

Level 3 Project Study Plan*2021 Cuyahoga River Environmental Monitoring***Table of Contents**

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2021 Cuyahoga River Environmental Monitoring
April 29, 2021

List of Acronyms

AOC	Area of Concern
EPA	Environmental Protection Agency
GPS	Global Positioning System
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
MIwb	Modified Index of Well-Being
NEORS	Northeast Ohio Regional Sewer District
NPDES	National Pollution Discharge Elimination System
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
SOMRS	SOM Relief Sewer
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
WQIS	Water Quality & Industrial Surveillance
WWTC	Wastewater Treatment Center

(1) Objective

The lower 46.5 miles of the Cuyahoga River has been designated as one of 42 Great Lakes Areas of Concern (AOC) by the International Joint Commission. Past monitoring indicated impairment of aquatic biota in the river and was the basis for the establishment of Total Maximum Daily Loads (TMDLs) for the Lower Cuyahoga River. The causes of impairment to the river were classified as organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration (Ohio EPA, 2003). Recent monitoring by the Northeast Ohio Regional Sewer District (NEORSD), however, has shown recovery of the biological communities in some reaches of the river. The purpose of this study is to determine the attainment status of the river sections in their relation to point and nonpoint sources of pollution.

During the course of this study, the fish communities, benthic macroinvertebrate communities, habitat, and water chemistry will be surveyed at four sites in the Cuyahoga River. This sampling will be conducted by the NEORSD's Environmental Assessment group in the Water Quality and Industrial Surveillance (WQIS) Division. Fish assessments at RMs 22.40 and 20.75 may be conducted in conjunction with Ohio EPA staff. Sampling will occur from June 15 through September 30, 2021 (through October 15 for fish sampling assessments), as required in the Ohio EPA Biological Criteria for the Protection of Aquatic Life Volume III (1987b). The results from these surveys will be used to characterize the overall fish and macroinvertebrate community health in the river.

Fish and macroinvertebrate community health will be evaluated using Ohio EPA's Index of Biotic Integrity (IBI), Modified Index of Well-Being (MIwb) and Invertebrate Community Index (ICI). An examination of the biological communities will be used in conjunction with water quality data, the NEORSD Macroinvertebrate Field Sheet, and Qualitative Habitat Evaluation Index (QHEI) results in order to identify impacts to the communities. Results will be compared to historic data to show temporal as well as spatial trends. Water chemistry data will also be compared to the Ohio Water Quality Standards to determine attainment of applicable uses (Ohio EPA, 2021).

In addition, chlorophyll *a* levels in the river may be measured at all four sites to assist in the determination of the impacts from nutrients in the river on the algal production. If completed, data sondes may be installed in the river as part of this sampling to provide a more comprehensive understanding of the relationship among algal production, nutrient levels, and dissolved oxygen level swings in the river.

Please see "2021 NEORSD Watershed Monitoring Study Plan" for further details regarding study activities and supporting documentation.

(2) Non-point/Point Sources

Point Sources (Location on river)	Nonpoint Sources
Mill Creek (RM 11.49)	Agricultural runoff
West Creek (RM 11.05)	Urban runoff
Southerly WWTC (RM 10.57)	Landfills
Ohio Canal (RM 8.78)	Spills
Combined Sewer Overflows	
Storm Sewer Outfalls	
Home Septic Systems	
NPDES permitted facilities	

A map has been provided below (Figure 1) to show the wastewater collection system that may be influencing the water quality at each sample location. These sources, along with the ones listed in the table above, may be impacting the health of the fish, benthic macroinvertebrate communities and water chemistry in the Cuyahoga River watershed.

(6) Sampling Locations

The following electrofishing and macroinvertebrate sampling locations, listed from upstream to downstream, will be surveyed during the 2021 field season and are summarized in Table 2 below. Benthic macroinvertebrate and water chemistry collection sites are located near the midpoint of each electrofishing zone, indicated by RM, unless otherwise noted. GPS coordinates are recorded at the downstream end of each sampling zone.

Table 2. Cuyahoga River Monitoring Sites							
Location	Latitude	Longitude	River Mile	Station ID	Description	USGS HUC 8	Purpose
Upstream of Rockside Road	41.3929	-81.6295	13.15	502020	Upstream of Rockside Road	04110002 - Cuyahoga	Evaluate Southerly WWTC and CSO discharges on fish, habitat, macroinvertebrates, water chemistry, and chlorophyll <i>a</i> levels.
Upstream of Southerly WWTC	41.4196	-81.6547	10.75	F01A25	Upstream of Southerly WWTC effluent discharge	04110002 - Cuyahoga	Evaluate Southerly WWTC and CSO discharges on fish, habitat, macroinvertebrates, water chemistry and chlorophyll <i>a</i> levels.
Downstream of Southerly WWTC	41.4242	-81.6638	10.10	F99Q02	Downstream of Southerly WWTC effluent discharge	04110002 - Cuyahoga	Evaluate Southerly WWTC and CSO discharges on fish, habitat, macroinvertebrates, water chemistry and chlorophyll <i>a</i> levels.
Downstream of Southerly WWTC	41.4381	-81.6680	8.60	200025	Downstream of Southerly WWTC effluent discharge	04110002 - Cuyahoga	Evaluate Southerly WWTC and CSO discharges on fish, habitat, macroinvertebrates, water chemistry and chlorophyll <i>a</i> levels.



Figure 1. Map of Cuyahoga River Monitoring Sites

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List of Acronyms

DELTs	Deformities, Eroded Fins, Lesions & Tumors
EPA	Environmental Protection Agency
GPS	Global Positioning System
HD	Hester-Dendy
HUC	Hydrologic Unit Code
IBI	Index of Biotic Integrity
ICI	Invertebrate Community Index
LIBI	Lacustrary Index of Biotic Integrity
LICI	Lacustrary Invertebrate Community Index
L-QHEI	Lacustrary Qualitative Habitat Evaluation Index
MIwb	Modified Index of Well-Being
NEORSD	Northeast Ohio Regional Sewer District
PVC	Polyvinyl Chloride
PVDF	Polyvinylidene Fluoride
QDC	Qualified Data Collector
QHEI	Qualitative Habitat Evaluation Index
RM	River Mile
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
USGS	United States Geological Survey
WQIS	Water Quality & Industrial Surveillance

(3) Parameters Covered

Fish specimens will be identified to species level, weighed, counted and examined for the presence of external anomalies including DELTs (deformities, eroded fins, lesions and tumors). An Ohio EPA Fish Data Sheet (Appendix A) will be completed during each assessment. Quantitative fish sampling is expected to be conducted at all locations.

Macroinvertebrate community assemblages will be collected from each location. An external Level 3 Qualified Data Collector for Benthic Macroinvertebrate Biology Identification will identify and enumerate the specimens collected from each site¹. All specimens will be identified to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b)². The NEORSD Macroinvertebrate Field Sheet (Appendix A) will be completed at each site during sample retrieval or when qualitative sampling is conducted.

Stream habitat will be measured by scoring components of the QHEI at all locations, including the substrate, instream cover, channel morphology, riparian zone, bank erosion, pool/glide and riffle/run quality and gradient. The Lacustrary QHEI (L-QHEI) will be performed at sites that are affected by the water level of Lake Erie. Examples of the Ohio EPA field sheets for the QHEI and the L-QHEI can be found in Appendix A.

Water chemistry samples will be collected at each electrofishing/ macroinvertebrate sampling site included in the study. Water chemistry samples will be analyzed by NEORSD's Analytical Services Division. Appendix B lists the parameters to be tested along with the detection limits and practical quantitation limits. Field measurements for dissolved oxygen, pH, temperature, conductivity and turbidity will also be performed. A Surface Water Condition Sampling Field Data Form will be completed at each site during each sampling event (Appendix A).

Benthic and water column chlorophyll *a* samples may be collected from stream locations. Chemical and physical water quality parameters to be measured in conjunction with the chlorophyll *a* samples include total phosphorus, dissolved reactive phosphorus, nitrite, nitrate+nitrite, ammonia, alkalinity, turbidity and suspended solids. In the Cuyahoga River, YSI 6600EDS, or EXO2 data sondes may be installed at RMs 16.20, 10.75, 10.10, and 7.00 around the time that this sampling

¹ The contractor responsible for doing this work as not been identified yet. Once this contract is awarded, their contact information will be submitted.

²See Appendix H for a list of all references.

is conducted to more frequently monitor dissolved oxygen, temperature, conductivity, specific conductivity and pH.

(4) Field Collection and Data Assessment Techniques

Field collections for fish will be conducted at all stream locations. Sampling will be conducted using longline, tote barge, backpack, or boat electrofishing techniques and will consist of shocking all habitat types within a sampling zone. Headwater and wading sites, which are 0.15 and 0.20 kilometers in length, respectively, will be surveyed by moving from downstream to upstream. Boat sites, which are 0.50 kilometers in length, will be surveyed by moving from upstream to downstream. The stunned fish will be collected and placed into a live well for later identification. The longline, tote barge, backpack, and boat electrofishing zones will be assessed one to three times during the field season (June 15 - October 15).

Fish will be identified to the species level, weighed, counted, and examined for the presence of external anomalies including DELTs. Fish easily identified (commonly collected from year to year) will be returned to the site from which they are collected. Fish species difficult to identify will be brought back to the laboratory for verification by NEORSD Level 3 Fish Qualified Data Collectors (QDC). If necessary, vouchers will be sent to The Ohio State University Museum of Biological Diversity for verification by the Curator and/or Associate Curator of Fish. Voucher specimens will be collected as described in section (14). Endangered species and those too large for preservation will not be collected as voucher specimens, but will instead be photographed. Photographed vouchers will include features that permit definitive identification of the particular species.

