



2014 Monitoring of Lake Erie and the Maumee River Estuary



Division of Surface Water
April 15, 2014

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V 1.0

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Introduction

This study plan is an effort by Ohio EPA to implement an annual Lake Erie monitoring program. Until recently, Ohio EPA's focus in Lake Erie has been on restoration projects in the four Areas of Concern (AOC) located in the state and contributing to development of the Lakewide Management Plan (LaMP). The Lake Erie LaMP was first introduced in 2000 and is updated every two years. In 2009, significant federal funding was proposed as part of the FY 2010 President's Budget to address longstanding environmental challenges in the Great Lakes region. A task force of 11 federal agencies developed an action plan and in February 2010 the Obama Administration released the Great Lakes Restoration Initiative (GLRI).

As GLRI planning was being done, Ohio EPA participated in the 2010 National Coastal Condition Assessment (NCCA). This was a statistical survey led by U.S. EPA designed to report on the condition of our Nation's marine and Great Lakes coasts. This project gave Ohio EPA an opportunity to train and collaborate with the Great Lakes National Program Office (GLNPO) and other Region 5 states and helped the agency gain valuable experience with sampling equipment and methods.

In June 2010, Ohio EPA submitted a GLRI proposal titled "Ohio Lake Erie Comprehensive Nearshore Monitoring Program" and funding was subsequently awarded to support a three year project. A variety of habitats were assessed, including open water, shorelines, bays, harbors and estuaries. All areas had a physical and chemical assessment of water and sediment done. Open water areas had samples collected to evaluate zooplankton and phytoplankton populations and a set of historical locations were visited in the spring to evaluate trends in burrowing mayfly densities. The lake's shoreline, bays, harbors and estuaries had assessments done to evaluate fish and macroinvertebrate populations and periphyton was sampled in the harbors and estuaries. Details of the study are in the *2011-2013 Lake Erie Nearshore Monitoring Study Plan, V1.3* (Ohio EPA, 2013a).

Select water quality data obtained during the GLRI study is summarized in the *2014 Ohio Integrated Water Quality Monitoring and Assessment Report* (Ohio EPA, 2014). The report defines assessment units, nutrient targets and data evaluation methods used to report on the status of Lake Erie in Ohio waters. To develop these guidelines Ohio EPA relied heavily on a technical document prepared by the Lake Erie Nutrient Science Task Group, under direction of the Lake Erie LaMP, titled *Status of Nutrients in the Lake Erie Basin* (U.S. EPA, 2009).

Water Quality Sampling

Stations that will be sampled are listed in Table 1. Sampling will be initiated after April 1 and continue through September 30. Samples from the Maumee River estuary, Western Basin and Sandusky Basin will be collected on a bi-weekly basis. Samples from the Central Basin will be collected on a monthly basis. Special consideration needs to be given to safety due to the unpredictable nature of weather and sea conditions on the Great Lakes. Work scheduled in this study plan will only be done if it can be completed in a safe manner. This decision will be made by the sample collector.

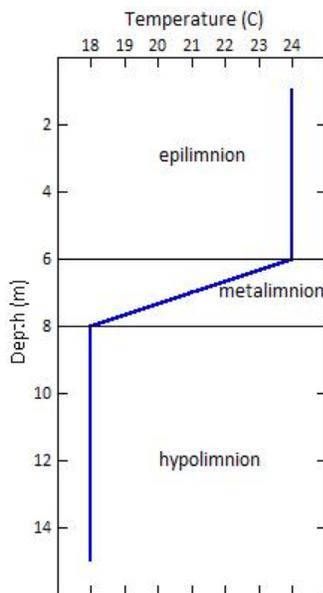
Mayfly Density

Mayfly stations will be sampled once in the spring (April/May) prior to the annual hatch. A triplicate set of samples will be collected at each station using a standard Ponar® dredge. Contents from the dredge 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 5% 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 replicate container will be removed, counted and recorded on the lab bench sheet shown in Appendix A. Once counting is complete the nymphs will be placed in a labeled glass vial and preserved with 60% ethanol so they can be archived.

Water Quality

Water quality stations will have physical conditions measured in the field with either a SeaBird® profiler or YSI® Pro Series meter. Water depth and secchi depth measurements will also be taken. A summary of the field measurements is listed in Table 2. The SeaBird® units will be deployed at a rate of about 0.2m/second down and back through the water column and the YSI probes are simply lowered to the desired depth. Water samples submitted to the Ohio EPA Division of Environmental Services (DES) will be analyzed for the parameters listed in Table 3. Samples for analysis of Microcystin will only be collected from stations located in the estuary and shoreline assessment units and only submitted during the summer (July 1-Sept. 30). Microcystin testing will focus on these areas because this is where public beaches and most water treatment plant intakes are located. 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 estuary and shoreline assessment units (Maumee River, Maumee Bay and Sandusky Bay) will be grabs collected at 0.5m below the surface.



Samples collected from stations in the nearshore and offshore assessment units will be a set of three integrated grabs mixed in a churn device fitted with a spigot. 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, 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 epilimnion is >4 m deep grabs will be collected 1m below the surface, mid epilimnion and 1m above the top of the metalimnion. If the epilimnion is <4m deep the sample will be collected in the middle of the layer.

