Northeast Ohio
Regional Sewer District

Level 3 Project Study Plan

2023 Lake Erie Beach Monitoring

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Appendices

List of Acronyms

CSO	Combined Sewer Overflow
EIMS	Environmental Information Management System
EPA	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
NELAC	National Environmental Laboratory Accreditation Conference
NEORSD	Northeast Ohio Regional Sewer District
ODH	Ohio Department of Health
QDC	Qualified Data Collector
RM	River Mile
SOP	Standard Operating Procedures
USGS	United States Geological Survey
WQIS	Water Quality & Industrial Surveillance

(1) Objective

Microorganisms from urban runoff, combined sewer overflows (CSOs), wildlife, bather shedding, and non-point sources can be contributing factors to illnesses for individuals utilizing freshwater bathing beaches. The U.S. Environmental Protection Agency has adopted *Escherichia coli* (*E. coli*) as one of the best indicator organisms at beaches because its presence has been correlated to other pathogenic microorganisms that can cause illnesses.

The purpose of this study is to monitor water quality in Lake Erie at Edgewater, Euclid, and Villa Angela beaches in order to communicate beach conditions to the public and to evaluate the attainment of water quality standards. During the study, *E. coli* densities will be monitored (weather permitting) at three beach sites during the recreation season. Sampling will be conducted by the Northeast Ohio Regional Sewer District's (NEORSD) Water Quality and Industrial Surveillance (WQIS) division and may occur May 1st through October 31st, 2023. NEORSD's Analytical Services division will perform sample analysis. WQIS will evaluate the collected data and distribute the daily results. WQIS will also be responsible for evaluating the results to determine water quality standards attainment. The data obtained from this sampling will be reported to the Ohio Department of Health (ODH) and used for public notification of water quality advisories.

In addition to water quality sampling at the beach sites, water samples will be collected from Euclid Creek, which has historically had elevated bacteriological densities that may adversely impact the Villa Angela and Euclid Beaches. NEORSD will compare the results to the applicable water quality standards to determine the attainment status of Euclid Creek.

(2) Non-point/Point Sources

Point Sources	Non-point Sources
Publicly Owned Treatment Works	Urban runoff
CSOs	Sand
Storm sewer outfalls	
Bathers	
Feces (birds, dogs, wildlife)	

A map has been provided in Appendix A to show potential point sources that may be influencing the water quality at each sample location. These sources of pollution, along with the non-point sources listed in the table above, may be negatively impacting the water quality conditions at the beaches. Other factors that may influence water quality and bacteriological densities during the study may include wet weather, wind, wave action, and beach morphology.

(3) Parameters Covered

Water samples will be collected at each site and analyzed for *E. coli* densities as outlined by NEORSD's most current Standard Operating Procedures (SOP) for *Total Coliform and E. coli by Colilert®, Enterococci by Enterolert ®* or *Determination of E. coli by Membrane Filtration*. Field parameters to be measured during the study will include pH, water temperature, specific conductance, and turbidity (Appendix B). In addition, a field assessment of each beach will be conducted following the procedures outlined in NEORSD's *Beach Sampling* SOP (Appendix C). Observations such as number of swimmers and birds, wave height, average and maximum wind speed, wind direction, water color, clarity, odor and surface coating, lake surface conditions, and weather conditions may be recorded on a field sheet or in electronic format using an Apple iPad equipped with GIS data entry software. Examples of the *Beach Sampling Field Data Forms* can be found in Appendix D.

(4) Field Collection and Data Assessment Techniques

Individual bacteriological samples will be collected from one site on Euclid Creek (river mile (RM) 0.55) and at each of the three beach sampling sites in at least a 250-milliliter sterilized polypropylene container and up to a 2000-milliliter sterilized polypropylene container, depending on the needs of NEORSD's Analytical Services. A 473-milliliter plastic bottle will be used to collect a water sample from each site to be analyzed for turbidity by WQIS personnel.

All samples will be collected as grab samples where the total depth of water at each beach sample site is approximately three feet. Samples will be collected approximately 6-12 inches below the water surface, as stated in Appendix C. At the time of collection, field parameters (pH, specific conductance, and temperature) will be measured directly at the sample location. Field measurements will include the use of the following meters to collect readings of pH, water temperature and specific conductance: Hanna HI 98129, YSI 600XL Sonde, YSI EXO1 Sonde, or YSI EXO2 Sonde. Turbidity samples will be collected with a 473-milliliter container and measured using one of the following portable field turbidity meters: the Hach 2100Q or Hach 2100P Turbidimeter. Specifications for the meters are included in Appendix E.

Field blanks are not required by method 1603 or by the National Environmental Laboratory Accreditation Conference (NELAC) for bacteria analysis. NEORSD's Analytical Services division has procedures in place which are required by NELAC to demonstrate that the sample containers are clean and sterile. If the sterility check comes back positive, all equipment is re-cleaned and sterilized. Additionally, bacteriological field replicates will be collected from a randomly chosen site at a frequency not less than 5% of the total samples collected.

If weather conditions prevent the sampler from safely wading out to a depth of three feet, a sampling pole will be used to collect bacteriological and turbidity samples from Lake Erie. If weather conditions do not permit the use of a sampling pole, no samples will be collected. Additionally, if sampling at the Euclid Creek site is deemed unsafe due to high flow or other conditions, samples will not be collected. Refer to section 7.6 of Appendix C for an explanation of sample collection during inclement weather.

Notes and observations pertaining to the beach and water conditions will be recorded using the NEORSD *Beach Sampling Field Data Form* (refer to Appendix D for an example form) or recorded in electronic format using an Apple iPad equipped with GIS data entry software. In the case of electronic data submission, daily field sheets may still be electronically generated upon request. Electronic data submission will allow beach modeling experts in NEORSD's WQIS division to enter data into Virtual Beach v3.0 modeling software prior to the return of the field sampling team. Implementation of the electronic field data submission should expedite water quality predictions and public beach water quality advisory postings.

All water samples and field parameters will be collected as specified in NEORSD's *Beach Sampling* SOP (Appendix C) and Ohio EPA's *Surface Water Field Sampling Manual for water column chemistry, bacteria and flows* (2021). All bacteriological sample results will be compared to the State of Ohio Water Quality Standards to determine whether any exceedances of the applicable water quality criteria have occurred.

NEORSD will collect additional samples at Edgewater Beach in the event of a discharge from CSO-069 (Permit Number 3PA0002069), in accordance with its Emergency Response Plan. CSO-069 (41.487253, -81.744972) is a stormwater outlet for the Northwest Interceptor, located on the western edge of the beach. CSO-069 is located near a highly utilized public recreation area; therefore, such sampling is necessary when a CSO discharge occurs during the recreation season. These samples will be collected at three locations on the west side of Edgewater beach, near the CSO outfall, and at several near shore and far shore locations to determine the impact of the CSO discharge on the water quality. An outline for actions and sampling during a discharge at CSO-069 is located in NEORSD's *Emergency Response Plan 2.2.4, Edgewater Overflow.* All samples will be collected as specified in Ohio EPA's *Surface Water Field Sampling Manual for water column chemistry, bacteria and flows* (2021). All samples will be analyzed using approved EPA methods as specified in NEORSD's Analytical Services' most current *Quality Assurance Manual* (effective May 15, 2020).

If unusual water quality conditions are noted at any of the beaches, the NEORSD may collect additional water samples during the recreation season.

(5) Stream Flow Measurements

Not applicable.

(6) Sampling Locations

One location at the eastern section of Edgewater, Villa Angela and Euclid Beaches in Cleveland will be sampled for the duration of this study. An additional sample will be collected from Euclid Creek at RM 0.55. The locations of each sampling site are illustrated on the map provided in Appendix A. The following table details the sampling locations with respect to latitude/longitude, general location description, U.S. geological survey HUC 8 name and number, and purpose. Additional pictures and maps of the sample locations can be found in Appendix 1 of Appendix C.

Water Body	Site	Latitude	Longitude	Location Information	USGS HUC 8 Number-Name	Purpose
Edgewater Beach	East	41.4897	-81.7391	Eastern half of the beach. In line with the brick stack on the other side of the freeway.	04120200-Lake Erie	Public notification of water quality conditions at bathing beaches, determination of water quality standards attainment, and determination of the impact of point and non-point sources.
Villa Angela Beach	East	41.5862	-81.5667	Eastern half of beach mid-distance between the 3rd and 4th break walls.		
Euclid Beach	East	41.5842	-81.5687	In front of the pile of stones on the east side of the beach.		
Euclid Creek	RM 0.55	41.5835	-81.5595	Downstream of Lakeshore Boulevard.	04110003-Ashtabula-Chagrin	

(7) Schedule

Beach monitoring is expected to begin on May 1, 2023, and end on September 28, 2023 (Appendix F). From May 1 through May 18, bacteriological water samples from all sites listed in section 6 will be collected four days a week (Monday through Thursday). Beginning May 22, and lasting through September 4, bacteriological water quality samples will be collected seven days a week from all sites. From September 4 through September 28, bacteriological water quality sampling at the beach sites is expected to return to four days a week (Monday through Thursday). Additional sampling may take place in October. All sampling will be dependent on weather conditions, and will be collected as scheduled, unless water conditions are deemed unsafe or there is inadequate staff availability.

(8) QA/QC

All samples will be collected, labeled and immediately placed on ice inside of a sample cooler. Upon completion of a sampling event at the site, the sample cooler will be stored inside the field truck. The field truck will remain locked at all times when not occupied or visible. Sampling activities, including sample time and condition of surface water sampled, will be entered in a log book and on the *Beach Sampling Field Data Form* (see Appendix D for examples). The samples will then be delivered immediately to NEORSD's Analytical Services and sample custody will be transferred to Analytical Services. The NEORSD's Analytical Services' *Quality Assurance Manual* (effective date: May 15, 2020) and associated SOPs are on file with Ohio EPA. The Analytical Services' Quality Assurance Officer will send updates, revisions, and any information on document control to Ohio EPA as needed.

(9) Work Products

Reports summarizing, interpreting, graphically presenting and discussing the bacteriological data and any excursions from water quality standards will be submitted to the Ohio EPA or an Ohio EPA approved data warehouse as well as to the Ohio Department of Health. Field parameters and bacteriological data will be used internally, to update a predictive model created using Virtual Beach v.3.0. Results of the predictive modeling will be reported daily to the Cleveland Metroparks for the purpose of posting water quality advisories.

Pictures will be taken during each sampling event by the samplers to document the conditions at the beach. Daily photos will be electronically delivered from the field crew's iPads to an electronic photo catalog. Copies of the *Beach Sampling Field Data Form* and summary reports will also be stored electronically. Additionally, field observations will also be entered into the Environmental Information Management System (EIMS).

(10) Qualified Data Collectors

The following Level 3 Qualified Data Collectors (QDC) certified by the Ohio EPA in Chemical Water Quality Assessment may be involved with this study. Official certification letters for the Level 3 Chemical Water Quality Assessment QDC approvals are on file with Ohio EPA.

Name	QDC Number	Address	Email Address	Phone Number
John W. Rhoades	QDC-00008-CWQA	4747 E. 49th Street, Cuyahoga Heights, OH 44125	rhoadesj@neorsd.org	216-641-6000

Name	QDC Number	Address	Email Address	Phone Number
Seth Hothem [1]	QDC-00010-CWQA	4747 E. 49th Street, Cuyahoga Heights, OH 44125	hothems@neorsd.org	216-641-6000
Jillian Knittle	QDC-00512-CWQA	4747 E. 49th Street, Cuyahoga Heights, OH 44125	knittlej@neorsd.org	216-641-6000
Eric Soehnlen	QDC-01030-CWQA	4747 E. 49th Street, Cuyahoga Heights, OH 44125	soehnlene@neorsd.org	216-641-6000
Ron Maichle	QDC-00145-CWQA	4747 E. 49th Street, Cuyahoga Heights, OH 44125	maichler@neorsd.org	216-641-6000
Mark Matteson	QDC-01020-CWQA	4747 E. 49th Street, Cuyahoga Heights, OH 44125	mattesonm@neorsd.org	216-641-6000
Denise Phillips	QDC-01203-CWQA	4747 E. 49th Street, Cuyahoga Heights, OH 44125	phillipsd@neorsd.org	216-641-6000
Justin Telep	QDC-01304-CWQA	4747 E. 49th Street, Cuyahoga Heights, OH 44125	telepj@neorsd.org	216-641-6000

[1] Project Manager

All non-QDC samplers will receive training that consists of reviewing all pertinent SOPs and completion of required demonstrations of capabilities for the collection of field parameters. Training on sampling techniques and field analysis will be conducted by having the samplers assist a QDC at the sample locations while the techniques are being demonstrated. The non-QDC samplers will then get an opportunity to conduct the sampling, and the QDC will determine their proficiency by observing and assessing the samplers' techniques. All samplers must meet and complete all requirements to be permitted to sample on their own. A complete checklist of training is provided in Appendix G (*Beach Sampling Training Checklist*). Once samplers have met the outlined criteria, they will be permitted to sample without the direct supervision of a QDC. The QDCs will perform monthly audits of the sampling, using a *Beach Sampling Audit Form* (Appendix H), and correct deficiencies through re-training, if necessary. Re-training will consist of accompaniment to the sample locations, further instruction and observation by a QDC until deficiencies are no longer noted.

The following is a list of persons not qualified as Level 3 QDCs who may also be involved in the project. The Project Manager, with assistance from the current QDCs, will provide training on the sampling methodology and conduct monthly audits. The Project Manager

and QDCs will be responsible for reviewing all reports and data analysis prepared prior to the completion of this study.

Name	Address	Email Address	Phone Number
Chris Abraham	4747 E. 49th Street, Cuyahoga Heights, OH 44125	abrahamc@neorsd.org	216-641-6000
Brittany Dalton	4747 E. 49th Street, Cuyahoga Heights, OH 44125	daltonb@neorsd.org	216-641-6000
Laura Ferguson	4747 E. 49th Street, Cuyahoga Heights, OH 44125	fergusonl@nerosd.org	216-641-6000
Rae Grant	4747 E. 49th Street, Cuyahoga Heights, OH 44125	grantr@neorsd.org	216-641-6000
Jeff Harrison	4747 E. 49th Street, Cuyahoga Heights, OH 44125	harrisonj@neorsd.org	216-641-6000
Margret Hodgkiss-Lilly	4747 E. 49th Street, Cuyahoga Heights, OH 44125	Hodgkiss-lillym@nerosd.org	216-641-6000
Matthew Johnson	4747 E. 49th Street, Cuyahoga Heights, OH 44125	johnsonmatthew@neorsd.org	216-641-6000
Christina Miller	4747 E. 49th Street, Cuyahoga Heights, OH 44125	millerchristina@neorsd.org	216-641-6000
Ryan Parrish	4747 E. 49th Street, Cuyahoga Heights, OH 44125	parrishr@neorsd.org	216-641-6000
Shawn Robinson	4747 E. 49th Street, Cuyahoga Heights, OH 44125	robinsons@neorsd.org	216-641-6000
Brandan Saner	4747 E. 49th Street, Cuyahoga Heights, OH 44125	sanerb@nerosd.org	216-641-6000
Frank Schuschu	4747 E. 49th Street, Cuyahoga Heights, OH 44125	schuschuf@neorsd.org	216-641-6000
Wolfram von Kiparski	4747 E. 49th Street, Cuyahoga Heights, OH 44125	vonkiparskiw@neorsd.org	216-641-6000

Name	Address	Email Address	Phone Number
Paraprofessional Intern (TBD)	4747 E. 49th Street, Cuyahoga Heights, OH 44125	_____@neorsd.org	216-641-6000
Paraprofessional Intern (TBD)	4747 E. 49th Street, Cuyahoga Heights, OH 44125	_____@neorsd.org	216-641-6000
Paraprofessional Intern (TBD)	4747 E. 49th Street, Cuyahoga Heights, OH 44125	_____@neorsd.org	216-641-6000
Paraprofessional Intern (TBD)	4747 E. 49th Street, Cuyahoga Heights, OH 44125	_____@neorsd.org	216-641-6000

(11) Contract Laboratory

All bacteriological and/or 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 I. The contact information for NEORSD's Analytical Services Division is:

Cheryl Soltis-Muth
4747 E. 49th Street
Cuyahoga Heights, Ohio 44056
Soltis-MuthC@neorsd.org
216-641-6000

(12) Scientific Collectors Permit

Not applicable.

(13) Digital 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), the riparian zone adjacent to the sampling location(s) and the general land use in the immediate vicinity of the sampling location(s).

Print/Signature: Seth Hothem / _____ Date: 3/6/23

(14) Voucher Statement

Not applicable.

(15) Sample Location(s) 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 river mile (where possible), 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: 3/6/23

(16) Additional Data Type Signed Statement

The Lead Project Manager for all locations is approved for all project data types.

Print/Signature: Seth Hothem / Seth Hothem Date: 3/6/23

(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 / John W. Rhoades Date: 03/01/23

Print/Signature: Seth Hothem / Seth Hothem Date: 3/6/23

Print/Signature: Jill Knittle / Jill Knittle Date: 3/1/23

Print/Signature: Eric Soehnlen / Eric Soehnlen Date: 3/1/23

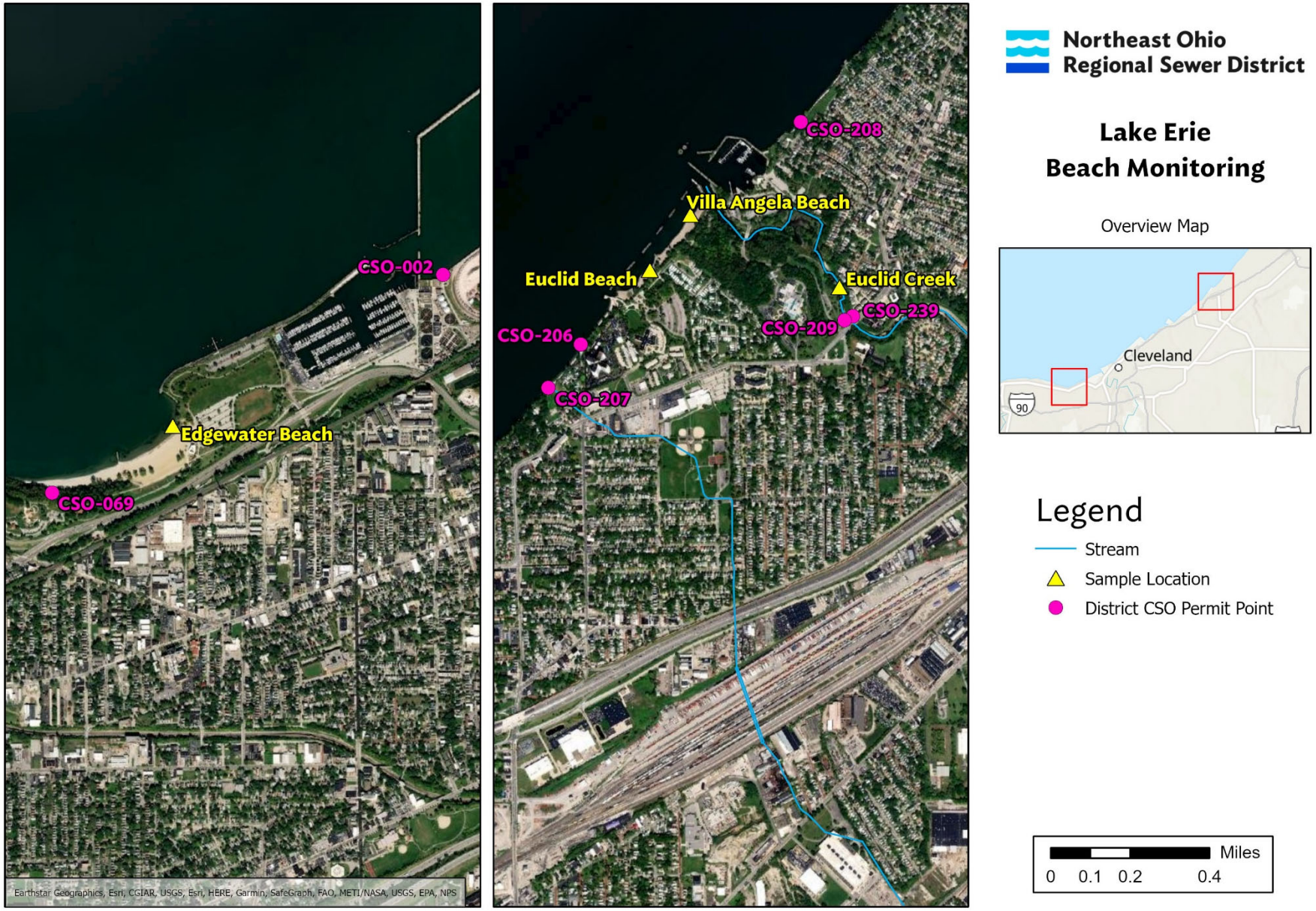
Print/Signature: Ron Maichle / R. Maichle Date: 4-3-23

Print/Signature: Mark Matteson / _____ Date: 3/6/23

Print/Signature: Denise Phillips / _____ Date: 3/1/23

Print/Signature: Justin Telep / _____ Date: 3/1/23

Appendix A. Sample Location Map



This information is for display purposes only. The Northeast Ohio Regional Sewer District (NEORSD) makes no warranties, expressed or implied, with respect to the accuracy of and the use of this map for any specific purpose. This map was created to serve as base information for use in Geographic Information Systems (GIS) for a variety of planning and analysis purposes. The NEORSD expressly disclaims any liability that may result from the use of this map. For more information please contact: NEORSD GIS Services, 3900 Euclid Avenue, Cleveland, Ohio 44115 --- (216) 881-6600 GIS@neorsd.org.

