Level 3 Project Study Plan

2016 Greater Cleveland Area Lake Erie Nutrient Study

(1) Objectives

Over the last few years, there has been a significant increase in the occurrence of harmful algal blooms within the central basin of Lake Erie. In 2011, an algal bloom, the majority of which consisted of *Microcystis*, spread east of Cleveland and persisted there until the middle of October. In August 2014, an algal bloom interfered with the drinking water in Toledo, Ohio. The increase in algae throughout the lake may be attributed to increases in bioavailable phosphorus which includes dissolved reactive phosphorus (US EPA, 2015) coupled with favorable weather conditions. The algae bloom in 2015 was the largest in this century according to the National Oceanic and Atmospheric Academy (NOAA, 2015). Northeast Ohio Regional Sewer District (NEORSD) facilities, including wastewater treatment plants and the combined sewer overflows (CSOs), could be a potential source of nutrients to the lake. The extent to which these potential sources, along with other sources within the study area, are contributing to the problem is not well known.

The purpose of this study is to monitor the levels of nutrients, algae, and *Microcystis* and its associated toxins, in Lake Erie and its tributaries near the greater Cleveland area from April through October. Protecting public health is also important and this study will attempt to monitor harmful algal blooms if they do occur, in conjunction with NEORSD's Beach Monitoring Study. In addition to this, the study attempts to establish temporal and spatial trends among these parameters, and potentially relate them to levels of precipitation. Chlorophyll *a* will be measured as a means of determining the total quantity of algae present. Nutrient analyses will include several forms of both phosphorus and nitrogen in the Lake and tributaries, with additional monitoring of phosphorus at the three treatment plants. Other water quality parameters that may also influence algal production will also be measured (Section 3).

(2) Table 1. Point/Nonpoint Sources

Point Sources	Nonpoint Sources
Easterly WWTP	Urban Runoff
Westerly WWTC	Spills
NEORSD-owned CSOs	Agricultural runoff
Cuyahoga River	
Rocky River	
Euclid Creek	
9-Mile Creek	

Point Sources	Nonpoint Sources
Dugway Brook	
Doan Brook	
Shaw Brook	
Green Creek	

A map has been provided in Section 6 (Figure 1.) to show point sources that may be influencing the water quality at each sample location. These sources, along with the ones listed in the table above, may be impacting nutrient and algal levels within Lake Erie.

(3) Parameters Covered

Water chemistry samples will be collected at each site and analyzed by NEORSD's Analytical Services. Chemical and physical water quality parameters to be measured in conjunction with water column chlorophyll *a* samples and *Microcystis* sampling include total phosphorus, dissolved reactive phosphorus, nitrate+nitrite, ammonia, alkalinity, turbidity and suspended solids. Appendix A lists the parameters to be tested, along with the detection limits and practical quantitation limits. Field measurements for dissolved oxygen (DO), pH, temperature, conductivity, specific conductance and turbidity will also be performed. Observations such as water color, clarity, odor and surface coating, lake surface conditions, and weather conditions will be recorded on a field sheet or in electronic format using an Apple iPad equipped with GIS data entry software. A *Lake Sampling Field Data Form* will be completed at each site during each sampling event (Appendix B).

(4) Field Collection and Data Assessment Techniques

Techniques used for water chemistry sampling and chemical analyses will follow the Ohio EPA *Surface Water Field Sampling Manual* (2015a). These techniques will be used for the lake sites and the three river sites. The effluent samples from the NEORSD wastewater treatment plants will be grab samples using similar techniques. Chemical water quality samples from each site will be collected with one 4-liter disposable polyethylene cubitainer with disposable polypropylene lids and two 473-mL plastic bottles. An additional sample to be analyzed for dissolved reactive phosphorus will be filtered in the field using a 0.45-µm PVDF syringe filter and put into a 125-mL plastic bottle. All water quality samples will be collected as grab samples at a depth of six to twelve inches below the water surface. Duplicate samples and field blanks will be collected at randomly selected sites at a frequency of not less than 5% of the total samples collected for this study plan. The acceptable relative percent difference (RPD) for field duplicate samples

