Level 3 Project Study Plan

2015 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 dissolved reactive phosphorus (Ohio EPA, 2011) coupled with favorable weather conditions. 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. 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	
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. 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* (2013). 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 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 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 1): 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, and ELISA (Enzyme-Linked-Immunosorbent Assay) protocol. Specifications for these analyses and sampling methods are included in Table 1 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 put into 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 put into a 125-mL plastic bottle.

Where possible, data assessment will include an analysis of spatial and temporal trends in the collected data. Water chemistry data collected will be compared to Ohio water quality standards to determine whether any excursions from the applicable water quality criteria have occurred. It will also be used to evaluate potential relationships among individual parameters and chlorophyll *a* concentrations.

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, < 6oC and protected from light	< 6oC and protected from light (do not freeze)	< 6oC (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 2015 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	
Southerly WWTC	6000 Canal Rd Cuyahoga Heights, OH 44125			Treated Effluent	Discharges to: 04110002-Cuyahoga	

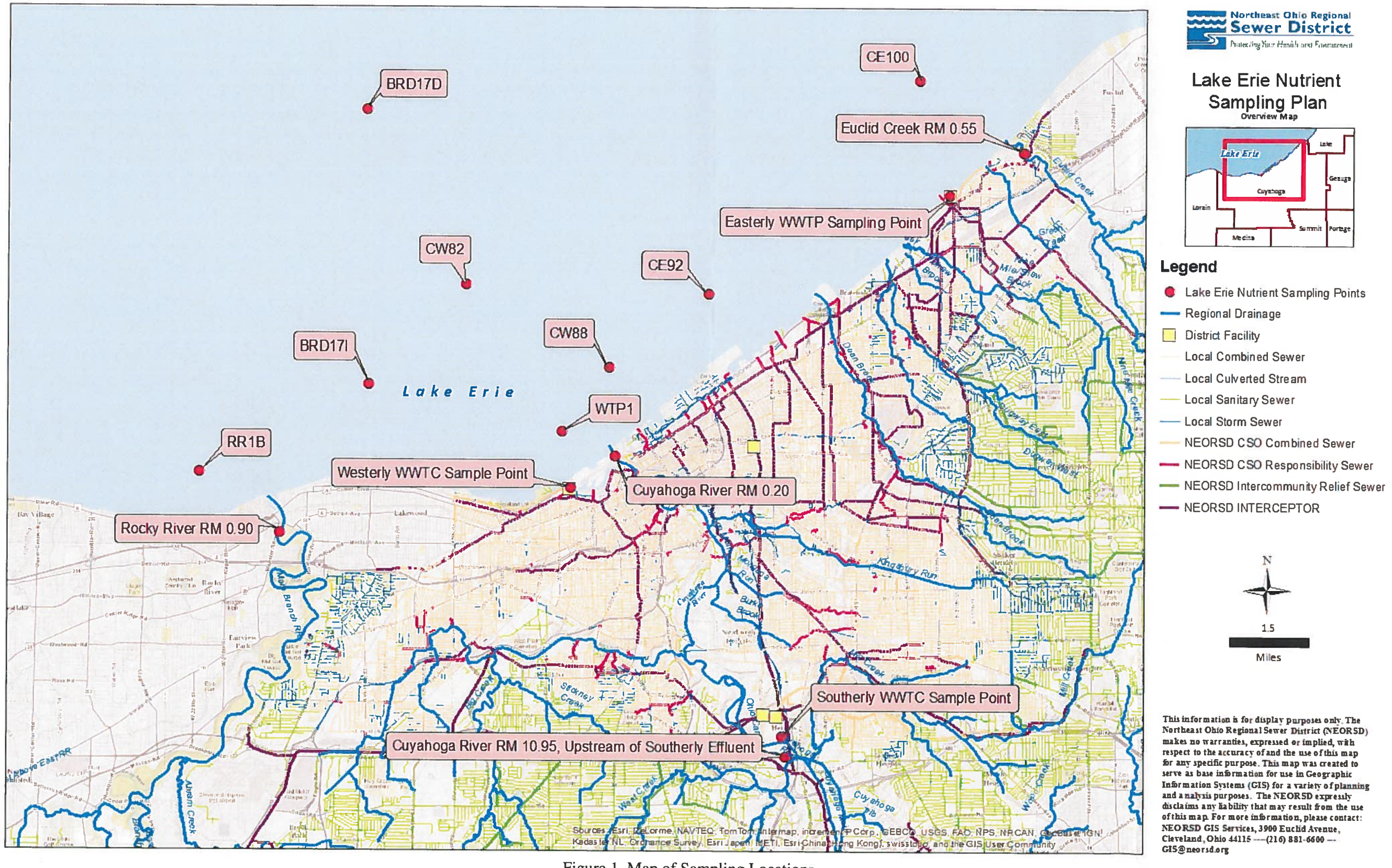


Figure 1. Map of Sampling Locations

(7) Schedule

Water chemistry sampling will be attempted at least once per month in May, June, and July 2015 and twice per month in August, September, and October 2015. 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). The samples will then be delivered immediately to the NEORSD Analytical Services cooler, after which the door to the cooler will be locked, 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[1]	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	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

[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
Mark Colvin	4747 East 49th Street Cuyahoga Hts., Ohio 44125	colvinm@neorsd.org	216-641-6000
Tim Dobriansky	4747 East 49th Street Cuyahoga Hts., Ohio 44125	dobrianskyt@neorsd.org	216-641-6000
Donna Friedman	4747 East 49th Street Cuyahoga Hts., Ohio 44125	friedmand@neorsd.org	216-641-6000
