division of Surface Water- Central Office		
Tiffani Kavalec, Environmental Administrator	*tiffani.kavalec@epa.ohio.gov*	(614) 644-3538
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Division of Surface Water- Northeast District Office		
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Division of Surface Water- Northwest District Office		
John Weaver, Geology Program Supervisor	*john.weaver@epa.ohio.gov*	(419) 373-3098
Brent Kuenzli, Environmental Specialist 2	*brent.kuenzli@epa.ohio.gov*	(419) 373-3005
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Division of Environmental Services (Lab)		
Jennifer Kraft, Environmental Manager	*jennifer.kraft@epa.ohio.gov*	(614) 644-3020
Steve Roberts, Environmental Supervisor	*steven.roberts@epa.ohio.gov*	(614) 644-4225
Division of Drinking and Ground Water- Central Office		
Amy Jo Klei, Chief	*amy.klei@epa.ohio.gov*	(614) 644-2871
Colin White, Environmental Manager	*colin.white@epa.ohio.gov*	(614) 644-2759
Ruth Briland, Environmental Specialist 3	*ruth.briland@epa.ohio.gov*	(614) 369-4045
Ohio Lake Erie Commission		
Lynn Garrity, Program Administrator	*Lynn.Garrity@lakeerie.ohio.gov*	(614) 506-0619

A4 – Project/Task Organization and Communication

Table 2 — Roles and Responsibilities.

Individual(s) Assigned:	Responsible for:	Authorized to:
Division of Surface Water		
Tiffani Kavalec/Brian Hall DSW Chief/Assistant Chief	Overall coordination and administration of division.	Approve project, approve resources, resolve disputes, suggest changes and edits
John Mathews SWIF Section Manager	Oversee Lake Erie programs and prepare federal grants.	Review budgets and project proposals.
Cherie Blair Lake Erie Program Staff	Coordination of Lake Erie program grant.	Allocate staff resources, approve purchases and pay invoices.
Mari Piekutowski AMS Section Manager	Plan and manage section activities.	Review documents and reports and suggest changes and edits.
Paul Gledhill Lake Erie & MATS Staff	Coordinate Lake Erie technical activities in DSW. Integrate GLWQA and DAP commitments.	Review documents and reports; suggest changes and edits.
Melinda Harris TMDL Supervisor	Oversee completion of IR.	Supervise staff and assign project tasks.
Kate Hamilton TMDL Staff	Compile information for IR and write assigned sections.	
Audrey Rush STS Section Manager	Coordinate the review of QAPPs and SOPs and establish training programs.	Review documents and reports; suggest changes and edits.
Vacant QA Officer	Implement DSWs quality management program. Track training.	Review documents and reports; suggest changes and edits.
Rich Blasick District Managers	Ensure division programs are implemented at the district.	Review documents and reports; suggest changes and edits; obtain approvals and signatures.
Bill Zawiski/ John Weaver District Water Quality Supervisors	Ensure district techs are properly trained, supplied and equipped.	Review reports, suggest changes and edits, obtain approvals and signatures and develop budgets.
Scott Winkler/Brent Kuenzli District Water Quality Technicians	Data collection, validation and management and report writing.	Schedule and complete field activities. Procure supplies, equipment and maintenance.
Division of Environmental Services		
Jennifer Kraft Program Administrator	Oversee sample analysis. Direct method development.	Technical assistance. Coordinate information management system.
Steve Roberts QA Officer	Oversee data validation and delivery.	Review documents and reports; suggest changes and edits.
Kristin Sowards Lab Coordinator	Sample scheduling and receiving.	Log samples. Send lab supplies when needed.

Individual(s) Assigned:	Responsible for:	Authorized to:
Division of Drinking and Ground Waters		
Amy Jo Klei DDAGW Chief	Overall coordination and administration of division.	Approve Harmful Algae Bloom program resources.
Colin White, Emerging Contaminants Manager	Plan and manage section activities.	Review documents and reports and suggest changes and edits.
Ruth Briland	Implement HAB management program. Coordinate with DSW.	Review documents and reports and suggest changes and edits.
Ohio Lake Erie Commission		
Lynn Garrity	Coordinates implementation of Lake Erie Management Plan (LAMP) activities.	Review documents and reports and suggest changes and edits.

KEY

DSW - Division of Surface Water; SWIF - Surface Water Improvement Fund; AMS – Assessment and Modeling Section; MATS – Modeling, Assessment and TMDL Section; STS - Standards and Technical Support; GLWQA - Great Lakes Water Quality Agreement; DAP - Domestic Action Plan; IR - Integrated Report