will be less than or equal to $[(0.9465x^{-0.344})*100]+5$, where x = sample result/detection limit; results above this range will be rejected. Acid preservation of the samples, as specified in the NEORSD laboratory's standard operating procedure for each parameter, will also occur in the field. Appendix A lists the analytical method, method detection limit and practical quantitation limit for each parameter analyzed. Field analyses include the use of an YSI EXO1 sonde, YSI EXO2 sonde, YSI 600XL sonde, or YSI 6600EDS sonde to measure dissolved oxygen (DO), water temperature, conductivity and pH; and when necessary, a Hanna HI 98129 meter to measure water temperature, specific conductivity and pH and a Hach HQ30d meter with LDO101 probe to measure DO. Turbidity will be measured using either a Hach 2100P IS Portable Turbidimeter or a Hach 2100Q Portable Turbidimeter. Specifications for these meters have been included in Appendix C.

Water column chlorophyll *a* samples will be collected during each sampling event using a 1L glass amber-colored jar. All chlorophyll *a* samples will be collected as grab samples at a depth of six to twelve inches below the water surface. One duplicate chlorophyll *a* sample will be collected at randomly selected sites at a frequency of not less than 5% of the total samples collected for this study plan. After returning to the NEORSD Environmental and Maintenance Services Center, each sample will be filtered in triplicate using 47 mm glass fiber filters and a vacuum with a pressure not exceeding 6 in. Hg. Filtered samples will be stored in a freezer at -37°C for storage prior to analysis.

Microcystin samples will be collected for four different analyses (Table 2): microscope ID and enumeration, EPA 545 for Cylindrospermopsin and Anatoxin-A by LC/MS/MS1, EPA 544 for Microcystins and Nodularin by LC/MS/MS2, ISO 20179 Determination of Microcystins using SPE (Solid Phase Extraction) and HPLC (High Performance Liquid Chromatography) with UV3, and ELISA (Enzyme-Linked-Immunosorbent Assay) protocol. Specifications for these analyses and sampling methods are included in Table 2 below. These samples will be collected at each lake and river site, except for the Cuyahoga River site upstream of Southerly. Only one 1-L amber glass jar will be collected at this site for Microscope ID and Enumeration along with a sample collected and analyzed for dissolved reactive phosphorus. Filtering will be done at time of collection using a 0.45-µm PVDF syringe filter and transferred to a 125-mL plastic bottle.

Samples at Westerly, Easterly, and Southerly Treatment Plants will be collected from the final treated effluent and will be analyzed for dissolved reactive phosphorus. Filtering will be done at time of collection using a 0.45-µm PVDF syringe filter and transferred to a 125-mL plastic bottle.

Water chemistry parameters pertaining to the lake sampling and water conditions will be recorded using the NEORSD's *Lake Sampling Field Data Form* (refer to Appendix D for an example form) or recorded in electronic format using an Apple iPad equipped with GIS data entry software. In the case of electronic data submission daily field sheets may still be electronically generated upon request.