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. The transect stations listed in Table 4 will be used to measure the severity and extent of this phenomenon by collecting field measurement at a series of points along each line using a SeaBird® 19Plus CTD profiler. An attempt will be made to visit the transect stations at least three times after stratification is established. Clearly defined epilimnion,

metalimnion and hypolimnion layers should be present. An effort will also be made to visit all four transects either on the same day or as close together as possible. A map of water quality and transect sampling locations is shown in Figure 1.

Plankton

Data from the 2011-2013 Lake Erie Nearshore Monitoring project needs to be further evaluated to determine what organism groups have value as water quality indicators and to develop appropriate indices. Plankton samples will be collected, preserved and stored until a decision can be made about what level of assessment is needed. It will also be necessary to secure a contract lab to analyze the samples and funds to pay for them. Phytoplankton and zooplankton will be collected during all water quality sampling events. Phytoplankton will be collected at all shoreline, nearshore and offshore stations and zooplankton will be collected at nearshore and offshore stations only because the shoreline sites are too shallow to deploy the net. Diatoms will be sampled from the shoreline fish zones when they are assessed.

Whole water from the integrated grab sample collected for chemistry will be used for phytoplankton analysis. The sample will be placed in a labeled 250ml jar and preserved with 2-3ml of Lugol's solution until stained the color of weak tea. Zooplankton samples will be collected by vertical tow with a weighted 63 μ mesh net that is 2m long and has a 50cm diameter at the mouth. The net ring is designed so a weight can be added with a 2m section of rope. A PVC connector is clamped to the end of the net so a 1L canning jar can be attached to collect the sample. A General Oceanics® model 2030R mechanical flow meter is also attached to the mouth of the net. The flow meter should be inspected prior to use to ensure it's moving freely and doesn't contain air bubbles. Tap water can be added to eliminate bubbles by removing a set screw at the base of the meter. The initial reading on meter counter should be recorded. Lower the net to the water and wet the bag to remove air and to fill the jar with water that passes through the net. Aim the mouth of the net downward, drop the weight into the water and allow the net to free fall as much as possible by keeping slack in the retrieving line. After the weight touches bottom retrieve the net to the surface and note the final reading on the flow meter. This allows the water column to be sampled on both the down and up cast. Rinse the net with a combination of lake water from the outside and tap water from the inside to wash contents into the collection jar. Remove the collection jar and concentrate the sample by pouring it through a cup with a 63 μ mesh. The sample can then be transferred to a labeled 400ml canning jar. Add tap water if necessary to reach a volume of 300ml and then preserve with 100ml of 50% buffered formalin solution.

Diatoms will be assessed by examining deposits on natural substrates collected at a depth of ≤ 1 m. In soft substrate sediment can be collected with either a 6.5 cm diameter push corer or a dredge sampler. Extrude the core or access the top of the dredge so the top 1cm of sediment can be carefully removed using a spoon or spatula and placed in a labeled 100ml specimen cup. The sampling equipment should be inspected between sites and rinsed to remove residue. In hard substrate rocks or vegetation can be collected by hand and the surfaces scraped clean with a small brush or plastic knife until a layer of material covers the bottom of the cup. Samples should be placed on wet ice in the field and kept cool until they can be dried. Samples should be dried within 24 hours of collection by placing the cups in an oven set at 80°C for 24 hours. The samples can then be stored until analysis.

Fish Community Assessment

The fish community will be assessed in a cooperative effort between Ohio EPA and Ohio DNR at the stations listed in Table 5. Generally, the sampling will be done so that all of the stations will be sampled at least once every five years. The Ohio DNR stations are identified by site numbers in the station ID

column. The Ohio DNR will complete one pass annually at the stations highlighted in red and one pass every five years at the remaining stations. The Ohio EPA will complete the second pass at all of these stations and will also complete two passes at 4-5 of the remaining stations. Sampling by Ohio EPA will be limited in years that U.S. EPA conducts the National Coastal Condition Assessment (NCCA) so workload can be devoted to that project. The NCCA is next scheduled for 2015 and is repeated on a five year cycle.

Ohio EPA uses a 5.8m modified V-hull Jon Boat to conduct electrofishing. The sampling is done during the evening hours because research has shown that this is the most effective time to collect a representative sample. Electrical current will be provided by a 7,000 watt generator and Smith-Root pulsator. Controls will be set on DC current, 60 pulses per second, 240-340 volts and 5-6 amps. Anodes will be two separately charged 0.5m circumference stainless steel electrospheres positioned approximately 2.1m in front of the boat and approximately 20 degrees to either side of the center line. In most conditions, eight cathodes will be deployed (four on each side of the boat) starting approximately 1.8m from the front of the boat and ending approximately 2.3m from the front of the boat. Each cathode will have an electrified portion of 1.6m. In areas of deeper water (such as ship channels) four cathodes will be deployed off the front of the boat. These cathodes will have an electrified portion that is 1.6m in length, but the electrified portion will be attached to a shielded cable creating an overall length of 7.3m.

A dip net will be used by each of the three members of the crew. The dip nets will be made of 6.35mm mesh and create a bag no deeper than 15cm to allow rapid elimination of fish into a live well. All fish except common carp and goldfish will be placed in one live well continuously supplied with fresh water by one or more pumps. Common carp and goldfish will be placed in their own live well to avoid excess oxygen consumption and the death of small fish that may become crushed.