Appendix B. Parameter Information

Parameter	Test	Value Reported in	Minimum Detection Limit (MDL)	Practical Quantitation Limit (PQL)
E. coli	Colilert QT (SM 9223 B 20th Ed)	MPN (Most Probable Number)	1 MPN	--
	EPA 1603	colony forming units /100mL	1 colony	--
Turbidity*	EPA 180.1	NTU	0.1 NTU	0.2 NTU
Field Parameter	**Test**	**Value Reported in**		
pH	EPA 150.1	s.u.		
Specific Conductivity	SM2510B	µs/cm		
Temperature	EPA 170.1	°C		
Turbidity*	EPA 180.1	NTU		

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

Appendix C. Standard Operating Procedures

Northeast Ohio Regional Sewer District

Water Quality and Industrial Surveillance
4747 East 49th Street
Cuyahoga Heights, Ohio 44125

Title

Beach Sampling

SOP–EA016-19

Effective Date: 4/26/2021

Approvals

Prepared By: Eric Soehnlen Date: 4/26/21

Reviewed By Supervisor: Seth Hothem Date: 4/26/21

Approved By Manager: John W. Rhoades Date: 04/29/21

Northeast Ohio Regional Sewer District

Water Quality and Industrial Surveillance
4747 East 49th Street
Cuyahoga Heights, OH 44125

TABLE OF CONTENTS

1. Scope and Application

1.1. This SOP describes the procedure for the collection of bacteriological beach water samples.

1.2. Beaches are sampled during the recreational season (May 1-October 31) to monitor levels of bacteria in order to inform the public of a possible risk of exposure to high levels of bacteria.

1.3. *E. coli* are commonly associated with sewage contamination resulting from a number of sources including over ground runoff and overflows of sewage systems from rain events, warm-blooded animal waste and the effects of increased wave height. The presence of the bacteria only indicates that other pathogenic bacteria may be present.

1.4. The EPA has determined that *E. coli* are one of the best indicator organisms of water quality for freshwater bathing beaches.

1.5. *E. coli* densities are compared to the Ohio water quality standards to determine recreation use attainment and beach and bathing water advisories. Beach advisories are based on single sample concentrations of *E. coli* bacteria.

1.6. The data from beach sampling are sent to the Ohio Department of Health for a daily assessment of bathing water quality. The Ohio Department of Health and the Ohio Department of Natural Resources use this data to determine when beach advisory postings should be made.

2. Interferences

2.1. The use of a sample bottle that is not autoclaved may cause elevated bacteria counts or false positives. Autoclaving kills any residual bacteria that may be present in the bottle.

2.2. Do not touch the inside of the bottle or the inside of the cap. This can contaminate the sample.

2.3. Sampling at a distance too close to the shoreline may cause elevated bacteria counts or false positives. Avoid sampling near bird feces, sediment, and floating debris and trash.

2.4. Avoid disturbing and kicking up bottom material at the sampling station.

3. Definitions

3.1. Anemometer- A device used to measure wind speed (maximum and average).

3.2. Beach Sampling Field Data Form- A field form to be filled out at each beach site in order to record field observations and field parameters.

3.3. Edgewater State Park- Lake Erie beach located at 6700 Cleveland Memorial Shoreway, Cleveland.

3.4. EMSC- Environmental Maintenance and Service Center (4747 East 49th Street, Cuyahoga Heights, Ohio 44125; 216-641-6000)

3.5. Sampling pole- Pole that extends to 12 feet and is used to take samples at a distance. Can be used during beach sampling if lake conditions are deemed unsafe due to high wave height.

3.6. Villa Angela/Euclid State Parks- Lake Erie beaches located at 16301 Lakeshore Boulevard, Cleveland.

4. Safety

4.1. Safety Equipment

- 4.1.1. Personal Flotation Device (PFD) (see Section 4.2.7.)
- 4.1.2. Chest waders
- 4.1.3. Gloves, if desired
- 4.1.4. Throw bag with 50 feet of nylon rope (refer to *Throw Bag SOP-EA007-00*)
- 4.1.5. District-issued cell phone

4.2. Sampling Safety Procedures

- 4.2.1. A District cell phone has been provided for additional safety. The phone should be charged and turned on while off District premises.
- 4.2.2. Sampling may not occur during a thunderstorm. During times of inclement weather, check with a Supervisor or Manager of Water Quality and Industrial Surveillance (WQIS) prior to sampling.
- 4.2.3. If inclement weather occurs while sampling, seek safety and call a WQIS Supervisor or Manager for instructions.
- 4.2.4. Samples will not be collected when wave heights are over 3.5 feet.
- 4.2.5. The sampler MUST put on chest waders before entering the water.
- 4.2.6. A PFD is provided for the sampler.
  - 4.2.6.1. A PFD must be worn when factors indicate that a drowning hazard may exist, such as rip current advisories, waves are greater than 2 feet in height and when waters are over waist deep, are swift, cold or turbid.
  - 4.2.6.2. Use of PFD during all other lake conditions is at the discretion of the sampler.

4.2.7. The sampler must wade out to a water depth of 3 feet to collect samples. The wave stick is used as a depth indicator. Do not wade out farther than recommended.

4.2.8. When the water is rough, the sampler may use a 12-foot sampling pole to assist with sampling. The sampler should wade out to a safe distance and then extend the sampling pole to obtain a representative sample. The use of the sampling pole shall be noted on the Beach Sampling Field Data Form.

4.2.9. Safety training will be given to all employees sampling.

4.2.10. Additional safety concerns should be brought to the attention of a WQIS Supervisor or Manager.

5. Equipment and Supplies

5.1. Sample Bottles

5.1.1. 250 milliliter, 500 milliliter, 1000 milliliter, or 2000 milliliter sterilized bacteriological bottle (at least 4 bottles)

5.1.2. 473 milliliter ISCO turbidity bottles (at least 4 bottles)

5.2. Sample Tags and Chain of Custody Sheet

5.3. Beach Sampling Field Data Forms for each beach and creek

5.4. Field Meters

5.4.1. Hanna HI 98129,

5.4.2. YSI 600XL Sonde, or

5.4.3. YSI-556 MPS Multi-Parameter Water Quality Meter

5.4.4. YSI EXO1 Sonde

5.5. Field Turbidity Meter

5.5.1. HACH 2100P Turbidimeter or

5.5.2. HACH 2100Q Turbidimeter

5.6. Anemometer

5.7. Sampling Pole (12 feet) with Zip Ties

5.8. Cooler with Ice

5.9. Throw Bag with 50 feet of Nylon Rope (refer to *Throw Bag SOP-EA007-00*)

5.10. Personal Flotation Device

5.11. District-issued Cell Phone

5.12. Digital Camera

5.13. GPS, if needed

5.14. Wave Height Stick(marked at inch and foot increments)

5.15. Gloves, if desired

5.16. Hand Sanitizer

5.17. Chest Waders

6. Calibration and Standardization

6.1. All field meters must be calibrated daily or verified that the instrument is in calibration by an independent standard.

6.1.1. See "*Operation of the Hanna HI98129 Meter SOP-EA015-00*" for use and calibration of the meter.

6.1.2. Refer to the manufacturer's operations manual or user's guide for the use and calibration of the YSI EXO1 Sonde.

6.1.3. Refer to the manufacturer's operations manual or user's guide for the use and calibration of the HACH 2100P Turbidimeter.

6.1.4. Refer to the manufacturer's operations manual or user's guide for the use and calibration of the HACH 2100Q Turbidimeter.

6.1.5. See "*Procedures for the Calibration and Use of the YSI 556 Multi-Parameter Water Quality Meter & YSI 650 MDS/600XL Sonde SOP-EA010-00*" for the use and calibration of the YSI 556 Multi-Parameter Water Quality Meter and the YSI 600XL Sonde.

6.1.6. Refer to manufacturer's operations manual or user's guide for additional information on all the above meters.

6.2. A log of the calibration history is to be maintained to assure that the meter is working properly.

7. Procedure

7.1. Directions to the Beaches and Euclid Creek

7.1.1. Edgewater Beach – (From 4747 E. 49th Street)

- Take E. 49th Street to Harvard Avenue.
- Make a right turn at Harvard Avenue.
- Make a left onto I-77 N.
- Take I-77N to I-90E.
- Take I-90E to Route 2W.
- Take Route 2 to the Edgewater Park exit.
- Take the exit and follow straight, following the signs to the beach area.
- Park the truck in the parking lot to the left or underneath the pavilion.

7.1.2. Villa Angela Beach/Euclid Beach/Euclid Creek (From 4747 E. 49th Street)

- Take E. 49th Street to Harvard Avenue.
- Make a right turn at Harvard Avenue.
- Make a left onto I-77 N.
- Take I-77N to I-90E.
- Take I-90E to the Lakeshore Boulevard exit.
- Make a right onto Lakeshore Boulevard.
- Follow Lakeshore Boulevard until you see the "Euclid Beach" entrance sign on the left. Turn into the premises (Villa Angela Drive).
- Euclid Creek will be on your right hand side as you enter.
    - Take the bike path on the right hand side and park in the grass at the first bend.
    - RM 0.55 sampling location is approximately 485 feet north of the Lakeshore Boulevard bridge.
- Take a right onto the bike path right before the foot bridge on Villa Angela Drive.
- Go onto the bike path very slowly; watch out for pedestrians.
- Villa Angela is the first beach on your right. Park on the right hand side in the grass by the entrance that leads you down to the beach.
- Euclid Beach is the second beach on your right. Park in the grass near the picnic tables.

7.2. Sampling Locations

7.2.1. Additional sampling locations may be added as needed.

7.2.2. See attached site diagrams for sampling locations (Appendix 1 and 2).

7.2.3. Edgewater Beach – There are 2 buoys and 3 lifeguard stations at this beach.

7.2.3.1. The sample is taken in line with the brick stack on the other side of the freeway.

7.2.3.2. **GPS Location**: 41.489694/-81.739117

7.2.4. Villa Angela Beach – There are 4 stone break walls at this beach. Count them left to right.

7.2.4.1. The sample is taken mid-distance between the 3rd and 4th break walls.

7.2.4.2. **GPS Location:** 41.586242/-81.566656

7.2.5. Euclid Beach – There are 2 stone break walls at this beach.

7.2.5.1. The sample is taken in front of the pile of stones on the east side of the beach.

7.2.5.2. **GPS Location:** 41.584244/-81.568739

7.2.6. Euclid Creek

7.2.6.1. **Euclid Creek RM 0.55 –** Downstream of Lakeshore Boulevard

7.2.6.2. **RM 0.55 GPS Location:** 41.583525/-81.5595

7.3. General Field Analysis/Observations Required at All Sampling Locations

7.3.1. Digital pictures are to be taken prior to sampling to avoid causing any disturbances of the bird activity.

7.3.1.1. Pictures of the east, west and overall views of the beach are to be taken (Appendix 3). Additional pictures of beach conditions that could impact the outcome of the testing should be taken as well as noted on the Beach Sampling Field Data Form.

7.3.2. The sample tag must be completed at the sampling site with the following information:

- Signature
- Employee ID
- Start Time (time sample was collected)

7.3.3. Field observation notes, field parameters and other miscellaneous information must be entered onto the Beach Sampling Field Data Form (Appendix 3) at the sampling site. The form must be filled out completely.

7.3.4. The sample collected in the 250mL, 500mL, 1000mL or 2000mL bottle will be used for microbiological tests at the laboratory. Turbidity will be collected in a 473-mL ISCO bottle.

7.3.5. Once the field collection has been performed, place the sample into the portable cooler filled with ice.

7.3.6. The samples must remain in the cooler until delivered to the Sample Custodian in the Analytical Services Department at the Environmental Maintenance and Service Center (EMSC).

7.3.7. Upon returning to EMSC, the field data and scanned in field forms are entered into eAquaPro and pictures are saved to the W:/ drive.

7.4. Bacteriological and Turbidity Field Sample Collection Protocol

7.4.1. Sampling method shall follow Ohio EPA's *Surface Water Field Sampling Manual for water quality parameters and flow (*2019).

7.4.2. Locate the sampling location by the markers on the beach as indicated in section 7.2.

7.4.3. If necessary, take a GPS reading to verify the location.

7.4.4. Wade out to a water depth of approximately 3 feet. Use the wave stick to verify the depth. The distance from the shoreline will vary daily based on the depth of Lake Erie and wave height.

7.4.5. The sampler must remove the cap from the sterilized bacteriological bottle invert the sample bottle and plunge the sample bottle 6-12 inches below the surface of the water.
7.4.6. The bottle should be rotated with the opening facing the surface to allow sample to fill the bottle. Make sure to leave headspace in order to provide sufficient space for shaking the sample for analysis.
7.4.7. The sample container should be capped and secured.
7.4.8. Repeat steps 7.4.4. through 7.4.6. to obtain the turbidity samples.
7.4.9. All samples are to be placed into the portable cooler containing ice.
7.4.10. Repeat Section 7.4 to collect samples at other sites.

7.5. Field Observations/Parameters
7.5.1. Take the maximum and minimum wave height before returning to the shoreline by using the wave stick. This is done by observing the minimum and maximum height of waves for one minute. Record the minimum and maximum wave heights, in inches, on the Beach Sampling Field Data Form (Appendix 3). Perform the following calculation to get the wave height:

[Maximum height (in)] (-) [-minimum height (in)] = wave height (in)

7.5.2. If you are unable to enter the water because of unsafe conditions, estimate the wave height and indicate so on the Beach Sampling Field Data Form.
7.5.3. Field parameters must be collected in the water at each sample site. Measure pH, conductivity and temperature in the water with the appropriate field meter. A turbidity sample will be collected in a 473-mL plastic bottle and analyzed at EMSC with a turbidimeter.

7.6. Sample Collection During Inclement Weather
7.6.1. Locate the sampling location by the markers on the beach.
7.6.2. If necessary, take a GPS reading to verify the location.
7.6.3. A sampling pole must be used to obtain samples when the water is rough and you are unable to wade out to 3 feet. If the wave height is over 3.5 feet, then samples will not be collected.
7.6.4. Bacteriological Sample Collection
7.6.4.1. Secure the sampling bottle to the pole with at least three zip ties then remove the cap of a sterilized bacteriological bottle.
7.6.4.2. Wade out into the water to a safe depth, at least 1.5 feet deep. The distance from the shoreline will vary based on the depth of Lake Erie and wave height.

7.6.4.3. The sample pole should be extended to maximum length and the sample bottle is inverted and plunged below the surface of the water.

7.6.4.4. Cap and secure the sample.

7.6.5. Repeat steps 7.6.4.1. through 7.6.4.4. using the 473-mL bottle to obtain the turbidity sample.

7.6.6. If unable to obtain field parameters in the water due to high waves or dangerous conditions, field parameters may be obtained from the turbidity sample on the shoreline.

7.6.7. Return to the shoreline, tag the samples and place the samples into the ice-filled portable cooler.

7.6.8. Be sure to fill in the Beach Sampling Field Data Form (Appendix 3) completely and indicate that the sampling pole was used.

7.7. Turbidity Analysis

7.7.1. Turbidity analysis is to be performed at EMSC for all sites.

7.7.1.1. Each beach site is run for turbidity twice and the values are averaged for a final turbidity result.

8. Data Handling and Review

8.1. The Project Leader will review all Beach Sampling Field Data Forms for accuracy and neatness.

8.2. The Project Leader will periodically audit the sampling process.

8.3. Report any unusual circumstances to the Project Leader or WQIS Supervisor.

8.4. For all beach sites, the sampler must enter the field measurements and observations into eAquaPro immediately upon returning to EMSC.

8.5. Scan and save all Beach Sampling Field Data Forms and pictures into the W\: drive upon returning to EMSC.

9. Additional Information

9.1. Using the Anemometer to Measure Wind Speed

9.1.1. Refer to the manufacturer's operations manual or user's guide for the use of the Kestrel 2000 Pocket Weather Meter.

10. References

10.1. Microbiological Methods for Monitoring the Environment Water and Wastes, EPA-600/8-78-017 (1978). Cincinnati, OH.

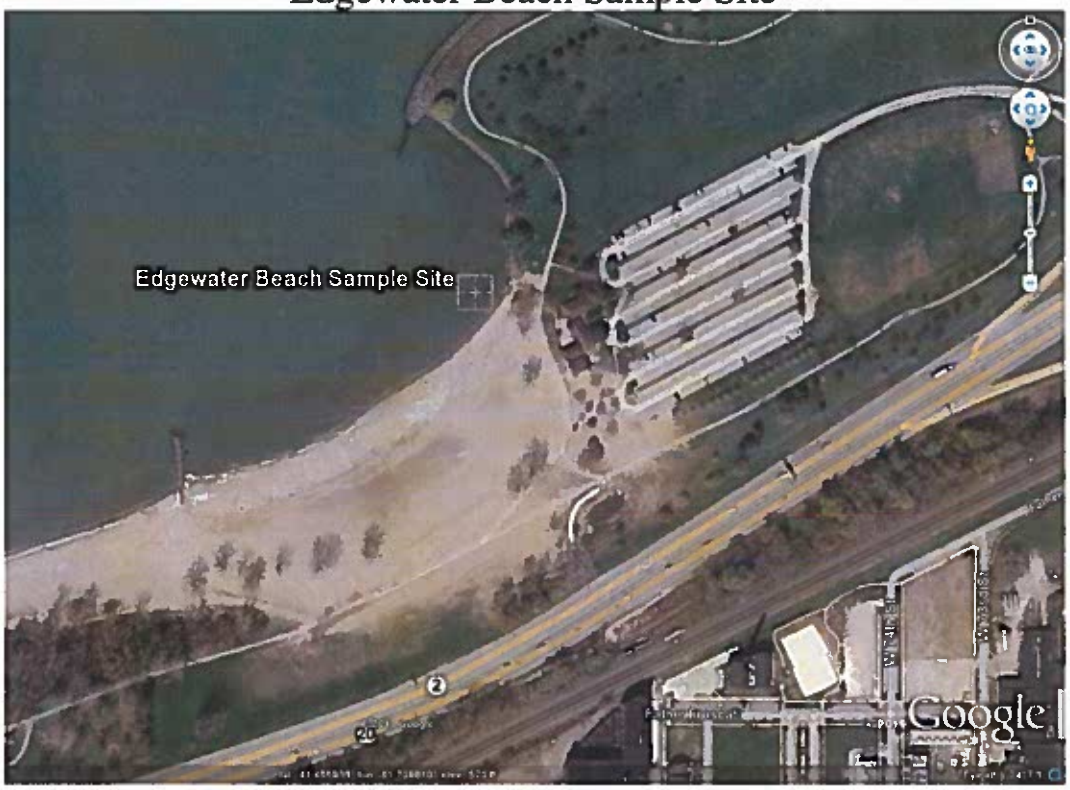
10.2. Ohio Environmental Protection Agency. (2019). *Surface Water Field Sampling Manual for water quality parameters and flow.* Columbus, OH: Division of Surface Water.