Rae Grant	4747 East 49th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Mark Matteson	4747 East 49th Street Cuyahoga Hts., Ohio 44125	mattesonm@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
Denise Phillips	4747 East 49th Street Cuyahoga Hts., Ohio 44125	phillipsd@neorsd.org	216-641-6000

Name	Address	Email Address	Phone Number
Brandy Reischman	4747 East 49th Street Cuyahoga Hts., Ohio 44125	reischmanb@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49th Street Cuyahoga Hts., Ohio 44125	schuschuf@neorsd.org	216-641-6000
Eric Soehnlen	4747 East 49th Street Cuyahoga Hts., Ohio 44125	soehnlene@neorsd.org	216-641-6000
William Stanford	4747 East 49th Street Cuyahoga Hts., Ohio 44125	stanfordw@neorsd.org	216-641-6000
Wolfram von Kiparski	4747 East 49th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@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:

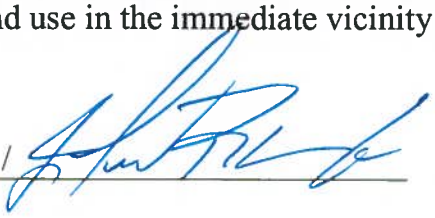
NEORSD Analytical Services
Mr. Mark Citriglia
4747 E. 49th Street
Cuyahoga Heights, Ohio 44056
citrigliam@neorsd.org
216-641-6000

(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: John W. Rhoades /  Date: 03/20/15

(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: John W. Rhoades / Date: 03/20/15

(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: John W. Rhoades / Date: 03/20/15

(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: John W. Rhoades / Date: 03/20/15

Print/Signature: Cathy Zamborsky / Date: 3/20/15

Print/Signature: Seth Hothem / Date: 3/20/15

Print/Signature: Tom Zablotny / Date: 3/20/15

Print/Signature: Ron Maichle / Date: 03-20-15

Print/Signature: Francisco Rivera / Date: 3/20/15

Print/Signature: Jillian Knittle / Date: 3/20/15

References

Ohio Environmental Protection Agency. (2009). *State of Ohio Water Quality Standards Ohio Administrative Code Chapter 3745-1* (Revision: Adopted July 9, 2009; Effective October 9, 2009). Columbus, OH: Division of Surface Water, Standards and Technical Support Section.

Ohio Environmental Protection Agency. (2011). *Draft Nutrient Reduction Strategy Framework for Ohio Waters*. Columbus, OH: Division of Surface Water.

Ohio Environmental Protection Agency. (2013). *Surface Water Field Sampling Manual*. Columbus, OH: Divisions of Surface Water and Environmental Services.

Appendix A

Parameter	Additional Name	Test	Minimum Detection Limit	Practical Quantitation Limit
Alkalinity		EPA 310.2	2.5 mg/L	10 mg/L
Ammonia	NH_3	EPA 350.1	0.003 mg/L	0.010 mg/L
Nitrite + Nitrate	$NO_2 + NO_3$	EPA 353.2	0.003 mg/L	0.010 mg/L
Dissolved Reactive Phosphorus	DRPhos	EPA 365.1	0.003 mg/L	0.010 mg/L
Total Phosphorus	Total-P	EPA 365.1	0.001 mg/L	0.010 mg/L
Chlorophyll *a*	Chlorophyll *a*	EPA 445.0	0.03 µg/L	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 laborntory.