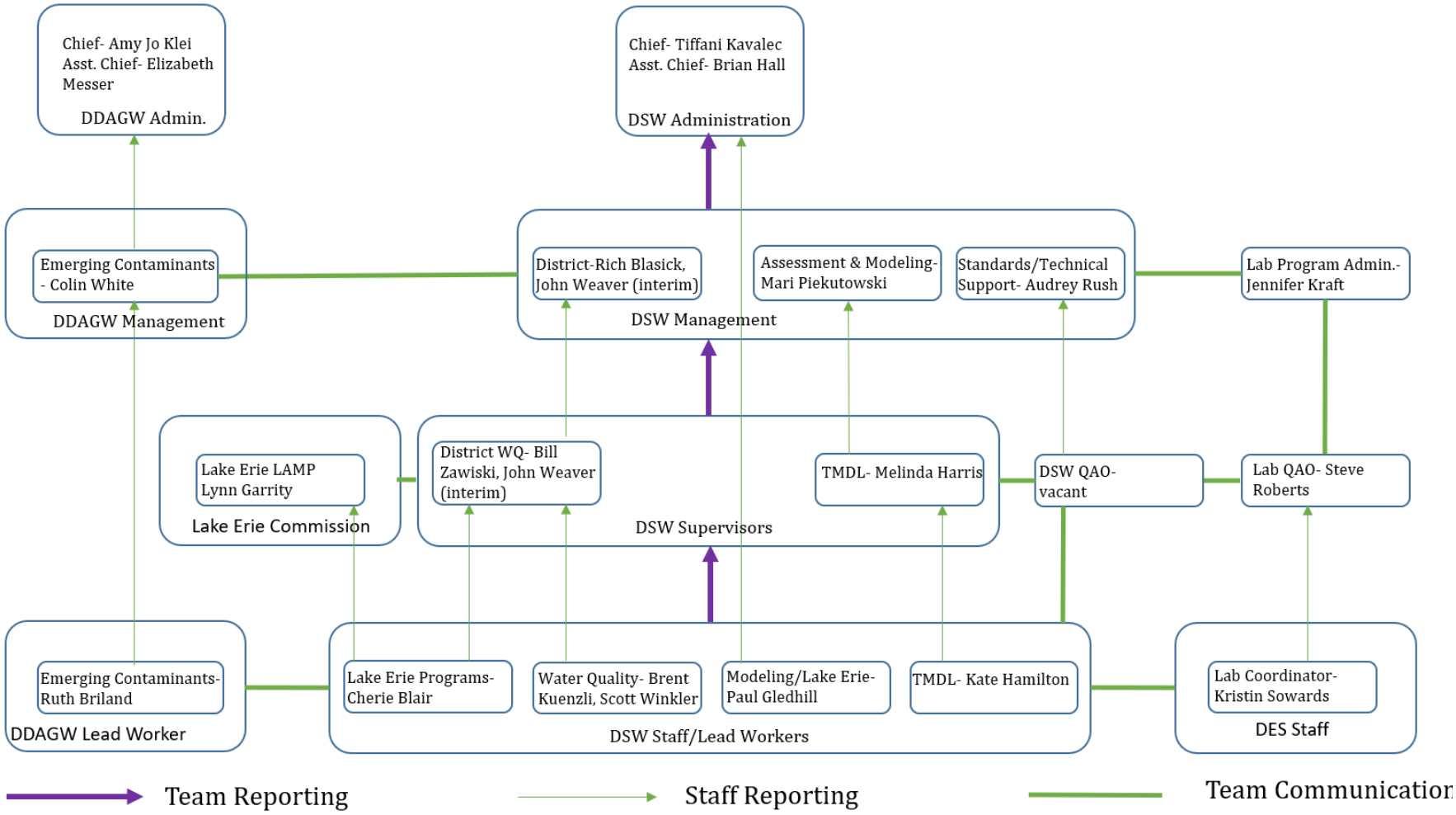


Figure 1 — Organization Chart

A5 – Problem Definition/Background

Building on the 2010 National Coastal Condition Assessment (NCCA) Ohio EPA launched the Comprehensive Nearshore Monitoring Program in 2011 using funding under the Great Lakes Restoration Initiative (GLRI). The project was designed over a three-year cycle to develop methods, gain expertise and build a baseline for water quality conditions in nearshore areas of Lake Erie. The experience gained served as the impetus to integrate annual Lake Erie nearshore monitoring into Ohio's statewide strategy.

The data generated by this project supports several state and federal initiatives. Sections 305(b) and 303(d) of the Clean Water Act require authorized states to submit biennial reports on the general condition of waters of the state and to develop a prioritized list of those that are not meeting goals. Ohio EPA's Division of Surface Water (DSW) submits the *Integrated Water Quality Monitoring and Assessment Report* (Integrated Report) to fulfill this requirement. The report summarizes the status of select beneficial uses based on the assessment unit framework.

The Great Lakes Water Quality Agreement (GLWQA) establishes bi-national objectives for the Great Lakes. Annex 1 of the act addresses Great Lakes Areas of Concern (AOCs). These are highly contaminated sites in need of restoration. There are four AOCs in Ohio waters of Lake Erie: Maumee; Black; Cuyahoga; and Ashtabula. Annex 2 of the act addresses Lakewide Action and Management Plans (LAMPs). These documents report on existing scientific information and are intended to develop and implement lake-specific strategies needed to address initiatives called for under other annexes. Annex 4 of the act addresses nutrients and establishes both ecosystem objectives and interim substance objectives for total phosphorus.

Lake Erie monitoring objectives:

- Provide credible water quality data.
- Support Integrated Report beneficial use assessments.
- Support AOC beneficial use assessment and de-listing.
- Track nutrient concentrations against interim substance objectives.
- Evaluate minimum dissolved oxygen in the hypolimnion of the Central Basin.
- Monitor burrowing Mayfly populations as an indicator of eutrophication.
- Collect algal community composition and biomass information.
- Support Cyanotoxin advisory database.

A6 – Project/Task Description

The Ohio Water Quality Standards (WQS) are codified in Ohio Administrative Code (OAC) Chapter 3745-1. The standards include beneficial use designations for waters of the state and narrative and numeric criteria established to protect those uses. This project is intended to gather data so beneficial uses can be evaluated and the results reported in the Integrated Report based on the assessment unit framework. Beneficial uses for Lake Erie are listed in OAC 3745-1-31. The *2020 Integrated Report* divides Lake Erie into four shoreline assessment units (Western, Islands, Sandusky and Central) that are defined as the portion that extends along each basin out to and including a depth of three meters from the shore. Three open water assessment units (western, Sandusky and central) are also delineated as area beyond three meters of depth. Beneficial uses being evaluated include Recreation and Water Supply.

In previous recent years, Ohio EPA has collected fish community data to assess the Aquatic Life Use of Lake Erie's shoreline assessment units. This monitoring will not occur in 2021. Ohio EPA is currently working with academic and government experts in Lake Erie biological resources to better refine and define our assessment for this beneficial use.

Lake Erie is designated as Bathing Water for recreation. Bathing Waters are heavily used for swimming during the recreation season and include beaches where a lifeguard or bathhouse facilities are present. This project will not evaluate Lake Erie beaches because an advisory system for bacteria is administered by the Ohio Department of Health .

Lake Erie assessment units are also evaluated for recreation use impairments due to harmful algae blooms (HABs). The data that are collected and outlined in this QAPP are not used for these assessments. Refer to the 2020 Ohio Integrated Report for details of this evaluation and previous year's assessment results.

Parameter	OMZA (mg/L)
Nitrate-Nitrite	10
Dissolved Solids	500
Chloride	250
Sulfate	250

Lake Erie is designated as Public Water Supply (PWS). These are waters suitable for potable use with conventional treatment and meet federal regulations for drinking water. Numeric chemical criteria associated with this use are found in OAC 3745-1-33 and apply as outside mixing zone averages (OMZA) within 500 yards of surface intakes. Nitrate is a product of the bacterial oxidation of ammonia. It is typically the most abundant form of dissolved inorganic nitrogen available to microorganisms and plants in nature. Nitrite is an intermediate form of dissolved inorganic nitrogen in the aerobic conversion of ammonia to nitrate and is generally found at low levels. Elevated nitrates in drinking water (>10 mg/l) can result in decreased oxygen carrying capacity of hemoglobin in infants, sometimes resulting in death. Dissolved solids are the amount of filterable residue in water measured by weighing the amount of material remaining after the evaporation of a filtrate. It measures the amount of minerals and other substances dissolved in the sample. Chloride and sulfate are common anions dissolved in surface water. Chloride is considered a conservative parameter because its concentrations vary primarily through dilution or evaporation and not biological or chemical processes. Sulfur is an important plant nutrient. It is derived from sedimentary rock and is cyclic in lakes. Sulfate is an oxidized form of sulfur that is readily available for plant uptake.

Ecosystem objectives established in Annex 4 of the GLWQA include: minimize the extent of hypoxic zones; maintain algal biomass below nuisance condition; maintain algal species consistent with healthy ecosystems in nearshore waters; maintain cyanobacteria biomass at levels that do not produce concentrations of toxins that pose a threat to human or ecosystem health; and maintain mesotrophic conditions in the open waters of the Western and Central basins of Lake Erie.