The start and end of each zone will be marked by a waypoint on a GPS and with marking paint or a length of surveyor flag. Each zone will be 500m in length based on straight line measurements between the starting and ending points unless there is a distinct point of change (greater than 45 degrees) in which case a new waypoint will be created at the point of change and the distance from that point to the start and end points will be added to produce the total distance. The starting time and the time fished will be recorded on the field sheet. Sample time will vary based on the number of fish caught and the complexity of the shoreline.

At the end of sampling all fish will be separated by species and placed in buckets. Each species will be counted, weighed and inspected for externally observable deformities, eroded fins, lesions, and tumors. The total weight per species and number of individuals will be recorded on the field sheet shown in Appendix B. An assessment of shoreline habitat will also be done by completing the Lake Qualitative Habitat Evaluation Index (QHEI) sheet shown in Appendix C.

Quality Assurance

All water quality sample collection and preservation methods will follow guidelines established in the *Surface Water Field Sampling Manual* (Ohio EPA, 2013b). Field QC requirements for duplicates and blanks are summarized in Table E-1 of the 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. Detailed fish assemblage sampling protocols are documented in

Biological Criteria for the Protection of Aquatic Life: Volume IV: Fish and Macroinvertebrate Indices for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustraries (Ohio EPA, 1999). 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.

Data Management

Knowledge of the Division of Surface Water (DSW) Cyberintern and Ecological Assessment and Analysis Application (EA3) programs is needed to manage data. The station ID numbers that are assigned to each sampling location are created using EA3. Project names are also created in EA3 so stations can be grouped together to facilitate data assessment. Sampling trips are organized using the Cyberintern program. The sample collector selects the stations to be sampled to create a run. The software assigns an external ID number and bar code specific to each sample and prints the laboratory sample submission forms and container labels. Samples delivered to the 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.

Header Information	
Ship:	NWDO
Station:	301258_061714
Operator:	Last Name
Depth (m):	12.0
Secch (m):	3.54
Wind Direction:	SSW
Wind Speed (mi):	10-15
Air Temp (C):	70-75
Notes:	Add comments if need.

Field data collected with the SeaBird® is managed using Seasave V7 software. The unit needs to be connected to an external device (tablet or laptop) to accomplish this. A shot of the screen used to enter site information is displayed. The files should be named based on the station ID # and sampling date. For example, the file for station #301258 sampled on June 17, 2014 should be saved as 301258_061714. These files will be downloaded to an Ohio EPA desktop PC and housed in the State of Ohio Computer Center (SOCC). The profile data will not be imported into EA3 at this time, but this service should be available in the future.

The YSI® Pro Series units have an internal file storage system. A site list based on station ID # is first created using YSI® Pro Series Data Manager V1.1.8 software installed on a desktop PC. The field meter is then connected to the PC via a USB port so the site list can be uploaded to the meter. Data is saved in the field by selecting the correct station from the menu. After sampling is completed the files are downloaded to the Data Manager software. They are then exported as an Excel file to the DSWs Water Quality Data Acquisition Manager and uploaded to the Ohio EPA SQL server database.

After water samples are analyzed and the results are approved by the lab QA Officer the data will be loaded into the Laboratory Information Management System (LIMS). Individual lab sheets are also posted on a web based server accessible by the DSW. Once the lab data is available in LIMS it can be imported into EA3. Before the chemistry data is imported it's important to verify that field data has been uploaded since the system uses the external ID number tag to merge the two datasets. Once the sheets are imported the sample collector reviews them for accuracy, completes edits if necessary,

validates field QC and approves the sheet. All data approved in EA3 is sent to the U.S. EPA Water Quality Exchange.

The original fish and QHEI data sheets will be sent to the Groveport Field Office and copies will be filed at the Northeast District Office. Data from the field sheet is manually entered into EA3 using the appropriate data entry screen. The sheets are double entered to eliminate mistakes. At this time, EA3 is not programmed to calculate Lake IBI scores. However, the data can be extracted to calculate index scores using a program developed by the DSW for that purpose.

Data Evaluation

Water Quality

Ohio EPA is required by the federal Clean Water Act to monitor and report on the quality of water resources in the state. To fulfill this requirement the agency submits an Integrated Water Quality Monitoring and Assessment Report to U.S. EPA in even numbered years. This report provides a summary of the status of the State's surface waters and includes a list of waters that do not meet established goals. The Lake Erie shoreline has been assessed and reported on in previous Integrated Reports. The 2014 Integrated Report was the first that Ohio EPA described open water assessment units and presented a method to evaluate their status.

Parameter	OAC 3745-1
Dissolved Oxygen	Table 7-1
pH	Table 7-1
Dissolved Solids	Table 7-1
Ammonia	Table 7-6
Temperature	Table 31-1

Lake Erie is defined in the Ohio Water Quality Standards (Ohio Administrative Code Chapter 3745-1) as Exceptional Warmwater Habitat (EWH). Numeric criteria for the protection of aquatic life set forth in rules 3745-1-07 (statewide criteria), 3745-1-31 (Lake Erie standards) and 3745-1-33 (Lake Erie drainage basin criteria) apply and must be met as outside mixing zone standards. The adjacent table summarizes where criteria are found in the rules for parameters with numeric criteria that will be measured in the water column.

