Northeast Ohio Regional Sewer District

Level 3 Project Study Plan

2020 Greater Cleveland Area Lake Erie Nutrient Study

(1) Objectives

Harmful algal blooms pose a threat to Lake Erie and the cities which surround it. 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), are a 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 2020 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. 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	
Dugway Brook	
Doan Brook	
Shaw Brook	

Point Sources	Nonpoint Sources
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* (2018b). These techniques will be used for the lake sites and the three river sites. 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.

Samples may be collected for cyanotoxin analysis and cyanobacteria identification if an algal bloom is visible. The screening procedure is to analyze the sample by qPCR to determine if the toxin producing gene is present. Based on the results of the qPCR analysis, the laboratory will determine the appropriate analysis for toxin quantification: EPA 544, EPA 545, EPA 546, or any other testing necessary. Specifications for these analyses and sampling methods are included in Table 2 below.

Filtering for DRP 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 B 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.

Data from DRP samples collected at the wastewater treatment plants may also be used in the findings of the study. These samples are a requirement of the NPDES permits and are collected separately from this study.

(5) Microcystin Analyses

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**	**EPA 546 ELISA**
Container	1 liter amber glass	100-mL amber glass vials with PTFE caps	100-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, < 6º C and protected from light	< 6º C and protected from light (do not freeze)	< 6º 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	14 days
Volume needed for analysis	10 uL	1 mL	500 mL or entire sample	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 < 10º C during shipment.	Preservatives (as solids) added to each sample container prior to use in the field. Sample must be chilled < 10º C during shipment.	None

(6) Sampling Locations

The following sample locations will be surveyed during the 2020 field season (Table 3 and Figure 1.):

Water Body	Latitude	Longitude	Site 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	
	41.5828	-81.5552	RM 1.00	Concrete Structure Upstream of Lake Shore Bouldevard		
Cuyahoga River	41.5008	-81.7098	RM 0.20	Near mouth of river in navigation channel	04110002 - Cuyahoga	
	41.4182	-81.6479	RM 10.95	Chlorine-access railroad bridge, near ash lagoons	04110002 - Cuyahoga	

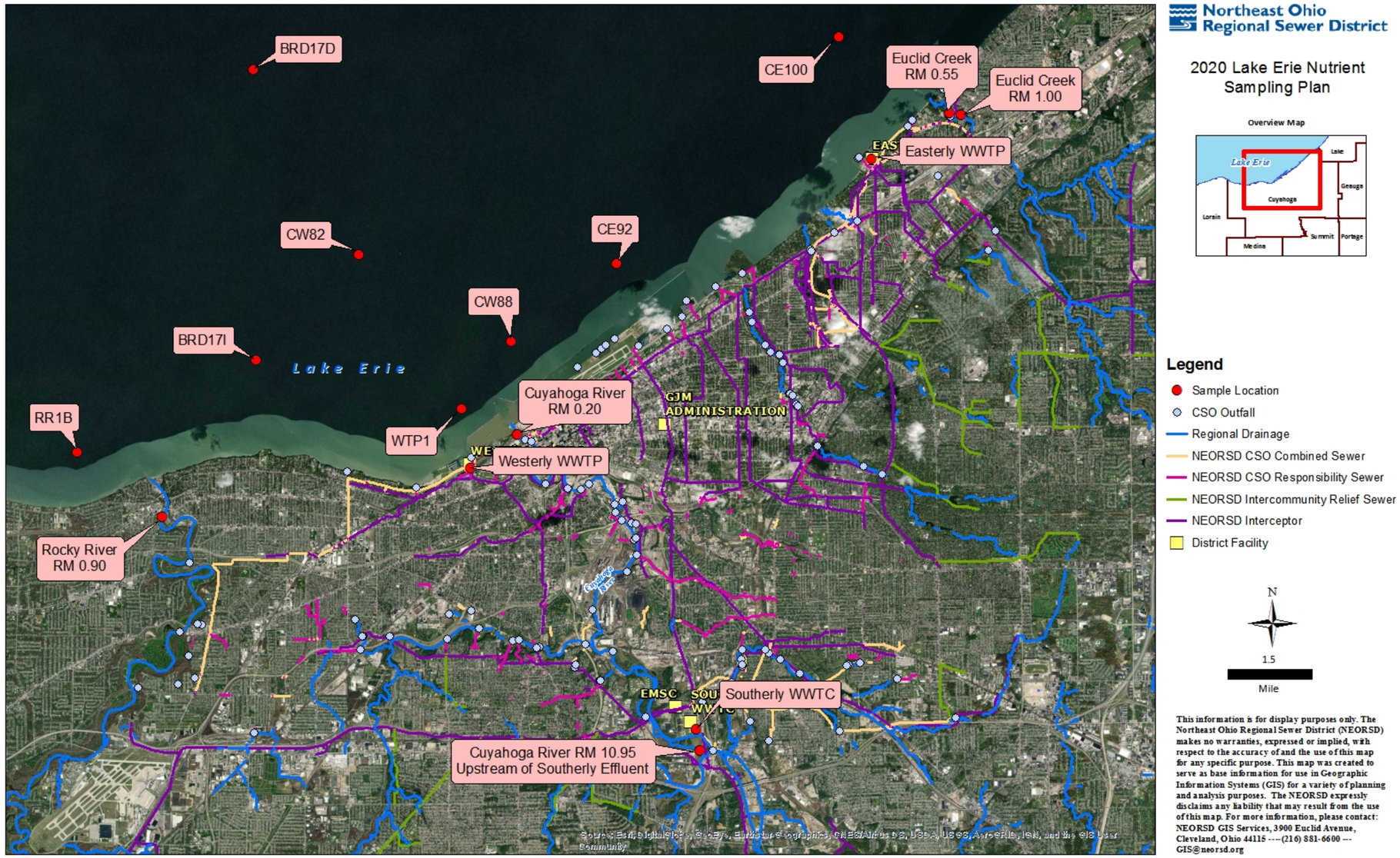


Figure 1. Map of Sampling Locations

(7) Schedule

Water chemistry sampling will be attempted at least once per month in May, June, and July 2020, and twice per month in August, September, and October 2020 if weather permits. 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 (Ohio EPA, 2018a) 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)
Hannah Boesinger	4747 East 49th Street Cuyahoga Hts., Ohio 44125	boesingerh@neorsd.org	216-641-6000	QDC – 01374 CWQA
Seth Hothem[1]	4747 East 49th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 00010 CWQA
Jill Knittle	4747 East 49th Street Cuyahoga Hts., Ohio 44125	knittlej@neorsd.org	216-641-6000	QDC - 00512 CWQA
Ron Maichle	4747 East 49th Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 00145 CWQA
Mark Matteson	4747 East 49th Street Cuyahoga Hts., Ohio 44125	mattesonm@neorsd.org	216-641-6000	QDC - 01020 CWQA
Denise Phillips	4747 East 49th Street Cuyahoga Hts., Ohio 44125	Phillipsd@neorsd.org	216-641-6000	QDC - 01203 CWQA
Francisco Rivera	4747 East 49th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000	QDC - 00262 CWQA
Eric Soehnlen	4747 East 49th Street Cuyahoga Hts., Ohio 44125	soehnlene@neorsd.org	216-641-6000	QDC - 01030 CWQA
Justin Telep	4747 East 49th Street Cuyahoga Hts., Ohio 44125	telepj@neorsd.org	216-641-6000	QDC - 01304 CWQA
Cathy Zamborsky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	QDC - 00009 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
Lindsay Baker	4747 East 49th Street Cuyahoga Hts., Ohio 44125	bakerl@neorsd.org	216-641-6000
Kevin Fitzgibbons	4747 East 49th Street Cuyahoga Hts., Ohio 44125	fitzgibbonsk@neorsd.org	216-641-6000
Rae Grant	4747 East 49th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Alex Johnson	4747 East 49th Street Cuyahoga Hts., Ohio 44125	johnsonalex@neorsd.org	216-641-6000
Matthew Johnson	4747 East 49th Street Cuyahoga Hts., Ohio 44125	johnsonmatthew@neorsd.org	216-641-6000
Mario Meany	4747 East 49th Street Cuyahoga Hts., Ohio 44125	meanym@neorsd.org	216-641-6000