Fish will be preserved in 10 percent formalin in the field, soaked in tap water for 24 to 48 hours after 5 to 7 days, then transferred to solutions of 30 and 50 percent ethanol for 5 to 7 days each and, finally, to 70 percent ethanol for long-term storage. Specimens larger than six inches will be slit along the right side and then soaked in formalin for approximately 10 to 14 days before being transferred to water and solutions of 30, 50 and 70 percent ethanol. Label information will include location (description and coordinates), date, time, collectors' names and sample identification code for each specimen collected.

Macroinvertebrate sampling will be conducted using quantitative and qualitative sampling techniques. Quantitative sampling will be done using a modified Hester-Dendy multi-plate artificial substrate sampler (HD) that is colonized for a six-week period. Multiple HD samplers may be installed at one or all sampling locations in case samplers are lost due to vandalism, burial, etc. or for the purposes of providing a replicate sample. Qualitative sampling will be conducted using a D-frame dip net when HD samplers are retrieved. The NEORSD Macroinvertebrate Field Sheet will

be completed during each HD retrieval. NEORSD Level 3 QDCs for Benthic Macroinvertebrate Biology Identification may identify specimens in replicate samples to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b).

Macroinvertebrate voucher specimens for both quantitative and qualitative sampling will be collected as described in section (14). Macroinvertebrate community assemblages collected will be shipped to an external Level 3 Qualified Data Collector for Benthic Macroinvertebrate Biology Identification for identification and enumeration. The Level 3 QDC will identify specimens to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b).

A detailed description of the sampling and analysis methods utilized in the fish community and macroinvertebrate surveys, including calculations of the IBI, MIwb, and ICI, can be found in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). Methods for assessing fish and macroinvertebrate communities in lacustrine zones can be found in Ohio EPA's draft *Biological Criteria for the Protection of Aquatic Life, Volume IV* (1997).

The QHEI, as described in Ohio EPA's *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006) will be used to assess aquatic habitat conditions at each sample location. The L-QHEI will be used where appropriate and will follow Ohio EPA's *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1)* (2010).

Water chemistry sampling may occur across a variety of flow conditions. Techniques used for water chemistry sampling and chemical analyses will follow the *Surface Water Field Sampling Manual for water quality parameters and flows* (Ohio EPA, 2019). Chemical water quality samples from each site will be collected with at least one 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and two 473-mL plastic bottles. Water samples collected for analysis of dissolved reactive phosphorus will be filtered using a 0.45- μm PVDF syringe filter and will be collected in a 125-mL plastic bottle. Bacteriological samples will be collected in a sterile plastic bottle preserved with sodium thiosulfate. All water quality samples will be collected as grab samples. Field blanks and duplicate samples will each comprise not less than 5% of the total samples collected for this study plan, for a total frequency of quality control samples of not less than 10% of the total samples collected. With the exception of bacteriological duplicate samples, the acceptable percent RPD will be based on the ratio of the sample concentration and detection limit (Ohio EPA, 2019): Acceptable % RPD = $[(0.9465X^{-0.344}) * 100] + 5$, where X = sample/detection limit ratio. For

bacteriological duplicates, duplicate samples more than 5x apart from one another (%RPD > 133.3%) will be rejected in accordance with the Ohio EPA approved method for data validation of bacteriological samples outlined in Section F of the *Ohio 2020 Integrated Water Quality Monitoring and Assessment Report* (Ohio EPA, 2020). Those RPDs that were higher than acceptable may indicate potential problems with sample collection and, as a result, the data will not be used for comparison to the water quality standards. Acid preservation of the samples, as specified in the NEORSD laboratory's standard operating procedure for each parameter, will occur in the field. Appendix B lists the analytical method, method detection limit and practical quantitation limit for each parameter analyzed. Field analyses include the use of either a YSI EXO1 sonde, or YSI 600XL sonde to measure dissolved oxygen (DO), water temperature, conductivity and pH; and when necessary, a Hanna HI 98129 meter to measure pH and a Hach HQ30d meter with LDO101 probe to measure DO. Field turbidity will be measured using a Hach 2100Q Turbidimeter. Specifications for these meters have been included in Appendix C.

Benthic and water column chlorophyll *a* samples may be collected if time and resources allow. Sampling methods will follow those detailed in the NEORSD *Chlorophyll a Sampling and Field Filtering Standard Operating Procedure* (SOP-EA001-00). A Chlorophyll *a* Sampling Field Sheet will be completed for each site (Appendix D). Water chemistry grab samples will be collected at the same time using the methods discussed previously and will be analyzed for nutrients, turbidity, alkalinity and suspended solids. Additionally, in the Cuyahoga River, approximately 24-hours prior to each chlorophyll *a* sampling event, YSI 6600 EDS, or EXO2 data sondes may be deployed at RMs 16.20, 10.75, 10.10 and 7.00. If installed, each data sonde will record, at fifteen-minute intervals, dissolved oxygen concentration, pH, temperature, and conductivity from the time the data sonde is deployed until the time it is retrieved. These data sondes will be placed in the stream by inserting each one into a 4.5-inch PVC pipe with holes drilled into the sides of the lower third of the pipe to allow water to pass through it. The data sondes will remain in the river for approximately 24-hours or longer following collection of the chlorophyll *a* samples.

Where possible, data assessment will include an analysis of temporal and spatial trends in the collected data. Species assemblages and individual metrics will be analyzed. Graphs that show current and historic QHEI, L-QHEI, IBI, LIBI, MIwb, ICI, and LICCI scores and how these scores compare to attainment status of biocriteria will be prepared. Water chemistry data collected will be compared to Ohio water quality standards to determine whether any excursions from the applicable water quality criteria have occurred. It will also be used to determine any relationships among individual parameters and chlorophyll *a* concentrations.

Comparisons between water quality and biological community health will only be made if at least three water quality samples have been collected from that site.

(5) Stream Flow Measurement

Stream flow will be recorded for all locations during each electrofishing pass utilizing data from the United States Geological Survey (USGS) gauge station nearest the stream location, if applicable.

Stream flow will be measured with a Marsh-McBirney FloMate Model 2000 Portable Flow Meter, a HACH FH950 Flow Meter or an Aquaflow Probe Model 6900, which measure flow in feet per second, when HD samplers are installed and retrieved. The specifications for the flow meters can be found in Appendix C.

(7) Schedule

One to three electrofishing surveys will be conducted at each site between June 15 and October 15, 2021. Surveys will be conducted at least three weeks apart. Specific dates have not been scheduled. River flow and weather conditions will be assessed weekly to determine when each electrofishing pass will be conducted.

Artificial substrate samplers will be installed at stream locations between June 15 and August 19, 2021 and retrieved six weeks later. Qualitative macroinvertebrate sampling will be conducted one time at all sites. Specific dates have not been scheduled. River flow and weather conditions will be assessed weekly to determine when the HD sampler installations and retrievals and qualitative sampling will be conducted.

QHEI, and, if necessary, L-QHEI habitat evaluations will be conducted one time between June 15 and October 15, 2021. QHEI evaluations will be conducted around the same time as one of the electrofishing surveys.

Water chemistry samples will be collected a minimum of three times from stream locations between June 15 and October 15, 2021.

Benthic and water column chlorophyll *a* samples may be collected at least one time from stream locations between June 15 and October 15, 2021. These samples will be collected under low-flow conditions.

(8) QA/QC

Quality assurance and quality control of sampling and analysis methods for habitat, fish, and macroinvertebrate evaluations will follow Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b), *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006), draft *Biological Criteria for the Protection of Aquatic Life: Volume IV: Fish and Macroinvertebrate Indices for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustraries* (1997) and *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1)* (2010)

Electrofishing equipment will be used according to the guidelines listed in the operation and maintenance manual provided by Smith-Root, Inc. Malfunctioning equipment will not be used to collect data. Proper steps will be taken to correct any problems as soon as possible, whether by repairing in the field, at the NEORSD Environmental & Maintenance Services Center, or by contacting the supplier or an appropriate service company.

Fish species difficult to identify will be brought back to the laboratory for verification by Level 3 Fish QDC's, and if necessary, sent to The Ohio State University Museum of Biological Diversity for verification by the Curator and/or Associate Curator of Fish. Voucher specimens will be collected as described in section (14). Endangered species and those too large for preservation will not be collected as voucher specimens, but will instead be photographed. Photographed vouchers will include features that permit definitive identification of the particular species.

All macroinvertebrate community assemblages from stream locations, except for any replicate samples, will be collected and shipped to an external Level 3 Qualified Data Collector for Benthic Macroinvertebrate Biology Identification for identification and enumeration. All specimens will be identified to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b). All macroinvertebrate specimens will be returned to NEORSD. At least two voucher specimens of each species, when available, will be separated into individual vials and kept as described in section (14). The remaining specimens for each site will be returned in a single container labeled with the site number and collection method and date. All specimens and accompanying chain-of-custody documentation will be retained by NEORSD and stored at the Environmental & Maintenance Services Center for a period not less than ten years.