Temperature, dissolved oxygen and pH will be evaluated using either profile or grab data measured by a field meter. Profile data will be pooled by parameter and statistically summarized. An average will be calculated for temperature and dissolved oxygen and a median for pH. These values will then be compared to the appropriate standard. If the lake isn't stratified readings from the entire water column will be used. If stratified only readings from the epilimnion will be used.

Other parameters with numeric criteria are evaluated based on analysis of a water sample. Criteria for dissolved solids are a fixed value. Those for ammonia are tiered depending on the temperature and pH of the sample because more alkaline conditions favor the production of ammonium hydroxide which is toxic to aquatic life.

Assessment Unit Name	Targets (ppb)	
	TP	Chl. a
Western Basin Shoreline	30	9.8
Western Basin Nearshore	20	5.3
Western Basin Offshore	15	3.6
Sandusky Basin Shoreline	30	9.8
Sandusky Basin Nearshore	20	5.3
Sandusky Basin Offshore	15	3.6
Central Basin Shoreline	20	5.3
Central Basin Nearshore	15	3.6
Central Basin Offshore	10	2.6

An ability to evaluate total phosphorus and chlorophyll a is important due to the emergence of harmful algae blooms in the last decade. In addition, the Great Lakes Water Quality Protocol of 2012 has a goal to maintain mesotrophic conditions in the open waters of the Western and Central Basins of Lake Erie. This goal is the basis of targets presented in the *Status of Nutrients in the Lake Erie Basin*. Ohio EPA relied heavily on this document to define assessment units, targets and evaluation methods previewed in the 2014 Integrated Report. Ohio EPA will continue to calculate averages for spring phosphorus (April 1-June 30) and summer chlorophyll a (July 1-Sept. 30) for

each assessment unit and present the results in future Integrated Reports. Any modifications to the methods such as adjusting the seasons or using a median value instead of mean will also be discussed. Lake Erie IBI scores for the shoreline assessment units will also be updated.

Mayfly Index

To calculate burrowing mayfly density (m^2) the mean of the triplicate sample counts is divided by 0.0537. This is a constant determined based on the surface area of a standard Ponar® dredge. Since station densities can vary considerably from year to year it may also be useful to assess trends based on a median for the entire Western Basin.

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

As an indicator organism, the status of mayfly populations can be used to evaluate long term changes in water and sediment quality. A metric score and narrative description of population health developed for the Lake Erie Quality Index is described by Krieger *et al*, 2004. A moving average for the Western Basin is recommended to account for annual variability.

Fish Community Status

Results from fish sampling will be used to update attainment status in the Integrated Report. Ohio EPA does not have numeric biological criteria for Lake Erie codified in the water quality standards. Volume IV of the Biological Criteria for the Protection of Aquatic Life presents a foundation to establish numeric biological targets using IBI and MIwb scores for the Lake Erie shoreline.

Habitat Type	IBI	MIwb
Rubble	42	8.9
Sand	31	7.2

Status of the shoreline assessment units will be determined by the percentage of sites in narrative full attainment as sufficient data are available. Fish targets are based on the 90th percentile of index scores and are scaled to prevailing habitat type.

References

Krieger, K.A. 2004. Mayfly Metric of the Lake Erie Quality Index: Design of an Efficient Censusing Program, Data Collection and Development of the Metric. Final Report for Ohio Lake Erie Protection Fund Grant LEQI 01-03.

Ohio EPA. 2013a. 2011-2013 Lake Erie Nearshore Monitoring Study Plan, Version 1.3, March 15, 2013. Division of Surface Water, Columbus, Ohio.

Ohio EPA. 2013b. Surface water field sampling manual for water column chemistry, bacteria and flows. Version 4.0, January 31, 2013. Division of Surface Water, Columbus, Ohio. 41pp.

Ohio EPA. 2014. 2014 Ohio Integrated Water Quality Monitoring and Assessment Report.

Ohio EPA. 1999. Draft. Biological Criteria for the Protection of Aquatic Life: Volume IV: Fish and Macroinvertebrate Indices for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustraries. Division of Surface Water, Ecological Assessment Unit, Ohio EPA, Columbus, Ohio.

U.S. EPA, 2009. Status of Nutrients in the Lake Erie Basin.

Table 1. Water quality and mayfly stations that will be sampled in Lake Erie open waters, bays and estuaries.