Name	Address	Email Address	Phone Number
Carrie Millward	4747 East 49th Street Cuyahoga Hts., Ohio 44125	millwardc@neorsd.org	216-641-6000
Daniel Neelon	4747 East 49th Street Cuyahoga Hts., Ohio 44125	neelond@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
Justin Telep	4747 East 49th Street Cuyahoga Hts., Ohio 44125	telepj@neorsd.org	216-641-6000
Wolfram von Kiparski	4747 East 49th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Theresa Walsh	4747 East 49th Street Cuyahoga Hts., Ohio 44125	walsht@neorsd.org	216-641-6000
Paraprofessional Intern (TBD)	4747 East 49th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000
Paraprofessional Intern (TBD)	4747 East 49th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000
B-STEM Intern (TBD)	4747 East 49th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000
B-STEM Intern (TBD)	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
Cheryl Soltis-Muth
4747 E. 49th Street
Cuyahoga Heights, Ohio 44056
soltis-muthc@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 / Seth Hothem Date: 3/10/2020

(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 / Seth Hothem Date: 3/10/2020

(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 / Seth Hothem Date: 3/10/2020

(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: Hannah Boesinger / Hannah Boesinger Date: 3/10/2020

Print/Signature: Seth Hothem / Seth Hothem Date: 3/10/2020

Print/Signature: Jill Knittle/ Jill Knittle Date: 3/10/2020

Print/Signature: Ron Maichle / R. Maichle Date: 03-10-2020

Print/Signature: Mark Matteson / Mark Matteson Date: 3/10/20

Print/Signature: Denise Phillips / Denise Phillips Date: 3/12/20

Print/Signature: Francisco Rivera / Francisco Rivera Date: 3/10/20

Print/Signature: Eric Soehnlen / Eric Soehnlen Date: 3/10/20

Print/Signature: Justin Telep / Justin Telep Date: 3/10/20

Print/Signature: Cathy Zamborsky / C Zamborsky Date: 3/10/20

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. (2018a). *State of Ohio Water Quality Standards Ohio Administrative Code Chapter 3745-1* (Revision: February 8, 2018). Columbus, OH: Division of Surface Water; Standards and Technical Support Section.

Ohio Environmental Protection Agency. (2018b). *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	6.44 mg/L	16 mg/L
Ammonia	NH_3	EPA 350.1	0.0218 mg/L	0.05 mg/L
Nitrite + Nitrate	$NO_2 + NO_3$	EPA 353.2	0.014 mg/L	0.04 mg/L
Dissolved Reactive Phosphorus	DRPhos	EPA 365.1	0.0135 mg/L	0.04 mg/L
Low Level Dissolved Reactive Phoshorus	LLDRP	EPA 365.1	2.33 µg/L	5 µg/L
Total Phosphorus	Total-P	EPA 365.1	0.010 mg/L	0.02 mg/L
Chlorophyll *a*	Chlorophyll *a*	EPA 445.0	0.014 µg/L	0.20 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	s.u.	
Conductivity		SM 2510A [1]	µs/cm	
Dissolved Oxygen	DO	SM 4500-O G [1]	mg/L	
Temperature	Temp	EPA 1701.1	°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. Method approved by Standard Methods Committee, 1997. Editorial revisions, 2011.

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

*This is subject to change.

Appendix B

NEORSD Lake Sampling Field Data Form

Water Body: _____ Date: _____ Collectors: _____

Water Quality Meters Used (Circle): **EXO or 600XL, Letter:** Hach meter: _____

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:

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

Field Parameters: pH (s.u.): _____ Temperature (°C): _____

Specific Conductivity (µmhos/cm): _____ Conductivity (µmhos/cm): _____

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

Chlorophyll (µg/L): _____ BGA-PC (µg/L): _____

Turbidity: _____

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: _____

Sample ID:

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

Field Parameters: pH (s.u.): _____ Temperature (°C): _____

Specific Conductivity (µmhos/cm): _____ Conductivity (µmhos/cm): _____

Dissolved Oxygen (mg/L): _____ Percent D.O.: _____

Chlorophyll (µg/L): _____ BGA-PC (µg/L): _____

Turbidity: _____

General Comments: _____

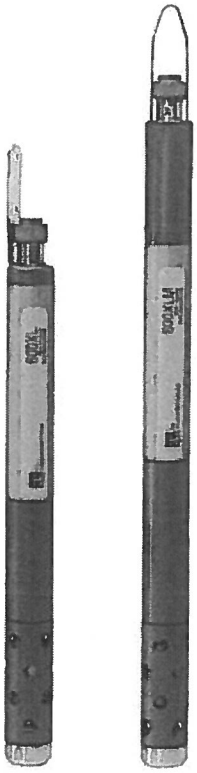
Appendix C

YSI 600XL and 600XLM Sondes

Measure multiple parameters simultaneously

The YSI 600XL and YSI 600XLM compact sondes measure eleven parameters simultaneously:

Temperature	TDS
Conductivity	pH
Specific Conductance	ORP
Salinity	Depth or Level
Resistivity	Rapid Pulse™ DO (% and mg/L)



The YSI 600XL and 600XLM

Connect with Data Collection Platforms

Either sonde can easily connect to the YSI 6200 DAS (Data Acquisition System), YSI EcoNet™ or your own data collection platform, via SDI-12 for remote and real-time data acquisition applications.

Economical Logging System

The YSI 600XLM is an economical logging system for long-term, *in situ* monitoring and profiling. It will log all parameters at programmable intervals and store 150,000 readings. At one-hour intervals, the instrument will log data for about 75 days utilizing its own power source. The 600XL can also be utilized in the same manner with user-supplied external power.

- Either sonde fits down 2-inch wells
- Horizontal measurements in very shallow waters
- Stirring-independent Rapid Pulse® dissolved oxygen sensor
- Field-replaceable sensors
- Easily connects to data collection platforms
- Available with detachable cables to measure depth up to 200 feet
- Compatible with YSI 650 Multiparameter Display System
- Use with the YSI 5083 flow cell for groundwater applications

Pure Data for a Healthy Planet.®

Economical, multiparameter sampling or logging in a compact sonde

Sensor performance verified*

The 6820 V2 and 6920 V2 sondes use sensor technology that was verified through the US EPA's Environmental Technology Verification Program (ETV). For information on which sensors were performance-verified, turn this sheet over and look for the ETV logo.

ETV

To order, or for more info, contact YSI Environmental.

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ISO 9001
ISO 14001
Yellow Springs, Ohio Facility

CE

*Sensors with listed with the ETV logo were submitted to the ETV program on the Xylem 6000XLM. Information on the performance characteristics of YSI water quality sensors can be found at www.ysi.com, ysi.com/etv, or call YSI at 800.897.4151 for the ETV verification report. Use of the ETV name or logo does not imply approval or certification of this product nor does it make any explicit or implied warranties or guarantees as to product performance.

YSI incorporated
Who's Minding the Planet?

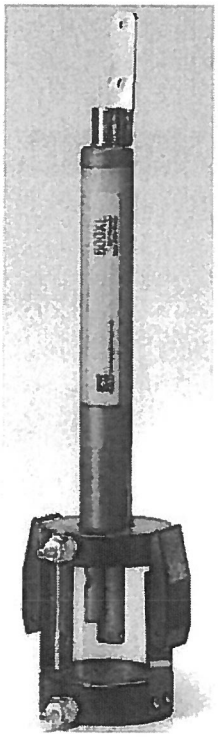
YSI 600XL & 600XLM Sensor Specifications

		Range	Resolution	Accuracy
Dissolved Oxygen % Saturation ETV 6562 Rapid Pulse™ Sensor*		0 to 500%	0.1%	0 to 200%: ±2% of reading or 2% air saturation, whichever is greater; 200 to 500%: ±6% of reading
Dissolved Oxygen mg/L ETV 6562 Rapid Pulse™ Sensor*		0 to 50 mg/L	0.01 mg/L	0 to 20 mg/L: ± 0.2 mg/L or 2% of reading, whichever is greater; 20 to 50 mg/L: ±6% of reading
Conductivity* ETV 6560 Sensor*		0 to 100 mS/cm	0.001 to 0.1 mS/cm (range dependent)	±0.5% of reading + 0.001 mS/cm
Salinity		0 to 70 ppt	0.01 ppt	±1% of reading or 0.1 ppt, whichever is greater
Temperature ETV 6560 Sensor*		-5 to +50°C	0.01°C	±0.15°C
pH ETV 6561 Sensor*		0 to 14 units	0.01 unit	±0.2 unit
ORP		-999 to +999 mV	0.1 mV	±20 mV
Depth & Level	Medium	0 to 200 ft, 61 m	0.001 ft, 0.001 m	±0.4 ft, ±0.12 m
	Shallow	0 to 30 ft, 9.1 m	0.001 ft, 0.001 m	±0.06 ft, ±0.02 m
	Vented Level	0 to 30 ft, 9.1 m	0.001 ft, 0.001 m	±0.01 ft, 0.003 m

* Report outputs of specific conductance (conductivity corrected to 25° C), resistivity, and total dissolved solids are also provided. These values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (ed 1989).