[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.

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):_____

Dissolved Oxygen (mg/L):_____ pH (s.u.):_____

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:

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

Dissolved Oxygen (mg/L):_____ pH (s.u.):_____

General Comments: _____
_____

Modified: March 6, 2013

Appendix C

Y S I Environmental

YSI 556 Multiparameter System

Versatile, multiparameter handheld instrument

The 556 has multiple language capabilities and graphing!

Rugged and reliable, the YSI 556 MPS (Multiprobe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multiparameter system.

- Simultaneously measures dissolved oxygen, pH, conductivity, temperature, and ORP
- Field-replaceable electrodes
- Compatible with EcoWatch® for Windows® data analysis software
- Stores over 49,000 data sets, time and date stamped, interval or manual logging
- Three-year warranty on the instrument; one-year on the probes
- GLP assisting, records calibration data in memory
- Available with 4, 10, and 20-m cable lengths
- IP-67, impact-resistant, waterproof case
- Easy-to-use, screw-on cap DO membranes
- RS-232 interface for PC connection

Options to Fit Your Applications!

- Battery Options – The unit is powered by alkaline batteries or an optional rechargeable battery pack with quick-charge feature.
- Optional Barometer – Internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure. (Choose 556-02)
- Optional Flow Cell - The 5083 flow cell can be used for ground water applications or anytime water is pumped for sampling.
- Carrying Case – The instrument comes standard with YSI 5061, a soft-sided carrying case with enough space for the 556, a 20-meter cable, and calibrating supplies. An optional 5080 hard-sided carrying case is also available.
- Confidence Solution® - Quality assurance ensured. Quickly check conductivity, pH, and ORP readings with one solution.

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A rugged, cost-effective multiparameter handheld system designed for the field!

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CE

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Who's Minding the Planet?®

5563 MPS Sensor Specifications

Dissolved Oxygen (% saturation)	Sensor Type	Steady state polarographic
	Range	0 to 500% air saturation
	Accuracy	0 to 200% air saturation, ± 2% of the reading or ±2% air saturation, whichever is greater; 200 to 500% air saturation, ± 6% of the reading
	Resolution	0.1% air saturation
Dissolved Oxygen (mg/L)	Sensor Type	Steady state polarographic
	Range	0 to 50 mg/L
	Accuracy	0 to 20 mg/L, ± 2% of the reading or ±0.2 mg/L, whichever is greater; 20 to 50 mg/L, ± 6% of the reading
	Resolution	0.01 mg/L
Temperature	Sensor Type	YSI Temperature Precision™ thermistor
	Range	-5 to 45°C
	Accuracy	± 0.15°C
	Resolution	0.1°C
Conductivity	Sensor Type	4-electrode cell with autoranging
	Range	0 to 200 mS/cm
	Accuracy	± 0.5% of reading or ± 0.001 mS/cm; whichever is greater (4-meter cable) ± 1.0% of reading or ± 0.001 mS/cm; whichever is greater (20-meter cable)
	Resolution	0.001 mS/cm to 0.1 mS/cm (range-dependent)
Salinity	Sensor Type	Calculated from conductivity and temperature
	Range	0 to 70 ppt
	Accuracy	± 1.0% of reading or ±0.1 ppt, whichever is greater
	Resolution	0.01 ppt
pH (optional)	Sensor Type	Glass combination electrode
	Range	0 to 14 units
	Accuracy	±0.2 units
	Resolution	0.01 units
ORP (optional)	Sensor Type	Platinum button
	Range	-999 to +999 mV
	Accuracy	± 20 mV
	Resolution	0.1 mV
Total Dissolved Solids (TDS)	Sensor Type	Calculated from conductivity (variable constant, default 0.65)
	Range	0 to 100 g/L
	Resolution	4 digits
Barometer (optional)	Range	500 to 800 mm Hg
	Accuracy	± 3 mm Hg within ± 10°C temperature range from calibration point
	Resolution	0.1 mm Hg