Station ID	Description	Latitude	Longitude
Maumee River Estuary			
301641	Maumee River dsnt. I-280	41.661067	-83.510567
P11S32	Maumee River near Mouth	41.694300	-83.467067
Western Basin Shoreline Assessment Unit			
301788	Maumee Bay near Woodtick Peninsula	41.73300	-83.41623
302142	Maumee Bay near State Park	41.70163	-83.37407
Western Basin Nearshore Assessment Unit			
301258	Lake Erie near Toledo Lighthouse	41.76832	-83.30080
302502	Lake Erie North of Port Clinton	41.55781	-82.93635
Western Basin Offshore Assessment Unit			
300898	Lake Erie near West Sister Island	41.72670	-83.15000
301076	Lake Erie near Middle Bass Island	41.68500	-82.93330
302153	Lake Erie near Middle Sister Island	41.86035	-83.07294
Sandusky Basin Shoreline Assessment Unit			
300900	Sandusky Bay near Johnsons Island	41.47500	-82.73830
Sandusky Basin Offshore Assessment Unit			
301075	Lake Erie near Cedar Point	41.52774	-82.60062
300897	Lake Erie near Huron	41.44485	-82.45436
301257	Lake Erie near Lorain	41.48657	-82.23877
Central Basin Nearshore Assessment Unit			
300895	Lake Erie near Rocky River	41.60670	-81.89670
301256	Lake Erie near Wildwood	41.60404	-81.58445
301255	Lake Erie near Fairport	41.77903	-81.31017
301254	Lake Erie near Geneva	41.87507	-80.98111
300892	Lake Erie near Conneaut	41.99457	-80.52996
Mayfly stations			
301356	East of Middle Bass Island	41.69166	-82.76666
301357	Between Pelee and Kelleys Islands	41.66667	-82.66666
301358	Between Kelleys Island and Marblehead Peninsula	41.56666	-82.66666
301359	Maumee Bay	41.71383	-83.42500
301360	Maumee Bay off State Park	41.73333	-83.29716
301361	Between Port Clinton and Catawba Island	41.54866	-82.91666
301362	West of South Bass Island	41.64033	-82.94450
301363	North of Toussaint River	41.68750	-83.04033
300863	Maumee Bay off Ottawa River	41.74250	-83.44766

Table 2. List of field measurements recorded in Lake Erie open water, bay and estuary samples collected by Ohio EPA.

Parameter	PCS#	RL	Units
Water Depth		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	$\mu\text{S}/\text{cm}$
Specific Conductance	00095	0.01	$\mu\text{S}/\text{cm}$
pH	00400	0.1	SU
Fluorescence (SeaBird® only)		0.01	mg/m^3

Table 3. List of parameters to analyze in Lake Erie open water, bay and estuary samples collected by Ohio EPA.

Parameter	PCS#	Method	RL	Units	Container	Preservative	Hold	Cost
Alkalinity, Total (as CaCO_3)	00410	USEPA 310.1	5	mg/L	1L LDPE	cool $\leq 6^\circ\text{C}$	14d	\$7.50
Bicarbonate, Total (as HCO_3)	00440	SM 2320 B	5	mg/L	1L LDPE	cool $\leq 6^\circ\text{C}$	28d	\$12
Carbonate, Total (as CO_3)	00445	SM 2320 B	5	mg/L	1L LDPE	cool $\leq 6^\circ\text{C}$	28d	
Chloride, Total (as Cl)	00940	USEPA 325.1	5	mg/L	1L LDPE	cool $\leq 6^\circ\text{C}$	28d	\$11
Sulfate, Total (as SO_4)	00945	USEPA 375.2	10	mg/L	1L LDPE	cool $\leq 6^\circ\text{C}$	28d	\$12
Solids, Total Dissolved	70300	SM 2540 C	10	mg/L	1L LDPE	cool $\leq 6^\circ\text{C}$	7d	\$12
Solids, Total Suspended	00530	SM 2540 D	5	mg/L	1L LDPE	cool $\leq 6^\circ\text{C}$	7d	\$12
Ammonia, Total (as N)	00610	USEPA 350.1	0.05	mg/L	1L LDPE	2 ml H_2SO_4 to pH<2, cool $\leq 6^\circ\text{C}$	28d	\$11
Nitrite, Total (as N)	00615	USEPA 353.2	0.02	mg/L	1L LDPE	cool $\leq 6^\circ\text{C}$	48 hr.	\$11
Nitrate-Nitrite, Total (as N)	00630	USEPA 350.1	0.5	mg/L	1L LDPE	2 ml H_2SO_4 to pH<2, cool $\leq 6^\circ\text{C}$	28d	\$11
Kjeldahl, Total (as N)	00625	USEPA 351.2	0.2	mg/L	1L LDPE	2 ml H_2SO_4 to pH<2, cool $\leq 6^\circ\text{C}$	28d	\$12
Phosphorus, Total (as P)	00665	USEPA 365.4	1	$\mu\text{g}/\text{L}$	125ml jar	$\frac{1}{2}$ ml H_2SO_4 to pH<2, cool $\leq 6^\circ\text{C}$	28d	\$23
Orthophosphate, Dissolved (as P)	00671	US EPA 365.1	1	$\mu\text{g}/\text{L}$	125ml jar	cool $\leq 6^\circ\text{C}$	48 hr.	\$23
Chlorophyll a	32230	USEPA 445.0			GF/C	freeze	25d	\$52
Microcystins		OEPA 701.0	0.3	$\mu\text{g}/\text{L}$	1L LDPE	cool $\leq 6^\circ\text{C}$		\$45