YSI 600XL & 600XLM Sonde Specifications

Medium		Fresh, sea or polluted water
Temperature	Operating	-5 to +50°C
	Storage	-10 to +60°C
Communications		RS-232, SDI-12
Software		EcoWatch®
Dimensions 600XL | 600XLM	Diameter	3.65 in, 4.19 cm | 3.65 in, 4.9 cm
	Length	16 in, 40.6 cm | 21.3 in, 54.1 cm
	Weight	1.3 lbs, 0.59 kg | 1.5 lbs, 0.69 kg
Power	External	12 V DC
	Internal (600XLM only)	4 AA-size alkaline batteries



YSI model 5083 flow cell and 600XL. This is an ideal combination for groundwater applications.

HI 98129

Combo pH/EC/TDS/Temperature Tester with Low Range EC

Description

The HI 98129 Combo waterproof tester offer high accuracy pH, EC/TDS and temperature measurements in a single tester! No more switching between meters for your routine measurements. The waterproof Combo (it even floats) has a large easy-to-read, dual-level LCD and automatic shut-off. pH and EC/TDS readings are automatically compensated for the effects of temperature (ATC). This technologically advanced tester has a replaceable pH electrode cartridge with an extendable cloth junction as well as an EC/TDS graphite electrode that resists contamination by salts and other substances. This gives these meters a greatly extended life. Your tester no longer needs to be thrown away when the pH sensor is exhausted.

The EC/TDS conversion factor is user selectable as is the temperature compensation coefficient (ß). Fast, efficient, accurate and portable, the Combo pH, EC/TDS and temperature tester brings you all the features you've asked for and more!

Specifications

Range	pH	0.00 to 14.00 pH
Range	EC	0 to 3999 µS/cm
Range	TDS	0 to 2000 ppm
Range	Temperature	0.0 to 60.0°C / 32 to 140.0°F
Resolution	pH	0.01 pH
Resolution	EC	1 µS/cm
Resolution	TDS	1 ppm
Resolution	Temperature	0.1°C / 0.1°F
Accuracy	pH	±0.05 pH
Accuracy	EC/TDS	±2% F.S.
Accuracy	Temperature	±0.5°C / ±1°F
Temperature Compensation		pH: automatic; EC/TDS: automatic with ß adjustable from 0.0 to 2.4% / °C
Calibration	pH	automatic, 1 or 2 points with 2 sets of memorized buffers (pH 4.01 / 7.01 / 10.01 or 4.01 / 6.86 / 9.18)
Calibration	EC/TDS	automatic, 1 point
TDS Conversion Factor		adjustable from 0.45 to 1.00
pH Electrode		HI 73127 (replaceable; included)
Environment		0 to 50°C (32 to 122°F); RH max 100%
Battery Type / Life		4 x 1.5V / approx. 100 hours of continuous use; auto-off after 8 minutes of non-use
Dimensions		163 x 40 x 26 mm (6.4 x 1.6 x 1.0")
Weight		100 g (3.5 oz.)

HQ30d Portable pH, Conductivity, Dissolved Oxygen (DO), ORP, and ISE Multi-Parameter Meter

Product #: HQ30D53000000 Quantity
USD Price: $792.00

★★★★★ 5/5
Read 1 review Write a review Follow this product

Portable meter measures critical water quality parameters - without the need for multiple instruments
Single input channel for flexible measurement of pH, Conductivity, Dissolved Oxygen (DO), BOD, ORP, Ammonia, Ammonium, Fluoride, Chloride, Sodium, and temperature - any intelliCAL™ smart probe

Intuitive user interface for simple operation and accurate results
Guided calibration and check standard routines reduce calibration errors. Stabilization alerts and visual measurement lock ensure that you can trust the accuracy of the results

Trust your measurements - intelliCAL™ smart probes store all calibrations in the probe
Calibration history allows quick and easy change out of probes without re-calibrating. The HQd™ smart system records serial numbers, current calibration data, user ID, sample ID, time, and date automatically in the data log for complete GLP traceability

Designed for demanding conditions
Rugged, waterproof (IP67) meter provides worry-free, reliable operation in lab or field environments

Convenient kit includes everything you need to start testing
Meter kit includes, 4 AA batteries, quick-start guide, user manual, and documentation CD

Specifications

AC and USB Operation	optional
Automatic Buffer Recognition	Color-coded: 4.01, 7.00, 10.01 pH IUPAC: 1.679, 4.005, 7.000, 10.012, 12.45 DIN: 1.09, 4.65, 9.23 User-defined custom buffer sets
Barometric Pressure Measurement	For automatic compensation of DO when using an LDO or LBOD probe
Battery Requirements	4, AA
Benchtop	with stand
BOD5/CBOD resolution	Available when used with Hach WIMS BOD Manager software
Cable resistance correction	Digital - not needed
Calibration curves display	Calibration summary data logged and displayed
Calibration Intervals/Alerts/Reminder	2 hours to 7 days
Compliance	CE, WEEE
Conductivity Accuracy	± 0.5 % from (1µS/cm - 200 mS/cm)
Conductivity measurement	5 different stability modes
Conductivity Measurement Range	0.01 µS/cm to 200 mS/cm
Conductivity resolution	0.01 µS/cm with 2 digits
Custom Calibration Standards	User-defined standard sets
Data Export	Download via USB connection to PC or flash stick. Automatically transfer entire data log or as readings are taken
Data Memory	500 results
Digital (intelligent) electrode inputs	2
Dimensions (H x W x D)	7.8 in x 3.7 in x 1.4 in (197 mm x 95 mm x 36 mm)
Display	Display readings from one or two probes Simultaneous readings from two probes (HQ40d only) pH: pH, mV, temperature Conductivity: Conductivity, TDS, salinity, resistivity, temperature LDO: dissolved oxygen, pressure, temperature LBOD: dissolved oxygen, pressure, temperature ORP/Redox: mV, temperature Sodium: Sodium, mV, temperature
Display Lock Function	Continuous measurement or press to read mode available with averaging function for LDO measurement.
Display Type	240 x 160 pixel Display readings from one or two probes pH: pH, mV, temperature Conductivity: Conductivity, TDS, salinity, resistivity, temperature LDO: dissolved oxygen, pressure, temperature ORP/Redox: mV, temperature Sodium: Sodium, mV, temperature
DO Measurement Range	0.01 to 20 mg/L (0 to 200%)
DO Resolution	0.01 mg/L
Fixed Buffer Selection	IUPAC standards (DIN 19266) or Technical buffer (DIN 19267) or 4-7-10 series or user defined
Inputs	M12 digital (1) for intelliCAL probes
Interface Languages	13**
Internal Data Storage	500
IP Rating	IP67
Languages:	English, French, German, Italian, Spanish, Danish, Dutch, Polish, Portuguese, Turkish, Swedish, Czech, Russian
mV Accuracy	± 0.1 mV
mV Measurement at Stable Reading	5 (auto) stabilization settings
mV Resolution	0.1 mV
Operating Error Messages	Text messages displayed
Operating Humidity	90 % relative humidity (non-condensing)
Operating Interface	Keypad
Operating Temperature	5 to 45 °C
ORP Electrode Calibration	Predefined ORP standards (including Zobell's solution)
Outputs	USB to PC / flash stick
PC Data Transfer Software	Included
pH Measurement at stable reading	5 stabilization settings
Printer	Optional accessory
Salinity Resolution	0.01 ppt
Warranty	3 years
Water Resistance	Meter Casing: 1 meter submersion for 30 minutes (IP67)
Weight	0.74 lbs (0.335 kg)

2100P and 2100P IS Portable Turbidimeter

The Hach 2100P and 2100P IS Portable Turbidimeters bring laboratory-level performance on-site, offering fast, accurate results and the ease-of-use analysts demand in the field. With a measurement range of 0 to 1000 NTU and a resolution of 0.01 NTU, the 2100P turbidimeter is ideal for regulatory monitoring, process control or field studies.