10.3. USEPA National Beach Guidance and Required Performance Criteria for Grants (EPA-823-B-02-004). (2002). Chapter 4-Beach Monitoring and Assessment.

10.4. Website: http://www.epa.gov/waterscience/beaches/grants/index.html.

APPENDIX 1

Edgewater Beach Sample Site



SAMPLE SITE
Brick stack on other side of freeway

APPENDIX 2

Villa Angela Sample Site

SAMPLE SITE
Mid-distance between 3rd and 4th break walls

Euclid Beach Sample Site

SAMPLE SITE
Pile of stones

Euclid Creek Sample Site

EUCLID CREEK RM 0.55
Downstream of Lakeshore Boulevard

APPENDIX 3

Example Beach Observation Sheet

NEORSD Beach Sampling Field Data Form

Location: _____ Date: _____ Time: _____ (hrs)

Samplers: _____

Meter(s) Used: _____

Sample ID: _____

General Observations

Weather: _____ 1-Clear 2-Partly Cloudy 3-Overcast 4-Light Rain 5-Heavy Rain 6-Steady Rain 7-Heavy Snow Melt 8-Other

Water Surface Conditions: _____ 1-None 2-Foam 3-Oily 4-Scum 5-Other

Lake Surface Conditions: _____ 1-Calm 2-Ripple 3-Moderate Waves 4-White Caps

Color: _____ 1-Clear 2-Muddy 3-Tea 4-Milky 5-Other

Odor: _____ 1-Normal 2-Petroleum 3-Septic 4-Sewage 5-Chemical 6-Other

Algae: _____ Debris: _____ 1-None 2-Some 3-Floating 4-Thick Layer 5-Multiple Layers

Fecal Matter: _____ 1-None 2-Sparse 3-Some 4-Multiple Areas 5-All Along Shoreline

Number of Swimmers: _____

Number of Birds: Gulls _____ Geese _____ Ducks _____ Other (ie, pigeons) _____ Total _____

Was the sample taken during or following a wet weather event? _____ (Yes/No)

Physical Parameters

Water Temp: _____ (°C)

pH :_____ (SU)

Turbidity: (1) _____ (2) _____ Avg _____ (NTU)

[Duplicate Turbidity: (1) _____ (2) _____ Avg _____ (NTU)]

Conductivity: _____ (µmhos/cm)

Location: _____ Date: _____ Time: _____ (hrs)

Measurements

Wave Height: _____ (in)

Wave Run Up: _____ (1-5)

1 – ≤1ft	3 – 4ft to 6ft	5 – ≥10ft
2 – 1ft to 3ft	4 – 7ft to 9 ft	

Wind Direction: _____ (degrees)

Wind Speed: Max _____ Avg _____ (mph)

Air temp: _____ (°C)

Fecal Contamination on Beach: _____ (%)

Debris on the Beach: _____ (%)

1 – ≤1%	4 – 30-49%
2 – 2- 14%	5 – 50-75%
3 – 15-29%	6 – >75%

Comments

_____

_____

_____

_____

To be completed by Lab Personnel

Storm Water Effects on the Beach _____

0 – No Rain Event	1 – Wet Sand, No Run Off
2 – Wet Sand, Mild Scouring	3 – Wet Sand, Moderate Scouring
4 – Wet Sand, Major Scouring, No Standing Water	
5 – Wet Sand, Major Scouring, Standing and flowing Water	

[Place Label Here]

2/6/14 JM

Northeast Ohio
Regional Sewer District

Analytical Services, 4747 East 49th St., Cuyahoga Heights, OH 44125

Enumeration of Total Coliforms & E. coli by SM 9223 B: Colilert® and Colilert-18® Quanti-Tray®

SOP–2109-13

Effective Date: ***09/30/2022***

Approvals

Prepared by Supervisor: Kristen Greenwood Kristen Greenwood Date: 9/29/2022

Reviewed by QA/QC Specialist: Denice Johnson Denice Johnson Date: 9/29/2022

Revised by QA Manager: Sheela Agrawal Sheela G. Agrawal Date: 9/29/2022

Approved By AS Manager: Cheryl Soltis-Muth Cheryl Soltis-Muth Date: 9/30/2022

Table of Contents

1.0 Scope and Application

1.1. This SOP describes the procedure for the Colilert® and Colilert®-18 Quanti-Tray® tests for the enumeration of total coliforms and *E. coli* bacteria in potable (drinking) waters, wastewaters, ambient waters, and solids. *Refer to the Appendix for solids analyses procedures.*

1.2. This SOP also describes the procedure for conducting research analyses on solids, such as sands.

1.3. This procedure is based on SM 9223 B Enzyme Substrate Test, Multi-Well Procedures.

1.4. This procedure enumerates total coliform and *E. coli* using Most Probable Number (MPN) statistical theory.

2.0 Summary of Method

2.1. β-D-galactosidase produced by total coliforms and β-glucuronidase enzymes produced *E. coli*, hydrolyze proprietary test enzyme substrates to create chromogenic and/or fluorogenic responses. These responses or lack thereof are therefore indicative of the presence/absence of these organisms which can in turn be enumerated.

2.2. Since most non-coliforms do not have these enzymes, they are unable to grow and interfere. The few non-coliforms that do have these enzymes are selectively suppressed by the Colilert Test's specifically formulated

2.3. This test comes in two different formulations, Colilert® and Colilert®-18 which are incubated at 35°C for 24 (+ 4 hours) and 18 (+ 4 hours), respectively

2.3.1. The enzyme substrate used for total coliform detection via Colilert® is ortho-nitrophenyl-D-galactopyranoside (ONPG)

2.3.2. The enzyme substrate used for *E. coli* detection in both Colilert® and Colilert®-18 is 4-methyl-umbelliferyl-B-D-glucuronide (MUG)

2.4. 100 mL or smaller volume of larger sample (usually ~ 250 mL) is aseptically transferred into a 120-mL clear, sterile, plastic bottle. Smaller sample volumes, as may be used for dilutions, are brought up to the 100 mL volume line using sterile DI water.

2.5. Pre-packaged Colilert® or Colilert®-18 reagent is added to the 100 mL aliquot. The sample is capped and shaken to dissolve the media and poured into a Quanti-Tray® 2000 (wastewater and ambient waters) or Quanti-Tray® 200 (potable water)

2.6. The Quanti-Trays® are sealed and incubated at 35°C for 24 + 4 hours (Colilert®) or 18 + 4 hours (Colilert®-18)

2.7. Yellow-colored wells in the Quanti-Tray® are positive for total coliform. These wells are summed and evaluated against and MPN chart to calculate total coliforms density in MPN/100 mL. See §12.0.

2.8. Total coliform positive Quanti-Trays® are then placed under a 365 nm UV light for detection and enumeration of *E. coli* via fluorescence, following a similar counting procedure as total coliform. See §12.0.

3.0 Definitions

3.1. **Analysis Batch** – A group of 20 samples comprised of 19 unique samples and a duplicate (DUP), plus a blank (LCB) and positive control (LCS) processed in the same day, by the same analyst, using the same lot of reagents. *Note: Colilert® and Colilert®-18 reagents require separate batches.*

3.2. **ATCC** – American Type Culture Collection

3.3. **Batch Quality Control Samples/Standards (Batch QC/QC Samples)** – used to evaluate method accuracy and precision, method contamination, matrix interference, sample homogeneity and/or continued acceptable calibration. For this method Batch QC is as follows:

3.3.1. **Duplicate (DUP)** – A second aliquot of a sample poured off and processed through the same steps as the sample to help assess analyst precision.

3.3.2. **Laboratory Control Blank (LCB)** – The LCB is an aliquot of sterile DI water that undergoes the same analysis as samples. It is prepared at a minimum frequency of once per batch. It is used to demonstrate analyses are free from contamination, as well as test reagent efficacy.

3.3.3. **Laboratory Control Standard (LCS)** - The LCS control is an aliquot of sterile DI water inoculated with a colony of *E. coli* pure culture

(§7.1.4). It is prepared like a sample and at a minimum frequency of once per batch. It is used to demonstrate test reagent efficacy. See §11.0 for preparation details.

3.4 **Data Packet** – Documentation submitted to Supervisor for data review and approval for reported samples. All forms and sheets must be filled out correctly and completely. ALL data produced, even if data is not valid, must be attached in chronological order with all appropriate notations.

3.5 **Deionized Water (DI water)** – ASTM Type II/Medium Grade reagent water provided by an ion exchange system used in series with activated carbon, ultrafiltration, microfiltration, reverse osmosis, and/or UV disinfection/oxidation. This is the water that flows from permanently affixed labeled ("DI" by large sinks and "DW" by bench cup sinks) taps and has a resistivity of >1 ΩM-cm, most typically > 14 ΩM-cm.

3.5.1 **Sterile DI Water** – DI water that has been autoclaved

3.6 ***E. coli*** – Heterotrophic fecal coliforms commonly found in the intestines of animals and humans and used as an indicator of fecal contamination in aqueous and other matrices.

3.6.1 ATCC pure cultures of *E. coli* are used as positive controls to validate Colilert® and Colilert®-18 media. Total coliform positive, *E. coli* positive.

3.7 ***Klebsiella variicola*** – heterotrophic bacteria used to validate Colilert® and Colilert®-18 media. Will produce total coliform positive and *E. coli* negative test results.

3.8 **LIMS** – Laboratory Information Management System

3.9 **May** – This action, activity, or procedural step is neither required nor prohibited.

3.10 **May not** – This action, activity, or procedural step is prohibited.

3.11 **MMO-MUG** – Minimal Media ONPG-MUG (see § 2.2).

3.12 **Must** – This action, activity, or procedural step is required.

3.13 **Negative Control Cultures** – Cultures which demonstrate the medium does not support growth of non-target organisms or does not exhibit the

typical positive reaction of the target organisms. Used to validate media, bottles, and reagents on a lot # basis.

3.14 **ONPG** – O-nitrophenyl-beta-D-galactopyranoside

3.15 **Positive Control Cultures** – Cultures with demonstrate that the medium supports growth of the target organism(s), and that the medium produces the specified or expected reaction to the target organism(s). Positive control cultures are also used in the LCS.

3.16 ***Pseudomonas aeruginosa*** – Heterotrophic bacteria used to validate Colilert® and Colilert®-18 media. Will produce total coliform negative and *E. coli* negative test results

3.17 **Shall** – This action, activity or procedural step is required.

3.18 **Should** – This action, activity or procedural step is suggested but not required.

3.19 **Sample Submission Request (SSR)** – Form submitted by client with *drinking samples* for Ohio EPA public water system compliance reporting or private water systems for local health department compliance reporting. The most current SSR for OEPA is found on the OEPA website and must. The private water system SSRs are provided by the laboratory. SSRs must be submitted with samples for OEPA or private water system compliance reporting.

3.20 **Total coliform** – Aerobic and facultative anaerobic, gram negative, non-spore forming rod shaped bacteria that ferment lactose in 24-48 hours at 35°C.

4.0 Interferences

4.1 The color and/or turbidity of the sample can interfere with the results. Take a duplicate sample or reserve a portion of the sample to use as a color and/or turbidity control blank.

4.2 Sunlight can hydrolyze the reagent enzyme substrates resulting in a false positive test. Store reagents away from sunlight.

4.3 Samples containing chlorine will interfere with sample results and display a transient blue color ('blue flash') when the reagent is added. Test all

samples for total chlorine residual. *Any samples with chlorine present will produce invalid results and must not be analyzed.*

4.4 High concentrations of calcium salt may form a precipitate but should NOT interfere with results.

4.5 Samples with high iron/manganese in combination with hydrogen sulfide may turn greenish black with a black precipitate after 24 hours incubation.

4.6 Heterotrophic bacteria (e.g., *Pseudomonas, Aeromonas, Klebsiella, Flavobacterium, Acinetobacter, Alcaligenes*) present in concentrations > 2, 000,000/100 mL can yield a false positive for coliforms.

4.7 Inadequate sample mixing can produce erroneous results. Bacteria are known to clump together and are therefore not homogeneously distributed throughout the sample.

5.0 Safety

5.1 The analyst must be familiar with the appropriate protective attire such as safety glasses and gloves when working with chemicals or near equipment. Users of this procedure must be cognizant of inherent laboratory hazards. All chemicals and samples shall be treated as a potential health hazard and a reference of safety data sheets (SDS) shall be available to all personnel involved in the chemical analysis. All laboratory personnel performing this analysis must be familiar with the SDS for all materials used in this procedure.

5.2 Proper protective equipment must be worn at all times.

5.2.1 Apron or Lab Coat

5.2.2 Protective Gloves (PVC or Nitrile)

5.2.3 Long Pants

5.2.4 Approved Safety Glasses

5.2.5 Closed Toed Shoes.

5.3 Follow the approved Chemical Hygiene Plan (CHP; SOP 3022). This includes awareness of the proper disposal procedures of contaminated materials and appropriate segregation of hazardous wastes.

5.4 All personnel handling environmental samples known to contain or to have been in contact with human waste should be immunized against known disease causative agents.

6.0 Equipment and Supplies

6.1 Sterile 250 mL plastic bottles with caps and sodium thiosulfate ($Na_2S_2O_3$), commercially purchased, Stock # 994753. *Note: These are used for sample collection. The amount of $Na_2S_2O_3$ in each bottle must be capable of dechlorinating up to 15 mg/L total chlorine residual.*

6.2 Sterile, dilution bottles containing 99 mL sterile DI water, Stock #994974

6.3 Sterile 1000 mL bottles, Stock # 665634 and/or 2000 mL bottles with caps, purchased as needed. *These are used to prepare and store sterile DI water.*

6.4 Sterile 120 mL plastic bottles with cap and. Ordered as necessary. *Note: These are used for sample analysis and QC sample preparation.*

6.5 365-366 nm UV light and dark box with protective eye screen, 6-watt bulb. Purchased as needed.

6.6 Incubators capable of maintaining 35 ± 0.5°C, with one dedicated to potable water only

6.7 Water bath capable of maintaining 35 ± 0.5°C with bottle rack or weights

6.8 Refrigerators dedicated to potable water only sample storage.

6.9 Thermometers, one for each shelf of the incubator, and one for drying oven

6.10 Autoclave capable of maintaining 121°C.

6.11 ≥ 170°C hot air sterilizing oven for sterilizing glass

6.12 Data logger to measure temperature and pressure for the autoclave

6.13 pH meter accurate to 0.1 SU with flat bottom electrode

6.14 Analytical balance with a readability to 0.001g

6.15 Top loading balance with readability to 0.1g

6.16 Sterile inoculation loops, Stock # 994605

6.17 Sterile Erlenmeyer flask

6.18 Sterile spoonula

6.19 Sterile sand (solids only)

6.20 Aluminum foil, Stock # 994830

6.21 Class A or similarly validated, sterile graduated cylinders, 100 mL,

6.22 Weigh boats, Stock #202940

6.23 Laboratory deionized (DI) water system capable of producing Type II/Medium Grade/reagent grade water

6.24 0.22 μm in-line filter, Whatman Polycap TC (Catalog # 67179501) or equivalent, (for DI tap), Stock #994696

6.25 Validated, sterile 25 mL, 10 mL, 1.0 mL serological pipettes, Stock # 276728, 276743 and 994742.

6.26 IDEXX Quanti-Tray® heat sealer

6.27 IDEXX rubber sealing tray templates 2000 and 200

6.28 Sample Shaker, Thermolyne Big Bill Model M49125 or similar

6.29 Quanti-Tray®/2000, NEO Stock # 994322

6.30 Quanti-Tray®/200, NEO Stock # 994798

6.31 Quanti-Tray® 2000 comparator for Colilert® and Colilert-18®, NEO Stock # 994697

6.32 Quanti-Tray® 200 comparator for Colilert® and Colilert-18®, NEO Stock# 994798

7.0 Reagents and Standards

All reagents and standards must be analytical/trace grade or as specified in the reference method. Standards must be NIST traceable, or equivalent Manufacturer expiration dates are typically used for purchased standard, reagents and other chemicals. Expiration of prepared reagents, standards and other chemicals may coincide with manufacturer expirations or are otherwise specified. Expired standards and reagents may not be used. Reagents and standards prepared by EHS&L must be labelled with an ITRC number.

7.1 Purchased

7.1.1 Colilert® WP200 nutrient indicator reagent packs, validated, Stock # 994321

7.1.2 Colilert®-18 WP020I-18 nutrient indicator reagent packs, validated, Stock # 994789

7.1.3 Colilert® QT 2000 and 200s Comparators, Stock # 994797 and 994829 (Note: Same comparators are used for Colilert-18 QT)

7.1.4 *E. coli* pure culture, ATCC 11775 or 25922

7.1.5 Isopropyl alcohol or 2-propanol, Stock # 994017

7.1.5.1 70% 2-propanol – add 700 mL of 2-propanol to 300 mL of DI water. *Expires after 1 year.*

7.1.6 Total chlorine residual test strips (low-level), validated, Stock #994827

7.1.7 Sodium thiosulfate ($Na_2S_2O_3$), powder – ACS grade, Stock # 994215

7.1.8 Refer to *SOP 3015 Media Preparation and Validation for Microbiology* for additional control cultures used to validate all media and reagents, and for information on spore testing, and media checks.

7.2 Prepared - *Prepared in EHS&L unless noted otherwise.*

7.2.1 Sterile, 0.22 μm filtered DI water – See *SOP 3015* for preparation. *Expires after 1 month.*

7.2.2 $Na_2S_2O_3$, 10% solution - Add 0.1 mL to a 120 mL sterile bottle. When filled with sample (or dilution water) to the 100 ml mark, this result is 10 mg per 100 mL or 10% concentration. *Expires after 6 months. Note: Only prepared if $Na_2S_2O_3$ treated bottles are unavailable.*

7.2.3 Refer to *SOP 3015* for preparation of any support media and positive and negative control cultures used for media and reagent validation.

7.2.4 *Batch QC*

7.2.4.1 LCB - Aliquot 100 mL of sterile DI water into a 120 ml sterile bottle. Prepare simultaneously with and under the same conditions as the samples as described in §11.0. Expires with batch.

7.2.4.2 LCS – Aliquot 100 mL of sterile DI water into a 120 ml sterile bottle and inoculate with ATCC 11775. Prepare simultaneously with and under the same conditions as the samples as described in §11.0. Expires with batch.

8.0 Sample Collection, Preservation, & Storage

8.1 Sample Collection & Preservation

8.1.1 Samples must be collected into sterile sample containers. Samples from chlorinated sources (e.g., wastewaters and drinking waters) must be collected in sterile containers containing enough $Na_2S_2O_3$ to neutralize up to 15 mg/L of total chlorine residual. Ambient water sample containers do not require $Na_2S_2O_3$.

8.1.1.1 Take precautions to avoid contaminating sample (e.g., wear clean disposable gloves when collecting sample and avoid touching bottle mouth with either hands or the sample tap if applicable)

8.1.2 Chain-of-custody procedures must be followed (e.g., fill out COC with sample info, date, time, etc.)

8.1.3 Wastewater and Ambient Waters

8.1.3.1 Gather appropriately preserved sample container(s).

8.1.3.2 For wastewaters, collected from a tap or sampler tube, follow the same procedure as described for potable water in §8.1.4.

8.1.3.3 For wastewater not collected from a tap or for ambient waters, refer to WQIS sampling SOPs and *Standard Methods 9060A Sample Collection* for collection procedures.