Table 2. Microcystin Analyses and Descriptions

	Microscope ID and Enumeration	**EPA 545 for Cylindrospermopsin and Anatoxin-A by LC/MS/MS1**	**EPA 544 for Microcystins and Nodularin by LC/MS/MS2**	**ISO 20179 Determination of microcystins using SPE and HPLC with UV3**	**ELISA**
Container	1 liter amber glass	100 mL amber glass vials with PTFE caps	500-mL amber glass bottles with PTFE caps	1 liter glass container	
Preservation	Lugol's Solution (done in the lab)	Sodium bisulfate = 1g/L Ascorbic Acid = 0.10 g/L	Trizma = 7.75 g/L 2-Chloroacetamide = 2 g/L Ascorbic Acid = 100 mg/L EDTA = 0.35 g/L	None	
Collection	Grab sample from densest part of the bloom	Grab sample 6-12 inches beneath surface	Grab sample 6-12 inches beneath surface	Take sample at location where unusual phenomena have been observed. Composite of 3 samples depending on bloom depth.	
Storage	Ambient field temperature, < 6° C and protected from light	< 6° C and protected from light (do not freeze)	< 6° C (do not freeze)	Refrigerate for up to 5 days, freeze for storage longer than 5 days; protect from light	
Hold Time	24 hours	28 days	28 days	48 hours	14 days
Volume needed for analysis	10 uL	1 mL	500 mL or entire sample	50-100 mL	50 uL
Special Notes	Preservation to be added in lab.	Preservatives (as solids) added to each sample container prior to use in the field. Sample must be chilled < 10oC during shipment.	Preservatives (as solids) added to each sample container prior to use in the field. Sample must be chilled < 10oC during shipment.	None	

(5) Stream Flow Measurements

Not applicable.

(6) Sampling Locations

The following sample locations will be surveyed during the 2016 field season (Table 3 and Figure 1.):

Water Body	Latitude	Longitude	Station ID	Location Information	USGS HUC 8 Number - Name	Purpose
Lake Erie	41.49720	-81.86200	RR1B	Near Rocky River	04120200-Lake Erie	Determine trends in algal densities and nutrient concentrations in Lake Erie.
	41.59630	-81.80000	BRD17D	About 7 miles off shore of Lakewood		
	41.52080	-81.80000	BRD17I	Near Lakewood		
	41.54800	-81.76400	CW82	Near Garrett Morgan Water Intake		
	41.50765	-81.72907	WTP1	Near Westerly WWTC Diffusers		
	41.52500	-81.71170	CW88	Outside the City of Cleveland's Breakwall		
	41.54500	-81.67500	CE92	Outside the City of Cleveland’s Breakwall		
	41.60333	-81.59717	CE100	2 miles north of Easterly WWTP outfall		
Rocky River	41.4802	-81.8327	RM 0.90	Upstream of Detroit Avenue	04110002 - Cuyahoga	Determine the contribution and effect to receiving waterbody.
Euclid Creek	41.5833	-81.5594	RM 0.55	Downstream of Lake Shore Boulevard	04110003 Ashtabula-Chagrin	
Cuyahoga River	41.5008	-81.7098	RM 0.20	Near mouth of river in navigation channel	04110002 - Cuyahoga	
Cuyahoga River	41.4182	-81.6479	RM 10.95	Chlorine-access railroad bridge, near ash lagoons	04110002 - Cuyahoga	
Easterly WWTP	14021 Lakeshore Blvd, Cleveland, OH 44110			Treated Effluent	Discharges to: 04120200-Lake Erie	
Westerly WWTC	5800 Cleveland Memorial Shoreway, Cleveland, OH 44102			Treated Effluent	Discharges to: 04120200-Lake Erie	

Water Body	Latitude	Longitude	Station ID	Location Information	USGS HUC 8 Number - Name	Purpose
Southerly WWTC	6000 Canal Rd Cuyahoga Heights, OH 44125			Treated Effluent	Discharges to: 04110002-Cuyahoga	