Water samples obtained for chemical analyses will be collected, preserved (see Section 4), labeled and then placed on ice inside the field truck. The field truck will

remain locked at all times when not occupied/visible. Sampling activities, including sample time and condition of surface water sampled, will be entered in a field log book and on the Surface Water Condition Sampling Field Data Form. The samples will then be delivered immediately to the NEORSD Analytical Services cooler, after which the door to the cooler will be locked, and the samples will be transferred to the custody of Analytical Services. The NEORSD Analytical Services Quality Manual and associated Standard Operating Procedures are on file with Ohio EPA. The Quality Assurance Officer at Analytical Services will send updates, revisions and any information on document control to Ohio EPA as needed.

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

Calibration of YSI 600XL, 6600EDS, EXO1, and EXO2 data sondes will be done according to the YSI Environmental Operations Manual. The conductivity will be calibrated first using a 1.413 mS/cm standard. Second, the pH will be calibrated using two different buffers (7 and 10 s.u.). The DO will be calibrated last with an acceptable error of 0.2 mg/L.

Once the 6600EDS or EXO2 sondes are removed from the river following long-term installation, the accuracy of the data that has been collected will be checked by comparing readings taken by the sondes to known standards. If the measurements taken at this time meet quality control goals, all of the data collected since the last calibration will be considered accurate. The acceptable differences for pH and conductivity will be ± 0.3 with pH 7 buffer and $\pm 10\%$ of the conductivity standard, respectively (EPA New England- Region 1, 2005). The acceptable difference for DO will be ± 0.2 mg/L. If the measurements do not meet quality control goals, best professional judgment will be used to decide if any of the data collected during that period may still be accurate. For example, the data collected from the four locations may be plotted on the same graph, and if it appears that the data points are following similar trends, they may be considered accurate. If any data that do not meet quality control goals are used, a rationale for their inclusion will be provided when the data are submitted.

(9) Work Products

Within one year of completion of the project, fish data (species, numbers, weights, pollution tolerances, the incidence of DELT anomalies, IBI or LIBI, MIwb scores), macroinvertebrate data (types and numbers of macroinvertebrates collected and ICI or LICI scores), habitat data (QHEI or L-QHEI raw data and scores) and water chemistry results will be submitted to the Ohio EPA or an Ohio EPA approved data warehouse. Additionally, reports summarizing, interpreting, graphically presenting

and discussing the IBI (LIBI, where applicable), MIwb, ICI (LICI, where applicable) and QHEI (L-QHEI, where applicable) scores, chlorophyll *a* results, and any excursions from water quality standards may be prepared for internal use.

(10) Qualified Data Collectors

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

Name	Address	Email Address	Phone Number	QDC Specialty(s)
Hannah Boesinger	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	boesingerh@neorsd.org	216-641-6000	QDC – 01374 CWQA
Seth Hothem ¹	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 00010 CWQA/FCB/SHA/ BMB
Jillian Knittle	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	knittlej@neorsd.org	216-641-6000	QDC – 00512 CWQA/SHA/BMB
Ron Maichle	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 00145 CWQA/SHA/BMB
Mark Matteson	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	mattesonm@neorsd.org	216-641-6000	QDC – 01020 CWQA/FCB/SHA
Denise Phillips	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	phillipsd@neorsd.org	216-641-6000	QDC – 01203 CWQA
Francisco Rivera	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000	QDC - 00262 CWQA/SHA
Eric Soehnlen	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	soehnlene@neorsd.org	216-641-6000	QDC – 01030 CWQA/SHA/BMB
Justin Telep	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	telepj@neorsd.org	216-641-6000	QDC – 01304 CWQA
John Rhoades	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	QDC - 00008 CWQA/SHA
Kelsey Amidon ²	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	amidonk@neorsd.org	216-641-6000	QDC – 01091 CWQA

¹ NEORSD Lead Project Manager
² See acknowledgement letter for conducting QHEIs and water chemistry sampling (Appendix F)
³Benthic Macroinvertebrate Identification

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

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Name	Address	Email Address	Phone Number
Lindsay Baker	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	bakerl@neorsd.org	216-641-6000
Kevin Fitzgibbons	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	fitzgibbonsk@neorsd.org	216-641-6000
Rae Grant	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Alex Johnson	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	johnsonalex@neorsd.org	216-641-6000
Matthew Johnson	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	johnsonmatthew@neorsd.org	216-641-6000
Mario Meany	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	meanym@neorsd.org	216-641-6000
Carrie Millward	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	millwardc@neorsd.org	216-641-6000
Daniel Neelon	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	neelond@neorsd.org	216-641-6000
Joseph Schiel	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	schielj@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	schuschuf@neorsd.org	216-641-6000
William Stanford	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	standfordw@neorsd.org	216-641-6000
Wolfram von Kiparski	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Theresa Walsh	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	walsht@neorsd.org	216-641-6000
Paraprofessional Intern (TBD)	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000
Paraprofessional Intern (TBD)	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000
B-STEM Intern (TBD)	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000
B-STEM Intern (TBD)	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	_____@neorsd.org	216-641-6000

(11) Contract laboratory contact information

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 E. The contact information for NEORSD’s Analytical Service Division is:

NEORSD Analytical Services
 Cheryl Soltis-Muth, Manager
 4747 E. 49th Street
 Cuyahoga Heights, Ohio 44056
 soltis-muthc@neorsd.org
 216-641-6000

Any fish that is not positively identified in the field, or at NEORSD, will be sent to The Ohio State University Museum of Biological Diversity for verification by the Curator and/or Associate Curator of Fish. Fish will be identified to the species level.

Mr. Marc Kibbey, Associate Curator of Fish
1315 Kinnear Road, Columbus, Ohio 43212
cavender.1@osu.edu / kibbey.3@osu.edu
614-292-7873

Identification of macroinvertebrates for stream locations will be completed by an external Level 3 Qualified Data Collector for Benthic Macroinvertebrate Biology Identification³. Benthic macroinvertebrates will be identified to the lowest practical level as recommended by Ohio EPA (1987b). Contact information for this contractor will be submitted once the contract is awarded.

- (12) Copy of ODNR collector's permit

To be submitted once received from ODNR.

- (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: 3/31/21

- (14) Voucher Specimen Statement

NEORSD will maintain a benthic macroinvertebrate and fish voucher collection which includes two specimens, or appropriate photo vouchers, of each species or taxa collected during the course of biological sampling from any stream within the NEORSD's service area. When benthic macroinvertebrates from multiple surface waters are collected within the same year and identified by the same QDC, one voucher collection will be created to represent the specimens collected from those

³ A letter of acknowledgement of the macroinvertebrate identification responsibilities will be added as an addendum to this study plan, in Appendix F, upon finalization of the macroinvertebrate identification contract.

streams. When fish specimens from multiple surface waters are collected within the same year, one voucher collection will be created to represent the specimens collected from those streams. A separate collection for each sampling event will not be maintained.

NEORSD will provide specimens or photo vouchers to the Director upon request. This collection will be stored at the NEORSD laboratory in the Environmental and Maintenance Services Center.

Print/Signature: Seth Hothem/  Date: 3/31/21

(15) Sample Location Statement

I attest that I will make available any and all sampling location information, including but not limited to; the name of the water body sampled, sampling location latitude and longitude, sampling location 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/  Date: 3/31/21

(16) Additional L3 Data Collector Statement







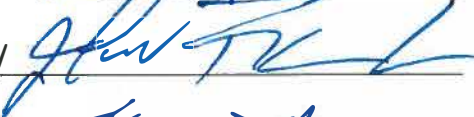



The Lead Project Manager for all stream locations is approved for all project data types.

Print/Signature: Seth Hothem/  Date: 3/31/21

2021 NEORSD Watershed Monitoring Study Plan
April 29, 2021

(17) Trespassing Statement

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

Print/Signature:	Hannah Boesinger/ 	Date:	3/17/2021
Print/Signature:	Seth Hothem/ 	Date:	3/17/21
Print/Signature:	Jillian Knittle/ 	Date:	3/23/21
Print/Signature:	Ron Maichle/ 	Date:	03-18-21
Print/Signature:	Mark Matteson/ 	Date:	3/23/21
Print/Signature:	Denise Phillips/ 	Date:	3/29/21
Print/Signature:	John Rhoades/ 	Date:	03/31/21
Print/Signature:	Francisco Rivera/ 	Date:	3/17/21
Print/Signature:	Eric Soehnen/ 	Date:	3/17/2021
Print/Signature:	Justin Telep/ 	Date:	3/19/21

Appendix A. Field Forms



FISH DATA SHEET

Sheet ID For Office Use Only

[Empty box for Sheet ID]

New Station

(requires lat/long & county)

Mix Zone

Page ___ of ___

Station ID _____ River Code _____ RM _____ Date _____ Time _____

Stream _____ Location _____

Comments _____

Lat _____ Long _____ County _____ ALP _____ Time Fished _____

Crew _____ Netter _____ Others _____ Sampler Type _____

Distance _____ Flow _____ Temp. C _____ Secchi _____ Source _____ Project _____

Fins Code Number Weighed Total Counted Total Weight

Weights **Counts**

DELT ANOMALIES
Deformities, Erosions, Lesions, Tumors
Multiple DELTs on one fish

1										D	E	L	T	M	*
	V	10x													
2										D	E	L	T	M	*
	V	10x													
3										D	E	L	T	M	*
	V	10x													
4										D	E	L	T	M	*
	V	10x													
5										D	E	L	T	M	*
	V	10x													
6										D	E	L	T	M	*
	V	10x													
7										D	E	L	T	M	*
	V	10x													
8										D	E	L	T	M	*
	V	10x													
9										D	E	L	T	M	*
	V	10x													