8.1.4 Potable (Drinking) Water

8.1.4.1 Select an appropriate tap such as a faucet, petcock, or small valve. Avoid taps with a leaky stem or a swivel joint.

8.1.4.2 If present, remove the tap aerator prior to sample collection.

8.1.4.3 If present, place all carbon filters, sediment filters and water softeners on bypass.

8.1.4.4 Flush the cold tap for one minute and then shut off.

8.1.4.5 Disinfect faucet tip for 2 minutes with a sanitizing solution (e.g., household bleach or isopropyl alcohol) using a spray bottle or a plastic bag to get the sanitizing solution into the faucet.

8.1.4.6 Open the tap fully and flush for 3 – 5 minutes then reduce the flow to allow the sampling bottles to fill without splashing.

8.1.4.7 Verify that the water is within the expected concentration range for chlorine using a digital or colorimetric/DPD colorimeter.

8.1.4.8 If applicable, document the chlorine residual on the Sample Submission Report form (SSR for reporting to Ohio EPA or local health department)

8.1.4.9 Gather appropriately preserved sample container(s).

8.1.4.10 Keep container(s) capped until just before collecting sample. Remove cap as a unit and do not set on any surface.

8.1.4.11 Remove cap as unit and do not set on any surface

8.1.4.12 Fill container from sanitized, flowing tap making sure not to rinse or overflow it and replace cap immediately. Avoid touching bottle mouth with either hands or the faucet. Immediately recap the bottle.

8.1.4.13 If applicable, complete SSR.

8.1.4.14 Immediately store samples on ice if they cannot be processed within 1 hour of collection. Samples are to be kept at < 10°C, but not frozen, during transport and until analyzed.

8.2 Hold Time

8.2.1 Potable water samples must be analyzed within 30 hours of collection. All other samples mut be analyzed within 8 hours of collection.

9.0 Quality Assurance & Control

9.1 **Aseptic technique as described in *SOP 3028 Aseptic Technique* is used throughout this procedure, in the preparation of all media and equipment, and in the processing of samples**.

9.2 Demonstration of Capability

9.2.1 *Initial Demonstration of Capability (IDOC)* – Each new analyst performing the method must perform a passing IDOC before analyzing samples for compliance. Four unknown samples are set-up and analyzed. *Refer to SOP 5045 Micro DOC for IDOC procedure and passing criteria as well as the SOP 5000 Quality Manual for additional IDOC information.*

9.2.2 *Ongoing Demonstration of Capability (ODOC)* – Each existing analyst performing this method must perform a passing DOC every 12 months. Four unknown samples are set-up and analyzed. *Refer to SOP 5045 Micro DOC for ODOC procedure and passing criteria and SOP 5000 Quality Manual for additional ODOC information.*

9.3 Batch QC

9.3.1 Potable (drinking water), non-potable (wastewater, surface waters), and solids must be batched and incubated separately to avoid cross-contamination.

9.3.2 Required Batch QC for this method is listed below. Please refer to §3.0 for definitions and frequency requirements, §7.0 for formulations, §11.0 for preparation and use, and §14.0 for acceptance criteria, and contingencies.

9.3.2.1. LCB

9.3.2.2. LCS

9.3.2.3 DUP

9.4 Documentation

9.4.1 All appropriate forms, logbooks, data validation sheets, raw data and LIMS information must be completely and neatly filled out to ensure traceability. This includes but is not limited to standard and reagent ITRC numbers, dates and times of prep and analysis, troubleshooting and maintenance information, analysis issues and results, sample issues, etc.

9.4.2 Blue indelible ink must be used for written information, and errors corrected with single line strike through with analyst initials and date, and comment if the reason for the correction is not apparent.

9.4.3 *Logbooks*

9.4.3.1 Pipette Calibration Verification Logbook, Form 5010

9.4.3.2 Balance Calibration Verification Electronic (LIMS)

9.4.3.3 pH Meter Calibration Logbook, Form 3304

9.4.3.4 Culture Logbook, Form 3090

9.4.3.5 Colilert® Reagent Validation, Form 3236

9.4.3.6 Bottle Validation, Sterility and Fluorescence, Form 3235

9.4.3.7 Tray Validation, Sterility and Fluorescence, Form 3251

9.4.3.8 Treated Bottle Validation Logbook, Form 3258

9.4.3.9 Annual Frozen Culture Logbook, Form 3246

9.4.3.10 Autoclave Form 1055

9.4.3.11 Solution Filtration Logbook, Form 3250

9.4.3.12 Glassware pH Logbook, Form 2162

9.4.3.13 Desiccator Logbook, Form 3117

9.4.4 *Forms*

9.4.4.1 LIMS Batch Worklist (Internal COC), Form 5114

9.4.4.2 LIMS Batch Report (printed from LIMS, no form number)

9.4.4.3 Data Validation Sheet, Form 2131

9.4.4.4 Analysis Sheets

9.4.4.5 QA/QC Checklist for Microbiology, Form 3242

9.4.4.6 OEPA SSR, https://epa.ohio.gov/static/Portals/28/documents/reporting/MICROBIOLOGICAL.pdf

9.4.4.7 Lab SSR, Form 5076

9.4.4.8 Bench Form 2086

9.4.4.9 Senso Temperature Report (printed directly from Senso online application)

9.4.4.10 IDOC/ODOC, Form 5016

9.4.4.11 99 mL Dilution Water Bottle Validation, Form 3256

9.4.5 Secondary Sample Vessels

9.4.5.1 Traceability must be maintained between the original sample and the vessel into which it is transferred for analysis. This is accomplished by labeling the secondary vessel with the original sample ID via using a SHARPIE®

9.4.6 *Data Packet*

9.4.6.1 LIMS Batch Worklist (Internal COC) (Batch Worklist), Form 5114

9.4.6.2 LIMS Batch Report (Batch Report 9223DWQT or 9223AQQT)

9.4.6.3 Analysis Sheet, Form 2086 for aqueous samples, Form 3267 for solid samples, Form 3231 for drinking water samples.

9.4.6.4 Data Validation Sheet, Form 2131

9.4.6.5 OEPA SSR or Laboratory SSR (Form 5076)

9.4.6.6 Senso Report (printed from application if there is an incubation temperature issue)

9.5 Data Review

9.5.1 Data undergoes at least two rounds of data verification (analyst, supervisor) prior to reporting. Refer to Quality Manual (SOP 5001) §20.0 for data reduction and review practices.

9.6 Performance Evaluation Study (PE)/Proficiency Test (PT)

9.6.1 The laboratory participates in at least four PE/PT studies (2 for potable water, 2 for non-potable water) per year in which blind samples containing the analytes of interest are analyzed to demonstrate continued proficiency.

9.6.2 Performance is tracked and documented by QA. PE/PT failures always lead to corrective action. Refer to QA Manual for more information.

9.7 Other

9.7.1 Sterility checks are performed on each new lot/batch/cycle of Colilert® and Colilert®-18 reagents, broth and agar media, Quanti-Trays®, prepared DI water and dilution containers, glassware petri dishes, and other equipment. Refer to *SOP 3015 Media Preparation and Validation for Microbiology* and *SOP 3018 Equipment Preparation, Sterilization, and Validation for Microbiology* for frequency, procedure, and documentation protocols.

9.7.2 Validation of Colilert® and Colilert®-18 reagents using appropriate positive and negative control pure cultures (*E. coli, Klebsiella variicola,* and *Pseudomonas aeruginosa*; See §3.0 for definitions of each) is performed on each new manufacturer's lot. See *SOP 3015* and *SOP 3016 Bacterial Culturing*.

9.7.3 Validation of broth and agar media with and without inoculation and relative to current lot in use is performed as described in *SOP 3015* for each newly prepared batch of media.

9.7.4 Twice a year, evaluation of the laboratory environmental conditions is performed in the same area these analyses are conducted by collection of an Environmental Monitoring Sample. See §19.0 for preparation details.

9.7.5 The 0.22 μm filter is autoclaved as needed and changed every 6 months.

9.7.6 pH of cleaned glassware is checked on a batch basis. See *SOP 3018* for procedure.

9.7.7 Autofluorescence is checked for sample containers and Quanti-Trays® on a per lot basis.

9.7.8 120 ml and 250 ml sample containers are purchased sterile and are validated per lot. Refer to *SOP 3018* for procedure.

9.7.9 Chlorine depletion ability of 15 mg/L is validated for sample bottles containing $Na_2S_2O_3$ by lot. See *SOP 3018* for procedure.

9.7.10 Volume of sample containers is validated once per new lot. See *SOP 3018* for procedure.

9.7.11 Lab detergent inhibitory residue certificates of analysis are printed from the vendor website and are available by Lot#.

9.7.12 Quanti-Tray® sealers are evaluated monthly to ensure proper sealing of wells and trays. Refer to *SOP 3018* for procedure.

9.7.13 See §10.1 for Support Equipment QA measures.

10.0 Calibration and Standardization

10.1 Support Equipment

10.1.1 All auto-pipettes used for this method are validated daily prior to use. See *SOP 5007 Auto-pipetted Calibration Verification.*

10.1.2 Disposable serological pipettes are validated by lot prior to release for general lab use. See SOP 5041 Disposable Pipette Calibration.

10.1.3 All analytical balances used for this method are validated daily prior to use. See *SOP 5006 Analytical Balance Use and Calibration Verification.*

10.1.4 Thermometers are verified annually against NIST traceable thermometers either in-house or by a 3rd party provider. See SOP *5009 Thermometer Calibration Verification* for procedure.

10.1.5 Temperature of stored samples, standards and reagents is monitored continuously using the Senso web application. See *SOP 5008 Temperature Monitoring for Lab Equipment and Plant Refrigerators.*

10.1.6 New incubators and water baths undergo a temperature uniformity study prior to use. See *SOP 3018* for procedure.

10.1.7 Autoclave timing is verified quarterly using a timer. See *SOP 7003 Autoclave Operations.*

10.1.8 Autoclave sterilization temperature and pressure is validated continuously when in us by a data logger that is calibrated annually or a printout of the cycle. See *SOP 7003*.

10.1.9 Autoclaves and sterilization ovens are validated monthly for sterility by spore testing. See *SOP 3018* for procedure. In addition, autoclave tape is placed on all equipment that is autoclaved to indicate successful sterilization.

10.1.10 Autoclaves preventative maintenance and calibration of internal temperature and pressure sensors is performed quarterly by a 3rd party. See *SOP 7003*.

10.1.11 Desiccators use for media powder storage are monitored once per week.

10.2 Instrumentation

10.2.1 A color/fluorescence comparator is used to compare the color and fluorescence (if applicable) of all analyzed samples to that of the LCS.

10.2.2 An MPN table accompanying each IDEXX Colilert QT 2000/200 kit is used to quantify total coliforms and *E. coli*. See §19.0 for example tables.

11.0 Procedure

NOTE: Only analysts with current, valid DOCs can perform this procedure for compliance reporting purposes.

Document all required information and analysis and/or sample issues on/in applicable forms, logbooks, etc.

11.1 Batch and request samples in LIMS according to general LIMS procedures and retrieve samples from Sample Control following all internal COC procedures. **Make sure to batch potable drinking water, non-potable wastewaters, and solids all separately!**

11.1.1 In the LIMS, navigate to the backlog for the Microbiology department for the Chlorine Check prep batch process.

11.1.2 Select the samples to be analyzed by creating the Chlorine Check prep batch This is done by clicking on the sample(s) and click on the "Create Batch" button. Save the batch that was created.

11.1.3 Print the Batch Worklist report. This report is the sample request list and proof of chain of custody for the samples.

11.1.4 Receive the samples from Sample Control.

11.2 *Use aseptic technique at all times.* See *SOP 3028*.

11.3 Sterilize the work area with isopropyl alcohol (§7.1.7) prior to beginning any analysis.

11.4 Label all test bottles, one for each sample, one for the DUP, one for the blank, and one for the positive control.

11.5 Label all Quanti-Trays®, one for each test bottle, with sample ID and analysis volume.

11.6 Aqueous Samples

11.6.1 *LCB Setup*

11.6.1.1 Set-up blank first to avoid contamination.

11.6.1.2 Pour 100 mL of sterile DI water into a validated test vessel.

11.6.1.3 Add the contents of the Colilert® or Colilert®-18 reagent to the test vessels, cap, and shake. *Note: Colilert® and Colilert®-18 tests must be batched separately.*

11.6.1.4 Pour the blank into the correspondingly labelled Quanti-Tray®.

11.6.1.5 Carefully place the Quanti-Tray® onto the rubber tray template making sure that none of the sample spills out.

11.6.1.6 Place hand along the top of the tray and using other hand, gently smooth the tray from bottom to top to distribute the solution throughout the tray.

11.6.1.7 Seal the Quanti-Tray® using the IDEXX tray heat sealer.

11.6.2 *Sample Chlorine Check & LIMS Batching*

11.6.2.1 If sample is from a known chlorinated source or from an unknown source where chlorination is suspected check for the absence of chlorine residual:

11.6.2.2 Shake the sample and pour about 5 mL into a plastic cup. Immediately cap the sample bottle and shake the sample vigorously to homogenize.

11.6.2.3 Using a chlorine residual test strip, test the 5 mL portion of the sample for chlorine residual. DO NOT dip the chlorine strip directly into the sample. Document the result on Form 2085.

11.6.2.4 *If there is insufficient volume to perform the chlorine check, notify the Supervisor, Lab Manager, or QA Manager immediately and do not proceed with the analysis of the sample. Client follow-up is required. Comment in LIMS as appropriate.*

11.6.2.5 *If chlorine is present in the sample, notify the Supervisor, Lab Manager, or QA Manager immediately and do not proceed with the analysis of the sample. Client follow-up is required. Comment in LIMS as appropriate.*

11.6.2.6 Complete the Chlorine Check prep batch in the LIMS.

11.6.2.6.1 Enter the correct analyst's name, date, and time that the chlorine check was performed by selecting "Negative" or "Positive" in the Text column. Save all results and click on "Complete Review."

11.6.2.6.2 Chlorine checks are not performed directly on a DUP aliquot but on the original sample prior to splitting.

11.6.2.7 Create an analysis batch in LIMS by navigating to the backlog for the Microbiology department and selecting the appropriate analysis procedure:

11.6.2.7.1 For potable/drinking water select: 9223QT DW COLI ANLY

11.6.2.7.2 For non-potable/wastewater select:

11.6.2.7.2.1 For *E. coli* only: 9223 AQ EC ANLY

11.6.2.7.2.2 For both Total coliform and *E. coli* (typically used for wastewater PTs only): 9223QT AQ COLI ANLY

11.6.2.7.3 Select the sample(s) to be analyzed by highlighting the sample and then click on the "Create Batch" button.

11.6.2.7.4 Add all batch objects in the Additional Information Section and "SAVE" the batch.

11.6.2.7.5 The LCB, LCS, and DUP are automatically assigned to the batch.

11.6.2.7.6 The DUP is automatically assigned to the first sample in the batch. If the duplicate is not being performed on that sample, reassign the duplicate to the appropriate sample or delete the duplicate that was automatically assigned and assign a duplicate to the appropriate sample.

11.6.2.7.7 SAVE the batch.

11.6.3 *Sample and DUP Dilution and Set-Up*

11.6.3.1 Shake each sample to homogenize.

11.6.3.2 For non-potable matrices, determine if any of the samples and DUP should be diluted due to suspected high results.

11.6.3.2.1 Document any sample coloring before and after dilution

11.6.3.3 If the sample is a drinking water sample, <u>100 mL must be analyzed; do not dilute.</u> The sample can be directly poured into the test vessel up to the certified 100 mL mark.

11.6.3.3.1 If a sample has an innate color prior to analysis, save the remaining portion of the original sample (if applicable) as a control color blank to compare to the analyzed sample.

11.6.3.4 For dilutions ≤ 500x, measure the appropriate volume of sample using a sterile graduated cylinder or pipette and dispense into to pre-labelled test vessel.

11.6.3.4.1 Dilute sample in test vessel up to the 100 mL line with sterile DI water. *If analyzing 100 mL (no dilution), the*

sample can be directly poured into the test vessel up to the certified 100 mL mark

11.6.3.5 For dilutions > 500X, a serial dilution must be performed using the 99 mL sterile DI water dilution bottles (§6.4).

11.6.3.5.1 Add 1 mL of the sample to 99 mL sterile DI water bottles and mix.

11.6.3.5.2 Pipette the appropriate volume of that sample dilution to the sterile 125 mL test vessel and dilute up to the 100 mL line with sterile DI water.

11.6.3.6 Add the contents of the Colilert® or Colilert®-18 reagent to the test vessels, cap, and shake. Reagent may not dissolve completely. *Note: Colilert® and Colilert®-18 tests must be batched separately*

11.6.3.7 Add samples to Quanti-Trays® as described in §11.6.1.3 - §11.6.1.7

11.6.4 *LCS Setup*

11.6.4.1 Pour 100 mL of sterile DI water into a validated test vessel. Inoculate with a colony of *E. coli* 11775.

11.6.4.2 Using a sterile inoculation loop, transfer a loopful of E. coli to the positive control vessel.

11.6.4.3 Add the contents of the Colilert® or Colilert®-18 reagent to the test vessel, cap, and shake.

11.6.4.4 Add LCS to Quanti-Tray® as described in §11.6.1.3 -§11.6.1.7

11.6.5 *Incubation*

11.6.5.1 Within 30 minutes of adding reagents, place the batch of Quanti-Trays® in the appropriate into a 35°C incubator (drinking water vs non-potable water incubators), <u>wells facing down</u>.

11.6.5.1.1 Be sure to leave plenty of space between the stacks of trays so that the air can circulate well throughout the incubator.

11.6.5.1.2 **Do not cover the temperature probes installed in the incubators as this will affect temperature readings.**

11.6.5.2 Record date and time into incubator and incubator ID on Form 2086 (non-potable) or Form 3231 (drinking water) as applicable.

11.8 Quanti-Tray® Read-Out

11.8.1 Remove the trays from the incubator after 24-28 hours for Colilert® and 18-22 hours for Colilert-18®.

11.8.1.1 Document date and time-out of incubator on appropriate form and ensure time requirement is met.

11.8.2 Read out the LCB first, followed by the unknown samples, and LCS. and compare to applicable comparator.

11.8.3 A yellow color means positive for total coliforms. If the yellow color is faint:

11.8.3.1 Compare the intensity of the yellow color to that of the comparator.

11.8.3.2 If the intensity of the yellow color is less than that of the comparator the result is negative.

11.8.3.3 If the intensity of the yellow color is equal to or greater than that of the comparator the result is positive for total coliform.

11.8.4 Record the number of yellow large and small wells on appropriate form, if applicable.

11.8.5 For total coliform positive wells, mark a black dot on the total coliform positive wells so that when the tray is placed under the UV light, it is easy identify the total coliform positive wells. *If a well fluoresces but is not total coliform positive, it is not counted as E. coli positive.*

11.8.6 Place tray under the UV light and count the number of positive large and small wells that fluoresce and document on Form 2086, 3267 or 3231.

11.8.7 If a well is total coliform positive and fluoresces, the well is positive for *E. coli. Record the number of small and large positive wells. If a well fluoresces but is not total coliform positive, it is not counted as E. coli positive.*

11.8.8 Using the appropriate MPN table (See §19.0), determine the initial results for each sample based upon the amount positive large and small wells (or lack thereof). Final results are typically reported from the lowest sample dilution.

11.8.9 If the analysis was performed on a drinking water sample, another trained analyst with a current DOC must also review the number of positive well counts for Total coliform and E. coli and the MPN result(s). The second analyst must also sign off on Form 3231 as reviewed.

11.8.10 Document any analysis or sample issues and refer to §14.0 for data assessment, corrective actions, and reporting contingencies.

11.8.11 *Document results on applicable SSRs and other required documents. Note: Use the laboratory's ELAP identification number in place of an analyst identification number.*

11.9 LIMS Data Entry

11.9.1 Locate the analysis batch created in §11.6.2.7 in LIMS.

11.9.2 For each sample, only the result that has the greatest sample volume analyzed (or smallest dilution factor) with results that produced a result on the MPN chart are reported.