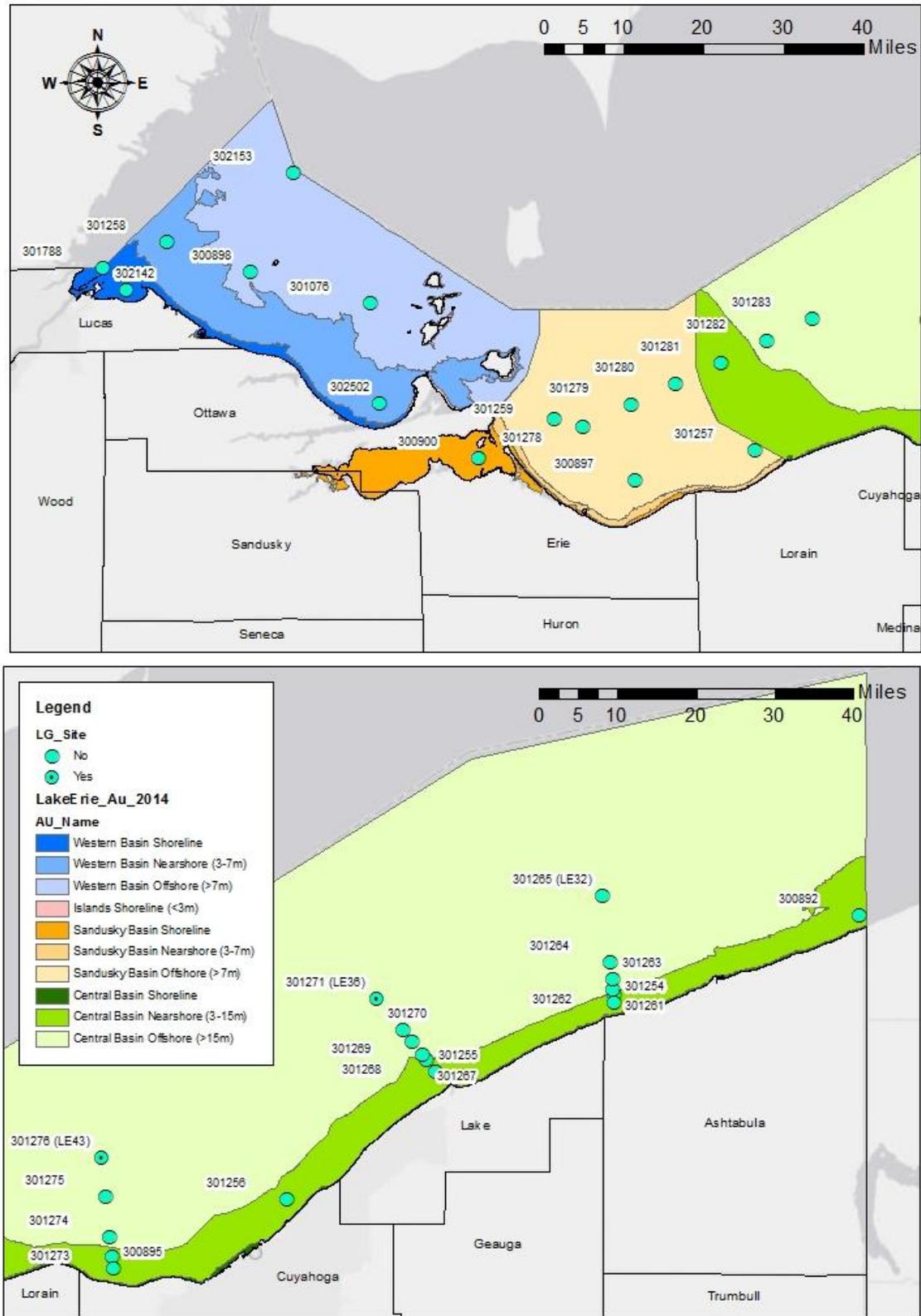
Table 4. Transect stations that will be monitored for hypoxia/anoxia by Ohio EPA.

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	41.6067	-81.89670
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	41.08166	-81.01166

Table 5. Fish stations that will be sampled in the Lake Erie shoreline assessment units. Ohio DNR site numbers are shown in parenthesis next to the Station ID. Ohio EPA will complete the second pass at all stations except those marked with an asterisk.