In-situ water column profile measurements will be recorded whenever sampling is done at an ambient monitoring station or at Central Basin transect point that connects a nearshore ambient station with a deep offshore location. These measurements will be done using a SeaBird® 19Plus CTD field meter. The unit measures dissolved oxygen, temperature, pH and conductivity. Dissolved oxygen (DO) is essential for the survival of aquatic organisms and numeric criteria are established in OAC 3745-1-35 to protect aquatic life. The minimum criterion for the EWH aquatic life use is 6.0 mg/L. Zones of low DO (hypoxia) can occur on lake bottoms as oxygen is consumed by bacterial decomposition. This problem can be exacerbated when thermal stratification blocks mixing from the surface. Hypoxia reduces the amount of habitat available to aquatic life and contributes to internal cycling of nutrients. The Annex 4 nutrients subcommittee recommends a minimum dissolved oxygen concentration of 2.0 mg/L in the bottom waters of the Central Basin.

Temperature measurements are important because most aquatic organisms inhabit preferred ranges. To address this, the OAC 3745-1-31 includes maximum and average temperature criteria for the western and central basins of Lake Erie and maximum criteria for the hypolimnion when the lake is stratified. Aquatic organisms are also sensitive to pH and to protect aquatic life a range of 6.5-9.0 is established in the Ohio WQS. Alkalinity buffers aquatic life against rapid changes in pH. Samples will be collected for lab analysis and expressed as calcium carbonate. Bicarbonate is generally the most common form of alkalinity in natural waters and will also be analyzed. It is an important source of dissolved carbon needed for

photosynthesis. Conductivity measures the ability of water to conduct electricity due to the presence of dissolved ions.

Chlorophyll a is a photosynthetic pigment present in phytoplankton. This analysis will be done at all ambient monitoring stations using a known volume of filtered water. There are many variables, but this value can be used to estimate algal biomass and calculate trophic state. Secchi depth is also correlated with primary productivity and will be measured at all ambient monitoring stations. It is a measure of light transparency through the water column using a black and white disk. Suspended solids will be analyzed to help discern turbidity due to inorganic matter. This measures the amount of filterable residue not soluble in water found in suspension by weighing the amount of material remaining on a dried filter. Phosphorus is an essential growth nutrient and will be analyzed at all ambient monitoring stations. It is less abundant than other nutrients and tends to be the limiting factor in biological activity. When the GLWQA was re-authorized in 2012, interim substance objectives for spring mean phosphorus concentration of 15 µg/L and 10 µg/L for the western and central basins, respectively, were retained. Phosphorus loading from tributaries is a better predictor of HABs, but this project will track lake concentration to monitor trends. Total phosphorus is a measure of all organic, inorganic, particulate and dissolved forms present, while orthophosphate is the dissolved inorganic fraction readily available for biological uptake. Nitrogen is also an essential growth nutrient, but it is usually not limiting. Total Kjeldahl Nitrogen (TKN) analyzes organic nitrogen and ammonia and combined with nitrate-nitrite can be used to calculate total nitrogen. Ammonia is a product of organic decomposition and the most reduced form of nitrogen. It is readily available for biological uptake, but concentrations are generally low in well oxygenated water. Ammonia is toxic to aquatic life under certain conditions and EWH aquatic life criteria in OAC 3745-1-35 apply to the waters of Lake Erie.

Narrative Description	Mayfly nymphs/m^2 (3 yr. moving avg.)
Imperiled	>400
Good	301-400
Excellent	201-300
Good	101-200
Fair	30-100
Poor	<30

Algal community health will be evaluated by sampling for species count and identification. Toxins will be evaluated by submitting samples for analysis of microcystins. Benthic community health will be evaluated by calculating burrowing mayfly density found in sediment samples collected at a series of historical monitoring stations in the western basin. The status of mayfly populations can be used to evaluate changes in water and sediment quality, such as eutrophication and hypoxia.

A7 – Quality Objectives and Criteria

To ensure that the physical measurements generated from the SeaBird® 19Plus CTD profilers are highest possible quality, calibration and maintenance will be performed according the manufactures requirements. The quality of the measurements generated by these meters is of a level suitable to support the evaluations and decisions required by this monitoring program. Secchi disc measurements will be read three times and the average result recorded.

Analytical chemistry data will be generated to meet or exceed the methods and performance criteria identified in Section B. Achieving these performance criteria will ensure the data is of sufficient quality to evaluate the numerical targets and criterion identified in Section A6. It will be necessary to evaluate the sampling methods and performance criterion as targets and standards are updated to ensure that objectives are meet. Field QC samples (duplicates and blanks) will be collected at about five percent for the sum of field and equipment blanks and five percent for the sum of duplicates and replicates. Field QC sample types and collection frequency are defined in Subsection E5 of the *Surface Water Field Sampling Manual for water quality parameters and flows* (Ohio EPA, 2018), herein referred to as Surface Water Field Manual. Methods for data validation, including acceptable thresholds for blanks, duplicates and paired parameters, are found in Appendix IV, Section A of the Surface Water Field Manual. The district water

quality staff will plan each sampling trip to allow for collection of an appropriate number of QC samples. The DSW quality assurance officer will do an annual review of QC sampling rates, rates of blank detections and duplicate sample qualification by parameter.

Benthos samples for evaluation of mayfly density and distribution must be collected in early spring prior to the emergence of the nymph. Three separate substrate grabs are required using a standard Ponar® and 0.50 mm sieve bucket.

Quality objectives are primarily set for laboratory analytical chemistry parameters. Those for physical parameters and field measurements are not as rigorous as those for lab parameters. Quality objectives for biological assessment is incorporated into those specific methods. Representativeness is addressed through the sample site selection process.

Precision is assessed by collecting two environmental samples at the same time from the same sampling device. Each sample is preserved and numbered separately and sent to the laboratory as separate samples. Analysis of such duplicates allows data users to evaluate the precision of the entire data collection effort including sampling, sample transport and sample analysis. Results of the duplicate QC samples are evaluated using a scaled approach for acceptable Relative Percent Difference. Samples that do not meet the standard described may be qualified as estimated (J), suitable only for trend analyses (Trend) or rejected (R).

Bias is the systematic distortion of a measurement process that causes errors in one direction and is part of an overall assessment of accuracy. Bias and accuracy are assessed through analysis of analytical standards of known concentration, comparison among multiple instruments (when available) and assessment of Performance Testing (PT) samples. The Division of Environmental Services (DES) analyzes PT samples for all surface water parameters on an annual basis.

In addition to the use of inter-lab PT studies, DES employs several types of laboratory QC measures (for example, instrument calibration standards from multiple sources, method blanks, etc.) that provide information about the accuracy and bias associated with various components of the analysis process. Additionally, QC control charts are used to track any drift or other changes in QC accuracy over time.