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

NEORSD Macroinvertebrate Field Sheet

Stream: _____ River Mile: _____ Year: _____

Location: _____ Project: _____

Drainage Area (mi²): _____ Latitude (°N)/Longitude (°W): _____

Hester-Dendy Deployment Information

Install Date: _____ Crew (QDC Circled): _____

Current at HD (fps): _____ Depth (cm): _____ Pictures Obtained: Yes No

Reinstall Date: _____ Crew (QDC Circled): _____

Current (fps): _____ Depth (cm): _____ Reason: _____

Reinstall Date: _____ Crew (QDC Circled): _____

Current (fps): _____ Depth (cm): _____ Reason: _____

Sampling/Retrieval Information

Sampling Method: Hester-Dendy Dipnet Surber Core Other: _____

Sample ID: HD: _____ Qualitative: _____ Other: _____

Sampling Date: _____ Crew (QDC Circled): _____

HD Condition- Current (fps): _____ Depth (cm): _____ Water Temp: _____ °F / °C

Number of HD Blocks Obtained: _____ Remarks: _____

Disturbed: Yes No Comments: _____

Debris: Yes No Comments: _____

Silt/Solids: None Slight Moderate Heavy

Dipnet- Time Sampled (min): _____ X Number of Crew: _____ = Total (min): _____

Habitats Sampled: Pool Riffle Run Margin Backwater

River Sampling Conditions

Flow Condition: Flood Above Normal Normal Low Interstitial Intermittent Dry

Current Velocity: Fast Moderate Slow Non-detect

Channel Morphology: Natural Channelized Channelized (Recovered) Impounded

Bank Erosion: Extensive Moderate Slight None

Riffle Development: Extensive Moderate Sparse Absent

Riffle Quality: Good Fair Poor *Embedded:* Yes No

Water Clarity: Clear Murky Turbid *Other:* _____

Water Color: None Green Brown Grey *Other:* _____

Canopy over HD: Open 75 % 50 % 25 % Closed

Comment Section: _____

OEPA Comment Field Codes: _____

Samples Analyzed By: _____ **QDC #:** _____ **Date:** _____

Physical Characteristics

Substrate Characteristics

	Pool Units	Riffle Units	Run Units
Bedrock			
Boulder			
Rubble			
Coarse Gravel			
Fine Gravel			
Sand			
Silt			
Clay/Hardpan			
Detritus			
Peat			
Muck			
Other			
Macrophytes			
Algae			
Artifacts			
Compaction (F,M,S)			
Depth (Avg)			
Width (Avg)			

Predominant Land Use (Left, Right or Both)

Forest	Urban	Open Pasture
Shrub	Residential/Park	Closed Pasture
Old Field	Mining/Construction	
Rowcrop	Wetland	
Industrial	Other	

Predominant Riparian Vegetation

Left	Right	Type
_____	_____	Large Trees
_____	_____	Small Trees
_____	_____	Shrubs
_____	_____	Grass/Weeds
_____	_____	None

Margin Habitat

Margin Quality:	Good	Fair	Poor
Undercut Banks	Root Mats	Tree Roots	
Grass	Water Willow	Woody Debris	
Shallows	Clay/Hardpan	Macrophytes	
Rip Rap	Bulkhead		
Other			

Biological Characteristics

Riffle:

Predominant Organism: _____
 Other Common Organisms: _____
 Density: High Moderate Low
 Diversity: High Moderate Low

Run:

Predominant Organism: _____
 Other Common Organisms: _____
 Density: High Moderate Low
 Diversity: High Moderate Low

Pool:

Predominant Organism: _____
 Other Common Organisms: _____
 Density: High Moderate Low
 Diversity: High Moderate Low

Margin:

Predominant Organism: _____
 Other Common Organisms: _____
 Density: High Moderate Low
 Diversity: High Moderate Low

Other Notable Collections: _____

V= Very Abundant; A= Abundant; C= Common; R= Rare

Overall Amount (V= >151; A= 150-101; C= 100-11; R= 10-1)

/	Porifera, Bryozoa
/ /	Turbellaria, Oligochaeta, Hirudinea
/	Isopoda, Amphipoda
/	Decapoda, Hydracarina
	Ephemeroptera
	Baetidae
/ /	Heptageniidae, Leptohephidae, Caenidae
	Other _____
/	Zygoptera, Anisoptera
	Plecoptera
	Hemiptera
/	Megaloptera, Neuroptera
	Trichoptera
	Hydropsychidae
/	Hydroptilidae, Leptoceridae
	Other _____
	Coleoptera
	Elmidae
	Other _____
	Diptera
	Chironomidae
	Other _____
/	Gastropoda, Bivalvia
	Other _____

Field Narrative Rating: E VG G MG F P VP

Stream & Location: _____ RM: . . . Date: / /

Scorers Full Name & Affiliation: Northeast Ohio Regional Sewer District

River Code: - - - STORET #: - - - Lat./Long.: /8 . - - Office verified location []

1] SUBSTRATE Check ONLY Two substrate TYPE BOXES; estimate % or note every type present. Check ONE (Or 2 & average). BEST TYPES: BLDR /SLABS [10], BOULDER [9], COBBLE [8], GRAVEL [7], SAND [6], BEDROCK [5]. OTHER TYPES: HARDPAN [4], DETRITUS [3], MUCK [2], SILT [2], ARTIFICIAL [0]. ORIGIN: LIMESTONE [1], TILLS [1], WETLANDS [0], HARDPAN [0], SANDSTONE [0], RIP/RAP [0], LACUSTURINE [0], SHALE [-1], COAL FINES [-2]. QUALITY: HEAVY [-2], MODERATE [-1], NORMAL [0], FREE [1], EXTENSIVE [-2], MODERATE [-1], NORMAL [0], NONE [1].

2] INSTREAM COVER Indicate presence 0 to 3: 0-Absent; 1-Very small amounts or if more common of marginal quality; 2-Moderate amounts, but not of highest quality or in small amounts of highest quality; 3-Highest quality in moderate or greater amounts. AMOUNT: EXTENSIVE >75% [11], MODERATE 25-75% [7], SPARSE 5-<25% [3], NEARLY ABSENT <5% [1].

3] CHANNEL MORPHOLOGY Check ONE in each category (Or 2 & average). SINUOSITY: HIGH [4], MODERATE [3], LOW [2], NONE [1]. DEVELOPMENT: EXCELLENT [7], GOOD [5], FAIR [3], POOR [1]. CHANNELIZATION: NONE [6], RECOVERED [4], RECOVERING [3], RECENT OR NO RECOVERY [1]. STABILITY: HIGH [3], MODERATE [2], LOW [1].

4] BANK EROSION AND RIPARIAN ZONE Check ONE in each category for EACH BANK (Or 2 per bank & average). RIPARIAN WIDTH: WIDE > 50m [4], MODERATE 10-50m [3], NARROW 5-10m [2], VERY NARROW < 5m [1], NONE [0]. FLOOD PLAIN QUALITY: FOREST, SWAMP [3], SHRUB OR OLD FIELD [2], RESIDENTIAL, PARK, NEW FIELD [1], FENCED PASTURE [1], OPEN PASTURE, ROWCROP [0]. CONSERVATION TILLAGE [1], URBAN OR INDUSTRIAL [0], MINING / CONSTRUCTION [0].

5] POOL / GLIDE AND RIFFLE / RUN QUALITY MAXIMUM DEPTH: > 1m [6], 0.7-<1m [4], 0.4-<0.7m [2], 0.2-<0.4m [1], < 0.2m [0]. CHANNEL WIDTH: POOL WIDTH > RIFFLE WIDTH [2], POOL WIDTH = RIFFLE WIDTH [1], POOL WIDTH < RIFFLE WIDTH [0]. CURRENT VELOCITY: TORRENTIAL [-1], VERY FAST [1], FAST [1], MODERATE [1], SLOW [1], INTERSTITIAL [-1], INTERMITTENT [-2], EDDIES [1]. Recreation Potential: Primary Contact, Secondary Contact. Pool / Current Maximum 12.

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species: Check ONE (Or 2 & average). RIFFLE DEPTH: BEST AREAS > 10cm [2], BEST AREAS 5-10cm [1], BEST AREAS < 5cm [metric=0]. RUN DEPTH: MAXIMUM > 50cm [2], MAXIMUM < 50cm [1]. RIFFLE / RUN SUBSTRATE: STABLE (e.g., Cobble, Boulder) [2], MOD. STABLE (e.g., Large Gravel) [1], UNSTABLE (e.g., Fine Gravel, Sand) [0]. RIFFLE / RUN EMBEDDEDNESS: NONE [2], LOW [1], MODERATE [0], EXTENSIVE [-1]. Riffle / Run Maximum 8.

6] GRADIENT (ft/mi) [] VERY LOW - LOW [2-4], MODERATE [6-10], HIGH - VERY HIGH [10-6]. DRAINAGE AREA (mi^2) []. %POOL: [] %GLIDE: [] %RUN: [] %RIFFLE: []. Gradient Maximum 10.

A/ SAMPLED REACH

Check ALL that apply

Comment RE: Reach consistency/ Is reach typical of stream?, Recreation/ Observed - Inferred, Other/ Sampling observations, Concerns, Access directions, etc.