Features and Benefits

Laboratory Quality in a Portable Unit

The Hach 2100P and 2100P IS Portable Turbidimeters offer a level of performance previously possible only with laboratory instruments. Microprocessor-controlled operation and Hach's unique Ratio™ optics bring great accuracy, sensitivity, and reliability to field and in-plant testing.

Two Models for Specific Requirements

- **2100P Turbidimeter**—*Get fast, accurate turbidity testing in the field or the lab, over a wide range of samples. Compliant with USEPA Method 180.1 design criteria.*
- **2100P IS Turbidimeter**—*Designed to meet international standards that mandate measurement using an LED light source.*

Two-detector Optical System

The two-detector optical system compensates for color in the sample, light fluctuation, and stray light, enabling analysts to achieve laboratory-grade performance on a wide range of samples, even under difficult, onsite conditions.

Specifications*

	2100P	2100P IS
Measurement Method	Nephelometric Ratio	
Regulatory	Meets EPA Method 180.1	Meets EN ISO 7027
Light Source	Tungsten lamp	Light-emitting diode (LED) @ 860 nm
Range		
Automatic Range Mode	0 to 1000 NTU	0 to 1000 FNU
Manual Range Selection	0 to 9.99, 0 to 99.9 and 0 to 1000 NTU	0 to 9.99, 0 to 99.9 and 0 to 1000 FNU
Accuracy	±2% of reading plus stray light	
Repeatability	±1% of reading, or 0.01 NTU, whichever is greater	±1% of reading, or 0.01 FNU, whichever is greater
Resolution	0.01 on lowest range	
Signal Averaging	Selectable on/off	
Power Requirement	4 AA alkaline batteries or optional battery eliminator	
Battery Life, Typical	300 tests with signal average mode off 180 tests with signal average mode on	
Operating Temperature	0 to 50°C (32 to 122°F)	
Sample Required	15 mL (0.5 oz.)	
Sample Cells	60 x 25 mm (2.36 x 1 in.) borosilicate glass with screw caps	
Dimensions	22.2 x 9.5 x 7.9 cm (8.75 x 3.75 x 3.12 in.)	
Weight	0.5 kg (1.1 lb.); shipping weight 2.7 kg (6 lb.)	
Warranty	2 years	

**Specifications subject to change without notice.*

DW = drinking water WW = wastewater municipal PW = pure water / power
IW = industrial water E = environmental C = collections FB = food and beverage

HACH®

Be Right™

2100Q and 2100Q *is* Portable Turbidimeter

The Hach 2100Q and 2100Q is Portable Turbidimeters offer unsurpassed ease of use and accuracy in turbidity measurement. Only Hach offers this unique combination of advanced features, such as assisted calibration and simplified data transfer, and measurement innovation, giving you accurate results every time.

Features and Benefits

Easy Calibration and Verification

Hach 2100Q and 2100Q *is* Portable Turbidimeters provide confidence your measurements are right every time. On-screen assisted calibration and verification save you time and ensure accuracy. With an easy-to-follow interface, complicated manuals are not needed to perform routine calibrations. Single-standard RapidCal™ calibration offers a simplified solution for low level measurements.

Simple Data Transfer

Data transfer with the optional USB + Power Module is simple, flexible, and doesn't require additional software. All data can be transferred to the module and easily downloaded to your computer with a USB connection, providing superior data integrity and availability. With two different module options, you can customize connectivity and power to meet your unique needs.

Accurate for Rapidly Settling Samples

The Hach 2100Q Portable Turbidimeter incorporates an innovative Rapidly Settling Turbidity™ mode to provide accurate, repeatable measurements for difficult to measure, rapidly settling samples. An exclusive algorithm that calculates turbidity based on a series of automatic readings eliminates redundant measurements and estimating.

Convenient Data Logging

Up to 500 measurements are automatically stored in the instrument for easy access and backup. Stored information includes: date and time, operator ID, reading mode, sample ID, sample number, units, calibration time, calibration status, error messages and the result.

Optical System for Precision in the Field

The two-detector optical system compensates for color in the sample, light fluctuation, and stray light, enabling analysts to achieve laboratory-grade performance on a wide range of samples, even under difficult site conditions.

Two Models for Specific Requirements

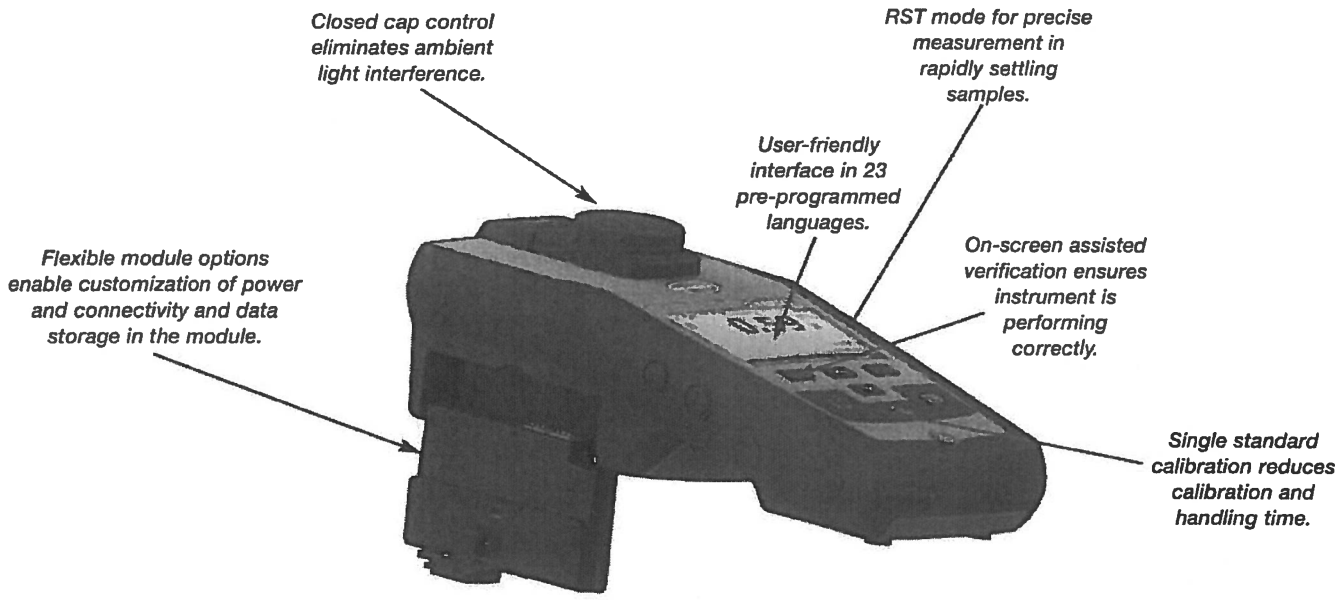
- **2100Q Turbidimeter**—*Compliant with USEPA Method 180.1 design criteria.*
- **2100Q *is* Turbidimeter**—*Compliant with ISO 7027 design criteria.*

DW = drinking water WW = wastewater municipal PW = pure water / power
IW = industrial water E = environmental C = collections FB = food and beverage

HACH®

Be Right™

Key Features



Specifications*

Measurement Method
Ratio turbidimetric determination using a primary nephelometric light scatter signal (90°) to the transmitted light scatter signal.