11.9.3 If all dilutions for one sample result in above range enumeration, report result as '>' using the largest dilution (smallest analysis volume) result.

11.9.3.1 A comment will need to be added on this sample if a ">" result is reported. See §14.0.

11.9.4 Enter the analysis volume and initial result(s) from the MPN chart and click "SAVE." If organisms are not detected, enter '0' as the result value.

11.9.5 Review all data and results entered and add any additional comments as necessary in LIMS.

11.9.6 Print and sign the batch report.

11.9.7 Click on "Complete Review" a box will open that lists the reports available. Select the "General Batch Report," click on preview and print the report. Click on the "DONE" button to confirm the data entered and push to the peer review process.

11.10 Data Packet

11.10.1 Submit all completed forms listed in §9.4.6 to Area Supervisor for data review and approval, preferably on the same day as completion of analysis

11.10.1.1 Any Ohio EPA samples that are positive or are repeats, and/or are ground water rule samples must be reported to Area Supervisor by end of day.

12.0 Calculations

12.1 The Colilert® MPN chart is used to determine the initial results. To calculate the final result of the sample, multiply the initial result by the dilution factor if appropriate. See §19.0 for the MPN charts.

12.2 Precision (Control Charts)

12.2.1 Add the range of log values for 30 samples (each QC chart contains 30 points):

$$\Sigma \text{ Rlog} = x1 + x2 + x3.....$$

Where:

R = range (difference between the log of the sample result and the log of the DUP result)
x = range of log of MPN values

12.2.2 Find the average of the range log:

$$\text{Average} = \Sigma \text{ Rlog}/30$$

12.3 Multiply the average range by 3.0 to determine Upper Control Limit:

Upper Control Limit = 3.27*Average

13.0 Method Performance

13.1 Total coliform and *E. coli* results are reported down to 1 MPN/100 ml

13.2 Analyzing 100 mL of sample with the Quanti-Tray 2000® allows results up to 2420 MPN.

13.3 Analyzing 100 mL of sample with the Quanti-Tray 200® allows results up to 200 MPN.

13.4 Samples can be diluted to increase reporting upper reporting range.

14.0 Data Assessment, Corrective Action, and Reporting

14.1 LCB

14.1.1 The LCB must be negative for both total coliform and *E. coli*.

14.1.2 If LCB fails results must be invalidated. Narrate on raw data accordingly. Narrate and cancel test/qualify result as applicable in LIMS and if applicable final report, including Ohio EPA compliance uploads. Client must also be contacted to resample.

14.2 LCS

14.2.1 The LCS must be positive for both total coliforms and *E. coli*.

14.2.2 If the LCS fails, results must be invalidated. Narrate on raw data accordingly. Narrate and cancel test/qualify result as applicable in LIMS and if applicable final report, including Ohio EPA compliance uploads. Client must also be contacted to resample.

14.3 DUP

14.3.1 DUP result should be within control chart limits for the range of logs. If DUP does not meet limit criteria comment in LIMS only. Data qualification is not required as a DUP is performed as additional QC.

14.4 Environmental Monitoring Sample

14.4.1 If an Environmental Monitoring Sample is run concurrently in the same batch as samples, it must also pass (negative for both total coliform and *E. coli*) for batch results to be reported.

14.4.2 If the Environmental Monitoring Sample fails (positive for total coliform or both total coliform and E. coli), the results for the batch

may need to be invalidated or qualified based upon client data quality objective. or the samples re-collected and re-analyzed in a different area/bench with another Environmental Sample.

15.0 Waste Management

15.1 The laboratory must comply with all federal, state, and local regulations governing waste management, particularly the discharge regulations, hazardous waste identification rules, and land disposal regulations. All potential releases from laboratory operations need to be minimized in order to protect the air, water, and land.

15.2 All laboratory supplies must be disposed of properly.

15.2.1 Spent sample disposal is handled by dumping remaining sample down the drain with copious amounts of water. If the sample vial contains a filter, dispose of it in the regular trash. If the sample vial does not contain a vial, it can be placed in a special bag to be sent to the recycling facility.

15.2.2 Expired working standards can be placed down the drain with copious amounts of water.

15.2.3 Expired stock standards are removed from the shelf and placed into a special container to be held until the waste disposal company removes.

15.2.4 Glass items require special care. Broken vials, cylinders and beakers are placed into the sharps bucket located in the area. Empty acid bottles are rinsed with copious amounts of water, the plastic protective coating is removed and disposed of in the regular trash and the empty bottle is placed in the sharps bucket.

15.2.5 Other supplies, including but not limited to paper towels, gloves, and pump tubing are placed in the regular trash receptacles.

15.3 <u>If an accidental release occurs, laboratory management must be notified immediately.</u>

16.0 Pollution Prevention

16.1 Stock standards, acids, and bases can be considered pollutants. However, the standards and reagents are used in dilute solutions and pose little threat to the environment when managed properly.

16.2 Sample vials are recycled, when possible, to minimize solid waste.

16.3 All laboratory supplies must be disposed of properly.

16.4 The quantity of chemicals purchased should be based on expected usage during their shelf life as well as the associated disposal costs of any unused materials. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

16.5 All biological waste must be autoclaved prior to disposal.

17.0 Analyst Responsibilities

17.1 All safety measures put into place must be followed. Any deviations from the prescribed measures must be reported immediately to the supervisor. Any injuries occurring while performing any part of this procedure must be reported immediately to the supervisor.

17.2 This procedure is restricted to use by, or under the supervision of, analysts experienced in the analysis of samples using this method. It is the responsibility of the analyst to read and understand this SOP, adhere to the procedures outlined, perform the initial demonstration of capability, and to properly document their data in the appropriate logbooks.

17.3 Any deviations from the procedure, even if unintentional or unavoidable, as well as irregularities with the samples, must be recorded in the appropriate logbook or form and reported to the supervisor immediately.

17.4 It is the responsibility of the supervisor to oversee that all analysts performing this method follow the SOP and properly document their work. The supervisor should perform periodic review of the area as well as logbooks and forms.

17.5 The analyst must exercise extreme care with the samples. Every precaution should be taken to eliminate contamination.

17.6 All analysts are responsible for performing instrument maintenance activities.

17.7 All analysts are responsible for reviewing data in accordance with the requirements of this SOP and related Quality Systems SOPs and technical memos, including but not limited to the Quality Manual, and before it is submitted for approval.

18.0 References

18.1 SM 9223 B, Presence-Absence, Standard Methods for the Examination of Water and Wastewater, 2004, 2016.

18.2 Colilert® Test Kit Instructions, Colilert®, Defined Substrate Technology.

18.3 Colilert-18® Test Kit Instructions, Colilert-18®, Defined Substrate Technology.

18.4 Diluting water samples for use with the Quanti-Tray* or Quanti-Tray*/2000 System. Guidance document provided by IDEXX to NEORSD.

19.0 Additional Information

19.1 Twice per year (typically, in June and December) an Environmental Monitoring Sample is evaluated to assess ambient conditions.

19.2 The Environmental Monitoring Sample is prepared, analyzed, and evaluated as followed:

19.2.1 Add 50 mL of sterile DI water and 50 mL of double strength TSB (Refer to SOP 3015 for TSB preparation) to a labelled 100 ml sterile test vessel.

19.2.2 Place the bottle on the bench in the area where microbiological work is being performed.

19.2.3 DO NOT cap or cover the bottle.

19.2.4 Allow the bottle to remain open to the environment for 15-20 minutes during the processing of a batch of samples.

19.2.5 Incubate with the batch.

19.2.6 If the sample has a positive result, a corrective action is to be initiated and analysis must stop in the area until the cause of the contamination can be determined and eliminated.

19.2.7 Document validation on Form 3242 QA/QC Checklist for Microbiology.

19.3 **MPN Tables**

19.3.1 <u>97 Well MPN</u>

IDEXX Quanti-Tray®/2000 MPN Table *(per 100ml)*

# Large Wells Positive	# Small Wells Positive																							
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
0	<1	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.1	15.1	16.1	17.1	18.1	19.1	20.2	21.2	22.2	23.3	24.3
1	1.0	2.0	3.0	4.0	5.0	6.0	7.1	8.1	9.1	10.1	11.1	12.1	13.2	14.2	15.2	16.2	17.3	18.3	19.3	20.4	21.4	22.4	23.5	24.5	25.6
2	2.0	3.0	4.1	5.1	6.1	7.1	8.1	9.2	10.2	11.2	12.2	13.3	14.3	15.4	16.4	17.4	18.5	19.5	20.6	21.6	22.7	23.7	24.8	25.8	26.9
3	3.1	4.1	5.1	6.1	7.2	8.2	9.2	10.3	11.3	12.4	13.4	14.5	15.5	16.5	17.6	18.6	19.7	20.8	21.8	22.9	23.9	25.0	26.1	27.1	28.2
4	4.1	5.2	6.2	7.2	8.3	9.3	10.4	11.4	12.5	13.5	14.6	15.6	16.7	17.8	18.8	19.9	21.0	22.0	23.1	24.2	25.3	26.3	27.4	28.5	29.6
5	5.2	6.3	7.3	8.4	9.4	10.5	11.5	12.6	13.7	14.7	15.8	16.9	17.9	19.0	20.1	21.2	22.2	23.3	24.4	25.5	26.6	27.7	28.8	29.9	31.0
6	6.3	7.4	8.4	9.5	10.6	11.6	12.7	13.8	14.9	16.0	17.0	18.1	19.2	20.3	21.4	22.5	23.6	24.7	25.8	26.9	28.0	29.1	30.2	31.3	32.4
7	7.5	8.5	9.6	10.7	11.8	12.8	13.9	15.0	16.1	17.2	18.3	19.4	20.5	21.6	22.7	23.8	24.9	26.0	27.1	28.3	29.4	30.5	31.6	32.8	33.9
8	8.6	9.7	10.8	11.9	13.0	14.1	15.2	16.3	17.4	18.5	19.6	20.7	21.8	22.9	24.1	25.2	26.3	27.4	28.6	29.7	30.8	32.0	33.1	34.3	35.4
9	9.8	10.9	12.0	13.1	14.2	15.3	16.4	17.6	18.7	19.8	20.9	22.0	23.2	24.3	25.4	26.6	27.7	28.9	30.0	31.2	32.3	33.5	34.6	35.8	37.0
10	11.0	12.1	13.2	14.4	15.5	16.6	17.7	18.9	20.0	21.1	22.3	23.4	24.6	25.7	26.9	28.0	29.2	30.3	31.5	32.7	33.8	35.0	36.2	37.4	38.6
11	12.2	13.4	14.5	15.6	16.8	17.9	19.1	20.2	21.4	22.5	23.7	24.8	26.0	27.2	28.3	29.5	30.7	31.9	33.0	34.2	35.4	36.6	37.8	39.0	40.2
12	13.5	14.6	15.8	16.9	18.1	19.3	20.4	21.6	22.8	23.9	25.1	26.3	27.5	28.6	29.8	31.0	32.2	33.4	34.6	35.8	37.0	38.2	39.5	40.7	41.9
13	14.8	16.0	17.1	18.3	19.5	20.6	21.8	23.0	24.2	25.4	26.6	27.8	29.0	30.2	31.4	32.6	33.8	35.0	36.2	37.5	38.7	39.9	41.2	42.4	43.6
14	16.1	17.3	18.5	19.7	20.9	22.1	23.3	24.5	25.7	26.9	28.1	29.3	30.5	31.7	33.0	34.2	35.4	36.7	37.9	39.1	40.4	41.6	42.9	44.2	45.4
15	17.5	18.7	19.9	21.1	22.3	23.5	24.7	25.9	27.2	28.4	29.6	30.9	32.1	33.3	34.6	35.8	37.1	38.4	39.6	40.9	42.2	43.4	44.7	46.0	47.3
16	18.9	20.1	21.3	22.6	23.8	25.0	26.2	27.5	28.7	30.0	31.2	32.5	33.7	35.0	36.3	37.5	38.8	40.1	41.4	42.7	44.0	45.3	46.6	47.9	49.2
17	20.3	21.6	22.8	24.1	25.3	26.6	27.8	29.1	30.3	31.6	32.9	34.1	35.4	36.7	38.0	39.3	40.6	41.9	43.2	44.5	45.9	47.2	48.5	49.8	51.2
18	21.8	23.1	24.3	25.6	26.9	28.1	29.4	30.7	32.0	33.3	34.6	35.9	37.2	38.5	39.8	41.1	42.4	43.8	45.1	46.5	47.8	49.2	50.5	51.9	53.2
19	23.3	24.6	25.9	27.2	28.5	29.8	31.1	32.4	33.7	35.0	36.3	37.6	39.0	40.3	41.6	43.0	44.3	45.7	47.1	48.4	49.8	51.2	52.6	54.0	55.4
20	24.9	26.2	27.5	28.8	30.1	31.5	32.8	34.1	35.4	36.8	38.1	39.5	40.8	42.2	43.6	44.9	46.3	47.7	49.1	50.5	51.9	53.3	54.7	56.1	57.6
21	26.5	27.9	29.2	30.5	31.8	33.2	34.5	35.9	37.3	38.6	40.0	41.4	42.8	44.1	45.5	46.9	48.4	49.8	51.2	52.6	54.1	55.5	56.9	58.4	59.9
22	28.2	29.5	30.9	32.3	33.6	35.0	36.4	37.7	39.1	40.5	41.9	43.3	44.8	46.2	47.6	49.0	50.5	51.9	53.4	54.8	56.3	57.8	59.3	60.8	62.3
23	29.9	31.3	32.7	34.1	35.5	36.8	38.3	39.7	41.1	42.5	43.9	45.4	46.8	48.3	49.7	51.2	52.7	54.2	55.6	57.1	58.6	60.2	61.7	63.2	64.7
24	31.7	33.1	34.5	35.9	37.3	38.8	40.2	41.7	43.1	44.6	46.0	47.5	49.0	50.5	52.0	53.5	55.0	56.5	58.0	59.5	61.1	62.6	64.2	65.8	67.3
25	33.6	35.0	36.4	37.9	39.3	40.8	42.2	43.7	45.2	46.7	48.2	49.7	51.2	52.7	54.3	55.8	57.3	58.9	60.5	62.0	63.6	65.2	66.8	68.4	70.0
26	35.5	36.9	38.4	39.9	41.4	42.8	44.3	45.9	47.4	48.9	50.4	52.0	53.5	55.1	56.7	58.2	59.8	61.4	63.0	64.7	66.3	67.9	69.6	71.2	72.9
27	37.4	38.9	40.4	42.0	43.5	45.0	46.5	48.1	49.6	51.2	52.8	54.4	56.0	57.6	59.2	60.8	62.4	64.1	65.7	67.4	69.1	70.8	72.5	74.2	75.9
28	39.5	41.0	42.6	44.1	45.7	47.3	48.8	50.4	52.0	53.6	55.2	56.9	58.5	60.2	61.8	63.5	65.2	66.9	68.6	70.3	72.0	73.7	75.5	77.3	79.0
29	41.7	43.2	44.8	46.4	48.0	49.6	51.2	52.8	54.5	56.1	57.8	59.5	61.2	62.9	64.6	66.3	68.0	69.8	71.5	73.3	75.1	76.9	78.7	80.5	82.4
30	43.9	45.5	47.1	48.7	50.4	52.0	53.7	55.4	57.1	58.8	60.5	62.2	64.0	65.7	67.5	69.3	71.0	72.9	74.7	76.5	78.3	80.2	82.1	84.0	85.9
31	46.2	47.9	49.5	51.2	52.9	54.6	56.3	58.1	59.8	61.6	63.3	65.1	66.9	68.7	70.5	72.4	74.2	76.1	78.0	79.9	81.8	83.7	85.7	87.6	89.6
32	48.7	50.4	52.1	53.8	55.6	57.3	59.1	60.9	62.7	64.5	66.3	68.2	70.0	71.9	73.8	75.7	77.6	79.5	81.5	83.5	85.4	87.5	89.5	91.5	93.6
33	51.2	53.0	54.8	56.5	58.3	60.2	62.0	63.8	65.7	67.6	69.5	71.4	73.3	75.2	77.2	79.2	81.2	83.2	85.2	87.3	89.3	91.4	93.6	95.7	97.8
34	53.9	55.7	57.6	59.4	61.3	63.1	65.0	67.0	68.9	70.8	72.8	74.8	76.8	78.8	80.8	82.9	85.0	87.1	89.2	91.4	93.5	95.7	97.9	100.2	102.4
35	56.8	58.6	60.5	62.4	64.4	66.3	68.3	70.3	72.3	74.3	76.3	78.4	80.5	82.6	84.7	86.9	89.1	91.3	93.5	95.7	98.0	100.3	102.6	105.0	107.3
36	59.8	61.7	63.7	65.7	67.7	69.7	71.7	73.8	75.9	78.0	80.1	82.3	84.5	86.7	88.9	91.2	93.5	95.8	98.1	100.5	102.9	105.3	107.7	110.2	112.7
37	62.9	65.0	67.0	69.1	71.2	73.3	75.4	77.6	79.8	82.0	84.2	86.5	88.8	91.1	93.4	95.8	98.2	100.6	103.1	105.6	108.1	110.7	113.3	115.9	118.6
38	66.3	68.4	70.6	72.7	74.9	77.1	79.4	81.6	83.9	86.2	88.6	91.0	93.4	95.8	98.3	100.8	103.4	105.9	108.6	111.2	113.9	116.6	119.4	122.2	125.0
39	70.0	72.2	74.4	76.7	78.9	81.3	83.6	86.0	88.4	90.9	93.4	95.9	98.4	101.0	103.6	106.3	109.0	111.8	114.6	117.4	120.3	123.2	126.1	129.2	132.2
40	73.8	76.2	78.5	80.9	83.3	85.7	88.2	90.8	93.3	95.9	98.5	101.2	103.9	106.7	109.5	112.4	115.3	118.2	121.2	124.3	127.4	130.5	133.7	137.0	140.3
41	78.0	80.5	83.0	85.5	88.0	90.6	93.3	95.9	98.7	101.4	104.3	107.1	110.0	113.0	116.0	119.1	122.2	125.4	128.7	132.0	135.4	138.8	142.3	145.9	149.5
42	82.6	85.2	87.8	90.5	93.2	96.0	98.8	101.7	104.6	107.6	110.6	113.7	116.9	120.1	123.4	126.7	130.1	133.6	137.2	140.8	144.5	148.3	152.2	156.1	160.2
43	87.6	90.4	93.2	96.0	99.0	101.9	105.0	108.1	111.2	114.5	117.8	121.1	124.6	128.1	131.7	135.4	139.1	143.0	147.0	151.0	155.2	159.4	163.8	168.2	172.8
44	93.1	96.1	99.1	102.2	105.4	108.6	111.9	115.3	118.7	122.3	125.9	129.6	133.4	137.4	141.4	145.5	149.7	154.1	158.5	163.1	167.9	172.7	177.7	182.9	188.2
45	99.3	102.5	105.8	109.2	112.6	116.2	119.8	123.6	127.4	131.4	135.4	139.6	143.9	148.3	152.9	157.6	162.4	167.4	172.6	178.0	183.5	189.2	195.1	201.2	207.5
46	106.3	109.8	113.4	117.2	121.0	125.0	129.1	133.3	137.6	142.1	146.7	151.5	156.5	161.6	167.0	172.5	178.2	184.2	190.4	196.8	203.5	210.5	217.8	225.4	233.3
47	114.3	118.3	122.4	126.6	130.9	135.4	140.1	145.0	150.0	155.3	160.7	166.4	172.3	178.5	185.0	191.8	198.9	206.4	214.2	222.4	231.0	240.0	249.5	259.5	270.0
48	123.9	128.4	133.1	137.9	143.0	148.3	153.9	159.7	165.8	172.2	178.9	186.0	193.5	201.4	209.8	218.7	228.2	238.2	248.9	260.3	272.3	285.1	298.7	313.0	328.2
49	135.5	140.8	146.4	152.3	158.5	165.0	172.0	179.3	187.2	195.6	204.6	214.3	224.7	235.9	248.1	261.3	275.5	290.9	307.6	325.5	344.8	365.4	387.3	410.6	435.2