Station ID	Description	Latitude	Longitude
Western Basin Shoreline Assessment Unit			
302439 (2)	Maumee Bay near Cullen Park along break wall	41.7035	-83.4678
204188 (3)	Maumee Bay near Immergrun	41.69	-83.4194
S03K12 (4)	Maumee Bay near Cedar Point NWR along west shore	41.7008	-83.3378
S03K10	Lake Erie near Cooley Canal	41.6756	-83.2936
302438 (5)	Lake Erie near Crane Creek State Park	41.6252	-83.175
300905 (6)	Lake Erie near Long Beach	41.6145	-83.1115
S02K08	Lake Erie near Port Clinton 2.5 mi. west of Portage R.	41.5281	-82.9778
Sandusky Basin Shoreline Assessment Unit			
302436 (13)	Sandusky Bay near Willow Inn Road	41.4807	-82.9663
304437 (14)	Sandusky Bay near Whites Landing	41.4255	-82.9101
301568 (15)	Sandusky Bay near Johnsons Island	41.4908	-82.7394
302435 (16)	Sandusky Bay near Cedar Point Causeway	41.4636	-82.6742
302432 (17)	* Sandusky Bay near City Boundary Causeway	41.4301	-82.6223
302433 (18)	* Sandusky Bay near Farthest East Point	41.4206	-82.6073
302443 (19)	Lake Erie east of Sandusky	41.4206	-82.6223
204167 (21)	Lake Erie east of Vermilion near Elberta Beach	41.4289	-82.3475
Islands Shoreline Assessment Unit			
302442 (9)	Lake Erie at Catawba Peninsula adj. Sand Road	41.5292	-82.8753
S02K07 (10)	Lake Erie at Catawba Peninsula near State Park	41.5747	-82.8592
302441 (11)	Lake Erie at Catawba Peninsula near Gem Beach	41.5756	-82.8235
302440 (12)	* Lake Erie at Catawba Peninsula near East Harbor	41.5522	-82.7988
204178	Lake Erie at Marblehead Peninsula near Lighthouse	41.5364	-82.7108
204200 (1)	Lake Erie at South Bass Island near State Park	41.6439	-82.8411
204210	Lake Erie at Kelleys Island near Northeast tip	41.6217	-82.6783
Central Basin Shoreline Assessment Unit			
301762	Lake Erie West of Miller Road Boat Ramp	41.5003	-82.0721
204141	Lake Erie West of Bay Village and East of Avon Lake	41.5086	-81.9775
204135	Lake Erie near Cuyahoga River and West Harbor	41.4992	-81.7172
F01K02	Lake Erie East of Euclid Creek	41.5928	-81.5578
204103	Lake Erie 2.1 miles West of Perry Power Plant	41.7894	-81.1767
204101	Lake Erie West of Geneva State Park	41.8517	-81.0061
A01K30	Lake Erie 0.3 miles West of OH/PA State Line	41.9756	-80.5269
302529	Lake Erie 2.0 miles East of Chagrin River	41.6951	-81.4070
302530	Lake Erie at Geneva on the Lake	41.8621	-80.9508
302531	Lake Erie West of Kent State Ashtabula Branch	41.8906	-80.8398

Figure 1. Lake Erie water quality and transect monitoring stations with Lake Guardian (LG) sites shown.



Appendix A. Burrowing Mayfly Lab Bench Sheet

Station ID	Sample Date	Replicate Number	Date Sorted	Sorted By	Nymph Count	Station Mean	Density (m ²) (#/0.0537)m ²	Comments
301360		1 of 3						
		2 of 3						
		3 of 3						
301361		1 of 3						
		2 of 3						
		3 of 3						
301356		1 of 3						
		2 of 3						
		3 of 3						
300863		1 of 3						
		2 of 3						
		3 of 3						
300863		1 of 3						
		2 of 3						
		3 of 3						
301362		1 of 3						
		2 of 3						
		3 of 3						
301359		1 of 3						
		2 of 3						
		3 of 3						
301357		1 of 3						
		2 of 3						
		3 of 3						
301358		1 of 3						
		2 of 3						
		3 of 3						

Appendix B. Snapshot of the fish data sheet used to record sampling results.

Ohio EPA FISH DATA SHEET Sheet ID For Office Use Only New Station (requires lat/long & county) Mix Zone Page of

Station ID River Code RM Date Time

Stream Location

Comments

Lat Long County ALP Time Fished

Crew Netter Others Sampler Type

Distance Flow Temp. C Secchi Source Project

1	Fins Code	Number Weighed	Total Counted	Total Weight	Weights		DELT ANOMALIES <small>Deformities, Erosions, Lesions, Tumors Multiple DELTs on one fish</small>													
					Counts		D	E	L	T	M	*								
	V	10x																		
	V	10x																		
	V	10x																		
	V	10x																		
	V	10x																		
	V	10x																		
	V	10x																		
	V	10x																		
	V	10x																		

* A-anchor worm; B-black spot; C-licees; F-fungus; N-blind; P-parasites; S-emaciated, W-swirled scales Y-popeye; Z-other EPA 4508 06/7/2006

Appendix C. Snapshot of the Lake QHEI field sheet used to record shoreline habitat.

Lake / Lacustrary (Lentic) QHEI Field Sheet



QHEI Score:

RIVERCODE _____ RIVERMILE _____ WATERBODY _____ DISTANCE ASSESSED (m): _____

DATE _____ LOCATION _____

SCORER: _____ LAT. _____ LONG. _____ COMMENT _____

1) SUBSTRATE (Check ONLY two Substrate TYPE BOXES; Estimate % or note every type present);

TYPE	SHORE BOTTOM	SHORE BOTTOM	SUBSTRATE ORIGIN
<input type="checkbox"/> BLDR/SLABS [7] <input type="checkbox"/> BOULDER [10] <input type="checkbox"/> COBBLE [8] <input type="checkbox"/> GRAVEL [7] <input type="checkbox"/> SAND [6]	<input type="checkbox"/> HARDPAN [4] <input type="checkbox"/> BEDROCK [3] <input type="checkbox"/> DETRITUS [3] <input type="checkbox"/> SILT [2] <input type="checkbox"/> MUCK [2]	<input type="checkbox"/> LIMESTONE [1] <input type="checkbox"/> TILLS [1] <input type="checkbox"/> WETLANDS [1] <input type="checkbox"/> LACUSTRINE [1] <input type="checkbox"/> SANDSTONE [1] <input type="checkbox"/> RIP/RAP [1] <input type="checkbox"/> HARDPAN [0] <input type="checkbox"/> SHALE [-1] <input type="checkbox"/> COAL/ORE [-2]	Check ONE (OR 2 & AVERAGE) SILT: <input type="checkbox"/> SILT HEAVY [-2] <input type="checkbox"/> SILT MODERATE [-1] <input type="checkbox"/> SILT NORMAL [0] <input type="checkbox"/> SILT FREE [1] ORIGIN: <input type="checkbox"/> CLAY [-2] <input type="checkbox"/> INDUSTRIAL [-1] <input type="checkbox"/> ORGANIC [1] <input type="checkbox"/> NONE [1]