Sensitivity is monitored and controlled using annual Method Detection Limit (MDL) studies required for each analyst on each instrument. DES has an MDL study protocol for this purpose and that protocol is based on CFR 40 Part 136 app. B. To determine an MDL using this protocol, at least seven replicate samples with a concentration of the pollutant of interest near the estimated MDL are analyzed. Resulting MDLs are posted on DES' intranet page and are updated annually.

Monitoring of completeness is an ongoing process and if a significant lack of completeness is noted causes of the problem(s) will be investigated and minimized and every effort will be made to fill any gaps in annual data sets. When samples are not collected at a station, the reason will be documented by field staff. If a significant lack of completeness occurs, an explanation of the reasons causing the issue(s) will be documented in an addendum to this QAPP.

Comparability expresses the confidence that two data sets can contribute to a common analysis and interpretation. Annual comparisons are made between sampling technique of the NWDO and NEDO samplers to minimize differences in field technique and account for any method drift that may arise. Similar technique comparisons are made among DES analytical staff. Additionally, written SOPS are followed and revised as needed for all staff in both areas.

A8 – Special Training/Certification

Ohio EPA's DSW uses a system called TrainTrack to document staff data collection training. All staff involved in collecting any type of environmental sample must complete training associated with that sampling method. Annual spring refresher training and fall workshop events cover a rotating sequence of different methods, instruments and other issues pertinent to field sampling. Staff who operate watercraft are required to attend annual boating safety refresher and demonstrate proficiency in boat operation to their supervisor. Lake Erie and Inland Lake monitoring programs coordinate and collaborate with each other. Specific lake sampling quality exercises were conducted in 2014 and 2015 wherein lake sampling staff from all districts conducted side-by-side sampling to confirm consistency of techniques. No collections methods have changed since these events.

Additionally, Ohio EPA Lake Erie field crews will continue to collaborate and train with USEPA for the National Coastal/Great Lakes assessments every five years. This occurred in 2010, 2015, and 2020.

A9 – Documents and Records

Microsoft® SharePoint software will be used as a documents library for Ohio EPA staff. The DSW Lake Erie Programs folder will act as a repository for all data collected or generated as part of this project, including the approved QAPP. All files will be retained by Ohio EPA in accordance with established retention schedules. Agency management and the QA Officer 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. The Ohio EPA Lake Erie Programs Internet page will also be used to share documents and records.

A combination of paper and electronic means will be used to document site conditions in the field. 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. Field data collected with the SeaBird® profiler are managed using Seasave V7 software provided by the manufacturer. The unit needs to be connected to an external device (tablet or laptop) to accomplish this. A file name based on the station ID# and sampling date is entered in the site information screen. Files saved in the field will be downloaded to an Ohio EPA PC that is backed-up in the State of Ohio Computer Center (SOCC). Profile data are not currently compatible with agency data management systems.

Lab samples will be submitted to Ohio EPA's Division of Environmental Services (DES) for analysis. DES manages workflow using Sample Master® software. The system generates a chain of custody form when an order is placed by the sample collector. The form includes an order number, a list of sample sites by name and station ID and the test group to be analyzed. A sheet with container labels is also generated. They include the sample#, station ID#, site name and type of preservative. This sheet is photo copied onto an adhesive label that is applied to the appropriate container. The original chain of custody form is delivered to DES along with the samples. A copy of the form is electronically retained by the sample collectors in both district offices. When samples are delivered to DES they are logged in the system as received.

After water samples are analyzed and the results are approved by the DES QA Officer the data will be released to Sample Master® and subsequently uploaded to DSW's Ecological Assessment and Analysis Application (EA3). The sample collector reviews them for completeness and accuracy, validates field QC, adds comments and completes edits if necessary and approves the sheet. All data approved in EA3 is sent to U.S. EPA's Water Quality Exchange. An Excel spreadsheet that summarizes the results will be saved to the collaboration site and posted on the Lake Erie Programs webpage.

Section B – Data Generation and Acquisition

B1 – Sampling Process Design

Design for Ohio's Lake Erie nearshore monitoring program implemented in 2014 was modeled after several previous studies, especially the 2011-2013 GLRI project. Nineteen ambient water quality and nine mayfly stations that will be sampled are listed in Table 3 and transect sampling points are listed in Table 4. Sites were selected to represent an even geographic distribution of the lake. Maps of these locations are shown in Figure 2 (three separate images).

B2 – Sampling Methods

Sampling will be initiated after ice out in the Western Basin and in May in the Central Basin and continue through the end of September. Samples from the Maumee River estuary and Western Basin will be collected once every two weeks and the Central Basin samples will be collected monthly. Special consideration needs to be given to safety due to the unpredictable nature of weather and sea conditions on the Great Lakes. This includes safety considerations due to current lake water elevation. Work will only be done if the sample collector decides it can be completed in a safe manner.

Staff will follow the agency COVID-19 General Protocols for Field Activity SOP and other associated SOPs such as the motor pool and COVID-19 General Protocols for Office Entry.

Mayfly Density

Mayfly sampling methods follow procedures that were developed for the Lake Erie Quality Index described in *Mayfly Metric of the Lake Erie Quality Index: Design of an Efficient Censusing Program, Data Collection and Development of the Metric* (Krieger, 2004). Mayfly sample collection, processing and storage is done at Northwest District Office since all the stations are in the Western Basin. Mayfly stations will be sampled once in the spring (April/May) prior to the annual hatch. Three separate sets of samples will be collected at each station using a standard Ponar® dredge. Contents from each dredge pull will be placed in a device (bucket or tray) equipped with a standard no. 40 sieve (0.50mm) and washed with site water until as much sediment is removed as possible and mostly benthos remains. The sample will then be placed in an individually labeled 1L HDPE container and preserved with five percent formaldehyde. Prior to enumeration a small amount of Phloxine dye (enough to cover the tip of a spatula) will be added to each container to aid in the identification of nymphs. The dyed samples will be rinsed under a fume hood with tap water through a standard no. 40 sieve and transferred to a white lab tray for sorting. Containers with large volumes of material will be processed in small aliquots until the entire sample is sorted. Nymphs from each container will be removed, counted and recorded on a lab bench sheet. Once counting is complete the nymphs will be placed in a labeled glass vial and preserved with 60 percent ethanol, so they can be archived. To calculate burrowing mayfly density at a site (m^2) the average calculated from the three sets of samples is divided by 0.0537.

Table 3 — Water quality and mayfly stations that will be sampled in Lake Erie nearshore, bays and estuaries.