YSI 556 Instrument Specifications

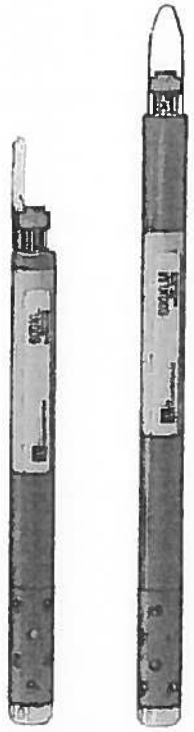
Size	11.9 cm width x 22.9 cm lenth (4. in. x 9 in.)
Weight with batteries	2.1 lbs. (916 grams)
Power	4 alkaline C-cells; optional rechargeable pack
Cables	4-, 10-, and 20-m (13.1, 32.8, 65.6 ft.) lengths
Warranty	3-year instrument; 1-year probes and cables
Communication Port	RS-232 Serial
Data Logger	49,000 data sets, date and time stamp, manual or logging, with user-selectable intervals

556 Ordering Information (Order all items separately)

556-01	Instrument (with 5061 large, soft-sided carrying case)
556-02	Instrument with barometer option (with 5061 carrying case)
5563-4	4-m cable and DO/temp/conductivity
5563-10	10-m cable and DO/temp/conductivity
5563-20	20-m cable and DO/temp/conductivity
5564	pH Probe for any 5563 cable
5565	pH/ORP Probe for any 5563 cable
6118	Rechargeable battery pack kit (includes battery, adapter, charger)
614	Ultra clamp, C-clamp mount
616	Charger, cigarette lighter
4654	Tripod (small tripod for instrument)
5060	Small carrying case, soft-sided (fits instrument and 4-m cable)
5065	Form-fitted carrrier with shoulder strap
5080	Small carrying case, hard-sided (fits instrument, 4-m cable, flow cell, batteries, membrane kit, calibration bottles)
5083	Flow cell
5085	Hands-free harness
5580	Confidence Solution® (insure probe accuracy with a simple field-check for conductivity, pH, and ORP)

The 5080 carrying case with 556, 5563-4 cable, and 5083 flow cell.

YSI 600XL and 600XLM Sondes



The YSI 600XL and 600XLM

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)

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

www.ysi.com

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

+1 937 767 7241
800 897 4151 (US)
www.ysi.com

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YSI Nanotech (Japan)
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Fax +81 44 221 1102
nanotech@ysi.com

ISO 9001
ISO 14001
Yellow Springs, Ohio Facility

CE

*Sensors with listed with the ETV logo were submitted to the ETV program on the YSI 6600EDS. Information on the performance characteristics of YSI water quality sensors can be found at www.epa.gov/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?

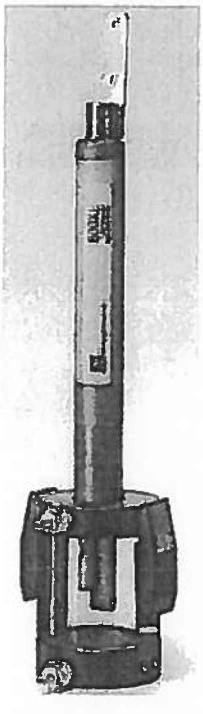
YSI 600XL & 600XLM Sensor Specifications

		Range	Resolution	Accuracy
Dissolved Oxygen % Saturation 6562 Rapid Pulse™ Sensor*	ETV✓	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 6562 Rapid Pulse™ Sensor*	ETV✓	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• 6560 Sensor*	ETV✓	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 6560 Sensor*	ETV✓	-5 to +50°C	0.01°C	±0.15°C
pH 6561 Sensor*	ETV✓	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	1.65 in, 4.19 cm | 1.65 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: $780.00

★★★★★ 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 Stability icon 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 9 223 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 curve display	Calibration summary data logged and displayed
Calibration Intervals/Alerts/Reminder	2 hours to 7 days
Compliance	CE WEEE
Conductivity Accuracy	± 0 5 % from (1 µS/cm - 200 mS/cm)
Conductivity measurement	3 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 (D.N 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

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.

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.

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.