Regulatory
2100Q: Meets EPA Method 180.1
2100Q *is:* Meets ISO 7027

Light Source
2100Q: Tungsten filament lamp
2100Q *is:* Light-emitting diode (LED) @ 860 nm

Range
0 to 1000 NTU (FNU)

Accuracy
±2% of reading plus stray light from 0 to 1000 NTU

Repeatability
±1% of reading, or 0.01 NTU (FNU), whichever is greater

Resolution
0.01 NTU on lowest range

Stray Light
<0.02 NTU (FNU)

Signal Averaging
Selectable on/off

Detector
Silicon photovoltaic

Reading Modes (user selectable)
Normal (Push to Read)
Signal Averaging
Rapidly Settling Turbidity

Data Logger
500 records

Power Requirement
110-230 Vac, 50/60 Hz (with Power or USB+Power Module)
4 AA alkaline batteries
Rechargeable NiMH (for use with USB+Power Module)

Operating Conditions
Temperature: 0 to 50°C (32 to 122°F)
Relative Humidity: 0 to 90% @ 30°C,
0 to 80% @ 40°C, 0 to 70% @ 50°C, noncondensing

Storage Conditions
-40 to 60°C (-40 to 140°F), instrument only

Languages
English, French, German, Italian, Spanish, Portuguese (BR), Portuguese (PT), Bulgarian, Chinese, Czech, Danish, Dutch, Finnish, Greek, Hungarian, Japanese, Korean, Polish, Romanian, Russian, Slovenian, Swedish, Turkish

Interface
Optional USB

Instrument Enclosure Rating
IP67 (closed lid, battery compartment excluded)

Protection Class
Power Supply: Class II

Certification
CE certified

Sample Required
15 mL (0.3 oz.)

Sample Cells
60 x 25 mm (2.36 x 1 in.) borosilicate glass with screw cap

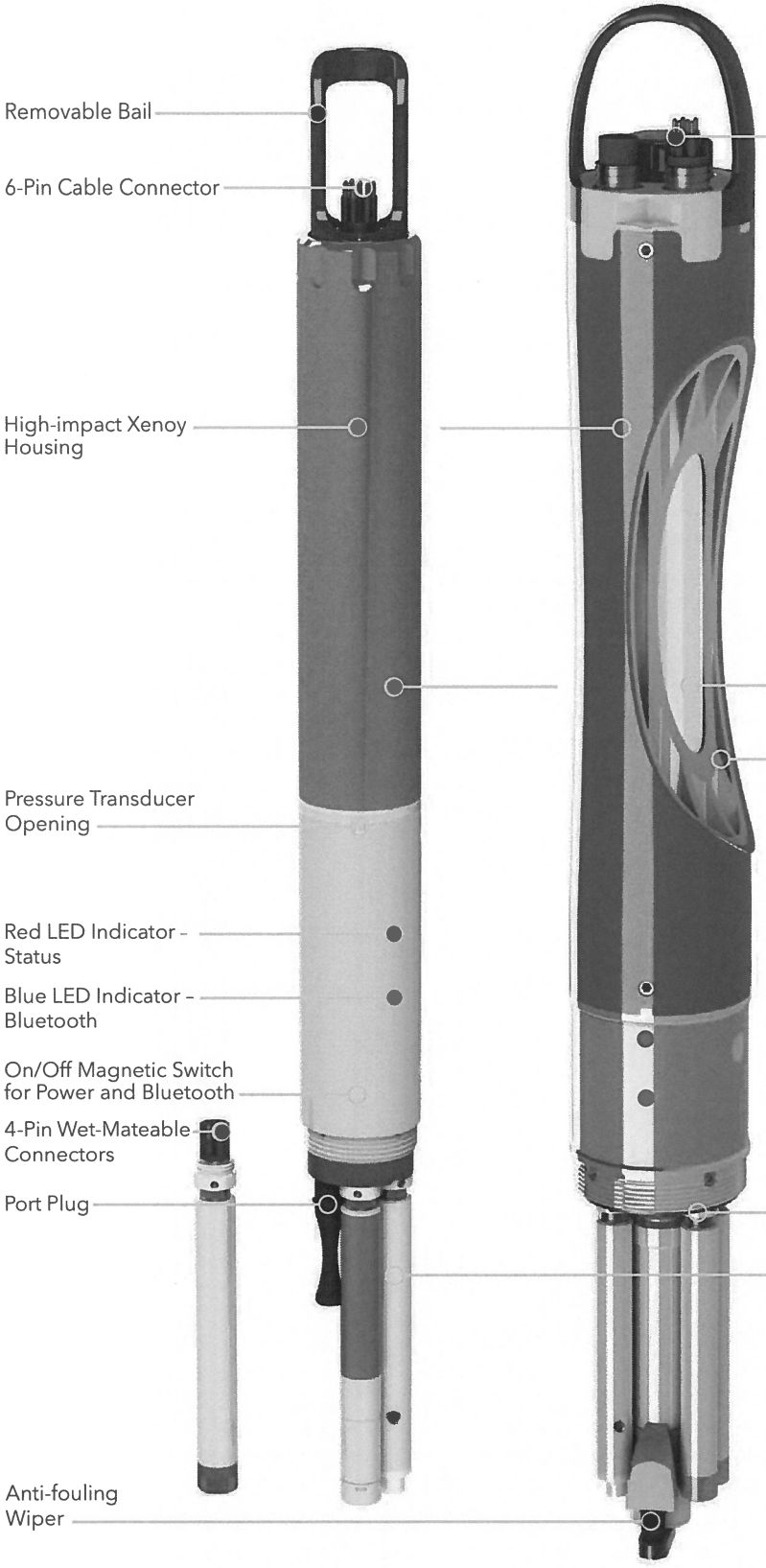
Dimensions
22.9 x 10.7 x 7.7 cm (9.0 x4.2 x 3.0 in.)

Weight
527 g (1.16 lb) without batteries
618 g (1.36 lb) with four AA alkaline batteries

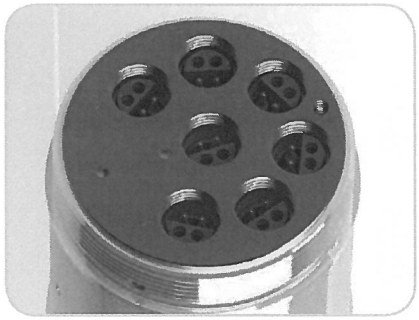
Warranty
1 year

**Specifications subject to change without notice.*

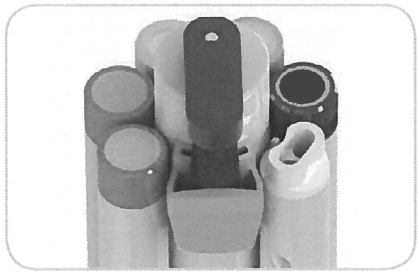
Sondes: EXO1 EXO2



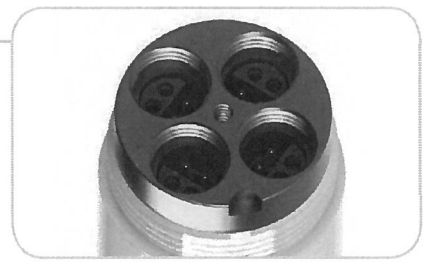
Cable connector, battery valve, and expansion port for an additional sensor



EXO2 sonde contains 6 universal sensor ports plus a central port for an anti-fouling wiper



Anti-fouling wiper keeps sensors clear of biofouling and lengthens deployment times by 25%