Station ID	Description	Latitude	Longitude
Maumee River Estuary[1]			
301641	Maumee River below I-280	41.6610	-83.5105
P11S32	Maumee River near Mouth	41.6943	-83.4670
Embayment's[1]			
301788	Maumee Bay near Woodtick Peninsula	41.7330	-83.4162
302142	Maumee Bay near State Park	41.7016	-83.3740
300900	Sandusky Bay near Johnsons Island	41.4750	-82.7383
Western Basin Nearshore[1]			
301258	Lake Erie near Toledo Lighthouse	41.7683	-83.3008
302821	Lake Erie between Toledo/Oregon WTP Intakes	41.6957	-83.2649
303470	Lake Erie near Crane Reef	41.6607	-83.0923
302502	Lake Erie North of Port Clinton	41.5578	-82.9363
303468	Lake Erie near Lakeside	41.5567	-82.7850
Central Basin Nearshore[2]			
303465	Lake Erie near City of Sandusky WTP Intake	41.4596	-82.6415
303466	Lake Erie near City of Huron WPT Intake	41.4055	-82.5570
303467	Lake Erie near City of Vermilion WTP Intake	41.4283	-82.3650
301257	Lake Erie near Lorain	41.4865	-82.2387
300895	Lake Erie near Rocky River	41.5090	-81.9052
301256	Lake Erie near Wildwood	41.6040	-81.5844
301255	Lake Erie near Fairport	41.7790	-81.3101
301254	Lake Erie near Geneva	41.8750	-80.9811
300892	Lake Erie near Conneaut	41.9945	-80.5299
Mayfly stations[3]			
301356	East of Middle Bass Island	41.69166	-82.7666
301357	Between Pelee and Kelleys Islands	41.66667	-82.6666
301358	Between Kelleys Island and Marblehead Peninsula	41.56666	-82.6666
301359	Maumee Bay	41.71383	-83.4250
301360	Maumee Bay off State Park	41.73333	-83.2971
301361	Between Port Clinton and Catawba Island	41.54866	-82.9166
301362	West of South Bass Island	41.64033	-82.9445
301363	North of Toussaint River	41.68750	-83.0403
300863	Maumee Bay off Ottawa River	41.74250	-83.4476

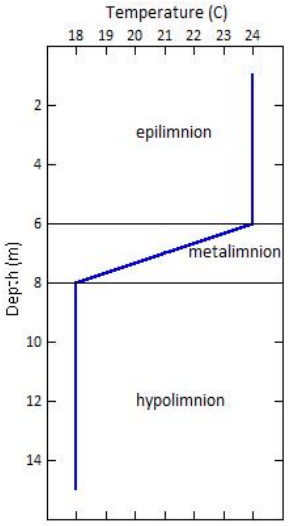
[1] Sites sampled every other week after ice out until the end of September.

[2] Sites sampled monthly May through the end of September.

[3] Sites sampled once in the spring.

Water Quality

Water quality sampling methods follow procedures described in the Surface Water Field Sampling Manual (note: the vertically oriented sample bottle procedure will be included within a forthcoming appendix to the manual that will be published in 2021). Water quality stations will have physical conditions measured in the field with a SeaBird® profiler. Water depth and secchi depth measurements will also be taken. A summary of the field measurements taken is listed in Table 5. The SeaBird® units will be deployed at a rate of about 0.2m/second down and back through the water column. Water samples submitted to Ohio EPA's Division of Environmental Services (DES) will be analyzed for the parameters listed in Table 6. Samples for analysis of microcystins will be submitted after June 15. Water samples for lab analysis will be collected with a vertically oriented sample bottle that can be deployed to depth and closed with a messenger. Samples collected from stations in the Maumee River, Maumee Bay and Sandusky Bay will be grabs collected at 1.0m below the surface. The remaining samples will be collected as a set of three integrated grabs mixed in a churn device to facilitate homogenization. The device is fitted with a spigot to fill containers.



The depth of the grab samples will be based on the presence or absence of thermal stratification. Stratification is defined as greater than a 1˚C drop in temperature over a 1m change in depth. These conditions are theoretically enough to create a density barrier. SeaBird® software will be used to display a temperature profile on an external device to determine if stratification exists and where the density layers are located. A simplified profile is shown in the adjacent figure. The point at which the temperature deflects should be identified as the top of the metalimnion. In the absence of thermal stratification, integrated grabs will be collected at 1m below the surface, mid depth and 1m above the bottom. In the presence of thermal stratification samples will be collected from the epilimnion. If the top of the metalimnion is >4 m deep integrated grabs will be collected 1m below the surface, mid epilimnion and 1m above the top of the metalimnion. If the top of the metalimnion is <4m deep the sample will be collected in the middle of the epilimnion.

Central Basin Hypoxia/Anoxia

Hypoxia/anoxia in the hypolimnion of the Central Basin reduces the amount of habitat available to aquatic life and contributes to internal cycling of phosphorus due to redox reactions that occur with phosphate molecules that are bound to iron and calcium. Field measurements will be recorded using a SeaBird® 19Plus CTD profiler at the transect stations listed in Table 4.

The results of the SeaBird® profiles will be reviewed to determine if the GLWQA Annex 4 goal of DO >2.0 mg/L in the hypolimnion is met. Clearly defined epilimnion, metalimnion and hypolimnion layers should be present. An effort will be made to visit all four transects either on the same day or as close together as possible. The transect stations will be visited up to three times after stratification is established, but the number of visits will be dictated by weather and resources.

Plankton

Phytoplankton will be collected at all water quality stations once during the months of May, July and September. Samples from individual stations will be collected during the same run to minimize temporal variability. The same whole water collected for chemistry will be used for phytoplankton. The phytoplankton sample will be placed in a labeled 1-pint canning jar and preserved with 3-4 ml of Lugol's solution until stained the color of weak tea. Sample jars will be held at the district offices until the end of the field season. At the conclusion of field season, samples will be packaged and shipped to BSA Environmental Services, Inc. for enumeration and bio-volume estimates. This involves Ohio EPA and

district name being used for client information on the chain of custody. Ohio EPA Lazarus Government Center and grant coordinator will be used for invoice information. Under special instructions, results will be requested to be emailed to both client and invoice addresses.

Table 4 — Transect stations that will be monitored for hypoxia/anoxia by Ohio EPA.

Station ID	Description	Latitude	Longitude
Huron Transect			
301278	Huron Transect 1	41.51765	-82.54841
301279	Huron Transect 2	41.54668	-82.46346
301280	Huron Transect 3	41.57538	-82.38235
301281	Huron Transect 4	41.60471	-82.29871
301282	Huron Transect 5	41.63395	-82.21755
301283	Huron Transect 6	41.66295	-82.13396
Rocky River Transect			
300895	Rocky River Ambient Station	41.50907	-81.90524
301273	Rocky River Transect 1	41.52482	-81.90803
301274	Rocky River Transect 2	41.55140	-81.91182
301275	Rocky River Transect 3	41.60671	-81.91955
301276	Rocky River Transect 4	41.66117	-81.92725
301277	Lake Guardian Station E-43	41.78833	-81.94500
Fairport Harbor Transect			
301255	Fairport Ambient Station	41.77903	-81.31017
301267	Fairport Transect 1	41.79527	-81.32765
301268	Fairport Transect 2	41.80262	-81.33567
301269	Fairport Transect 3	41.82050	-81.35468
301270	Fairport Transect 4	41.83699	-81.37241
301271	Fairport Transect 5	41.88008	-81.41897
301272	Lake Guardian Station E-36	41.93500	-81.47833
Geneva Transect			
301254	Geneva Ambient Station	41.87507	-80.98111
301261	Geneva Transect 1	41.88411	-80.98246
301262	Geneva Transect 2	41.89177	-80.98361
301263	Geneva Transect 3	41.90566	-80.98567
301264	Geneva Transect 4	41.92939	-80.98918
301265	Geneva Transect 5	42.02101	-81.00288
301266	Lake Guardian Station E-32	42.08166	-81.01166