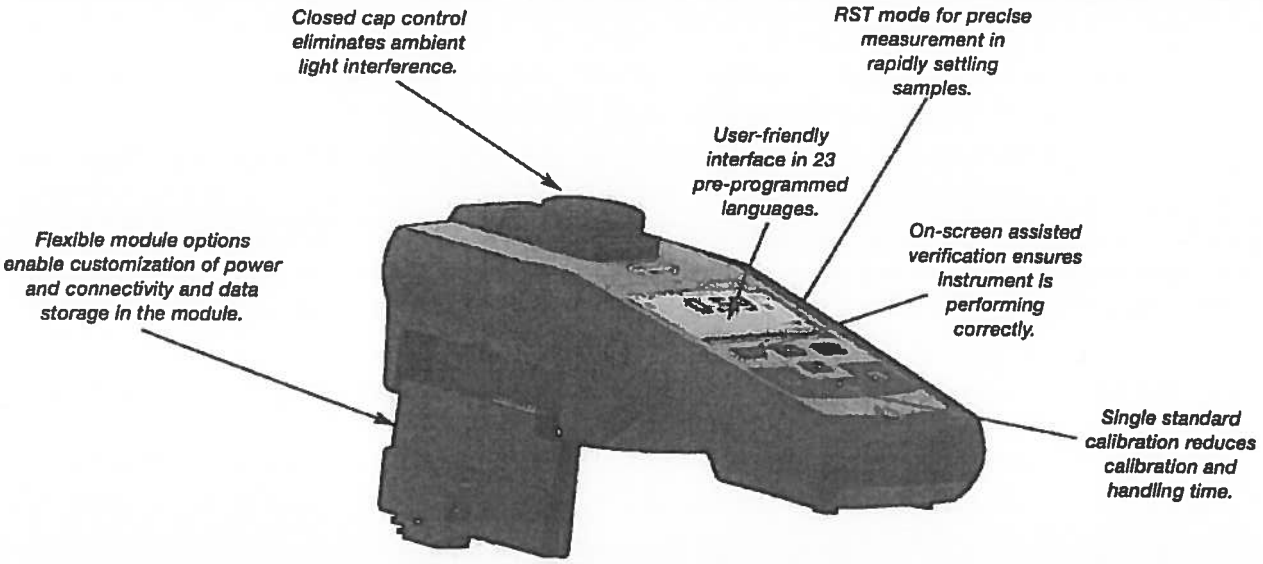
Two Models for Specific Requirements

- **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

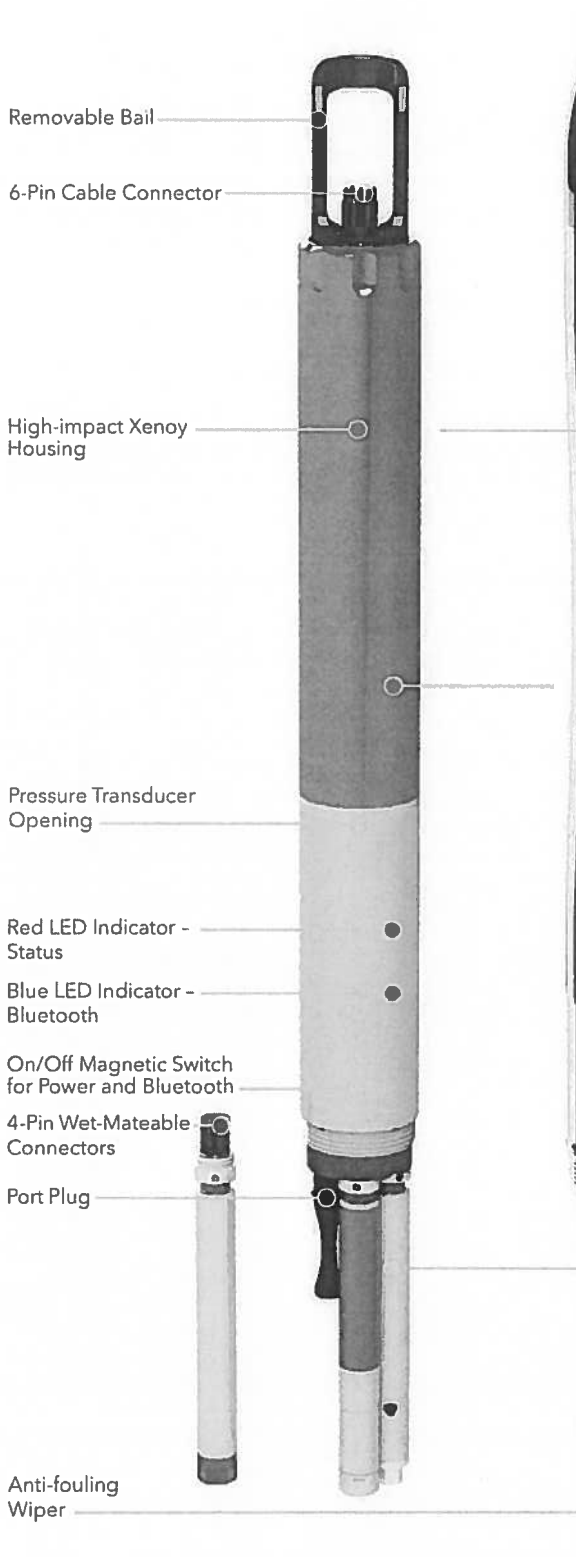
Dimensions
22.9 x 10.7 x 7.7 cm (9.0 x4.2 x 3.0 in.)