EXO1 sonde contains 4 universal sensor ports

Instrument Specifications*

EXO1 Sonde		
Ports	4 sensor ports Peripheral port: 1 power communication port	
Size	Diameter: 4.70 cm (1.85 in) Length: 64.77 cm (25.50 in)	
Weight	1.42 kg (3.15 lbs) with 4 probes, guard and batteries installed	
EXO2 Sonde		
Ports	7 sensor ports (6 ports available when central wiper used) Peripheral ports: 1 power communication port; 1 auxiliary expansion port	
Size	Diameter: 7.62 cm (3.00 in) Length: 71.10 cm (28.00 in)	
Weight	3.60 kg (7.90 lbs) with 5 probes, guard and batteries installed	
Sondes		
Operating Temperature	-5 to 50°C	
Storage Temperature	-20 to 80°C (except 0 to 60°C for pH and pH/ORP sensors)	
Depth Rating	0 to 250 m (0 to 820 ft)	
Communications	Computer Interface: Bluetooth wireless technology, RS-485, USB Output Options: USB with signal output adapter (SOA); RS-232 & SDI-12 with DCP-SOA	
Sample Rate	Up to 4 Hz	
Battery Life	90 days**	
Data Memory	512 MB total memory; >1,000,000 logged readings	
Sensors		Calculated Parameters
Ammonium	ORP	Salinity
Chloride	pH	Specific Conductance
Conductivity	Temperature	Total Dissolved Solids
Depth	Total Algae (Chlorophyll + BGA-PC or PE)	Total Suspended Solids
Dissolved Oxygen	Turbidity	
Fluorescent Dissolved Organic Matter (fDOM)	Vented Level	
Nitrate		
EXO Handheld		
Size	Width: 12.00 cm (4.72 in) Height: 25.00 cm (9.84 in)	
Weight	0.71 kg (1.56 lbs) without batteries	
Operating System	Windows CE 5.0	
Operating Temperature	-10 to 50°C	
Storage Temperature	-20 to 80°C	
IP Rating	IP-67	
Data Memory	2 GB total memory; >2,000,000 data sets	
Accessories		
Cables (vented and non-vented)	Flow cells	Sonde/sensor guard
Carrying case	KOR software	Calibration cup
DCP Signal Output Adapter	USB Signal Output Adapter	Anti-fouling components
Warranty		
3 months	Replaceable reagent modules for ammonium, chloride, and nitrate	
1 Year	Optical DO membranes and replaceable reagent moldules for pH and pH/ORP	
2 Years	Cables; sonde bulkheads; handheld; conductivity, temperature, depth, and optical sensors; electronics base for pH, pH/ORP, ammonium, chloride, and nitrate sensors; and accessories	

* Specifications indicate typical performance and are subject to change. Please check EXOwater.com for up-to-date information.

** Typically 90 days at 20°C at 15-minute logging interval; temperature/conductivity, pH/ORP, DO, and turbidity sensors installed on EXO1; or temperature/conductivity, pH/ORP, DO, total algae, and turbidity sensors installed with central wiper that rotates once per logging interval on EXO2. Battery life is heavily dependent on sensor configuration.

EXO Bluetooth modules comply with Part 15C of FCC Rules and have FCC, CE Mark and C-tick approval. Bluetooth-type approvals and regulations can be country specific. Check local laws and regulations to insure that the use of wireless products purchased from Xylem are in full compliance.

Sensor Specifications*

Sensor	Range	Accuracy*	Response	Resolution
Ammonium [11] (ammonia with pH sensor)	0 to 200 mg/L [1]	±10% of reading or 2 mg/L-N, w.i.g.	-	0.01 mg/L
Barometer	375 to 825 mmHg	±1.5 mmHg from 0 to 50°C	-	0.1 mmHg
Blue-green Algae Phycocyanin (PC) (part of Total Algae sensor)	0 to 100 RFU; 0 to 100 µg/L PC	Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 100 µg/mL PC equivalents	T63<2 sec	0.01 RFU; 0.01 µg/L PC
Blue-green Algae Phycoerythrin (PE) (part of Total Algae sensor)	0 to 100 RFU; 0 to 280 µg/L PE	Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 280 µg/mL PE equivalents	T63<2 sec	0.01 RFU; 0.01 µg/L PE
Chloride [11]	0 to 1000 mg/L-Cl [2]	±15% of reading or 5 mg/L-Cl, w.i.g.	-	0.01 mg/L
Chlorophyll (part of Total Algae sensor)	0 to 400 µg/L Chl; 0 to 100 RFU	Linearity: $R^2 > 0.999$ for serial dilution of Rhodamine WT solution from 0 to 400 µg/L Chl equivalents	T63<2 sec	0.01 µg/L Chl; 0.01 RFU
Conductivity [3]	0 to 200 mS/cm	0 to 100: ±0.5% of reading or 0.001 mS/cm, w.i.g.; 100 to 200: ±1% of reading	T63<2 sec	0.0001 to 0.01 mS/cm (range dependent)
Depth [4] (non-vented)	0 to 10 m (0 to 33 ft)	±0.04% FS (±0.004 m or ±0.013 ft)	T63<2 sec	0.001 m (0.001 ft) (auto-ranging)
	0 to 100 m (0 to 328 ft)	±0.04% FS (±0.04 m or ±0.13 ft)		
	0 to 250 m (0 to 820 ft)	±0.04% FS (±0.10 m or ±0.33 ft)		
Vented Level	0 to 10 m (0 to 33 ft)	±0.03% FS (±0.003 m or ±0.010 ft)		
Dissolved Oxygen Optical	0 to 500% air saturation	0 to 200%: ±1% of reading or 1% saturation, w.i.g.; 200 to 500%: ±5% of reading [5]	T63<5 sec [6]	0.1% air saturation
	0 to 50 mg/L	0 to 20 mg/L: ±0.1 mg/L or 1% of reading, w.i.g.; 20 to 50 mg/L: ±5% of reading [5]		0.01 mg/L
fDOM	0 to 300 ppb Quinine Sulfate equivalents (QSE)	Linearity: $R^2 > 0.999$ for serial dilution of 300 ppb QS solution Detection Limit: 0.07 ppb QSE	T63<2 sec	0.01 ppb QSE
Nitrate [11]	0 to 200 mg/L-N [1]	±10% of reading or 2 mg/L-N, w.i.g.	-	0.01 mg/L
ORP	-999 to 999 mV	±20 mV in Redox standard solutions	T63<5 sec [7]	0.1 mV
pH	0 to 14 units	±0.1 pH units within ±10°C of calibration temp; ±0.2 pH units for entire temp range [8]	T63<3 sec [9]	0.01 units
Salinity (Calculated from Conductivity and Temperature)	0 to 70 ppt	±1.0% of reading or 0.1 ppt, w.i.g.	T63<2 sec	0.01 ppt
Specific Conductance (Calculated from Cond. and Temp.)	0 to 200 mS/cm	±0.5% of reading or .001 mS/cm, w.i.g.	-	0.001, 0.01, 0.1 mS/cm (auto-scaling)
Temperature	-5 to 50°C	-5 to 35°C: ±0.01°C [10] 35 to 50°C: ±0.05°C [10]	T63<1 sec	0.001 °C
Total Dissolved Solids (TDS) (Calculated from Conductivity and Temperature)	0 to 100,000 g/L Cal constant range 0.30 to 1.00 (0.64 default)	Not Specified	-	variable
Total Suspended Solids (TSS) (Calculated from Turbidity and user reference samples)	0 to 1500 mg/L	Not Specified	T63<2 sec	variable
Turbidity [11]	0 to 4000 FNU	0 to 999 FNU: 0.3 FNU or ±2% of reading, w.i.g.; 1000 to 4000 FNU: ±5% of reading [12]	T63<2 sec	0 to 999 FNU: 0.01 FNU; 1000 to 4000 FNU: 0.1 FNU

All sensors have a depth rating to 250 m (820 ft), except shallow and medium depth sensors and ISEs. EXO sensors are not backward compatible with 6-Series sondes.

* Specifications indicate typical performance and are subject to change. Please check EXOwater.com for up-to-date information.
Accuracy specification is attained immediately following calibration under controlled and stable environmental conditions. Performance in the natural environment may vary from quoted specification.

[1] 0-30°C [2] 0-40°C w.i.g. = whichever is greater

[3] Outputs of specific conductance (conductivity corrected to 25°C) and total dissolved solids are also provided. The values are automatically calculated from conductivity according to algorithms found in *Standard Methods for the Examination of Water and Wastewater* (Ed. 1989).

[4] Accuracy specifications apply to conductivity levels of 0 to 100,000 µS/cm.