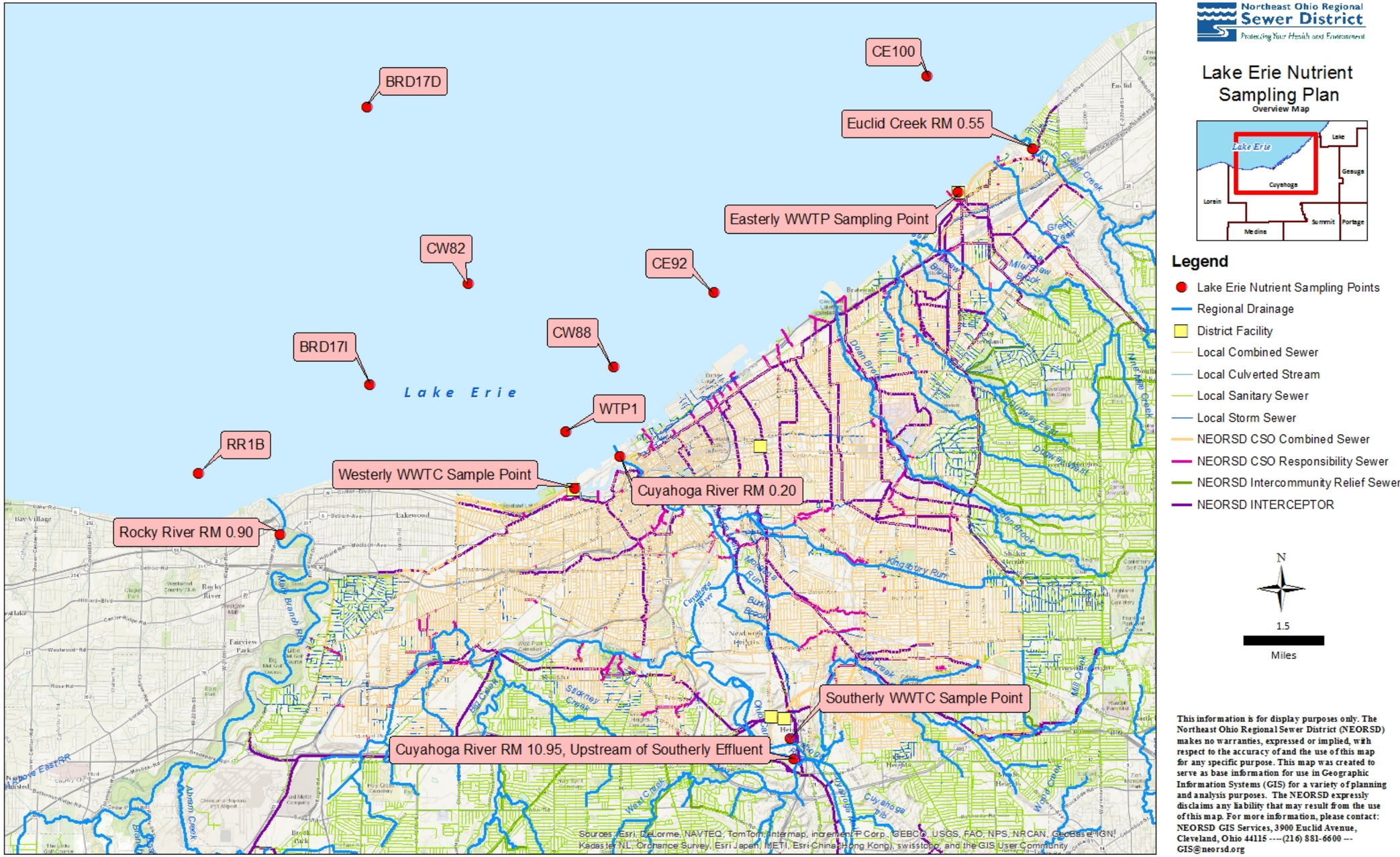

Figure 1. Map of Sampling Locations

(7) Schedule

Water chemistry sampling will be attempted at least once per month in May, June, and July 2016, and twice per month in August, September, and October 2016. Sampling will also take place after significant rain events if time and field conditions permit. More frequent sampling may be conducted if deemed necessary based upon the extent of any algal blooms. Sampling may also occur in April if weather permits. Specific dates have not been chosen and will be dependent upon weather and lake conditions.