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

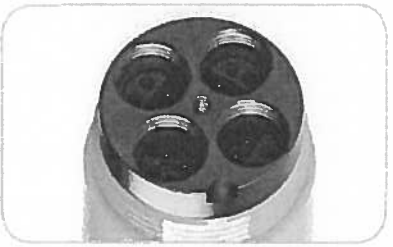
EXO2 sonde contains 6 universal sensor ports plus a central port for an anti-fouling wiper

Battery Compartment

Cutaway: Reinforced internal structure

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

Welded Titanium Housing



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

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF LABORATORIES

LABORATORY ACCREDITATION PROGRAM

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Certifies That

68-03670

Northeast Ohio Regional Sewer District Analytical Services

4747 East 49th Street, Cuyahoga Heights, OH 44125

Having duly met the requirement of
The act of June 29, 2002 (P.L. 596, No. 90)
dealing with Environmental Laboratories Accreditation
(27 Pa. C.S. §§4104-4113) and the
National Environmental Laboratory Accreditation Program Standard

is hereby approved as an

Accredited Laboratory

As more fully described in the attached Scope of Accreditation

Expiration Date: **11/30/2014**

Certificate Number: **007**

Aaren S. Alger, Chief
Laboratory Accreditation Program
Bureau of Laboratories

Continued accreditation status depends on successful ongoing participation in the program
Certificate not transferable Surrender upon revocation
To be conspicuously displayed at the Laboratory
Not valid unless accompanied by a valid Scope of Accreditation
Shall not be used to imply endorsement by the Commonwealth of Pennsylvania
Customers are urged to verify the laboratory's current accreditation status
PA DEP is a NELAP recognized accreditation body

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 007-001 expiration date November 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 68-03670 **EPA Lab Code: OH00300** **TNI Code:** **(216) 641-6000**

Northeast Ohio Regional Sewer District Analytical Services
4747 East 49th Street
Cuyahoga Heights, OH 44125

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 1000.0		Pimephales promelas	NELAP	PA	1/8/2009
EPA 1002.0		Ceriodaphnia dubia	NELAP	PA	1/8/2009
EPA 160.4		Residue, volatile	NELAP	PA	10/22/2008
EPA 1600		Enterococci	NELAP	PA	11/22/2010
EPA 1603		E. coli (Enumeration)	NELAP	PA	11/29/2007
EPA 1631	E	Mercury	NELAP	PA	3/31/2008
EPA 180.1		Turbidity	NELAP	PA	12/31/2007
EPA 200.7	4.4	Aluminum	NELAP	PA	11/29/2007
EPA 200.7	4.4	Antimony	NELAP	PA	11/29/2007
EPA 200.7	4.4	Arsenic	NELAP	PA	11/29/2007
EPA 200.7	4.4	Barium	NELAP	PA	11/29/2007
EPA 200.7	4.4	Beryllium	NELAP	PA	11/29/2007
EPA 200.7	4.4	Cadmium	NELAP	PA	11/29/2007
EPA 200.7	4.4	Calcium	NELAP	PA	11/29/2007
EPA 200.7	4.4	Chromium	NELAP	PA	11/29/2007
EPA 200.7	4.4	Cobalt	NELAP	PA	11/29/2007
EPA 200.7	4.4	Copper	NELAP	PA	12/31/2007
EPA 200.7	4.4	Iron	NELAP	PA	11/29/2007
EPA 200.7	4.4	Lead	NELAP	PA	11/29/2007
EPA 200.7	4.4	Magnesium	NELAP	PA	11/17/2010
EPA 200.7	4.4	Manganese	NELAP	PA	11/29/2007
EPA 200.7	4.4	Molybdenum	NELAP	PA	11/29/2007
EPA 200.7	4.4	Nickel	NELAP	PA	11/29/2007
EPA 200.7	4.4	Potassium	NELAP	PA	12/31/2007
EPA 200.7	4.4	Selenium	NELAP	PA	11/29/2007
EPA 200.7	4.4	Silver	NELAP	PA	11/29/2007
EPA 200.7	4.4	Sodium	NELAP	PA	12/31/2007
EPA 200.7	4.4	Tin	NELAP	PA	11/29/2007
EPA 200.7	4.4	Titanium	NELAP	PA	11/29/2007
EPA 200.7	4.4	Vanadium	NELAP	PA	11/29/2007
EPA 200.7	4.4	Zinc	NELAP	PA	12/31/2007
EPA 245.1	3.0	Mercury	NELAP	PA	11/29/2007
EPA 300.0	2.1	Bromide	NELAP	PA	11/22/2010
EPA 300.0	2.1	Chloride	NELAP	PA	11/22/2010
EPA 300.0	2.1	Fluoride	NELAP	PA	11/22/2010
EPA 300.0	2.1	Nitrate as N	NELAP	PA	11/22/2010
EPA 300.0	2.1	Nitrite as N	NELAP	PA	11/22/2010
EPA 300.0	2.1	Orthophosphate as P	NELAP	PA	11/22/2010
EPA 300.0	2.1	Sulfate	NELAP	PA	11/22/2010
EPA 3005	A	Preconcentration under acid	NELAP	PA	11/29/2007