METHOD **STAGE**

- BOAT 1st -sample pass- 2nd
- WADE HIGH
- L. LINE UP
- OTHER NORMAL
- LOW
- DRY

DISTANCE

- 0.5 Km
- 0.2 Km
- 0.15 Km
- 0.12 Km
- OTHER

CLARITY

- 1st --sample pass-- 2nd
- < 20 cm
 - 20-<40 cm
 - 40-70 cm
 - > 70 cm/ CTB
 - SECCHI DEPTH

_____ meters

CANOPY

- > 85%- OPEN
- 55%-<85%
- 30%-<55%
- 10%-<30%
- <10%- CLOSED

- 1st _____ cm
- pass
- 2nd _____ cm

C/ RECREATION

AREA DEPTH
POOL: >100ft² >3ft

B/ AESTHETICS

- NUISANCE ALGAE
- INVASIVE MACROPHYTES
- EXCESS TURBIDITY
- DISCOLORATION
- FOAM / SCUM
- OIL SHEEN
- TRASH / LITTER
- NUISANCE ODOR
- SLUDGE DEPOSITS
- CSOs/SSOs/OUTFALLS

D/ MAINTENANCE

- PUBLIC / PRIVATE / BOTH / NA
- ACTIVE / HISTORIC / BOTH / NA
- YOUNG-SUCCESSION-OLD
- SPRAY / SNAG / REMOVED
- MODIFIED / DIPPED OUT / NA
- LEVEED / ONE SIDED
- RELOCATED / CUTOFFS
- MOVING-BEDLOAD-STABLE
- ARMOURED / SLUMPS
- ISLANDS / SCOURED
- IMPOUNDED / DESICCATED
- FLOOD CONTROL / DRAINAGE

Circle some & COMMENT

E/ ISSUES

- WWTP / CSO / NPDES / INDUSTRY
- HARDENED / URBAN / DIRT&GRIME
- CONTAMINATED / LANDFILL
- BMPs-CONSTRUCTION-SEDIMENT
- LOGGING / IRRIGATION / COOLING
- BANK / EROSION / SURFACE
- FALSE BANK / MANURE / LAGOON
- WASH H₂O / TILE / H₂O TABLE
- ACID / MINE / QUARRY / FLOW
- NATURAL / WETLAND / STAGNANT
- PARK / GOLF / LAWN / HOME
- ATMOSPHERE / DATA PAUCITY

F/ MEASUREMENTS

- \bar{x} width
- \bar{x} depth
- max. depth
- \bar{x} bankfull width
- bankfull \bar{x} depth
- W/D ratio
- bankfull max. depth
- floodprone x² width
- entrench. ratio

Legacy Tree:

Stream Drawing:



Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) :

SITE NAME/LOCATION _____
 _____ SITE NUMBER _____ RIVER BASIN _____ DRAINAGE AREA (mi²) _____
 LENGTH OF STREAM REACH (ft) _____ LAT. _____ LONG. _____ RIVER CODE _____ RIVER MILE _____
 DATE _____ SCORER _____ COMMENTS _____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS:

NONE / NATURAL CHANNEL RECOVERED RECOVERING RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check ONLY two predominant substrate TYPE boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE	PERCENT	TYPE	PERCENT
<input type="checkbox"/> <input type="checkbox"/> BLDR SLABS [16 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> SILT [3 pt]	_____
<input type="checkbox"/> <input type="checkbox"/> BOULDER (>256 mm) [16 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> LEAF PACK/WOODY DEBRIS [3 pts]	_____
<input type="checkbox"/> <input type="checkbox"/> BEDROCK [16 pt]	_____	<input type="checkbox"/> <input type="checkbox"/> FINE DETRITUS [3 pts]	_____
<input type="checkbox"/> <input type="checkbox"/> COBBLE (65-256 mm) [12 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> CLAY or HARDPAN [0 pt]	_____
<input type="checkbox"/> <input type="checkbox"/> GRAVEL (2-64 mm) [9 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> MUCK [0 pts]	_____
<input type="checkbox"/> <input type="checkbox"/> SAND (<2 mm) [6 pts]	_____	<input type="checkbox"/> <input type="checkbox"/> ARTIFICIAL [3 pts]	_____

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock _____

(A)

Substrate Percentage Check

(B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES:

TOTAL NUMBER OF SUBSTRATE TYPES:

HHEI Metric Points

Substrate Max = 40

A + B

2. Maximum Pool Depth (Measure the maximum pool depth within the 61 meter (200 ft) evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check ONLY one box):

<input type="checkbox"/> > 30 centimeters [20 pts]	<input type="checkbox"/> > 5 cm - 10 cm [15 pts]
<input type="checkbox"/> > 22.5 - 30 cm [30 pts]	<input type="checkbox"/> < 5 cm [5 pts]
<input type="checkbox"/> > 10 - 22.5 cm [25 pts]	<input type="checkbox"/> NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS _____ MAXIMUM POOL DEPTH (centimeters):

Pool Depth Max = 30

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check ONLY one box):

<input type="checkbox"/> > 4.0 meters (> 13') [30 pts]	<input type="checkbox"/> > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
<input type="checkbox"/> > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	<input type="checkbox"/> ≤ 1.0 m (≤ 3' 3") [5 pts]
<input type="checkbox"/> > 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]	

COMMENTS _____ AVERAGE BANKFULL WIDTH (meters):

Bankfull Width Max=30

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream ☆

RIPARIAN WIDTH

L	R	(Per Bank)
<input type="checkbox"/>	<input type="checkbox"/>	Wide >10m
<input type="checkbox"/>	<input type="checkbox"/>	Moderate 5-10m
<input type="checkbox"/>	<input type="checkbox"/>	Narrow <5m
<input type="checkbox"/>	<input type="checkbox"/>	None

COMMENTS _____

FLOODPLAIN QUALITY

L	R	(Most Predominant per Bank)
<input type="checkbox"/>	<input type="checkbox"/>	Mature Forest, Wetland
<input type="checkbox"/>	<input type="checkbox"/>	Immature Forest, Shrub or Old Field
<input type="checkbox"/>	<input type="checkbox"/>	Residential, Park, New Field
<input type="checkbox"/>	<input type="checkbox"/>	Fenced Pasture

L	R	
<input type="checkbox"/>	<input type="checkbox"/>	Conservation Tillage
<input type="checkbox"/>	<input type="checkbox"/>	Urban or Industrial
<input type="checkbox"/>	<input type="checkbox"/>	Open Pasture, Row Crop
<input type="checkbox"/>	<input type="checkbox"/>	Mining or Construction

FLOW REGIME (At Time of Evaluation) (Check ONLY one box):

<input type="checkbox"/> Stream Flowing	<input type="checkbox"/> Moist Channel, isolated pools, no flow (Intermittent)
<input type="checkbox"/> Subsurface flow with isolated pools (Interstitial)	<input type="checkbox"/> Dry channel, no water (Ephemeral)

COMMENTS _____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check ONLY one box):

<input type="checkbox"/> None	<input type="checkbox"/> 1.0	<input type="checkbox"/> 2.0	<input type="checkbox"/> 3.0
<input type="checkbox"/> 0.5	<input type="checkbox"/> 1.5	<input type="checkbox"/> 2.5	<input type="checkbox"/> >3

STREAM GRADIENT ESTIMATE

Flat (0.5 ft/100 ft) Flat to Moderate Moderate (2 ft/100 ft) Moderate to Severe Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - Yes No QHEI Score _____ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

- WWH Name: _____ Distance from Evaluated Stream _____
- CWH Name: _____ Distance from Evaluated Stream _____
- EWH Name: _____ Distance from Evaluated Stream _____

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: _____ NRCS Soil Map Page: _____ NRCS Soil Map Stream Order _____

County: _____ Township / City: _____

MISCELLANEOUS

Base Flow Conditions? (Y/N): _____ Date of last precipitation: _____ Quantity: _____

Photograph Information: _____

Elevated Turbidity? (Y/N): _____ Canopy (% open): _____

Were samples collected for water chemistry? (Y/N): _____ (Note lab sample no. or id. and attach results) Lab Number: _____

Field Measures: Temp (°C) _____ Dissolved Oxygen (mg/l) _____ pH (S.U.) _____ Conductivity (µmhos/cm) _____

Is the sampling reach representative of the stream (Y/N) _____ If not, please explain: _____

Additional comments/description of pollution impacts: _____

BIOTIC EVALUATION

Performed? (Y/N): _____ (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) _____ Voucher? (Y/N) _____ Salamanders Observed? (Y/N) _____ Voucher? (Y/N) _____

Frogs or Tadpoles Observed? (Y/N) _____ Voucher? (Y/N) _____ Aquatic Macroinvertebrates Observed? (Y/N) _____ Voucher? (Y/N) _____

Comments Regarding Biology: _____

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

FLOW 

Lake / Lacustrary (Lentic) QHEI Field Sheet



Environmental Protection Agency

QHEI Score:

RIVERCODE _____ RIVERMILE _____ WATERBODY _____ DISTANCE ASSESSED (m): _____
 DATE _____ LOCATION _____
 SCORER _____ LAT. _____ LONG. _____ COMMENT _____

1) **SUBSTRATE** (Check *ONLY* Two Substrate TYPE BOXES; Estimate % or note every type present); LAKE: _____ LACUSTRARY: _____