09-63235-01

IDEXX Quanti-Tray®/2000 MPN Table (per 100ml)

# Large Wells Positive	# Small Wells Positive																						
	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
0	25.3	26.4	27.4	28.4	29.5	30.5	31.5	32.6	33.6	34.7	35.7	36.8	37.8	38.9	40.0	41.0	42.1	43.1	44.2	45.3	46.3	47.4	48.5	49.5
1	26.6	27.7	28.7	29.8	30.8	31.9	32.9	34.0	35.0	36.1	37.2	38.2	39.3	40.4	41.4	42.5	43.6	44.7	45.7	46.8	47.9	49.0	50.1	51.2
2	27.9	29.0	30.0	31.1	32.2	33.2	34.3	35.4	36.5	37.5	38.6	39.7	40.8	41.9	43.0	44.0	45.1	46.2	47.3	48.4	49.5	50.6	51.7	52.8
3	29.3	30.4	31.4	32.5	33.6	34.7	35.8	36.8	37.9	39.0	40.1	41.2	42.3	43.4	44.5	45.6	46.7	47.8	48.9	50.0	51.2	52.3	53.4	54.5
4	30.7	31.8	32.8	33.9	35.0	36.1	37.2	38.3	39.4	40.5	41.6	42.8	43.9	45.0	46.1	47.2	48.3	49.5	50.6	51.7	52.9	54.0	55.1	56.3
5	32.1	33.2	34.3	35.4	36.5	37.6	38.7	39.9	41.0	42.1	43.2	44.4	45.5	46.6	47.7	48.9	50.0	51.2	52.3	53.5	54.6	55.8	56.9	58.1
6	33.5	34.7	35.8	36.9	38.0	39.2	40.3	41.4	42.6	43.7	44.8	46.0	47.1	48.3	49.4	50.6	51.7	52.9	54.1	55.2	56.4	57.6	58.7	59.9
7	35.0	36.2	37.3	38.4	39.6	40.7	41.9	43.0	44.2	45.3	46.5	47.7	48.8	50.0	51.2	52.3	53.5	54.7	55.9	57.1	58.3	59.4	60.6	61.8
8	36.6	37.7	38.9	40.0	41.2	42.3	43.5	44.7	45.9	47.0	48.2	49.4	50.6	51.8	53.0	54.1	55.3	56.5	57.7	59.0	60.2	61.4	62.6	63.8
9	38.1	39.3	40.5	41.6	42.8	44.0	45.2	46.4	47.6	48.8	50.0	51.2	52.4	53.6	54.8	56.0	57.2	58.4	59.7	60.9	62.1	63.4	64.6	65.8
10	39.7	40.9	42.1	43.3	44.5	45.7	46.9	48.1	49.3	50.6	51.8	53.0	54.2	55.5	56.7	57.9	59.2	60.4	61.7	62.9	64.2	65.4	66.7	67.9
11	41.4	42.6	43.8	45.0	46.3	47.5	48.7	49.9	51.2	52.4	53.7	54.9	56.1	57.4	58.6	59.9	61.2	62.4	63.7	65.0	66.3	67.5	68.8	70.1
12	43.1	44.3	45.6	46.8	48.1	49.3	50.6	51.8	53.1	54.3	55.6	56.8	58.1	59.4	60.7	62.0	63.2	64.5	65.8	67.1	68.4	69.7	71.0	72.4
13	44.9	46.1	47.4	48.6	49.9	51.2	52.5	53.7	55.0	56.3	57.6	58.9	60.2	61.5	62.8	64.1	65.4	66.7	68.0	69.3	70.7	72.0	73.3	74.7
14	46.7	48.0	49.3	50.5	51.8	53.1	54.4	55.7	57.0	58.3	59.6	60.9	62.3	63.6	64.9	66.3	67.6	68.9	70.3	71.6	73.0	74.4	75.7	77.1
15	48.6	49.9	51.2	52.5	53.8	55.1	56.4	57.8	59.1	60.4	61.8	63.1	64.5	65.8	67.2	68.5	69.9	71.3	72.6	74.0	75.4	76.8	78.2	79.6
16	50.5	51.8	53.2	54.5	55.8	57.2	58.5	59.9	61.2	62.6	64.0	65.3	66.7	68.1	69.5	70.9	72.3	73.7	75.1	76.5	77.9	79.3	80.8	82.2
17	52.5	53.9	55.2	56.6	58.0	59.3	60.7	62.1	63.5	64.9	66.3	67.7	69.1	70.5	71.9	73.3	74.8	76.2	77.6	79.1	80.5	82.0	83.5	84.9
18	54.6	56.0	57.4	58.8	60.2	61.6	63.0	64.4	65.8	67.2	68.6	70.1	71.5	73.0	74.4	75.9	77.3	78.8	80.3	81.8	83.3	84.8	86.3	87.8
19	56.8	58.2	59.6	61.0	62.4	63.9	65.3	66.8	68.2	69.7	71.1	72.6	74.1	75.5	77.0	78.5	80.0	81.5	83.1	84.6	86.1	87.6	89.2	90.7
20	59.0	60.4	61.9	63.3	64.8	66.3	67.7	69.2	70.7	72.2	73.7	75.2	76.7	78.2	79.8	81.3	82.8	84.4	85.9	87.5	89.1	90.7	92.2	93.8
21	61.3	62.8	64.3	65.8	67.3	68.8	70.3	71.8	73.3	74.9	76.4	77.9	79.5	81.1	82.6	84.2	85.8	87.4	89.0	90.6	92.2	93.8	95.4	97.1
22	63.8	65.3	66.8	68.3	69.8	71.4	72.9	74.5	76.1	77.6	79.2	80.8	82.4	84.0	85.6	87.2	88.9	90.5	92.1	93.8	95.5	97.1	98.8	100.5
23	66.3	67.8	69.4	71.0	72.5	74.1	75.7	77.3	78.9	80.5	82.2	83.8	85.4	87.1	88.7	90.4	92.1	93.8	95.5	97.2	98.9	100.6	102.4	104.1
24	68.9	70.5	72.1	73.7	75.3	77.0	78.6	80.3	81.9	83.6	85.2	86.9	88.6	90.3	92.0	93.8	95.5	97.2	99.0	100.7	102.5	104.3	106.1	107.9
25	71.7	73.3	75.0	76.6	78.3	80.0	81.7	83.3	85.1	86.8	88.5	90.2	92.0	93.7	95.5	97.3	99.1	100.9	102.7	104.5	106.3	108.2	110.0	111.9
26	74.6	76.3	78.0	79.7	81.4	83.1	84.8	86.6	88.4	90.1	91.9	93.7	95.5	97.3	99.2	101.0	102.9	104.7	106.6	108.5	110.4	112.3	114.2	116.2
27	77.6	79.4	81.1	82.9	84.6	86.4	88.2	90.0	91.9	93.7	95.5	97.4	99.3	101.2	103.1	105.0	106.9	108.8	110.8	112.7	114.7	116.7	118.7	120.7
28	80.8	82.6	84.4	86.3	88.1	89.9	91.8	93.7	95.6	97.5	99.4	101.3	103.3	105.2	107.2	109.2	111.2	113.2	115.2	117.3	119.3	121.4	123.5	125.6
29	84.2	86.1	87.9	89.8	91.7	93.7	95.6	97.5	99.5	101.5	103.5	105.5	107.5	109.5	111.6	113.7	115.7	117.8	120.0	122.1	124.2	126.4	128.6	130.8
30	87.8	89.7	91.7	93.6	95.6	97.6	99.6	101.6	103.7	105.7	107.8	109.9	112.0	114.2	116.3	118.5	120.6	122.8	125.1	127.3	129.5	131.8	134.1	136.4
31	91.6	93.6	95.6	97.7	99.7	101.8	103.9	106.0	108.2	110.3	112.5	114.7	116.9	119.1	121.4	123.6	125.9	128.2	130.5	132.9	135.3	137.7	140.1	142.5
32	95.7	97.8	99.9	102.0	104.2	106.3	108.5	110.7	113.0	115.2	117.5	119.8	122.1	124.5	126.8	129.2	131.6	134.0	136.5	139.0	141.5	144.0	146.6	149.1
33	100.0	102.2	104.4	106.6	108.9	111.2	113.5	115.8	118.2	120.5	122.9	125.4	127.8	130.3	132.8	135.3	137.8	140.4	143.0	145.6	148.3	150.9	153.7	156.4
34	104.7	107.0	109.3	111.7	114.0	116.4	118.9	121.3	123.8	126.3	128.8	131.4	134.0	136.6	139.2	141.9	144.6	147.4	150.1	152.9	155.7	158.6	161.5	164.4
35	109.7	112.2	114.6	117.1	119.6	122.2	124.7	127.3	129.9	132.6	135.3	138.0	140.8	143.6	146.4	149.2	152.1	155.0	158.0	161.0	164.0	167.1	170.2	173.3
36	115.2	117.8	120.4	123.0	125.7	128.4	131.1	133.9	136.7	139.5	142.4	145.3	148.3	151.3	154.3	157.3	160.5	163.6	166.8	170.0	173.3	176.6	179.9	183.3
37	121.3	124.0	126.8	129.6	132.4	135.3	138.2	141.2	144.2	147.3	150.3	153.5	156.7	159.9	163.1	166.5	169.8	173.2	176.7	180.2	183.7	187.3	191.0	194.7
38	127.9	130.8	133.8	136.8	139.9	143.0	146.2	149.4	152.6	155.9	159.2	162.6	166.1	169.6	173.2	176.8	180.4	184.2	188.0	191.8	195.7	199.7	203.7	207.7
39	135.3	138.5	141.7	145.0	148.3	151.7	155.1	158.6	162.1	165.7	169.4	173.1	176.9	180.7	184.7	188.7	192.7	196.8	201.0	205.3	209.6	214.0	218.5	223.0
40	143.7	147.1	150.6	154.2	157.8	161.5	165.3	169.1	173.0	177.0	181.1	185.2	189.4	193.7	198.1	202.5	207.1	211.7	216.4	221.1	226.0	231.0	236.0	241.1
41	153.2	157.0	160.9	164.8	168.9	173.0	177.2	181.5	185.8	190.3	194.8	199.5	204.2	209.1	214.0	219.1	224.2	229.4	234.8	240.2	245.8	251.5	257.2	263.1
42	164.3	168.6	172.9	177.3	181.9	186.5	191.3	196.1	201.1	206.2	211.4	216.7	222.2	227.7	233.4	239.2	245.2	251.3	257.5	263.8	270.3	276.9	283.6	290.5
43	177.5	182.3	187.3	192.4	197.6	202.9	208.4	214.0	219.8	225.8	231.8	238.1	244.5	251.0	257.7	264.6	271.7	278.9	286.3	293.8	301.5	309.4	317.4	325.7
44	193.6	199.3	205.1	211.0	217.2	223.5	230.0	236.7	243.6	250.8	258.1	265.6	273.3	281.2	289.4	297.8	306.3	315.1	324.1	333.3	342.8	352.4	362.3	372.4
45	214.1	220.9	227.9	235.2	242.7	250.4	258.4	266.7	275.3	284.1	293.3	302.6	312.3	322.3	332.5	343.0	353.8	364.9	376.2	387.9	399.8	412.0	424.5	437.4
46	241.5	250.0	258.9	268.2	277.8	287.8	298.1	308.8	319.9	331.4	343.3	355.5	368.1	381.1	394.5	408.3	422.5	437.1	452.0	467.4	483.3	499.6	516.3	533.5
47	280.9	292.4	304.4	316.9	330.0	343.6	357.8	372.5	387.7	403.4	419.8	436.6	454.1	472.1	490.7	509.9	529.8	550.4	571.7	593.8	616.7	640.5	665.3	691.0
48	344.1	360.9	378.4	396.8	416.0	436.0	456.9	478.6	501.2	524.7	549.3	574.8	601.5	629.4	658.6	689.3	721.5	755.6	791.5	829.7	870.4	913.9	960.6	1011.2
49	461.1	488.4	517.2	547.5	579.4	613.1	648.8	686.7	727.0	770.1	816.4	866.4	920.8	980.4	1046.2	1119.9	1203.3	1299.7	1413.6	1553.1	1732.9	1986.3	2419.6	>2419.6

09-63235-01

19.3.2 51 Well MPN Table

IDEXX
51-Well Quanti-Tray®
MPN Table

No. of wells giving positive reaction	MPN per 100 ml sample	95% Confidence Limits Lower	Upper
0	<1.0	0.0	3.7
1	1.0	0.3	5.6
2	2.0	0.6	7.3
3	3.1	1.1	9.0
4	4.2	1.7	10.7
5	5.3	2.3	12.3
6	6.4	3.0	13.9
7	7.5	3.7	15.5
8	8.7	4.5	17.1
9	9.9	5.3	18.8
10	11.1	6.1	20.5
11	12.4	7.0	22.1
12	13.7	7.9	23.9
13	15.0	8.8	25.7
14	16.4	9.8	27.5
15	17.8	10.8	29.4
16	19.2	11.9	31.3
17	20.7	13.0	33.3
18	22.2	14.1	35.2
19	23.8	15.3	37.3
20	25.4	16.5	39.4
21	27.1	17.7	41.6
22	28.8	19.0	43.9
23	30.6	20.4	46.3
24	32.4	21.8	48.7
25	34.4	23.3	51.2
26	36.4	24.7	53.9
27	38.4	26.4	56.6
28	40.6	28.0	59.5
29	42.9	29.7	62.5
30	45.3	31.5	65.6
31	47.8	33.4	69.0
32	50.4	35.4	72.5
33	53.1	37.5	76.2
34	56.0	39.7	80.1
35	59.1	42.0	84.4
36	62.4	44.6	88.8
37	65.9	47.2	93.7
38	69.7	50.0	99.0
39	73.8	53.1	104.8
40	78.2	56.4	111.2
41	83.1	59.9	118.3
42	88.5	63.9	126.2
43	94.5	68.2	135.4
44	101.3	73.1	146.0
45	109.1	78.6	158.7
46	118.4	85.0	174.5
47	129.8	92.7	195.0
48	144.5	102.3	224.1
49	165.2	115.2	272.2
50	200.5	135.8	387.6
51	> 200.5	146.1	infinite

IDEXX Sales and Technical Support
1-800-321-0207 or 1-207-856-0496
www.idexx.com/water

09-63234-00

20.0 Revision History

20.1 SOP reformatted and additional QC information added. Refer to prior version for changes as they are too numerous to list. SGA 8/30/2022.

Appendix

Solid Sample Analysis (Research Only; Not for Compliance)

A1.1 Set-up analysis batch in LIMS as described in §11.6.2.7 using solids analysis procedure (*E. coli* only): 9223 SO EC ANLY

A1.2 LCB Setup

A1.2.1 Set-up blank first to avoid contamination.

A1.2.2 Prepare LCB with sterile sand.

A1.2.2.1 The mass of sterile sand used is not critical. An example is 50 g sand and 500 mL of DI water. However, document weight of sand and volume of DI water used on Form 2143.

A1.3 Sample Setup

A1.3.1 Weigh a predetermined mass of sample and transfer to a 500 ml sterile bottle.

A1.3.1.1 The sample mass is chosen based on the expected concentration of *E. coli,* the composition of the matrix (sand, mud etc.), and experience and can differ between samples.

A1.3.2 Add sterile DI water to the sample bottle and replace the cap.

A1.3.2.1 The volume of sterile DI water to use is determined by the amount of sample needed for the analysis and the expected concentration of *E. coli* in the sample.

A1.3.3 Document the weight of sample and volume of DI water on Form 2143.

A1.4 LCS Setup

A1.4.1 Set-up the LCS last to avoid cross-contamination.

A1.4.2 Inoculate 100 mL of sterile DI water with *E. coli* as described in §11.6.5. Document the weight and volume of DI water used on Form 2143.

A1.5 Place the LCB, LCS and sample bottles on a sample shaker. Use rubber bands to secure the bottles in place.

A1.6 Shake the samples for 2-5 minutes.

A1.7 Remove the bottles from the shaker.

A1.8 Allow the solids to settle for about 10 seconds.

A1.8.1 Measure the desired sample volume for analysis from the supernatant, transfer to a labeled, 120 ml sterile bottle.

A1.8.1.1 Some solid samples require filtering to remove suspended solids that can interfere with the analysis. Choose a filter with pore size > 0.45 μm so the bacteria do not get filtered out of the sample. Coffee filters are an example.

A1.8.2 Add the contents of the Colilert® or Colilert®-18 reagent to the test vessel, cap, and shake to homogenize

A1.8.3 Add LCB, sample, and LCS transferred supernatants to Quanti-Tray® as described in §11.6.1.3 -§11.6.1.7 and incubate as described in §11.6.5

Appendix D. Field Form

NEORSD Beach Sampling Field Data Form

Location: _____ Date: _____ Time (hrs): _____

Meter(s) Used: _____ Samplers: _____

Was this sample taken during or following a wet weather event? YES / NO

Weather Conditions Air Temp: _____ (°F)

Longshore Wind Speed: Max _____ Avg _____ (mph) Direction _____ (Deg)

Condition: Sunny Mostly Sunny Mostly Cloudy Cloudy Light Rain/Showers
Heavy Rain Heavy Snow Melt Other: _____

Beach Conditions Odor: _____ **1** - Normal **2** - Oil **3** - Septic **4** - Sewage **5** - Chemical 6-Other

Number of People on Beach: _____

Number of Birds: Gull _____ Geese _____ Duck _____ Other _____ Total _____

Number of Wildlife: Dog _____ Raccoon _____ Deer _____ Horse _____ Total _____

Debris on Beach: _____ (1-6)

Fecal Contamination on Beach: _____ (1-6)

1 - ≤1% **2** - 2-14% **3** - 15-29%
4 - 30-49% **5** - 50-75% **6** - >75%

Numer of Dead Organisms: Fish _____ Birds _____ Other _____

Lake Conditions: Number of Swimmers: _____

Color: _____ (1-5) **1** - Clear **2** - Muddy **3** - Tea **4** - Milky **5** - Other Wave Height: _____ (ft)

Wave Condition: _____ (1-3) **1** - Calm **2** - Normal **3** - Rough

Algae: _____ Debris: _____ (1-5) **1** - None **2** - Some **3** - Floating **4** - Thick Layer **5** - Multiple Layers

Water Surface Condition: _____ (1-5) **1** - None **2** - Foam **3** - Oily **4** - Scum **5** - Other

Lake Physical Parameters: Water Temp: _____ (°C) pH: _____ (s.u.)

Conductivity: _____ (µmhos/cm)

Turbidity* (NTU): (1) _____ (2) _____ (Avg) _____

Duplicate Turbidity 1 (NTU): (1) _____ (2) _____ (Avg) _____

General Comments: _____

_____

_____

* Clear = <1.9 NTU, Slightly Turbid = 2-9.9 NTU, Turbid = 10-249.9 NTU, Opaque = >250

Modified April 2021

Appendix E. Meter Specifications

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

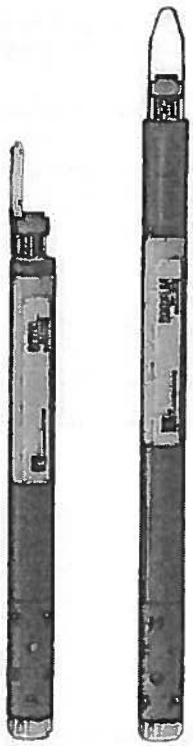
Range	pH	0.00 to 14.00 pH
Range	EC	0 to 3999 µS/cm
Range	TDS	0 to 2000 ppm
Range	Temperature	0.0 to 60.0°C / 32 to 140.0°F
Resolution	pH	0.01 pH
Resolution	EC	1 µS/cm
Resolution	TDS	1 ppm
Resolution	Temperature	0.1°C / 0.1°F
Accuracy	pH	±0.05 pH
Accuracy	EC/TDS	±2% F.S.
Accuracy	Temperature	±0.5°C / ±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.)