(8) QA/QC

Water samples obtained for chemical analyses on the boat will be preserved [see section (4)], labeled and then placed on ice in a cooler on the boat until all samples are collected. The sample cooler will then be transferred to the field truck upon returning to shore. The field truck will remain locked at all times when not occupied/visible. The water samples collected on land will be preserved, labeled and placed directly into the cooler in the field truck, which will be locked at all times. Sampling activities, including sample time and condition of surface water sampled, will be entered in a field log book and on the *Lake Sampling Field Data Form* (Appendix B) by hand or using the Apple iPad. The samples will then be delivered immediately to the NEORSD Analytical Services cooler and the samples will be transferred to the custody of Analytical Services. The NEORSD Analytical Services Quality Manual and associated Standard Operating Procedures are on file with Ohio EPA. The Quality Assurance Officer at Analytical Services will send updates, revisions and any information on document control to Ohio EPA as needed.

For chlorophyll *a* sampling, three filtrations will be performed for each sample. A field filtration blank will be submitted for every 20 samples.

(9) Work Products

Within one year of completion of the project, water chemistry results will be submitted to the Ohio EPA. Additionally, reports summarizing, interpreting, graphically presenting and discussing the chlorophyll *a* results and any excursions from water quality standards may be prepared for internal use.

(10) Qualified Data Collectors

The following Level 3 Qualified Data Collectors (QDC) will be involved with this study:

Name	Address	Email Address	Phone Number	QDC Specialty(s)
John W. Rhoades	4747 East 49th Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	QDC - 00008 CWQA
Cathy Zamborsky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	QDC - 00009 CWQA
Seth Hothem[1]	4747 East 49th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 00010 CWQA
Tom Zablotny	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zablotnyt@neorsd.org	216-641-6000	QDC - 00018 CWQA
Ron Maichle	4747 East 49th Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 00145 CWQA
Francisco Rivera	4747 East 49th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000	QDC - 00262 CWQA
Jill Knittle	4747 East 49th Street Cuyahoga Hts., Ohio 44125	knittlej@neorsd.org	216-641-6000	QDC - 00512 CWQA
Mark Matteson	4747 East 49th Street Cuyahoga Hts., Ohio 44125	mattesonm@neorsd.org	216-641-6000	QDC - 001020 CWQA
Eric Soehnlen	4747 East 49th Street Cuyahoga Hts., Ohio 44125	soehnlene@neorsd.org	216-641-6000	QDC - 001030 CWQA
Donna Friedman	4747 East 49th Street Cuyahoga Hts., Ohio 44125	friedmand@neorsd.org	216-641-6000	QDC - 001031 CWQA
[1] Lead Project Manager				

The following is a list of persons not qualified as level 3 QDCs who may be involved in the project. Prior to the start of sampling, the project managers will explain to each individual the proper methods for sampling. Sampling will only be completed under the direct observation of a QDC. The lead project manager will be responsible for reviewing all reports and data analysis prepared by qualified personnel prior to completion.

Name	Address	Email Address	Phone Number
Kelsey Amidon	4747 East 49th Street Cuyahoga Hts., Ohio 44125	Amidonk@neorsd.org	216-641-6000
Nick Barille	4747 East 49th Street Cuyahoga Hts., Ohio 44125	barillen@neorsd.org	216-641-6000
Bryanna Boggan	4747 East 49th Street Cuyahoga Hts., Ohio 44125	bogganb@neorsd.org	216-641-6000
Mark Colvin	4747 East 49th Street Cuyahoga Hts., Ohio 44125	colvinm@neorsd.org	216-641-6000
Rae Grant	4747 East 49th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Mario Meany	4747 East 49th Street Cuyahoga Hts., Ohio 44125	meanym@neorsd.org	216-641-6000
Carrie Millward	4747 East 49th Street Cuyahoga Hts., Ohio 44125	millwardc@neorsd.org	216-641-6000