TYPE	SHORE	BOTTOM	SUBSTRATE ORIGIN	SILT:	SUBSTRATE QUALITY
<input type="checkbox"/> BLDR/SLABS [7] <input type="checkbox"/> BOULDER [10] <input type="checkbox"/> COBBLE [8] <input type="checkbox"/> GRAVEL [7] <input type="checkbox"/> SAND [6]			Check ONE (or 2 & AVERAGE) <input type="checkbox"/> LIMESTONE [1] <input type="checkbox"/> TILLS [1] <input type="checkbox"/> WETLANDS [1] <input type="checkbox"/> LACUSTRARINE [1] <input type="checkbox"/> SANDSTONE [1] <input type="checkbox"/> RIPRAP [1] <input type="checkbox"/> HARDPAN [0] <input type="checkbox"/> SHALE [1] <input type="checkbox"/> COAL/ORE [-2]	<input type="checkbox"/> SILT HEAVY [-2] <input type="checkbox"/> SILT MODERATE [-1] <input type="checkbox"/> SILT NORMAL [0] <input type="checkbox"/> SILT FREE [1] <input type="checkbox"/> CLAY [-2] <input type="checkbox"/> INDUSTRIAL [-1] <input type="checkbox"/> ORGANIC [1] <input type="checkbox"/> NONE [1]	Substrate <div style="border: 1px solid black; width: 40px; height: 40px; margin: 0 auto;"></div> Max 20

NOTE: Ignore sludge that originates from point-sources, score on natural substrates

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

COMMENTS: _____

2) **COVER TYPES** TYPE: (Check All That Apply) AMOUNT: (Check *ONLY* One or check 2 and AVERAGE)

<input type="checkbox"/> OFF-SHORE SAND BARS [4] <input type="checkbox"/> OVERHANGING VEGETATION [1] <input type="checkbox"/> SHALLOWS (ON BEACH) [1] <input type="checkbox"/> ROOTMATS [1]	<input type="checkbox"/> DEEPWATER > 1 M [1] <input type="checkbox"/> ROOTWADS [1] <input type="checkbox"/> BOULDERS [1] <input type="checkbox"/> SAND BEACH [1]	<input type="checkbox"/> WETLAND POOLS [1] <input type="checkbox"/> SUBMERGED AQUATIC VEG. [4] <input type="checkbox"/> LOGS OR WOODY DEBRIS [1] <input type="checkbox"/> GRAVEL BEACH [1]	<input type="checkbox"/> EXTENSIVE > 75% [9] <input type="checkbox"/> MODERATE 25-75% [7] <input type="checkbox"/> SPARSE 5-25% [3] <input type="checkbox"/> NEARLY ABSENT < 5% [1]	Cover <div style="border: 1px solid black; width: 40px; height: 40px; margin: 0 auto;"></div> Max 20
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------

COMMENTS: _____

3) **SHORELINE MORPHOLOGY** (Check *ONLY* one PER category or check 2 and AVERAGE)

SHORE SINUOSITY	DEVELOPMENT	MODIFICATION	STABILITY	MODIFICATIONS OF SAMPLED SHORELINE
<input type="checkbox"/> HIGH [2] <input type="checkbox"/> MODERATE [4] <input type="checkbox"/> LOW [3] <input type="checkbox"/> NONE [1]	<input type="checkbox"/> EXCELLENT [6] <input type="checkbox"/> GOOD [5] <input type="checkbox"/> FAIR [3] <input type="checkbox"/> POOR [1]	<input type="checkbox"/> NONE [7] <input type="checkbox"/> RECOVERED [5] <input type="checkbox"/> RECOVERING [3] <input type="checkbox"/> RECENT OR NO RECOVERY [1]	<input type="checkbox"/> HIGH [3] <input type="checkbox"/> MODERATE [2] <input type="checkbox"/> LOW [1]	<input type="checkbox"/> CEMENTED [-1] <input type="checkbox"/> RIP RAPPED [1] <input type="checkbox"/> RAILROAD TIES [-1] <input type="checkbox"/> DREDGED [-1] <input type="checkbox"/> TWO SIDE CHANNEL MODIFICATIONS [-1] <input type="checkbox"/> SHIP CHANNEL [-2]
SHORE to BOTTOM SLOPE MORPHOLOGIES <input type="checkbox"/> SLOPE < 15 deg. [0] <input type="checkbox"/> SLOPE > 45 deg. [2] <input type="checkbox"/> SLOPE < 25 deg. [1] <input type="checkbox"/> SLOPE 90 deg. [0] <input type="checkbox"/> SLOPE > 25 deg. [3]		AVERAGE DEPTH (of 5 measures) <input type="checkbox"/> < 50 cm [0] <input type="checkbox"/> > 400 - 500 cm [4] <input type="checkbox"/> 50 - < 100 cm [1] <input type="checkbox"/> > 500 - 900 cm [2] <input type="checkbox"/> ≥ 100 - 200 cm [2] <input type="checkbox"/> > 900 cm [1] <input type="checkbox"/> > 200 - 4 00 cm [3]		Shore Line <div style="border: 1px solid black; width: 40px; height: 40px; margin: 0 auto;"></div> Max 20

COMMENTS: _____

4) **RIPARIAN ZONE AND BANK EROSION** (Check *ONE* box PER bank or 2 and AVERAGE)

★ Shore Right Looking East or South on Lake ★
 ★ Shore Right Looking Toward Lake in Lacustrary ★

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

Riparian
 Max 10

COMMENTS: _____

5) **AQUATIC VEGETATION QUALITY: PLANT SPECIES OBSERVED** (Sum All Scores)



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

<input type="checkbox"/> Pond Lilies (NYMPHAEA) <input type="checkbox"/> Pond Weed (POTAMOGETON)	<input type="checkbox"/> Sedge (CYPERACEAE) <input type="checkbox"/> Bulrush (SCIRPUS)	<input type="checkbox"/> Wild Celery (VALLISNERIA) <input type="checkbox"/> Waterweed (ELODEA) <input type="checkbox"/> Wild Rice (ZIZANIA)	Vegetation <div style="border: 1px solid black; width: 40px; height: 40px; margin: 0 auto;"></div> Max 30
(Score all for observed abundance: ABUNDANT = [-2]; COMMON = [-1]; FEW = [0]) <input type="checkbox"/> Purple Loosestrife <input type="checkbox"/> Reed Grass <input type="checkbox"/> Eurasian Milfoil <input type="checkbox"/> Cattails <input type="checkbox"/> Algae (mats) <input type="checkbox"/> Algae (planktonic)			

COMMENTS: _____

Is the Sampling Reach Representative of Area Habitat? (Y/N) ____ If Not, Explain: _____

Depth measures: _____
Zebra Mussel/Quagga Mussel Coverage >60% 60-25% 25-10% <10-1% 1-0%

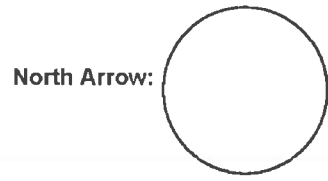
	Gear	Distance	Water Clarity	Wave Height		
First Sampling Pass:	_____	_____	_____	_____		
Second Sampling Pass:	_____	_____	_____	_____		
Third Sampling Pass:	_____	_____	_____	_____		

Subjective Rating (1-10) Aesthetic Rating (1-10)

Photos: _____

WATERBODY MEASUREMENTS: AVERAGE WIDTH: _____ AVERAGE DEPTH: _____ Maximum Depth: _____

DRAWING OF SITE:



PHWH STREAM BIOLOGICAL CHARACTERISTICS FIELD SHEET:

1. Fish: Voucher Specimens Retained? (select) Time Spent (minutes): _____
 Sample Method _____ Stream Length Assessed (meters) _____

Species	Number Caught	Notes

2. Salamanders: Voucher Specimens Retained? (circle) Y / N Time Spent (minutes): _____
 Sample Method _____ Stream Length Assessed (meters) _____

Species (<i>Genus</i>)	# Larvae	# Juveniles/Adults	Total Number
Mountain Dusky (<i>Desmognathus ochrophaeus</i>)			
Northern Dusky (<i>Desmognathus fuscus</i>)			
Two-lined (<i>Eurycea bislineata</i>)			
Long-tailed (<i>Eurycea longicauda</i>)			
Cave (<i>Eurycea lucifuga</i>)			
Red (<i>Pseudotriton ruber</i>)			
Mud (<i>Pseudotriton montanus</i>)			
Spring (<i>Gyrinophilus porphyriticus</i>)			
Mole spp. (<i>Ambystoma spp.</i>)			
Four-toed (<i>Hemidactylium scutatum</i>)			
Other (name)			
Total			

Notes on Vertebrates: _____

3. Macroinvertebrate Scoring Sheet:

THE HEADWATER MACROINVERTEBRATE FIELD EVALUATION INDEX (HMFEI) SCORING SHEET

Indicate Abundance of Each Taxa Above each White Box.

Record HMFEI Scoring Value Points Within each Box.

For EPT taxa, also indicate the different taxa present.