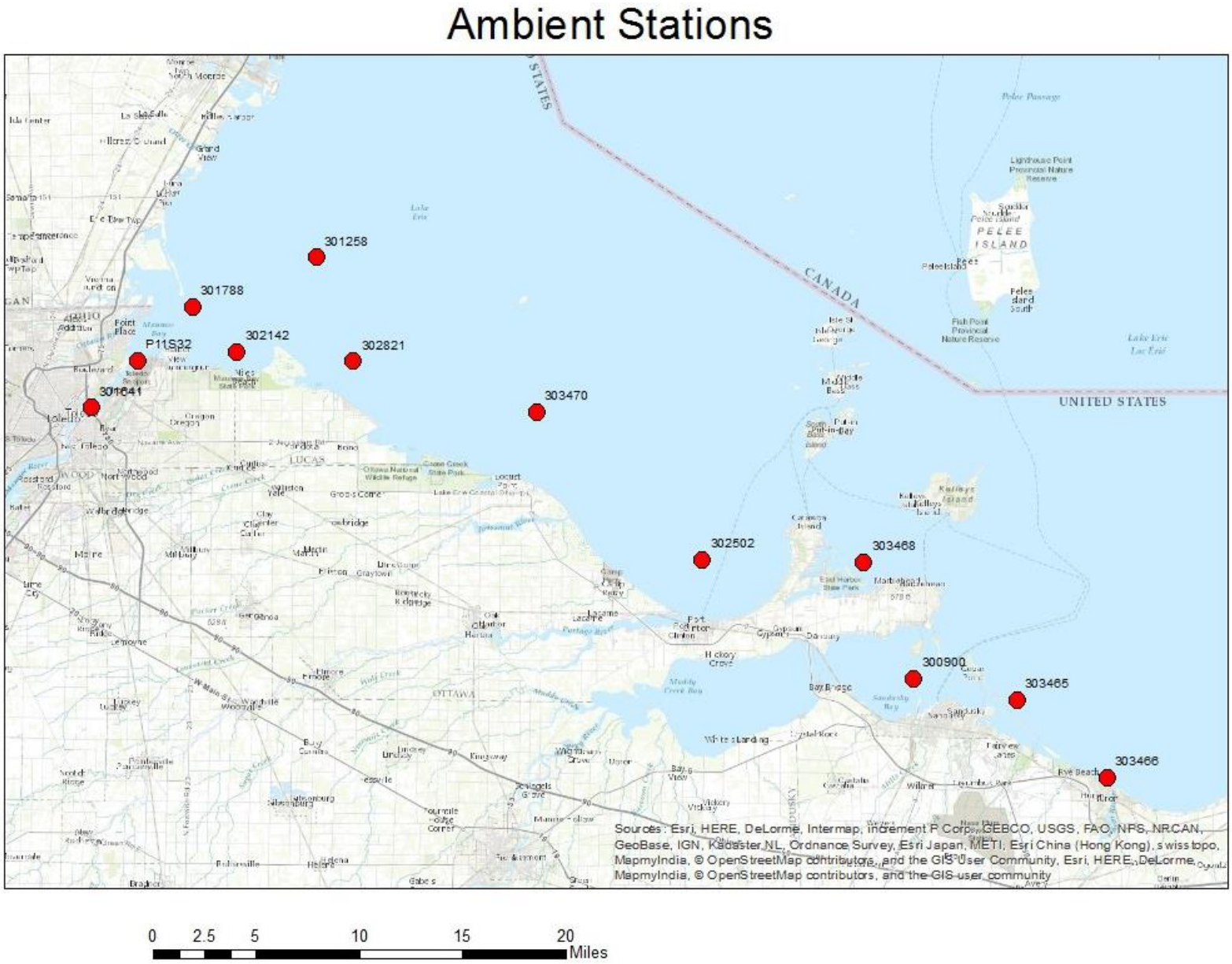


Figure 2 — Lake Erie water quality monitoring stations.