Name	Address	Email Address	Phone Number
Denise Phillips	4747 East 49th Street Cuyahoga Hts., Ohio 44125	phillipsd@neorsd.org	216-641-6000
Brandy Reischman	4747 East 49th Street Cuyahoga Hts., Ohio 44125	reischmanb@neorsd.org	216-641-6000
Joseph Schiel	4747 East 49th Street Cuyahoga Hts., Ohio 44125	schielj@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49th Street Cuyahoga Hts., Ohio 44125	schuschuf@neorsd.org	216-641-6000
William Stanford	4747 East 49th Street Cuyahoga Hts., Ohio 44125	stanfordw@neorsd.org	216-641-6000
Nicole Velez	4747 East 49th Street Cuyahoga Hts., Ohio 44125	velezn@neorsd.org	216-641-6000
Wolfram von Kiparski	4747 East 49th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Paraprofessional Intern	4747 East 49th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000
Paraprofessional Intern	4747 East 49th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000

(11) Contract laboratory contact information

All chemical sample analysis will be completed by NEORSD's Analytical Services Division. Evidence of NEORSD's Analytical Services current accreditation and method dates can be found in Appendix D. The contact information for NEORSD's Analytical Service Division is:

NEORSD Analytical Services
Mr. Mark Citriglia
4747 E. 49th Street
Cuyahoga Heights, Ohio 44056
citrigliam@neorsd.org
216-641-6000

(12) Copy of ODNR collector's permit

Not applicable

(13) Catalog Statement

A digital photo catalog of all sampling locations will be maintained for 10 years and will include photos of the specific sampling location(s), and, for those sites

close to shore, the general land use in the immediate vicinity of the sampling location(s).

Print/Signature: Seth Hothem / Date: _____

(14) Voucher Specimen Statement

Not applicable

(15) Sample Location Statement

I attest that I will make available any and all sampling location information, including but not limited to; the name of the water body sampled, sampling location latitude and longitude, sampling location, station ID, general location information, the U.S. geological survey HUC 8 number and name, and the purpose for data collection at each sampling location.

Print/Signature: Seth Hothem / Date: _____

(16) Additional L3 Data Collector Statement

The Lead Project Manager for all NEORSD project study plans is approved for all project data types.

Print/Signature: Seth Hothem / Date: _____

(17) Trespassing Statement

I have not been convicted or pleaded guilty to a Violation of section 2911.21 of the Revised Code (criminal trespass) or a substantially similar municipal ordinance within the previous five years.

Print/Signature: Seth Hothem / Date: _____

Print/Signature: John Rhoades/ Date: _____

Print/Signature: Cathy Zamborsky /

Print/Signature: Tom Zablotny / Date: _____

Print/Signature: Ron Maichle / Date: _____

Print/Signature: Francisco Rivera / Date: _____

Print/Signature: Jillian Knittle / Date: _____

Print/Signature: Mark Matteson / Date: _____

Print/Signature: Eric Soehnlen / Date: _____

Print/Signature: Donna Friedman / Date: _____

References

National Oceanic and Atmospheric Academy. (2015). *Bulletin 27: Experimental Lake Erie Harmful Algal Bloom Bulletin*. Ann Arbor, MI: National Centers for Coastal Ocean Science and Great Lakes Environmental Research Laboratory, NOAA-GLERL.

Ohio Environmental Protection Agency. (2015b). *Proposed Stream Nutrient Assessment Procedure*. Columbus, OH: Division of Surface Water, Ohio EPA Nutrients Technical Advisory Group.

Ohio Environmental Protection Agency. (2014). *State of Ohio Water Quality Standards Ohio Administrative Code Chapter 3745-1* (Revision: July 1, 2014; Effective October 1, 2014). Columbus, OH: Division of Surface Water; Standards and Technical Support Section.

Ohio Environmental Protection Agency. (2015a). *Surface Water Field Sampling Manual for water quality parameters and flow.* Columbus, Ohio: Division of Surface Water.