The Pennsylvania Department of Environmental Protection Laboratory Accreditation Program is a NELAP recognized Accreditation Body. Customers are urged to verify the laboratory's current accreditation standing.

www.dep.state.pa.us

Issue Date: 11/13/2013

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 007-001 expiration date November 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 68-03670 **EPA Lab Code: OH00300** **TNI Code:** **(216) 641-6000**

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 3010	A	Hot plate acid digestion (HNO3 + HCl)	NELAP	PA	11/29/2007
EPA 3015		Microwave-assisted acid digestion	NELAP	PA	11/29/2007
EPA 310.2		Alkalinity as CaCO3	NELAP	PA	9/20/2012
EPA 325.2		Chloride	NELAP	PA	11/17/2010
EPA 350.1		Ammonia as N	NELAP	PA	11/29/2007
EPA 351.2		Kjeldahl nitrogen, total (TKN)	NELAP	PA	11/17/2010
EPA 353.2		Nitrate as N	NELAP	PA	11/29/2007
EPA 353.2		Total nitrate-nitrite	NELAP	PA	11/17/2010
EPA 365.1		Orthophosphate as P	NELAP	PA	11/29/2007
EPA 365.1		Phosphorus, total	NELAP	PA	10/22/2008
EPA 410.4		Chemical oxygen demand (COD)	NELAP	PA	11/29/2007
EPA 420.4		Total phenolics	NELAP	PA	11/17/2010
EPA 445		Chlorophyll A	NELAP	PA	11/22/2010
EPA 6010		Aluminum	NELAP	PA	11/29/2007
EPA 6010		Antimony	NELAP	PA	11/29/2007
EPA 6010		Arsenic	NELAP	PA	11/29/2007
EPA 6010		Barium	NELAP	PA	11/29/2007
EPA 6010		Beryllium	NELAP	PA	11/29/2007
EPA 6010		Cadmium	NELAP	PA	11/29/2007
EPA 6010		Calcium	NELAP	PA	11/29/2007
EPA 6010		Chromium	NELAP	PA	11/29/2007
EPA 6010		Cobalt	NELAP	PA	11/29/2007
EPA 6010		Copper	NELAP	PA	12/31/2007
EPA 6010		Iron	NELAP	PA	11/29/2007
EPA 6010		Lead	NELAP	PA	11/29/2007
EPA 6010		Magnesium	NELAP	PA	11/29/2007
EPA 6010		Manganese	NELAP	PA	11/29/2007
EPA 6010		Molybdenum	NELAP	PA	11/29/2007
EPA 6010		Nickel	NELAP	PA	11/29/2007
EPA 6010		Potassium	NELAP	PA	12/31/2007
EPA 6010		Selenium	NELAP	PA	11/29/2007
EPA 6010		Silver	NELAP	PA	11/29/2007
EPA 6010		Sodium	NELAP	PA	12/31/2007
EPA 6010		Tin	NELAP	PA	11/29/2007
EPA 6010		Titanium	NELAP	PA	11/29/2007
EPA 6010		Vanadium	NELAP	PA	11/29/2007
EPA 6010		Zinc	NELAP	PA	12/31/2007
EPA 7470		Mercury	NELAP	PA	11/29/2007
Enterolert		Enterococci (Enumeration)	NELAP	PA	11/22/2010
Lachat 10-204-00-1X		Cyanide	NELAP	PA	11/17/2010
OIA 1677		Available cyanide	NELAP	PA	11/29/2007
SM 2540 B		Residue, total	NELAP	PA	11/29/2007
SM 2540 C		Residue, filterable (TDS)	NELAP	PA	11/29/2007
SM 2540 D		Residue, nonfilterable (TSS)	NELAP	PA	11/29/2007
SM 2540 F		Residue, settleable	NELAP	PA	11/29/2007
SM 2550 B		Temperature, deg. C	NELAP	PA	10/22/2008
SM 3500-Cr B	20-22	Chromium VI	NELAP	PA	11/29/2007

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

Laboratory Scope of Accreditation

Attached to Certificate of Accreditation 007-001 expiration date November 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate of accreditation.