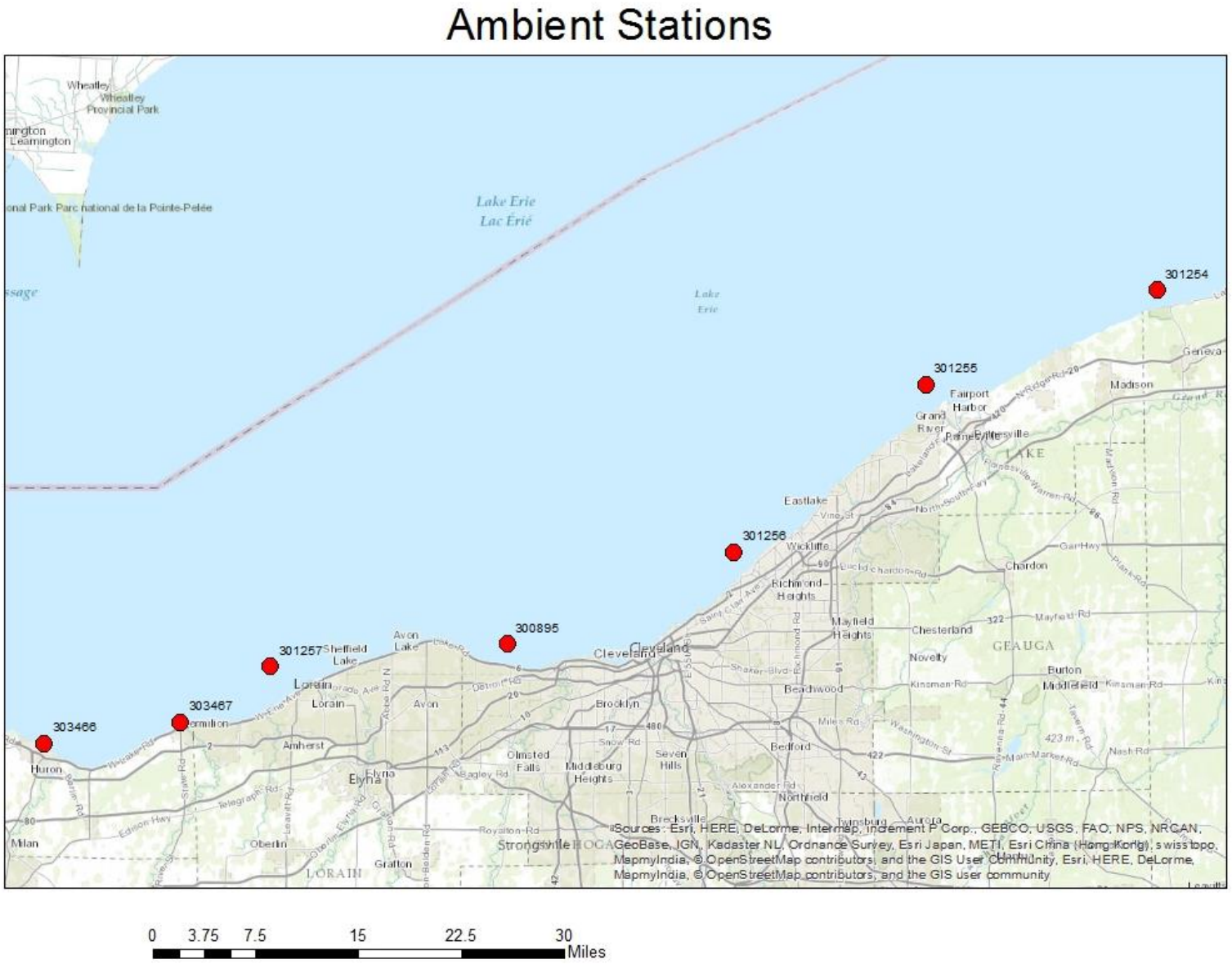


Figure 3 — Lake Erie water quality monitoring stations.

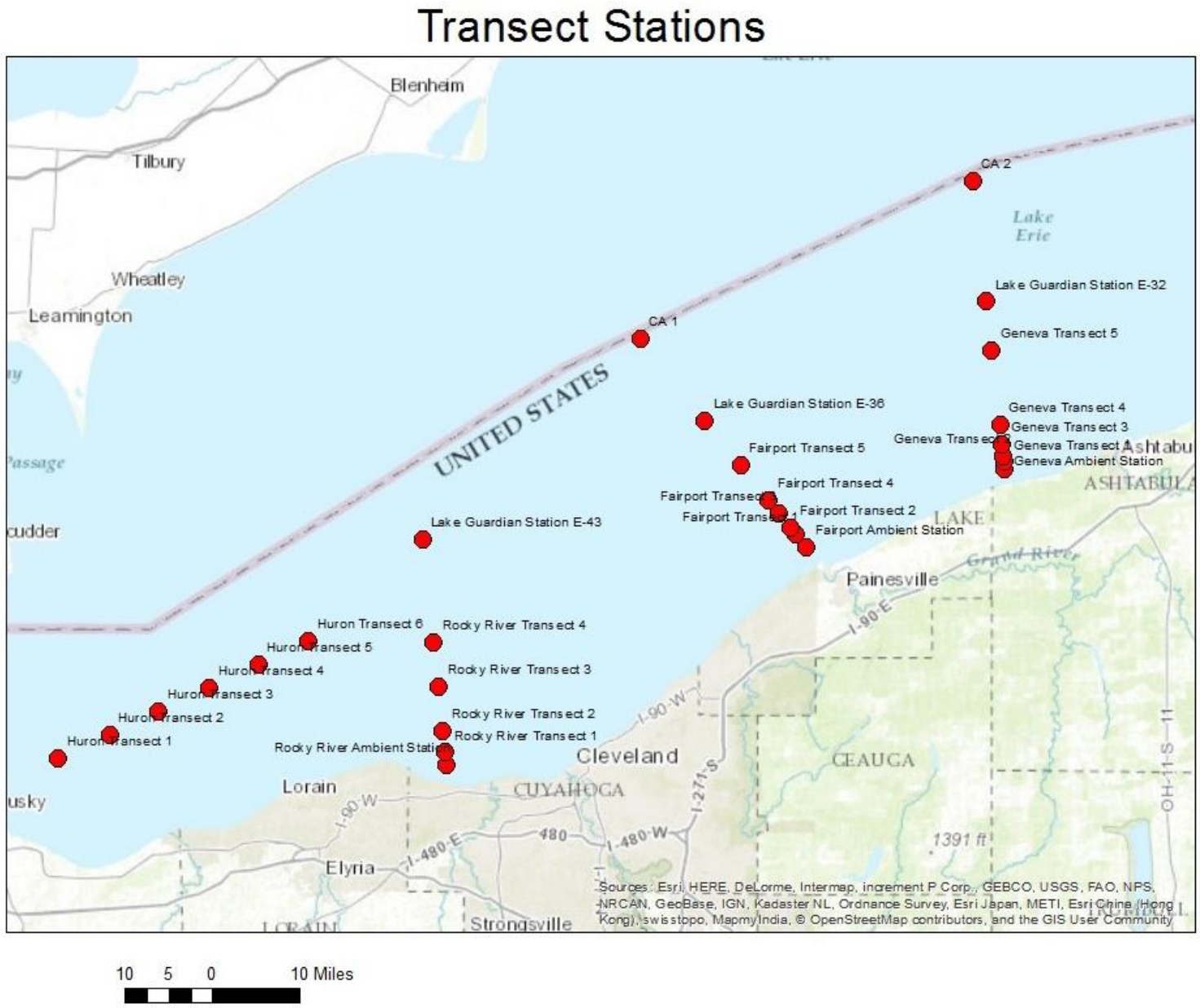


Figure 4 — Lake Erie transect monitoring stations.

Table 5 — List of field measurements recorded in Lake Erie nearshore, bay and estuary samples.

Parameter	PCS#	RL	Units
Water Depth	NA	0.1	m
Secchi Depth	00077	0.01	m
Temperature	00010	0.01	C
Dissolved Oxygen	00300	0.01	mg/L
Dissolved Oxygen	00301	0.01	%
Conductivity	00094	0.01	µS/cm
Specific Conductance	00095	0.01	µS/cm
pH	00400	0.1	SU

Table 6 — List of parameters to analyze in Lake Erie nearshore, bay and estuary samples.

Parameter	PCS#	Method	RL	Units	Container	Preservative	Hold
Alkalinity	00410	USEPA 310.1	5	mg/L	1L LDPE	cool ≤6˚C	14d
Bicarbonate	00440	SM 2320 B	5	mg/L			28d
Carbonate	00445	SM 2320 B	5	mg/L			28d
Chloride	00940	USEPA 325.1	5	mg/L			28d
Sulfate	00945	USEPA 375.2	10	mg/L			28d
Dissolved Solids	70300	SM 2540 C	10	mg/L			7d
Suspended Solids	00530	SM 2540 D	5	mg/L			7d
Nitrite	00615	US EPA 353.2	0.02	mg/L			48 hr.
Ammonia	00610	US EPA 350.1	0.05	mg/L	1L LDPE	2 mL H_2SO_4 to pH<2, cool ≤6˚C	28d
Nitrate-Nitrite	00630	US EPA 350.1	0.5	mg/L			28d
Kjeldahl Nitrogen	00625	US EPA 351.2	0.2	mg/L			28d
Phosphorus	00665	US EPA 365.4	1	µg/L	125ml jar	½ mL H_2SO_4 to pH<2, cool ≤6˚C	28d
Orthophosphate	00671	US EPA 365.1	1	µg/L	125ml jar	filter, cool ≤6˚C	48 hr.
Chlorophyll a	32230	US EPA 445.0	1	µg/L	GF/C	Freeze	25d
Microcystins	NA	Ohio EPA 701.0	0.3	µg/L	1L LDPE	cool ≤6˚C	36 hr.