US Environmental Protection Agency. (2015). *Recommended Phosphorus Loading Targets for Lake Erie*. US EPA, Annex 4 Objectives and Targets Task Team. Accessed: 22 February 2016. URL: http://www.epa.gov/sites/production/files/2015-06/documents/report-recommended-phosphorus-loading-targets-lake-erie-201505.pdf .

Appendix A

Parameter	Additional Name	Test	Minimum Detection Limit	Practical Quantitation Limit
Alkalinity		EPA 310.2	4.3 mg/L	10 mg/L
Nitrite + Nitrate	$NO_2 + NO_3$	EPA 353.2	0.007 mg/L	0.020 mg/L
Ammonia	NH3	EPA 350.1	0.009 mg/L	0.020 mg/L
Dissolved Reactive Phosphorus	DRPhos	EPA 365.1	0.42 ug/L[2]	1.00 ug/L
Total Phosphorus	Total-P	EPA 365.1	0.003 mg/L	0.010 mg/L
Chlorophyll *a* (NEORSD Analytical Services)	Chlorophyll *a*	EPA 445.0	0.03 ug/L[2]	0.15 µg/L
Total Suspended Solids	TSS	SM 2540 D [1]	0.5 mg/L	1.0 mg/L
Turbidity *		EPA 180.1	0.1 NTU	0.2 NTU
Field Parameter		**Test**	**(Value Reported in)**	
pH		EPA 150.1 [1]	s.u.	
Conductivity		SM 2510A [1]	µs/cm	
Dissolved Oxygen	DO	SM 4500-0 G [1]	mg/L	
Temperature	Temp	EPA 1701.1 [1]	°C	
Turbidity *		EPA 180.1	NTU	

* Turbidity will either be completed in the field or at the laboratory.

[1] Standard Methods for the Examination of Water and Wastewater, 19th Edition. Method approved by Standard Methods Committee, 1997. Editorial revisions, 2011.

[2] This is subject to change in April 2016.

Note: Additional tests will be done to analyze for microcystin, nodularin, cylindrospermopsin, and Anoxin-A.

Appendix B

NEORSD Lake Sampling Field Data Form

Water Body: _____ Date: _____ Collectors: _____

Water Quality Meters Used: _____

Time Arrived (hrs): _____ Time Left (hrs): _____ Site: _____

Coordinates: Latitude: _____ Longitude: _____

Weather: Clear Partly Cloudy Overcast Light Rain/Showers Heavy Rain
Steady Rain Other: _____ Wind Direction: _____

Lake Surface Condition: Calm Ripples Moderate Waves Whitecaps Other: _____

Color: Clear Muddy Tea Milky Other: _____

Surface Coating: None Other: _____ Odor: Normal Other: _____

Sample ID:

Field Parameters: Conductivity (µmhos/cm): _____ Temperature (°C): _____

Specific Conductivity (µmhos/cm): _____ pH (s.u.): _____

Dissolved Oxygen (mg/L): _____ Dissolved Oxygen (%): _____

General Comments: _____

Time Arrived (hrs): _____ Time Left (hrs): _____ Site: _____

Coordinates: Latitude: _____ Longitude: _____

Weather: Clear Partly Cloudy Overcast Light Rain/Showers Heavy Rain
Steady Rain Other: _____ Wind Direction: _____

Lake Surface Condition: Calm Ripples Moderate Waves Whitecaps Other: _____

Color: Clear Muddy Tea Milky Other: _____

Surface Coating: None Other: _____ Odor: Normal Other: _____

Depth: Total (m): _____ Secchi (ft): _____

Sample ID:

Field Parameters: Conductivity (µmhos/cm): _____ Temperature (°C): _____

Specific Conductivity (µmhos/cm): _____ pH (s.u.): _____

Dissolved Oxygen (mg/L): _____ Dissolved Oxygen (%): _____

General Comments: _____

Modified April 23, 2015

Appendix C

Appendix D