NOTE: (Ignore sludge that originates from point-sources; score on natural substrates)

NUMBER OF SUBSTRATE TYPES: - 5 or More [2] - 4 or Less [0]

COMMENTS: _____

2) COVER TYPES

TYPE: (Check All That Apply)	AMOUNT: (Check ONLY One or check 2 and AVERAGE)
<input type="checkbox"/> -OF SHORE SAND BARS [4] <input type="checkbox"/> -OVERHANGING VEGETATION [1] <input type="checkbox"/> -SHALLOWS (ON BEACH) [1] <input type="checkbox"/> -ROOTMATS [1]	<input type="checkbox"/> - DEEPWATER > 1 m [1] <input type="checkbox"/> - WETLAND POOLS [1] <input type="checkbox"/> - SUBMERGED AQUATIC VEG. [4] <input type="checkbox"/> - LOGS OR WOODY DEBRIS [1] <input type="checkbox"/> - GRAVEL BEACH [1]

COMMENTS: _____

3) SHORELINE MORPHOLOGY: (Check ONLY One PER Category OR check 2 and AVERAGE)

SHORE SINUOSITY	DEVELOPMENT	MODIFICATION	STABILITY
<input type="checkbox"/> - HIGH [2] <input type="checkbox"/> - MODERATE [4] <input type="checkbox"/> - LOW [3] <input type="checkbox"/> - NONE [1]	<input type="checkbox"/> - EXCELLENT [6] <input type="checkbox"/> - GOOD [5] <input type="checkbox"/> - FAIR [3] <input type="checkbox"/> - POOR [1]	<input type="checkbox"/> - NONE [7] <input type="checkbox"/> - RECOVERED [5] <input type="checkbox"/> - RECOVERING [3] <input type="checkbox"/> - RECENT OR NO RECOVERY [1]	<input type="checkbox"/> - HIGH [3] <input type="checkbox"/> - MODERATE [2] <input type="checkbox"/> - LOW [1]

COMMENTS: _____

MODIFICATIONS OF SAMPLED SHORELINE

Check all that apply

<input type="checkbox"/> - CEMENTED [-1] <input type="checkbox"/> - RIP RAPPED [1] <input type="checkbox"/> - RAILROAD TIES [-1] <input type="checkbox"/> - DREDGED [-1] <input type="checkbox"/> - TWO SIDE CHANNEL MODIFICATIONS [-1] <input type="checkbox"/> - SHIP CHANNEL [-2]	<input type="checkbox"/> - STEEL BULKHEADS [-2] <input type="checkbox"/> - ISLANDS [1] <input type="checkbox"/> - DIKES [-1] <input type="checkbox"/> - BANK SHAPING [-1] <input type="checkbox"/> - WOOD PILINGS [1]
---	---

Slope: Max 6 Depth: Max 4 Shore line: Max 20

4) RIPARIAN ZONE AND BANK EROSION (check ONE box per bank or 2 and AVERAGE per shore)

RIPARIAN WIDTH	SHORE LINE QUALITY (PAST 100 FOOT RIPARIAN)	BANK EROSION
<input type="checkbox"/> - WIDE > 50m [4] <input type="checkbox"/> - MODERATE 10-50m [3] <input type="checkbox"/> - NARROW 5-10 m [2] <input type="checkbox"/> - VERY NARROW < 5 m [1] <input type="checkbox"/> - NONE [0]	<input type="checkbox"/> - FOREST, WETLAND, LAKE [3] <input type="checkbox"/> - SHRUB OR OLD FIELD [2] <input type="checkbox"/> - VINYARD, ORCHARD [2] <input type="checkbox"/> - FENCED PASTURE [1] <input type="checkbox"/> - RESIDENTIAL, PARK, NEW FIELD [1]	<input type="checkbox"/> - CONSERVATION TILLAGE [1] <input type="checkbox"/> - URBAN OR INDUSTRIAL [0] <input type="checkbox"/> - OPEN PASTURE, ROWCROP [0] <input type="checkbox"/> - MINING/CONSTRUCTION [0] <input type="checkbox"/> - DIKED WETLAND [0]

COMMENTS: _____

5) AQUATIC VEGETATION QUALITY: PLANT SPECIES OBSERVED (SUM ALL SCORES)

(Score all for observed abundance: ABUNDANT = [3]; COMMON = [5]; FEW = [1]; UNCOMMON = [0] NO AQUATIC VEGETATION = 0)

- Pond Lilies (NYMPHAEA) - Sedge (CYPERACEAE) - Wild Celery (VALLISINARIA)
 - Pond Weed (POTAMOGETON) - Bulrush (SCIRPUS) - Waterweed (ELODEA) - Wild Rice (ZIZANIA)

(Score all for observed abundance: ABUNDANT = [-2]; COMMON = [-1]; FEW = [0])

- Purple Loosestrife - Reed Grass - Eurasian Milfoil - Cattails - Algae mats - Algae planktonic

COMMENTS: _____