B3 – Sample Handling and Custody

SampleMaster® software is used by DES to manage lab information. A guidance manual for use of the software is in Appendix IV of the Surface Water Field Manual. 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 Ohio EPA's Harmful Algae Bloom webpage in a timely manner.

B4 – Analytical Methods

The analytical methods to be used in this study are provided in Table 6 along with the containers, preservatives, holding times and reporting limits. Analytical SOPs for individual parameters are available on the Ohio EPA eDOCS system.

B5 – Quality Control

All water quality sample collection and preservation methods will follow guidelines established in the Surface Water Sampling Field Manual. An Excel Data Validation Tool will be used to determine if data needs to be rejected or qualified as estimated based on relative percent difference (RPD). Acceptable RPD is parameter specific and depends on the method reporting limit and how close the concentration is to that limit. Voucher specimens will be retained when there is a question regarding identification or the species is found outside the normal range. One mayfly station will be re-sorted by a second staff person to confirm that all nymphs are being identified.

Five percent of the water samples will be submitted to the lab as field duplicates. Field blanks and equipment blanks combined will occur at a minimum of five percent of the total water samples. Field instruments will be calibrated by the manufacturer. Matrix spike duplicates will be collected for organic water samples at a minimum of five percent.

B6 – Instrument/Equipment Testing, Inspection and Maintenance

The team leaders have operated and maintained the equipment to be used during this project for many years. When new equipment is introduced, the team leaders and other sampling staff will familiarize themselves accordingly. The team leaders will inspect the equipment prior to and during sampling and will ensure that all equipment remains in functional working condition. Team leaders will also coordinate with supervisors to purchase new equipment when necessary.

B7 – Instrument/Equipment Calibration and Frequency

The SeaBird® multimeter probes will be calibrated annually by the manufacturer in accordance with their protocol. All calibration documentation will be maintained at the appropriate district office. Other equipment used will follow specifications provided in the water quality sampling procedures manual.

B8 – Inspection/Acceptance of Supplies and Consumables

Supplies and consumables will be inspected upon receipt by the field sampling teams. Nearly all supplies utilized for this project are maintained and used during Ohio EPA's normal business operations. The field team leaders will be responsible for ensuring 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 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.

B9 – Data Acquisition Requirements for Non-Direct Measurements

This project consists mainly of field sampling. All the data generated during this sampling will be Level 3 Credible Data in accordance with state regulations. Only Ohio EPA results will be used in data summaries.

B10 – Data Management

The data management process is shared by the Division of Surface Water (DSW) and Division of Environmental Services (DES). DES uses SampleMaster® software to manage lab information and DSW uses the Ecological Assessment and Analysis Application (EA3) to manage data. These programs are linked together to allow the transfer of information 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. See the Surface Water Field Manual, Appendix IV, Section B for guidelines.

SampleMaster® 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 to be analyzed. The program creates a chain of custody and container labels for each site.

Field measurements are collected instantaneously using a multi-parameter meter. The SeaBird® multi-parameter units have an internal file storage system that saves all casts within the unit. The SeaBird® also allows for data to be viewed as a graph and saved to a computer in the field. All files will be saved with a standard naming system starting with the station ID number followed by the six-digit date of collection. These files can then be exported to 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).

Field and chemistry data tabulated in SampleMaster® 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 IR reports.

The project leader will maintain the project file in a dedicated folder on SharePoint. The goal or objective is to have a complete record of all decisions about modifications of data collection, validation or interpretation between the QAPP signoff and project report completion. To achieve this, the project leader will need to be included on emails or otherwise receive summaries of all actions that meet the above description. Project photos should all be filed in the Lynx photo management system.

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 are necessary to ensure that sampling goes smooth and data obtained meets project needs. This is an ongoing process that continues every day on which the project is implemented as well as larger scale assessments that take place less frequently (annually). 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.

The project leader or district supervisor will conduct an annual field audit to ensure consistency in sampling protocol between all districts. This will enable the auditor to: check for proper use and maintenance of equipment; check for adherence to calibration processes; assess supplies; and evaluate how samples were collected as compared to standard operating methods.

Annual assessments will include: reviews of data validation and verification; sample completeness and QA/QC review results; quality system targets and processes; and status of project resources. These assessments will be completed and reported to division management.

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 to not necessitate a formal response. More significant problems will be brought to the attention of the project leader or district supervisor 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; or
- 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 and 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 sample collector. The project leader or district supervisor will evaluate if data requires any additional qualifiers and/or if it is usable for its originally intended purpose. Before delivery to field crews, DES examines the quality of its reagent water to ensure it is sufficient to use for field blanks and to rinse sample jars or other equipment. Any blank analytes detected above the reporting limit will be documented by the lab via email to the sample collector, MATS manager, MATS (TMDL) supervisor and STS QA staff.

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

It is expected that adherence to SOPs will generate useable data. 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 project leader or district supervisor will receive regular updates from district technicians throughout the sampling season and will report to division management during Senior Management Team meetings. Any problems that jeopardize completion of the project will lead to memorandum and consultation with program management and quality assurance staff. The disposition of technical reports is to be determined.

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. 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 because of field observations or 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. DES 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 and QA/QC results (including assessment of results for blanks and duplicates). This will be an ongoing effort.

The Study Team will make final decisions regarding the validity and usability of the data 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 procedures in Appendix D, Data Management, of the Surface Water Field Manual. Much of this work is facilitated by a centralized automated QC data evaluation Excel file. Use of this file is explained in the document *QC Tracking and Data Qualification* available in SharePoint in DSW Quality Management/Documents/DSW Procedures.

Data qualifiers will be added by samplers to EA3 as part of their data review process. This will ensure the qualifier remains with the sample result. We want to be sure that valid conclusions can be made using our data for any current and future data uses.

D3 – Reconciliation with User Requirements

Pending connection issues, it is intended that water chemistry will be uploaded to the national Water Quality Exchange (WQX) data warehouse. Data approved in the EA3 database will then be available for query via the Water Quality Portal (WQP) under the organization ID 21OHIO_WQX. Data qualifiers applied to sample results by DES at the lab and by samplers in the EA3 system will remain with the analytical results when the data is transferred to U.S. 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.