[5] Relative to calibration gases

[6] When transferred from air-saturated water to stirred deaerated water

[7] When transferred from water-saturated air to Zobell solution

[8] Within the environmental pH range of pH 4 to pH 10

[9] On transfer from water-saturated air to rapidly stirred air-saturated water at a specific conductance of 800 µS/cm at 20°C; T63<5 seconds on transfer from water-saturated air to slowly-stirred air-saturated water.

[10] Temperature accuracy traceable to NIST standards

[11] Calibration: 1-, 2-, or 3-point, user-selectable

[12] Specification is defined in AMCO-AEPA Standards

FH950 Portable Velocity Meter with 20' Cable

Product #: FH950.10020 Quantity
USD Price: $4,585.00
Ships within 2 weeks

Reduce manhours 50%
The step-by-step user interface simplifies programming, delivers real-time data, and downloads directly to PC allowing a single person to take the readings and eliminating post site visit manual data transfer from logbook to PC

Automatically calculates total discharge based on USGS and ISO methods
Reduces time to manually calculate and likelihood of errors

Real-time velocity graphed on color display
Visualize velocity trends quickly

Lowest maintenance solution on the market
Electromagnetic velocity sensor with no moving parts never requires mechanical maintenance

Lightweight, rugged portable meter
Only 1.5 pounds

What's in the box

FH950.1 System Includes:
- Portable Velocity Meter
- Electromagnetic Sensor with 20' cable
- Fabric Carrying Case
- Adjustable Meter Rod Mount
- Universal Sensor Mount
- Battery Charger with Domestic/International Plug Adapters
- USB Cable
- Lanyard
- Sensor Screw Kit
- Absorbent Wipe

Specifications

Accuracy 2:	± 2% of reading ± 0.05 ft/s (± 0.015 m/s) through the range of 0 to 10 ft/s (0 to 3.04 ms/s); ± 4% of reading from 10 to 16 ft/s (3.04 to 4.87 m/s)
Battery Life:	heavy typical day use; 68°F (20°C)
Display: LCD:	Color, LCD 3.5 QVGA transflective (readable in direct sunlight)
Keypad:	Alpha-numerica
Operating Temperature Range:	-20 to 55 °C
Range:	to ft/s
Resolution:	Measurement Resolution - <10: 0.001; <100: 0.01; >100: 0.1
Storage Conditions:	-20 °C to 60 °C

Appendix D

State of New Hampshire

Environmental Laboratory Accreditation Program

Awards

PRIMARY NH ELAP ACCREDITATION

to

NORTHEAST OHIO REGIONAL SEWER DISTRICT ANALYTICAL SERVICES

of

CUYAHOGA HEIGHTS, OH

For the matrix, method and analytes listed on the latest Analyte List in accordance with the provisions on the 2009 TNI Standards and Env-C 300.

Certificate Number: 223819

Effective Date: 12/1/2019

Expiration Date: 11/30/2020

Laboratory ID: 2238

NORTHEAS11/19/2019

Bill Hall
NH ELAP Program Manager

Method accreditation does not imply acceptance for NHDES compliance testing. Laboratory is required to use EPA-approved methods required by regulation. Continuing accreditation status is dependent on successful ongoing participation in the program. Customers may verify the laboratory's current accreditation status by calling (603) 271-2998 or by visiting the NH ELAP website (https://www.des.nh.gov/organization/divisions/water/dwgb/nhelap/index.htm).

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

29 Hazen Drive, PO Box 95, Concord, NH 03302 (603) 271-2998

PRIMARY ACCREDITATION ANALYTE LIST

ANALYTE LIST NUMBER: 223819-A

NORTHEAST OHIO REGIONAL SEWER DISTRICT ANALYTICAL SERVICES
4747 EAST 49TH STREET

CUYAHOGA HEIGHTS OH 44125
216-641-6000
Lab ID: 2238

Analyte Code	Analyte Name	Effective Date	Expiration Date	Matrix	Category	Accr. Type
Method Code: 20211614	**Method Ref: SM 9223 B (COLILERT QUANTI-TRAY)-2004**		**Revision:**		**Date: 2004**	
2525	ESCHERICHIA COLI	12/01/2019	11/30/2020	N	MIC	NE
2500	TOTAL COLIFORMS	12/01/2019	11/30/2020	N	MIC	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1000	ALUMINUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1005	ANTIMONY, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1010	ARSENIC, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1015	BARIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1020	BERYLLIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1030	CADMIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1035	CALCIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1040	CHROMIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1050	COBALT, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1055	COPPER, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1070	IRON, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1075	LEAD, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1085	MAGNESIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1090	MANGANESE, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1100	MOLYBDENUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1105	NICKEL, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1125	POTASSIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1140	SELENIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1150	SILVER, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1155	SODIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1160	STRONTIUM,TOTAL	12/01/2019	11/30/2020	N	MET	NE
1165	THALLIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1175	TIN, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1180	TITANIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1185	VANADIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1190	ZINC, TOTAL	12/01/2019	11/30/2020	N	MET	NE
Method Code: 10014605	**Method Ref: EPA 200.8**		**Revision: 5.4**		**Date: 1994**	
1000	ALUMINUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1005	ANTIMONY, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1010	ARSENIC, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1015	BARIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE

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1020	BERYLLIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1030	CADMIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1035	CALCIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1040	CHROMIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1050	COBALT, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1055	COPPER, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1070	IRON, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1075	LEAD, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1085	MAGNESIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1090	MANGANESE, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1100	MOLYBDENUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1105	NICKEL, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1125	POTASSIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1140	SELENIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1150	SILVER, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1155	SODIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1160	STRONTIUM,TOTAL	12/01/2019	11/30/2020	N	MET	NE
1165	THALLIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1175	TIN, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1180	TITANIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1185	VANADIUM, TOTAL	12/01/2019	11/30/2020	N	MET	NE
1190	ZINC, TOTAL	12/01/2019	11/30/2020	N	MET	NE
Method Code: 10036609	**Method Ref: EPA 245.1**		**Revision: 3**		**Date: 1994**	
1095	MERCURY, TOTAL	12/01/2019	11/30/2020	N	MET	NE
Method Code: 10237204	**Method Ref: EPA 1631E**		**Revision:**		**Date: 2002**	
1095	MERCURY, TOTAL	12/01/2019	11/30/2020	N	MET	NE
Method Code: 20066266	**Method Ref: SM 3500-CR B-2011**		**Revision:**		**Date: 2011**	
1045	CHROMIUM VI	12/01/2019	11/30/2020	N	MET	NE
Method Code: 10010409	**Method Ref: EPA 160.4**		**Revision:**		**Date: 1971**	
1970	RESIDUE, VOLATILE	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10011800	**Method Ref: EPA 180.1**		**Revision: 2**		**Date: 1993**	
2055	TURBIDITY	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10053200	**Method Ref: EPA 300.0**		**Revision: 2.1**		**Date: 1993**	
1540	BROMIDE	12/01/2019	11/30/2020	N	NMI	NE
1575	CHLORIDE	12/01/2019	11/30/2020	N	NMI	NE
1730	FLUORIDE	12/01/2019	11/30/2020	N	NMI	NE
1810	NITRATE AS N	12/01/2019	11/30/2020	N	NMI	NE