DEP Laboratory ID: 68-03670 **EPA Lab Code: OH00300** **TNI Code:** **(216) 641-6000**

Matrix: Non-Potable Water

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
SM 4500-CN- C/E		Total cyanide	NELAP	PA	11/29/2007
SM 4500-CN- G		Amenable cyanide	NELAP	PA	11/29/2007
SM 4500-Cl E		Total residual chlorine	NELAP	PA	11/29/2007
SM 4500-Cl- C		Chloride	NELAP	PA	11/19/2012
SM 4500-H+ B		pH	NELAP	PA	11/29/2007
SM 4500-NO2- B		Nitrite as N	NELAP	PA	11/29/2007
SM 4500-Norg B		Kjeldahl nitrogen, total (TKN)	NELAP	PA	10/22/2008
SM 4500-P B		Preliminary treatment of phosphate samples	NELAP	PA	11/13/2013
SM 4500-P E		Orthophosphate as P	NELAP	PA	11/13/2013
SM 4500-S D		Sulfide	NELAP	PA	11/22/2010
SM 5210 B		Biochemical oxygen demand (BOD)	NELAP	PA	11/29/2007
SM 5210 B		Carbonaceous BOD (CBOD)	NELAP	PA	11/29/2007
SM 9222 D		Fecal coliform (Enumeration)	NELAP	PA	11/29/2007
SM 9223 Colilert MPN or QT		E. coli (Enumeration)	NELAP	PA	11/29/2007
SM 9223 Colilert MPN or QT		Total coliform (Enumeration)	NELAP	PA	11/22/2010

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 245.1	3.0	Mercury	NELAP	PA	11/22/2010
EPA 3051		Microwave digestion of solids (HNO3 only)	NELAP	PA	11/17/2010
EPA 6010		Aluminum	NELAP	PA	11/22/2010
EPA 6010		Antimony	NELAP	PA	11/13/2013
EPA 6010		Arsenic	NELAP	PA	11/22/2010
EPA 6010		Barium	NELAP	PA	11/22/2010
EPA 6010		Beryllium	NELAP	PA	11/22/2010
EPA 6010		Boron	NELAP	PA	11/22/2010
EPA 6010		Cadmium	NELAP	PA	11/22/2010
EPA 6010		Calcium	NELAP	PA	11/22/2010
EPA 6010		Chromium	NELAP	PA	11/22/2010
EPA 6010		Cobalt	NELAP	PA	11/22/2010
EPA 6010		Copper	NELAP	PA	11/22/2010
EPA 6010		Iron	NELAP	PA	11/22/2010
EPA 6010		Lead	NELAP	PA	11/22/2010
EPA 6010		Magnesium	NELAP	PA	11/22/2010
EPA 6010		Manganese	NELAP	PA	11/22/2010
EPA 6010	B	Metals by ICP/AES	NELAP	PA	1/22/2013
EPA 6010		Molybdenum	NELAP	PA	11/22/2010
EPA 6010		Nickel	NELAP	PA	11/22/2010
EPA 6010		Potassium	NELAP	PA	11/22/2010
EPA 6010		Selenium	NELAP	PA	11/22/2010
EPA 6010		Silver	NELAP	PA	11/22/2010
EPA 6010		Sodium	NELAP	PA	11/22/2010
EPA 6010		Thallium	NELAP	PA	11/22/2010
EPA 6010		Tin	NELAP	PA	4/15/2013

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DEP Laboratory ID: 68-03670 **EPA Lab Code: OH00300** **TNI Code:** **(216) 641-6000**

Matrix: Solid and Chemical Materials

Method	Revision	Analyte	Accreditation Type	Primary	Effective Date
EPA 6010		Titanium	NELAP	PA	11/22/2010
EPA 6010		Vanadium	NELAP	PA	11/22/2010
EPA 6010		Zinc	NELAP	PA	11/22/2010

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