Key: **V** = Very Abundant (> 50); **A** = Abundant (10 -50); **C** = Common (3 -9); **R** = Rare (< 3)

Sessile Animals (Porifera , Cnidaria , Bryozoa) (HMFEI pts = 1)	<input type="text"/>	Crayfish (Decapoda) (HMFEI pts = 2)	<input type="text"/>	Fishfly Larvae (Corydalidae) (HMFEI pts = 3)	<input type="text"/>
Aquatic Worms (Turbellaria , Hirudinea , Oligochaeta) (HMFEI pts = 1)	<input type="text"/>	Dragonfly Nymphs (Anisoptera) (HMFEI pts = 2)	<input type="text"/>	Water Penny Beetles (Psephenidae) (HMFEI pts = 3)	<input type="text"/>
Sow Bugs (Isopoda) (HMFEI pts = 1)	<input type="text"/>	Riffle Beetles (Dryopidae , Elmidae , Ptilodactylidae) (HMFEI pts = 2)	<input type="text"/>	Crane-fly Larvae (Tipulidae) (HMFEI pts = 3)	<input type="text"/>
Scuds (Amphipoda) (HMFEI pts = 1)	<input type="text"/>	Larvae of other Flies (enter name in comments) (Diptera): (HMFEI pts = 1)	<input type="text"/>	EPT TAXA* Total No. EPT Taxa = _____	
Water Mites (Hydracarina) (HMFEI pts = 1)	<input type="text"/>	Midges (Chironomidae) (HMFEI pts = 1)	<input type="text"/>	Mayfly Nymphs (Ephemeroptera) Taxa Present: HMFEI pts = _____ No. Taxa (x) 3] _____	<input type="text"/>
Damselfly Nymphs (Zygoptera) (HMFEI pts = 1)	<input type="text"/>	Snails (Gastropoda) (HMFEI pts = 1)	<input type="text"/>		
Alderfly Larvae (Sialidae) (HMFEI pts = 1)	<input type="text"/>	Clams (Bivalvia) (HMFEI pts = 1)	<input type="text"/>	Stonefly Nymphs (Plecoptera) Taxa Present: HMFEI pts = _____ No. Taxa (x) 3] _____	<input type="text"/>
Other Beetles (Coleoptera) (HMFEI pts = 1)	<input type="text"/>	Other Taxa :			
Other Taxa:		Other Taxa:		Caddisfly Larvae (Trichoptera) Taxa Present: HMFEI pts = _____ No. Taxa (x) 3] _____	<input type="text"/>
Other Taxa:		Other Taxa			

*Note: EPT identification based upon Family or Genus level of taxonomy

Voucher Sample ID _____

Time Spent (minutes): _____

Notes on Macroinvertebrates: (Predominant Organisms; Other Common Organisms; Diversity Estimate)

Final HMFEI Calculated Score (Sum of All White Box Scores) =

IF Final HMFEI Score is > 19, Then CLASS III PWHH STREAM
 IF Final HMFEI Score is 7 to 19, Then CLASS II PWHH STREAM
 IF Final HMFEI Score is < 7, Then CLASS I PWHH STREAM

NEORSD Surface Water Condition Sampling Field Data Form

Stream: _____ Date: _____ Collectors: _____

Gage Station and ID: _____ Daily Mean Discharge: _____ ft³/sec

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

Water Quality Meters Used: _____

Time (hrs): _____ River Mile (Site): _____

Weather: Clear Partly Cloudy Overcast Light Rain/Showers Heavy Rain
Steady Rain Heavy Snow Melt Other: _____

Flow: Dry Intermittent Minimal Baseline/Normal Elevated Flood

HD Status: OK Other: _____

Color: Clear Muddy Tea Milky Other: _____

Odor: Normal Petroleum Anaerobic Sewage Chemical Other: _____

Surface Coating: None Foam Oily Scum Other: _____

Field Parameters: Conductivity (µmhos/cm): _____ Sp. Cond. (µmhos/cm): _____

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

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

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

General Comments: _____

Sample ID: _____

Reporting sig figs: (Cond and DO% - 1) (pH, DO mg/L, and Chlor/BGA-PC - 0.1) (Temp- 0.01)

Time (hrs): _____ River Mile (Site): _____

Weather: Clear Partly Cloudy Overcast Light Rain/Showers Heavy Rain
Steady Rain Heavy Snow Melt Other: _____

Flow: Dry Intermittent Minimal Baseline/Normal Elevated Flood

HD Status: OK Other: _____

Color: Clear Muddy Tea Milky Other: _____

Odor: Normal Petroleum Anaerobic Sewage Chemical Other: _____

Surface Coating: None Foam Oily Scum Other: _____

Field Parameters: Conductivity (µmhos/cm): _____ Sp. Cond. (µmhos/cm): _____

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

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

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

General Comments: _____

Sample ID: _____

Appendix B. Parameter Information

Parameter	Additional Name	Test	Unit	2018/2019 Minimum Detection Limit	2018/2019 Practical Quantitation Limit
Alkalinity	Alkalinity	EPA 310.2	mg/L	6.44	16
Mercury	Hg	EPA 245.1	µg/L	0.022	0.05
Ammonia ¹	NH ₃	EPA 350.1	mg/L	0.022	0.05
Nitrite	NO ₂	EPA 353.2	mg/L	0.010	0.02
Nitrite + Nitrate	NO ₂ + NO ₃	EPA 353.2	mg/L	0.028	0.08
Total Kjeldahl Nitrogen	TKN	EPA 351.2	mg/L	0.247	0.5
Dissolved Reactive Phosphorus	DRP	EPA 365.1	mg/L	0.014	0.04
Low Level Dissolved Reactive Phosphorus	LLDRP	EPA 365.1	µg/L	2.33	5
Total Phosphorus	Total-P	EPA 365.1	mg/L	0.016	0.031
Chloride	Chloride by IC	EPA 300.0	mg/L	0.71	5
Sulfate	Sulfate by IC	EPA 300.0	mg/L	0.89	5
Silver	Ag	EPA 200.8 ³	µg/L	0.016	0.5
		EPA 200.8 ⁴	µg/L	0.071	0.5
Aluminum	Al	EPA 200.8 ³	µg/L	6.07	20
		EPA 200.8 ⁴	µg/L	7.632	20
Arsenic	As	EPA 200.8 ³	µg/L	1.16	5.00
		EPA 200.8 ⁴	µg/L	0.267	2
Barium	Ba	EPA 200.8 ³	µg/L	0.118	0.50
		EPA 200.8 ⁴	µg/L	0.062	0.5
Beryllium	Be	EPA 200.8 ³	µg/L	0.118	0.50
		EPA 200.8 ⁴	µg/L	0.058	0.5
Calcium	Ca	EPA 200.8 ³	µg/L	62.8	250
		EPA 200.8 ⁴	µg/L	71.7	250
Cadmium	Cd	EPA 200.8 ³	µg/L	0.026	0.5
		EPA 200.8 ⁴	µg/L	0.053	0.5
Cobalt	Co	EPA 200.8 ³	µg/L	0.032	1
		EPA 200.8 ⁴	µg/L	0.063	0.5
Chromium	Cr	EPA 200.8 ³	µg/L	0.364	2.5
		EPA 200.8 ⁴	µg/L	1.065	2.5
Copper	Cu	EPA 200.8 ³	µg/L	0.382	1
		EPA 200.8 ⁴	µg/L	0.052	0.5
Iron	Fe	EPA 200.8 ³	µg/L	12.2	50
		EPA 200.8 ⁴	µg/L	30.7	100
Potassium	K	EPA 200.8 ³	µg/L	39.3	250
		EPA 200.8 ⁴	µg/L	113	250

Parameter	Additional Name	Test	Unit	2018/2019 Minimum Detection Limit	2018/2019 Practical Quantitation Limit
Magnesium	Mg	EPA 200.8 ³	µg/L	13.3	125
		EPA 200.8 ⁴	µg/L	16.5	125
Manganese	Mn	EPA 200.8 ³	µg/L	0.588	2
		EPA 200.8 ⁴	µg/L	0.085	0.5
Molybdenum	Mo	EPA 200.8 ³	µg/L	0.196	1
		EPA 200.8 ⁴	µg/L	0.052	0.5
Sodium	Na	EPA 200.8 ³	µg/L	32.5	250
		EPA 200.8 ⁴	µg/L	31.920	125
Nickel	Ni	EPA 200.8 ³	µg/L	0.218	2
		EPA 200.8 ⁴	µg/L	0.116	0.5
Lead	Pb	EPA 200.8 ³	µg/L	0.062	0.5
		EPA 200.8 ⁴	µg/L	0.070	0.5
Antimony	Sb	EPA 200.8 ³	µg/L	1.9	5
		EPA 200.8 ⁴	µg/L	0.055	0.5
Selenium	Se	EPA 200.8 ³	µg/L	3.77	10
		EPA 200.8 ⁴	µg/L	1.42	10
Tin	Sn	EPA 200.8 ³	µg/L	10	40
		EPA 200.8 ⁴	µg/L	2.00	5
Strontium	Sr	EPA 200.8 ³	µg/L	0.268	2
		EPA 200.8 ⁴	µg/L	0.199	0.5
Titanium	Ti	EPA 200.8 ³	µg/L	0.562	4
		EPA 200.8 ⁴	µg/L	0.331	1
Thallium	Tl	EPA 200.8 ³	µg/L	0.264	2
		EPA 200.8 ⁴	µg/L	0.099	0.5
Vanadium	V	EPA 200.8 ³	µg/L	0.178	10
		EPA 200.8 ⁴	µg/L	3.573	10
Zinc	Zn	EPA 200.8 ³	µg/L	1.65	5
		EPA 200.8 ⁴	µg/L	1.147	5
Total Metals	Total Metals (calc.)	EPA 200.8	µg/L	µg/L = (Cr µg/L)+(Cu µg/L)+(Ni µg/L)+(Zn µg/L)	
Hardness	Hardness (calc.)	SM 2340B ²	mg/L	CaCO ₃ mg/L = (2.497*Ca mg/L)+(4.118*Mg mg/L)	
<i>Escherichia coli</i>	<i>E. coli</i>	SM9223 Colilert QT (18 & 24 Hour)	MPN/100mL	1 MPN	1 MPN
Chlorophyll <i>a</i>	Chlorophyll <i>a</i>	EPA 445.0	µg/L	0.23	1
Chemical Oxygen Demand	COD	EPA 410.4	mg/L	6.1	20

Parameter	Additional Name	Test	Unit	2018/2019 Minimum Detection Limit	2018/2019 Practical Quantitation Limit
Biological Oxygen Demand	BOD	SM 5210 ²	mg/L	2	N/A
Total Solids	TS	SM 2540 B ²	mg/L	1	5
Total Suspended Solids	TSS	SM 2540 D ²	mg/L	0.5	1
Total Dissolved Solids	TDS	SM 2540 C ²	mg/L	1	5
Turbidity **		EPA 180.1	NTU	0.1	0.2
Field Parameter	Additional Name	Test	(Value Reported in)		
pH		SM 4500 H+B	s.u.		
Conductivity		SM 2510A ²	µs/cm		
Specific Conductivity		SM 2510B ²	µs/cm		
Dissolved Oxygen	DO	SM 4500-0 G ₂	mg/L		
Temperature	Temp	EPA 1701.1 ²	°C		
Turbidity **		EPA 180.1	NTU		

¹ Listed MDL/PQL is for undistilled samples. Any samples that require distillation will have a MDL = 0.065 mg/L, PQL = 0.150 mg/L

² Standard Methods for the Examination of Water and Wastewater, Method approved by Standard Methods Committee, 1997. Editorial revisions, 2011.