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1840	NITRITE AS N	12/01/2019	11/30/2020	N	NMI	NE
1870	ORTHOPHOSPHATE AS P	12/01/2019	11/30/2020	N	NMI	NE
2000	SULFATE	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10055206	**Method Ref: EPA 310.2**		**Revision:**		**Date: 1974**	
1505	ALKALINITY	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10063602	**Method Ref: EPA 350.1**		**Revision: 2**		**Date: 1993**	
1515	AMMONIA	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10065404	**Method Ref: EPA 351.2**		**Revision: 2**		**Date: 1993**	
1795	TOTAL KJELDAHL NITROGEN (TKN)	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10067604	**Method Ref: EPA 353.2**		**Revision: 2**		**Date: 1993**	
1810	NITRATE AS N	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10070005	**Method Ref: EPA 365.1**		**Revision: 2**		**Date: 1993**	
1870	ORTHOPHOSPHATE AS P	12/01/2019	11/30/2020	N	NMI	NE
1910	PHOSPHORUS, TOTAL	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10077404	**Method Ref: EPA 410.4**		**Revision: 2**		**Date: 1993**	
1565	COD	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10079400	**Method Ref: EPA 420.1**		**Revision:**		**Date: 1978**	
1905	PHENOLICS, TOTAL	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10081400	**Method Ref: EPA 445**		**Revision: 1.2**		**Date: 1997**	
9345	CHLOROPHYLLS	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10261617	**Method Ref: EPA 1664B**		**Revision:**		**Date: 2010**	
1803	N-HEXANE EXTRACTABLE MATERIAL (O&G) [HEM]	12/01/2019	11/30/2020	N	NMI	NE
9500	N-HEXANE EXTRACTABLE MATERIAL - SILICA GEL TREATED (HEM-SGT)	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20049416	**Method Ref: SM 2540 B-2011**		**Revision:**		**Date: 2011**	
1950	RESIDUE, TOTAL (TS)	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20050413	**Method Ref: SM 2540 C-2011**		**Revision:**		**Date: 2011**	
1955	RESIDUE, FILTERABLE (TDS)	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20051212	**Method Ref: SM 2540 D-2011**		**Revision:**		**Date: 2011**	
1960	RESIDUE, NON-FILTERABLE (TSS)	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20052215	**Method Ref: SM 2540 F-2011**		**Revision:**		**Date: 2011**	
1965	RESIDUE, SETTLEABLE	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20053127	**Method Ref: SM 2550 B**		**Revision: 22ND ED**		**Date: 2010**	
2030	TEMPERATURE	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20080426	**Method Ref: SM 4500-CL E-2011**		**Revision:**		**Date: 2011**	
1940	CHLORINE, RESIDUAL TOTAL	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20085216	**Method Ref: SM 4500-CL C-2011**		**Revision:**		**Date: 2011**	
1575	CHLORIDE	12/01/2019	11/30/2020	N	NMI	NE

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

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PRIMARY ACCREDITATION ANALYTE LIST

ANALYTE LIST NUMBER: 223819-A

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Method Code: 20097227	**Method Ref: SM 4500-CN G-2011**		**Revision:**		**Date: 2011**	
1510	CYANIDE, AMENABLE	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20102414	**Method Ref: SM 4500-F C-2011**		**Revision:**		**Date: 2011**	
1730	FLUORIDE	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20105220	**Method Ref: SM 4500-H+ B-2011**		**Revision:**		**Date: 2011**	
1900	HYDROGEN ION (PH)	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20113115	**Method Ref: SM 4500-NO2 B-2011**		**Revision:**		**Date: 2011**	
1840	NITRITE AS N	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20135266	**Method Ref: SM 5210 B-2011**		**Revision:**		**Date: 2011**	
1530	BIOCHEMICAL OXYGEN DEMAND (BOD)	12/01/2019	11/30/2020	N	NMI	NE
1555	CARBONACEOUS BIOLOGICAL OXYGEN DEMAND	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 20137820	**Method Ref: SM 5310 B-2011**		**Revision:**		**Date: 2011**	
2040	TOTAL ORGANIC CARBON (TOC)	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 60007150	**Method Ref: LACHAT 10-204-00-1-X**		**Revision:**		**Date: NOV-00**	
1645	CYANIDE, TOTAL	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 60031405	**Method Ref: OIA 1677**		**Revision:**		**Date: 2004**	
1523	CYANIDE, AVAILABLE	12/01/2019	11/30/2020	N	NMI	NE
Method Code: 10133207	**Method Ref: SW-846 3005A**		**Revision: 1**		**Date: 1992**	
1438	PRECONCENTRATION UNDER ACID	12/01/2019	11/30/2020	N	PRE	NE
Method Code: 10133605	**Method Ref: SW-846 3010A**		**Revision: 1**		**Date: 1992**	
1420	HOT PLATE ACID DIGESTION (HNO3 + HCL)	12/01/2019	11/30/2020	N	PRE	NE
Method Code: 10133809	**Method Ref: SW-846 3015**		**Revision:**		**Date: 1994**	
1430	MICROWAVE-ASSISTED ACID DIGESTION OF TCLP EXTRACTS	12/01/2019	11/30/2020	N	PRE	NE
Method Code: 10214207	**Method Ref: EPA 1000.0 - FATHEAD MINNOW, 7-DAY CHRONIC, DAILY**		**Revision:**		**Date: 2002**	
3470	IC25 (ON) GROWTH	12/01/2019	11/30/2020	N	TOX	NE
3475	NOEC (GROWTH)	12/01/2019	11/30/2020	N	TOX	NE
3465	NOEC (SURVIVAL)	12/01/2019	11/30/2020	N	TOX	NE
Method Code: 10253040	**Method Ref: EPA 1002.0 - CERIODAPHNIA DUBIA, 3-BROOD CHRONIC,**		**Revision:**		**Date: 2002**	
3480	IC25 REPRODUCTION	12/01/2019	11/30/2020	N	TOX	NE
3465	NOEC (SURVIVAL)	12/01/2019	11/30/2020	N	TOX	NE
3485	NOEC REPRODUCTION	12/01/2019	11/30/2020	N	TOX	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1000	ALUMINUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1005	ANTIMONY, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1010	ARSENIC, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1015	BARIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1020	BERYLLIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE

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1030	CADMIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1035	CALCIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1040	CHROMIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1050	COBALT, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1055	COPPER, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1070	IRON, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1075	LEAD, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1085	MAGNESIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1090	MANGANESE, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1100	MOLYBDENUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1105	NICKEL, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1125	POTASSIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1140	SELENIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1150	SILVER, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1155	SODIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1160	STRONTIUM,TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1165	THALLIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1175	TIN, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1180	TITANIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1185	VANADIUM, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
1190	ZINC, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
Method Code: 10036609	**Method Ref: EPA 245.1**		**Revision: 3**		**Date: 1994**	
1095	MERCURY, TOTAL	12/01/2019	11/30/2020	SC	MET	NE
Method Code: 10063602	**Method Ref: EPA 350.1**		**Revision: 2**		**Date: 1993**	
1515	AMMONIA	12/01/2019	11/30/2020	SC	NMI	NE
Method Code: 10065404	**Method Ref: EPA 351.2**		**Revision: 2**		**Date: 1993**	
1795	TOTAL KJELDAHL NITROGEN (TKN)	12/01/2019	11/30/2020	SC	NMI	NE
Method Code: 10070005	**Method Ref: EPA 365.1**		**Revision: 2**		**Date: 1993**	
1910	PHOSPHORUS, TOTAL	12/01/2019	11/30/2020	SC	NMI	NE
Method Code: 20005270	**Method Ref: SM 2540 G-2011**		**Revision:**		**Date: 2011**	
1947	RESIDUE, FIXED	12/01/2019	11/30/2020	SC	NMI	NE
1950	RESIDUE, TOTAL (TS)	12/01/2019	11/30/2020	SC	NMI	NE
1970	RESIDUE, VOLATILE	12/01/2019	11/30/2020	SC	NMI	NE
Method Code: 10135805	**Method Ref: SW-846 3051**		**Revision: 0**		**Date: 1994**	
1451	MICROWAVE DIGESTION OF SOLIDS (HNO3)	12/01/2019	11/30/2020	SC	PRE	NE

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NORTHEAST 11/19/2019

Bill Hall
NH ELAP Program Manager
Issue Date: 11/19/2019

Matrix Legend: AE=Air; BT=Tissue; D=Drinking Water; N=Non-Potable Water; SC=Solid and Chemical Materials

Category Legend: MIC=Microbiology; MET=Metals; NMI=Non-Metal Inorganics; PRE=Preparation; VOC=Volatile Organic Compounds; SBN=SVOC-BNA; SHE=SVOC-Herbicides; SNO=SVOC-NOS; SPC=SVOC-PCB; SPE=SVOC-Pesticides; RAD=Radiochemistry; WET=Wet

Accreditation Legend: NE=NELAP; NH=NH State Certification; CE=State Certification; IN=Interim (NELAP); WI=Withdrawn; AP=Applied; RE=Revoked; SU=Suspended

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