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

www.ysi.com

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

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

YSI Environmental
+1 937 767 7241
Fax +1 937 767 9353
environmental@ysi.com

Endeco/YSI
+1 508 748 0366
Fax +1 508 748 2543
systems@ysi.com

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inquiry@sontek.com

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Fax +86 10 5203 9679
beijing@ysi-china.com

YSI Nanotech (Japan)
+81 44 222 0009
Fax +81 44 221 1102
nanotech@ysi.com

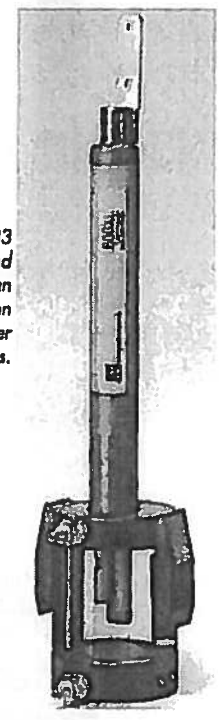
YSI 600XL & 600XLM Sensor Specifications

	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* 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.

ISO 9001
ISO 14001
Yellow Springs, Ohio Facility

CE

[illegible]

YSI incorporated
Who's Minding
the Planet?

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

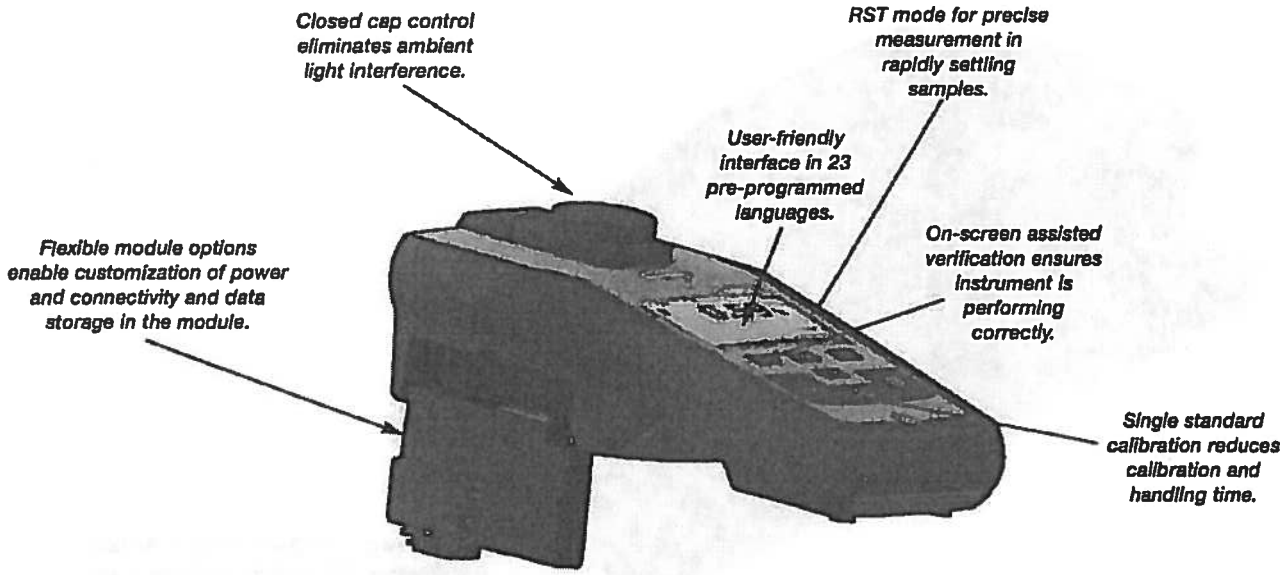
The two-detector optical system compensates for color in the sample, light fluctuation, and stray light, enabling analysts to achieve laboratory-grade performance on a wide range of samples, even under difficult site conditions.

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

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.*

EXO1 Water Quality Sonde

Recycling

The EXO1 multiparameter water quality sonde collects data with up to four user-replaceable smart sensors and an integral pressure transducer for depth.

Send me a Quote!

Description | Specifications | Resources | Accessories | Request a Quote

The EXO1 with

- 4 sensor ports
- Integral pressure transducer
- 1 peripheral port for power communication
- Depth: 820 ft, 250 m

Medium		Fresh, sea or polluted water
Temperature	Operating Storage	-5 to +50°C -20 to +80°C
Communications		Bluetooth wireless technology; USB cable RS-485, RS-232, SDI-12
Software		KOR®
Dimensions	Diameter Length, no depth Weight	1.85 in. 4.70 cm 25.50 in. 64.77 cm 1.42 kg 3.15 lbs (batteries and sensors installed)
Power	External Internal	9 to 16.5 V DC 2 D-size alkaline batteries

Memory 512 MB; >1,000,000 logged readings

Ratings CE, UL, RoHS, WEEE

Find a Distributor

YSI has Authorized Distributors all over the globe. View a map and find your closest contact for YSI EXO1 Water Quality Sonde products and accessories.

Get Support

Have a question about your YSI EXO1 Water Quality Sonde? Check out the support page with resources compiled just for you.

Product Service Centers

Want to return a product for service? Here you'll find authorized service centers and instructions on how to send in your YSI EXO1 Water Quality Sonde.

Appendix F. Sampling Schedule

2023 Beach Monitoring Sampling Schedule

Day	Date	Edgewater Beach	Villa Angela Beach	Euclid Beach	Euclid Creek (RM 0.55)
Monday	5/1/2023	√	√	√	√
Tuesday	5/2/2023	√	√	√	√
Wednesday	5/3/2023	√	√	√	√
Thursday	5/4/2023	√	√	√	√
Friday	5/5/2023				
Saturday	5/6/2023				
Sunday	5/7/2023				
Monday	5/8/2023	√	√	√	√
Tuesday	5/9/2023	√	√	√	√
Wednesday	5/10/2023	√	√	√	√
Thursday	5/11/2023	√	√	√	√
Friday	5/12/2023				
Saturday	5/13/2023				
Sunday	5/14/2023				
Monday	5/15/2023	√	√	√	√
Tuesday	5/16/2023	√	√	√	√
Wednesday	5/17/2023	√	√	√	√
Thursday	5/18/2023	√	√	√	√
Friday	5/19/2023				
Saturday	5/20/2023				
Sunday	5/21/2023				
Monday	5/22/2023	√	√	√	√
Tuesday	5/23/2023	√	√	√	√
Wednesday	5/24/2023	√	√	√	√
Thursday	5/25/2023	√	√	√	√
Friday	5/26/2023	√	√	√	√
Saturday	5/27/2023	√	√	√	√
Sunday	5/28/2023	√	√	√	√
Monday	5/29/2023	√	√	√	√
Tuesday	5/30/2023	√	√	√	√
Wednesday	5/31/2023	√	√	√	√
Thursday	6/1/2023	√	√	√	√
Friday	6/2/2023	√	√	√	√
Saturday	6/3/2023	√	√	√	√
Sunday	6/4/2023	√	√	√	√
Monday	6/5/2023	√	√	√	√
Tuesday	6/6/2023	√	√	√	√
Wednesday	6/7/2023	√	√	√	√
Thursday	6/8/2023	√	√	√	√
Friday	6/9/2023	√	√	√	√
Saturday	6/10/2023	√	√	√	√
Sunday	6/11/2023	√	√	√	√
Monday	6/12/2023	√	√	√	√
Tuesday	6/13/2023	√	√	√	√
Wednesday	6/14/2023	√	√	√	√
Thursday	6/15/2023	√	√	√	√
Friday	6/16/2023	√	√	√	√
Saturday	6/17/2023	√	√	√	√

Day	Date	Edgewater Beach	Villa Angela Beach	Euclid Beach	Euclid Creek (RM 0.55)
Sunday	6/18/2023	√	√	√	√
Monday	6/19/2023	√	√	√	√
Tuesday	6/20/2023	√	√	√	√
Wednesday	6/21/2023	√	√	√	√
Thursday	6/22/2023	√	√	√	√
Friday	6/23/2023	√	√	√	√
Saturday	6/24/2023	√	√	√	√
Sunday	6/25/2023	√	√	√	√
Monday	6/26/2023	√	√	√	√
Tuesday	6/27/2023	√	√	√	√
Wednesday	6/28/2023	√	√	√	√
Thursday	6/29/2023	√	√	√	√
Friday	6/30/2023	√	√	√	√
Saturday	7/1/2023	√	√	√	√
Sunday	7/2/2023	√	√	√	√
Monday	7/3/2023	√	√	√	√
Tuesday	7/4/2023	√	√	√	√
Wednesday	7/5/2023	√	√	√	√
Thursday	7/6/2023	√	√	√	√
Friday	7/7/2023	√	√	√	√
Saturday	7/8/2023	√	√	√	√
Sunday	7/9/2023	√	√	√	√
Monday	7/10/2023	√	√	√	√
Tuesday	7/11/2023	√	√	√	√
Wednesday	7/12/2023	√	√	√	√
Thursday	7/13/2023	√	√	√	√
Friday	7/14/2023	√	√	√	√
Saturday	7/15/2023	√	√	√	√
Sunday	7/16/2023	√	√	√	√
Monday	7/17/2023	√	√	√	√
Tuesday	7/18/2023	√	√	√	√
Wednesday	7/19/2023	√	√	√	√
Thursday	7/20/2023	√	√	√	√
Friday	7/21/2023	√	√	√	√
Saturday	7/22/2023	√	√	√	√
Sunday	7/23/2023	√	√	√	√
Monday	7/24/2023	√	√	√	√
Tuesday	7/25/2023	√	√	√	√
Wednesday	7/26/2023	√	√	√	√
Thursday	7/27/2023	√	√	√	√
Friday	7/28/2023	√	√	√	√
Saturday	7/29/2023	√	√	√	√
Sunday	7/30/2023	√	√	√	√
Monday	7/31/2023	√	√	√	√
Tuesday	8/1/2023	√	√	√	√
Wednesday	8/2/2023	√	√	√	√
Thursday	8/3/2023	√	√	√	√
Friday	8/4/2023	√	√	√	√
Saturday	8/5/2023	√	√	√	√
Sunday	8/6/2023	√	√	√	√

Day	Date	Edgewater Beach	Villa Angela Beach	Euclid Beach	Euclid Creek (RM 0.55)
Monday	8/7/2023	√	√	√	√
Tuesday	8/8/2023	√	√	√	√
Wednesday	8/9/2023	√	√	√	√
Thursday	8/10/2023	√	√	√	√
Friday	8/11/2023	√	√	√	√
Saturday	8/12/2023	√	√	√	√
Sunday	8/13/2023	√	√	√	√
Monday	8/14/2023	√	√	√	√
Tuesday	8/15/2023	√	√	√	√
Wednesday	8/16/2023	√	√	√	√
Thursday	8/17/2023	√	√	√	√
Friday	8/18/2023	√	√	√	√
Saturday	8/19/2023	√	√	√	√
Sunday	8/20/2023	√	√	√	√
Monday	8/21/2023	√	√	√	√
Tuesday	8/22/2023	√	√	√	√
Wednesday	8/23/2023	√	√	√	√
Thursday	8/24/2023	√	√	√	√
Friday	8/25/2023	√	√	√	√
Saturday	8/26/2023	√	√	√	√
Sunday	8/27/2023	√	√	√	√
Monday	8/28/2023	√	√	√	√
Tuesday	8/29/2023	√	√	√	√
Wednesday	8/30/2023	√	√	√	√
Thursday	8/31/2023	√	√	√	√
Friday	9/1/2023	√	√	√	√
Saturday	9/2/2023	√	√	√	√
Sunday	9/3/2023	√	√	√	√
Monday	9/4/2023	√	√	√	√
Tuesday	9/5/2023	√	√	√	√
Wednesday	9/6/2023	√	√	√	√
Thursday	9/7/2023	√	√	√	√
Friday	9/8/2023				
Saturday	9/9/2023				
Sunday	9/10/2023				
Monday	9/11/2023	√	√	√	√
Tuesday	9/12/2023	√	√	√	√
Wednesday	9/13/2023	√	√	√	√
Thursday	9/14/2023	√	√	√	√
Friday	9/15/2023				
Saturday	9/16/2023				
Sunday	9/17/2023				
Monday	9/18/2023	√	√	√	√
Tuesday	9/19/2023	√	√	√	√
Wednesday	9/20/2023	√	√	√	√
Thursday	9/21/2023	√	√	√	√
Friday	9/22/2023				
Saturday	9/23/2023				
Sunday	9/24/2023				

Day	Date	Edgewater Beach	Villa Angela Beach	Euclid Beach	Euclid Creek (RM 0.55)
Monday	9/25/2023	√	√	√	√
Tuesday	9/26/2023	√	√	√	√
Wednesday	9/27/2023	√	√	√	√
Thursday	9/28/2023	√	√	√	√
Friday	9/29/2023				
Saturday	9/30/2023				

√ = Bacteriological Sampling

Highlight = Replicate

Appendix G. Training Form

2023 Beach Training

Signature: _____ Project Manager: _____

Method Review	Yes	No	Initials	Date
1. Review “2023 Lake Erie Beach Monitoring” Level 3 Project Study Plan				
2. Review "Beach Sampling" SOP.				
3. Review two (2) Turbidity SOPs.				
4. Review District Cell Phone Policy.				
5. Review "Operation of the Hanna HI98129 Meter" SOP.				
6. Review “YSI 600XL Sonde” SOP.				
7. Review “NRS Compact Throw Bag Usage” SOP.				
8. Review “Vehicle and Mobile Radio Operation” SOP				
Safety Equipment Usage	**Yes**	**No**	**Initials**	**Date**
1. Life jacket or inflatable safety vest (must be worn if wave height is greater than two feet; all other conditions are at the Sampler’s discretion)				
2. Chest waders				
3. Gloves, if desired				
4. Throw bag				
5. Cell phone				
6. Sampling pole for inclement weather sampling				
Equipment	**Yes**	**No**	**Initials**	**Date**
1. Can calibrate and use the Hanna HI98129 meter.				
2. Can use digital camera/iPad and upload images.				
3. Can scan beach observation sheets.				
4. Can upload field data.				
5. Can check and use turbidity meter.				
6. Can use wind anemometer.				
7. Uses wave height stick to measure wave height.				
Sampling	**Yes**	**No**	**Initials**	**Date**
1. Samples at correct beach sites and Euclid Creek RM 0.55.				
2. Uses appropriate sample bottles.				
3. Uses proper sampling techniques.				
4. Can fill out Beach Sampling Field Data Form.				
5. Uses cooler with ice.				
6. Truck locked when not occupied/visible.				
7. Can sign over samples and complete Chain of Custody.				
LabLynx Skills	**Yes**	**No**	**Initials**	**Date**
1. Can log in field parameters and approve.				

Revised 02/14/23 JH

Appendix H. Audit Form

Beach Sampling Audit Form

Beach/Samplers Audited: _____ Auditing QDC: _____

Safety Equipment	Yes	No	Initials	Date
1. Life jacket or inflatable safety vest (must be worn if wave height is greater than two feet; all other conditions are at the Sampler's discretion)				
2. Chest waders				
3. Throw bag				
4. Cell phone				
5. Sampling pole for inclement weather sampling				
Sampling Equipment Checklist	**Yes**	**No**	**Initials**	**Date**
1. Field Observation Sheet(s) or iPad				
2. Sterile bacti bottles (enough for all sites being sampled)				
3. Sample tags				
4. Bottles for turbidity samples				
5. pH/Conductivity/Temp meter				
6. Wind anenometer				
7. Wave height stick				
8. Digital camera or iPad				
9. Cooler with ice				
Method Review	**Yes**	**No**	**Initials**	**Date**
1. Samplers obtained samples at appropriate sites.				
2. Sampled at appropriate depth of 3 feet using wave height stick to verify.				
3. Samplers exhibited proper sampling technique.				
a. Uses sterile bottles.				
b. Bottle inverted before it enters the water.				
c. Bottle is plunged 6-12 inches below the surface of the water.				
d. Bottle rotated with the opening facing the surface.				
e. Enough headspace left in bottle.				
f. Bottle capped securely.				
g. Second bottle collected for turbidity analysis.				
4. Can fill out Beach Observation Sheet or enter data into iPad correctly				
5. Uses cooler with ice.				
6. Truck locked when not occupied/visible.				
7. Uses buddy system.				
Equipment Skills	**Yes**	**No**	**Initials**	**Date**
1. Can calibrate and use the Hanna HI98129 meter.				
2. Can use digital camera or iPad and upload images to computer.				
3. Can scan beach observation sheets.				
4. Can check and use turbidity meter.				
5. Can use wind anemometer to measure wind speed.				
6. Can use wave height stick to measure wave height.				
LabLynx Skills	**Yes**	**No**	**Initials**	**Date**
1. Can enter field parameters and approve.				

Comments:

Appendix I. Laboratory Certifications

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: 223822-C

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: 20211443	**Method Ref: SM 9223 B (COLILERT® QUANTI-TRAY®)**		**Revision: 23RD ED**		**Date: 2016**	
2525	ESCHERICHIA COLI	03/23/2021	11/30/2023	D	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2023	D	MIC	NE
Method Code: 20213449	**Method Ref: SM 9223 B (COLILERT®-18 QUANTI-TRAY®)**		**Revision: 23RD ED**		**Date: 2016**	
2525	ESCHERICHIA COLI	03/23/2021	11/30/2023	D	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2023	D	MIC	NE
Method Code: 20214431	**Method Ref: SM 9223 B (COLILERT®-18)**		**Revision: 23RD ED**		**Date: 2016**	
2525	ESCHERICHIA COLI	03/23/2021	11/30/2023	D	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2023	D	MIC	NE
Method Code: 20214442	**Method Ref: SM 9223 B (COLILERT®)**		**Revision: 23RD ED**		**Date: 2016**	
2525	ESCHERICHIA COLI	03/23/2021	11/30/2023	D	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2023	D	MIC	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1000	ALUMINUM	03/23/2021	11/30/2023	D	MET	NE
1015	BARIUM	03/23/2021	11/30/2023	D	MET	NE
1020	BERYLLIUM	03/23/2021	11/30/2023	D	MET	NE
1030	CADMIUM	03/23/2021	11/30/2023	D	MET	NE
1035	CALCIUM	03/23/2021	11/30/2023	D	MET	NE
1040	CHROMIUM	03/23/2021	11/30/2023	D	MET	NE
1055	COPPER	03/23/2021	11/30/2023	D	MET	NE
1070	IRON	03/23/2021	11/30/2023	D	MET	NE
1085	MAGNESIUM	03/23/2021	11/30/2023	D	MET	NE
1090	MANGANESE	03/23/2021	11/30/2023	D	MET	NE
1105	NICKEL	03/23/2021	11/30/2023	D	MET	NE
1150	SILVER	03/23/2021	11/30/2023	D	MET	NE
1155	SODIUM	03/23/2021	11/30/2023	D	MET	NE
1190	ZINC	03/23/2021	11/30/2023	D	MET	NE
Method Code: 10014605	**Method Ref: EPA 200.8**		**Revision: 5.4**		**Date: 1994**	
1000	ALUMINUM	03/23/2021	11/30/2023	D	MET	NE
1005	ANTIMONY	03/23/2021	11/30/2023	D	MET	NE
1010	ARSENIC	03/23/2021	11/30/2023	D	MET	NE
1015	BARIUM	03/23/2021	11/30/2023	D	MET	NE
1030	CADMIUM	03/23/2021	11/30/2023	D	MET	NE
1040	CHROMIUM	03/23/2021	11/30/2023	D	MET	NE
1055	COPPER	01/25/2022	11/30/2023	D	MET	NE

This analyte list supersedes all previously issued analyte lists. 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/water/drinking-water/new-hampshire-environmental-laboratory-accreditation-program).

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

CUYAHOGA HEIGHTS OH 44125
216-641-6000
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1075	LEAD	03/23/2021	11/30/2023	D	MET	NE
1090	MANGANESE	03/23/2021	11/30/2023	D	MET	NE
1105	NICKEL	03/23/2021	11/30/2023	D	MET	NE
1140	SELENIUM	03/23/2021	11/30/2023	D	MET	NE
1150	SILVER	03/23/2021	11/30/2023	D	MET	NE
1190	ZINC	03/23/2021	11/30/2023	D	MET	NE
Method Code: 10036609	**Method Ref: EPA 245.1**		**Revision: 3**		**Date: 1994**	
1095	MERCURY	03/23/2021	11/30/2023	D	MET	NE
Method Code: 10011800	**Method Ref: EPA 180.1**		**Revision: 2.0**		**Date: 1993**	
2055	TURBIDITY	03/23/2021	11/30/2023	D	NMI	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1755	TOTAL HARDNESS AS CACO3	03/29/2021	11/30/2023	D	NMI	NE
Method Code: 10053200	**Method Ref: EPA 300.0**		**Revision: 2.1**		**Date: 1993**	
1575	CHLORIDE	03/23/2021	11/30/2023	D	NMI	NE
1730	FLUORIDE	12/07/2021	11/30/2023	D	NMI	NE
1810	NITRATE AS N	03/23/2021	11/30/2023	D	NMI	NE
1840	NITRITE AS N	03/23/2021	11/30/2023	D	NMI	NE
1870	ORTHOPHOSPHATE AS P	03/23/2021	11/30/2023	D	NMI	NE
2000	SULFATE	03/23/2021	11/30/2023	D	NMI	NE
Method Code: 10067604	**Method Ref: EPA 353.2**		**Revision: 2**		**Date: 1993**	
1810	NITRATE AS N	03/23/2021	11/30/2023	D	NMI	NE
1820	NITRATE PLUS NITRITE AS N	03/23/2021	11/30/2023	D	NMI	NE
1840	NITRITE AS N	03/23/2021	11/30/2023	D	NMI	NE
Method Code: 10070005	**Method Ref: EPA 365.1**		**Revision: 2**		**Date: 1993**	
1870	ORTHOPHOSPHATE AS P	03/23/2021	11/30/2023	D	NMI	NE
Method Code: 20048617	**Method Ref: SM 2510 B-2011**		**Revision:**		**Date: 2011**	
1610	CONDUCTIVITY	03/23/2021	11/30/2023	D	NMI	NE
Method Code: 20050457	**Method Ref: SM 2540 C**		**Revision: 23RD ED**		**Date: 2015**	
1955	RESIDUE-FILTERABLE (TDS)	03/23/2021	11/30/2023	D	NMI	NE
Method Code: 20102414	**Method Ref: SM 4500-F C-2011**		**Revision:**		**Date: 2011**	
1730	FLUORIDE	03/23/2021	11/30/2023	D	NMI	NE
Method Code: 20105220	**Method Ref: SM 4500-H+ B-2011**		**Revision:**		**Date: 2011**	
1900	PH	03/23/2021	11/30/2023	D	NMI	NE
Method Code: 20211443	**Method Ref: SM 9223 B (COLILERT® QUANTI-TRAY®)**		**Revision: 23RD ED**		**Date: 2016**	
2525	ESCHERICHIA COLI	03/23/2021	11/30/2023	N	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2023	N	MIC	NE
Method Code: 20213449	**Method Ref: SM 9223 B (COLILERT®-18 QUANTI-TRAY®)**		**Revision: 23RD ED**		**Date: 2016**	
2525	ESCHERICHIA COLI	03/23/2021	11/30/2023	N	MIC	NE

NORTHEAST OHIO REGIONAL SEWER DISTRICT ANALYTICAL SERVICES
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2500	TOTAL COLIFORMS	03/16/2021	11/30/2023	N	MIC	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1000	ALUMINUM	12/01/2019	11/30/2023	N	MET	NE
1005	ANTIMONY	12/01/2019	11/30/2023	N	MET	NE
1010	ARSENIC	12/01/2019	11/30/2023	N	MET	NE
1015	BARIUM	12/01/2019	11/30/2023	N	MET	NE
1020	BERYLLIUM	12/01/2019	11/30/2023	N	MET	NE
1030	CADMIUM	12/01/2019	11/30/2023	N	MET	NE
1035	CALCIUM	12/01/2019	11/30/2023	N	MET	NE
1040	CHROMIUM	12/01/2019	11/30/2023	N	MET	NE
1050	COBALT	12/01/2019	11/30/2023	N	MET	NE
1055	COPPER	12/01/2019	11/30/2023	N	MET	NE
1070	IRON	12/01/2019	11/30/2023	N	MET	NE
1075	LEAD	12/01/2019	11/30/2023	N	MET	NE
1085	MAGNESIUM	12/01/2019	11/30/2023	N	MET	NE
1090	MANGANESE	12/01/2019	11/30/2023	N	MET	NE
1100	MOLYBDENUM	12/01/2019	11/30/2023	N	MET	NE
1105	NICKEL	12/01/2019	11/30/2023	N	MET	NE
1125	POTASSIUM	12/01/2019	11/30/2023	N	MET	NE
1140	SELENIUM	12/01/2019	11/30/2023	N	MET	NE
1150	SILVER	12/01/2019	11/30/2023	N	MET	NE
1155	SODIUM	12/01/2019	11/30/2023	N	MET	NE
1160	STRONTIUM	12/01/2019	11/30/2023	N	MET	NE
1165	THALLIUM	12/01/2019	11/30/2023	N	MET	NE
1175	TIN	12/01/2019	11/30/2023	N	MET	NE
1180	TITANIUM	12/01/2019	11/30/2023	N	MET	NE
1185	VANADIUM	12/01/2019	11/30/2023	N	MET	NE
1190	ZINC	12/01/2019	11/30/2023	N	MET	NE
Method Code: 10014605	**Method Ref: EPA 200.8**		**Revision: 5.4**		**Date: 1994**	
1000	ALUMINUM	12/01/2019	11/30/2023	N	MET	NE
1005	ANTIMONY	12/01/2019	11/30/2023	N	MET	NE
1010	ARSENIC	12/01/2019	11/30/2023	N	MET	NE
1015	BARIUM	12/01/2019	11/30/2023	N	MET	NE
1020	BERYLLIUM	12/01/2019	11/30/2023	N	MET	NE
1030	CADMIUM	12/01/2019	11/30/2023	N	MET	NE
1035	CALCIUM	12/01/2019	11/30/2023	N	MET	NE

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4747 EAST 49TH STREET

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1040	CHROMIUM	12/01/2019	11/30/2023	N	MET	NE
1050	COBALT	12/01/2019	11/30/2023	N	MET	NE
1055	COPPER	12/01/2019	11/30/2023	N	MET	NE
1070	IRON	12/01/2019	11/30/2023	N	MET	NE
1075	LEAD	12/01/2019	11/30/2023	N	MET	NE
1085	MAGNESIUM	12/01/2019	11/30/2023	N	MET	NE
1090	MANGANESE	12/01/2019	11/30/2023	N	MET	NE
1100	MOLYBDENUM	12/01/2019	11/30/2023	N	MET	NE
1105	NICKEL	12/01/2019	11/30/2023	N	MET	NE
1125	POTASSIUM	12/01/2019	11/30/2023	N	MET	NE
1140	SELENIUM	12/01/2019	11/30/2023	N	MET	NE
1150	SILVER	12/01/2019	11/30/2023	N	MET	NE
1155	SODIUM	12/01/2019	11/30/2023	N	MET	NE
1160	STRONTIUM	12/01/2019	11/30/2023	N	MET	NE
1175	TIN	12/01/2019	11/30/2023	N	MET	NE
1180	TITANIUM	12/01/2019	11/30/2023	N	MET	NE
1185	VANADIUM	12/01/2019	11/30/2023	N	MET	NE
1190	ZINC	12/01/2019	11/30/2023	N	MET	NE
Method Code: 10036609	**Method Ref: EPA 245.1**		**Revision: 3**		**Date: 1994**	
1095	MERCURY	12/01/2019	11/30/2023	N	MET	NE
Method Code: 10237204	**Method Ref: EPA 1631E**		**Revision:**		**Date: 2002**	
1095	MERCURY	12/01/2019	11/30/2023	N	MET	NE
Method Code: 20066266	**Method Ref: SM 3500-CR B-2011**		**Revision:**		**Date: 2011**	
1045	CHROMIUM (VI)	12/01/2019	11/30/2023	N	MET	NE
Method Code: 10011800	**Method Ref: EPA 180.1**		**Revision: 2.0**		**Date: 1993**	
2055	TURBIDITY	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1755	TOTAL HARDNESS AS CACO3	03/29/2021	11/30/2023	N	NMI	NE
Method Code: 10014605	**Method Ref: EPA 200.8**		**Revision: 5.4**		**Date: 1994**	
1755	TOTAL HARDNESS AS CACO3	03/29/2021	11/30/2023	N	NMI	NE
Method Code: 10053200	**Method Ref: EPA 300.0**		**Revision: 2.1**		**Date: 1993**	
1540	BROMIDE	12/01/2019	11/30/2023	N	NMI	NE
1575	CHLORIDE	12/01/2019	11/30/2023	N	NMI	NE
1810	NITRATE AS N	12/01/2019	11/30/2023	N	NMI	NE
1840	NITRITE AS N	12/01/2019	11/30/2023	N	NMI	NE
1870	ORTHOPHOSPHATE AS P	12/01/2019	11/30/2023	N	NMI	NE
2000	SULFATE	12/01/2019	11/30/2023	N	NMI	NE

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Method Code: 10055206	**Method Ref: EPA 310.2**		**Revision:**		**Date: 1974**	
1505	ALKALINITY AS CACO3	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 10063602	**Method Ref: EPA 350.1**		**Revision: 2**		**Date: 1993**	
1515	AMMONIA AS N	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 10065404	**Method Ref: EPA 351.2**		**Revision: 2**		**Date: 1993**	
1795	TOTAL KJELDAHL NITROGEN (TKN)	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 10067604	**Method Ref: EPA 353.2**		**Revision: 2**		**Date: 1993**	
1810	NITRATE AS N	12/01/2019	11/30/2023	N	NMI	NE
1820	NITRATE PLUS NITRITE AS N	03/09/2020	11/30/2023	N	NMI	NE
1840	NITRITE AS N	03/23/2021	11/30/2023	N	NMI	NE
Method Code: 10070005	**Method Ref: EPA 365.1**		**Revision: 2**		**Date: 1993**	
1713	DISSOLVED REACTIVE PHOSPHORUS	11/26/2022	11/30/2023	N	NMI	NE
1870	ORTHOPHOSPHATE AS P	12/01/2019	11/30/2023	N	NMI	NE
1910	TOTAL PHOSPHORUS	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 10077404	**Method Ref: EPA 410.4**		**Revision: 2**		**Date: 1993**	
1565	CHEMICAL OXYGEN DEMAND (COD)	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 10079400	**Method Ref: EPA 420.1**		**Revision:**		**Date: 1978**	
1905	TOTAL PHENOLICS	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 10081400	**Method Ref: EPA 445**		**Revision: 1.2**		**Date: 1997**	
9345	CHLOROPHYLLS	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 10261617	**Method Ref: EPA 1664B**		**Revision:**		**Date: 2010**	
1803	N-HEXANE EXTRACTABLE MATERIAL (O&G)	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 20048617	**Method Ref: SM 2510 B-2011**		**Revision:**		**Date: 2011**	
1610	CONDUCTIVITY	03/23/2021	11/30/2023	N	NMI	NE
Method Code: 20049438	**Method Ref: SM 2540 B-2015**		**Revision:**		**Date: 2015**	
1950	RESIDUE-TOTAL (TS)	08/22/2021	11/30/2023	N	NMI	NE
Method Code: 20050457	**Method Ref: SM 2540 C**		**Revision: 23RD ED**		**Date: 2015**	
1955	RESIDUE-FILTERABLE (TDS)	03/23/2021	11/30/2023	N	NMI	NE
Method Code: 20051223	**Method Ref: SM 2540 D-2015**		**Revision:**		**Date: 2015**	
1960	RESIDUE-NONFILTERABLE (TSS)	08/22/2021	11/30/2023	N	NMI	NE
Method Code: 20080426	**Method Ref: SM 4500-CL E-2011**		**Revision:**		**Date: 2011**	
1940	TOTAL RESIDUAL CHLORINE	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 20085216	**Method Ref: SM 4500-CL C-2011**		**Revision:**		**Date: 2011**	
1575	CHLORIDE	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 20097023	**Method Ref: SM 4500-CN G**		**Revision: 23RD ED**		**Date: 2016**	
1510	AMENABLE CYANIDE	03/23/2021	11/30/2023	N	NMI	NE
Method Code: 20099814	**Method Ref: SM 4500-CN N**		**Revision: 23RD ED**		**Date: 2016**	
1645	TOTAL CYANIDE	11/26/2022	11/30/2023	N	NMI	NE

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Method Code: 20105220	**Method Ref: SM 4500-H+ B-2011**		**Revision:**		**Date: 2011**	
1900	PH	12/01/2019	11/30/2023	N	NMI	NE
Method Code: 20135039	**Method Ref: SM 5210 B-2016**		**Revision:**		**Date: 2016**	
1530	BIOCHEMICAL OXYGEN DEMAND (BOD)	03/23/2021	11/30/2023	N	NMI	NE
1555	CARBONACEOUS BOD (CBOD)	03/23/2021	11/30/2023	N	NMI	NE
Method Code: 20137637	**Method Ref: SM 5310 B-2014**		**Revision: 23RD ED**		**Date: 2014**	
2040	TOTAL ORGANIC CARBON (TOC)	03/23/2021	11/30/2023	N	NMI	NE
Method Code: 20138630	**Method Ref: SM 5310 C**		**Revision: 23RD ED**		**Date: 2014**	
2040	TOTAL ORGANIC CARBON (TOC)	03/23/2021	11/30/2023	N	NMI	NE
Method Code: 30034107	**Method Ref: ASTM D7781-14**		**Revision:**		**Date: 2014**	
1820	NITRATE PLUS NITRITE AS N	11/26/2022	11/30/2023	N	NMI	NE
Method Code: 60031450	**Method Ref: OIA 1677-09**		**Revision:**		**Date: 2010**	
1523	AVAILABLE CYANIDE	03/23/2021	11/30/2023	N	NMI	NE
Method Code: 10133207	**Method Ref: SW-846 3005A**		**Revision: UPDATE I**		**Date: 1992**	
1438	PRECONCENTRATION UNDER ACID	12/01/2019	11/30/2023	N	PRE	NE
Method Code: 10133605	**Method Ref: SW-846 3010A**		**Revision: UPDATE I**		**Date: 1992**	
1420	HOT PLATE ACID DIGESTION (HNO3 + HCL)	12/01/2019	11/30/2023	N	PRE	NE
Method Code: 10134006	**Method Ref: SW-846 3015A**		**Revision: UPDATE IV**		**Date: 2007**	
1430	MICROWAVE-ASSISTED ACID DIGESTION OF TCLP EXTRACTS	03/23/2021	11/30/2023	N	PRE	NH
Method Code: 20095458	**Method Ref: SM 4500-CN C**		**Revision: 23RD ED**		**Date: 2016**	
1412	CYANIDE, MANUAL DISTILLATION	11/26/2022	11/30/2023	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	11/30/2023	N	TOX	NE
3475	NOEC (GROWTH)	12/01/2019	11/30/2023	N	TOX	NE
3465	NOEC (SURVIVAL)	12/01/2019	11/30/2023	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	11/30/2023	N	TOX	NE
3465	NOEC (SURVIVAL)	12/01/2019	11/30/2023	N	TOX	NE
3485	NOEC REPRODUCTION	12/01/2019	11/30/2023	N	TOX	NE
Method Code: 10013806	**Method Ref: EPA 200.7**		**Revision: 4.4**		**Date: 1994**	
1000	ALUMINUM	12/01/2019	11/30/2023	SC	MET	NE
1005	ANTIMONY	12/01/2019	11/30/2023	SC	MET	NE
1010	ARSENIC	12/01/2019	11/30/2023	SC	MET	NE
1015	BARIUM	12/01/2019	11/30/2023	SC	MET	NE
1020	BERYLLIUM	12/01/2019	11/30/2023	SC	MET	NE
1030	CADMIUM	12/01/2019	11/30/2023	SC	MET	NE
1035	CALCIUM	12/01/2019	11/30/2023	SC	MET	NE

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1040	CHROMIUM	12/01/2019	11/30/2023	SC	MET	NE
1050	COBALT	12/01/2019	11/30/2023	SC	MET	NE
1055	COPPER	12/01/2019	11/30/2023	SC	MET	NE
1070	IRON	12/01/2019	11/30/2023	SC	MET	NE
1075	LEAD	12/01/2019	11/30/2023	SC	MET	NE
1085	MAGNESIUM	12/01/2019	11/30/2023	SC	MET	NE
1090	MANGANESE	12/01/2019	11/30/2023	SC	MET	NE
1100	MOLYBDENUM	12/01/2019	11/30/2023	SC	MET	NE
1105	NICKEL	12/01/2019	11/30/2023	SC	MET	NE
1125	POTASSIUM	12/01/2019	11/30/2023	SC	MET	NE
1140	SELENIUM	12/01/2019	11/30/2023	SC	MET	NE
1150	SILVER	12/01/2019	11/30/2023	SC	MET	NE
1155	SODIUM	12/01/2019	11/30/2023	SC	MET	NE
1160	STRONTIUM	12/01/2019	11/30/2023	SC	MET	NE
1165	THALLIUM	12/01/2019	11/30/2023	SC	MET	NE
1175	TIN	12/01/2019	11/30/2023	SC	MET	NE
1180	TITANIUM	12/01/2019	11/30/2023	SC	MET	NE
1185	VANADIUM	12/01/2019	11/30/2023	SC	MET	NE
1190	ZINC	12/01/2019	11/30/2023	SC	MET	NE
Method Code: 10036609	**Method Ref: EPA 245.1**		**Revision: 3**		**Date: 1994**	
1095	MERCURY	12/01/2019	11/30/2023	SC	MET	NE
Method Code: 10063602	**Method Ref: EPA 350.1**		**Revision: 2**		**Date: 1993**	
1515	AMMONIA AS N	12/01/2019	11/30/2023	SC	NMI	NE
Method Code: 10065404	**Method Ref: EPA 351.2**		**Revision: 2**		**Date: 1993**	
1795	TOTAL KJELDAHL NITROGEN (TKN)	12/01/2019	11/30/2023	SC	NMI	NE
Method Code: 10070005	**Method Ref: EPA 365.1**		**Revision: 2**		**Date: 1993**	
1910	TOTAL PHOSPHORUS	12/01/2019	11/30/2023	SC	NMI	NE
Method Code: 10198455	**Method Ref: SW-846 9045D**		**Revision: UPDATE IIIB**		**Date: 2004**	
1900	PH	03/23/2021	11/30/2023	SC	NMI	NE
Method Code: 20005270	**Method Ref: SM 2540 G-2011**		**Revision:**		**Date: 2011**	
1947	RESIDUE - FIXED	12/01/2019	11/30/2023	SC	NMI	NE
1950	RESIDUE-TOTAL (TS)	12/01/2019	11/30/2023	SC	NMI	NE
1970	RESIDUE-VOLATILE	12/01/2019	11/30/2023	SC	NMI	NE
Method Code: NH0344	**Method Ref: NEORSD SOP 2037-06**		**Revision: 6**		**Date:**	
1645	TOTAL CYANIDE	12/07/2021	11/30/2023	SC	NMI	NE
Method Code: 10136002	**Method Ref: SW-846 3051A**		**Revision: UPDATE IV**		**Date: 2007**	
1426	MICROWAVE DIGESTION OF SOLIDS	03/23/2021	11/30/2023	SC	PRE	NE

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NORTHEAST 1/11/2023

Bill Hall
NH ELAP Program Manager
Issue Date: 01/11/2023

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, PFC=Perfluorinated compound

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

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 2016 TNI Standards and Env-C 300.

Certificate Number: 223822

Effective Date: 12/1/2022

Expiration Date: 11/30/2023

Laboratory ID: 2238

NORTHEAS11/16/2022

Bill Hall
NH ELAP Program Manager

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