³ MDLs and PQLs specific to ICP-MS Xseries instrument

⁴ MDLs and PQLs specific to ICP-MS qNOVA instrument

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

Appendix C. Meter Specifications



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 VZ and 6920 VZ 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.





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ISO 9001
ISO 14001

Yellow Springs, Ohio Facility

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Printed in USA 0107 E55-01



*Sensors sold with the ETV logo were submitted into the ETV
program on the 1st of 2007. Information on the full range
characteristics of YSI water quality sensors can be found at
www.ysi.com or call YSI at 800 897 4151 for the ETV verification
report. Use of the ETV name or logo does not imply approval or
certification of this product nor does it make any explicit or
implied warranties or guarantees as to product performance.

YSI incorporated
Who's Minding
the Planet?

YSI 600XL & 600XLM Sensor Specifications

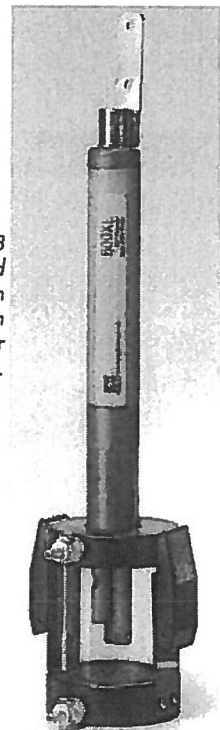
	Range	Resolution	Accuracy
Dissolved Oxygen % Saturation 6562 Rapid Pulse™ Sensor* ETV	0 to 500%	0.1%	0 to 200%: ±2% of reading or 2% air saturation, whichever is greater; 200 to 500%: ±6% of reading
Dissolved Oxygen mg/L 6562 Rapid Pulse™ Sensor* ETV	0 to 50 mg/L	0.01 mg/L	0 to 20 mg/L: ±0.2 mg/L or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

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

YSI 600XL & 600XLM Sonde Specifications

Medium		Fresh, sea or polluted water
Temperature	Operating	-5 to +50°C
	Storage	-10 to +60°C
Communications		RS-232, SDI-12
Software		EcoWatch*
Dimensions 600XL 600XLM	Diameter	1.65 in, 4.19 cm 1.65 in, 4.9 cm
	Length	16 in, 40.6 cm 21.3 in, 54.1 cm
	Weight	1.3 lbs, 0.59 kg 1.5 lbs, 0.69 kg
Power	External	12 V DC
	Internal (600XLM only)	4 AA-size alkaline batteries

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



HI 98129

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



Description

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

The EC/TDS conversion factor is user selectable as is the temperature compensation coefficient (β). 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 $\mu\text{S}/\text{cm}$
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 $\mu\text{S}/\text{cm}$
Resolution	TDS	1 ppm
Resolution	Temperature	0.1°C / 0.1°F
Accuracy	pH	± 0.05 pH
Accuracy	EC/TDS	$\pm 2\%$ F.S.
Accuracy	Temperature	$\pm 0.5^\circ\text{C}$ / $\pm 1^\circ\text{F}$
Temperature Compensation		pH: automatic; EC/TDS: automatic with β adjustable from 0.0 to 2.4% / °C
Calibration	pH	automatic, 1 or 2 points with 2 sets of memorized buffers (pH 4.01 / 7.01 / 10.01 or 4.01 / 6.86 / 9.18)
Calibration	EC/TDS	automatic, 1 point
TDS Conversion Factor		adjustable from 0.45 to 1.00
pH Electrode		HI 73127 (replaceable; included)
Environment		0 to 50°C (32 to 122°F); RH max 100%
Battery Type / Life		4 x 1.5V / approx. 100 hours of continuous use; auto-off after 8 minutes of non-use
Dimensions		163 x 40 x 26 mm (6.4 x 1.6 x 1.0")
Weight		100 g (3.5 oz.)



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



Product #: HQ30D53000000 Quantity
 USD Price: \$750.00

★★★★★ 5/5

[Read 1 review](#) [Write a review](#) [Follow this product](#)

Portable meter measures critical water quality parameters - without the need for multiple instruments

Single input channel for flexible measurement of pH, Conductivity, Dissolved Oxygen (DO), BOD, ORP, Ammonia, Ammonium, Fluoride, Chloride, Sodium, and temperature - any INTELiCAL™ smart probe

Intuitive user interface for simple operation and accurate results

Guided calibration and check standard reviews reduce calibration errors. Stabilization alerts and visual measurement lock ensure that you can trust the accuracy of the results.

Trust your measurements - INTELiCAL™ smart probes store all calibrations in the probe

Calibration history allows quick and easy change out of probes without re-calibrating. The HCD™ smart system records serial numbers, current calibration data, user ID, sample ID time, and date automatically in the data log for complete GLP traceability.

Designed for demanding conditions

Rugged, waterproof (IP67) meter provides worry-free, reliable operation in lab or field environments.

Convenient kit includes everything you need to start testing

Meter kit includes 4 AA batteries, quick-start guide, user manual and documentation CD

Specifications

AC and USB Operation	optional
Automatic Buffer Recognition	Color-coded: 4.01, 7.00, 10.01 pH IUPAC: 1.070, 4.005, 7.000, 10.012, 12.45 DIN: 1.00, 4.05, 6.323 User-defined custom buffer sets
Barometric Pressure Measurement	For automatic compensation of DO when using an LDO or LBOD probe
Battery Requirements	4 AA
Benchtop	with stand
BOD5/CBOD resolution	Available when used with Hach WIMS BOD Manager software
Cable resistance correction	Digital - not needed
Calibration curves display	Calibration summary data logged and displayed
Calibration Intervals/Alerts/Reminder	2 hours to 7 days
Compliance	CE, WEEE
Conductivity Accuracy	± 0.5 % from (1µS/cm - 200 mS/cm)
Conductivity measurement	5 different stability modes
Conductivity Measurement Range	0.01 µS/cm to 200 mS/cm
Conductivity resolution	0.01 µS/cm with 2 digits
Custom Calibration Standards	User-defined standard sets
Data Export	Download via USB connection to PC or flash stick Automatically transfer entire data log or as readings are taken
Data Memory	500 results
Digital (Intelligent) electrode inputs	2
Dimensions (H x W x D)	7.8 in x 3.7 in x 1.4 in (197 mm x 95 mm x 36 mm)
Display	Display readings from one or two probes Simultaneous readings from two probes (HQ40d only) pH, pH, mV, temperature Conductivity, Conductivity, TDS, salinity, resistivity, temperature LDO, dissolved oxygen, pressure, temperature LBOD, dissolved oxygen, pressure, temperature ORP/Redox, mV, temperature Sodium, Sodium, mV, temperature
Display Lock Function	Continuous measurement or press to read mode available with averaging function for LDO measurement.
Display Type	240 x 160 pixel Display readings from one or two probes pH, pH, mV, temperature Conductivity, Conductivity, TDS, salinity, resistivity, temperature LDO, dissolved oxygen, pressure, temperature ORP/Redox, mV, temperature Sodium, Sodium, mV, temperature
DO Measurement Range	0.01 to 20 mg/L (0 to 200%)
DO Resolution	0.01 mg/L
Fixed Buffer Selection	(IUPAC standards [DIN 19286] or Technical buffer [DIN 19287] or 4-7-10 series or user defined)
Inputs	M12 digital (1) for INTELiCAL probes
Interface Languages	13**
Internal Data Storage	500
IP Rating	IP67
Languages:	English, French, German, Italian, Spanish, Danish, Dutch, Polish, Portuguese, Turkish, Swedish, Czech, Russian
mV Accuracy	± 0.1 mV
mV Measurement at Stable Reading	5 (auto) stabilization settings
mV Resolution	0.1 mV
Operating Error Messages	Text messages displayed
Operating Humidity	90 % relative humidity (non-condensing)
Operating Interface	Keypad
Operating Temperature	5 to 45 °C
ORP Electrode Calibration	Predefined ORP standards (including Zobell's solution)
Outputs	USB to PC / flash stick
PC Data Transfer Software	Included
pH Measurement at stable reading	5 stabilization settings
Printer	Optional accessory
Salinity Resolution	0.01 ppt
Warranty	3 years
Water Resistance	Meter Casing: 1 meter submersion for 30 minutes (IP67)
Weight	0.74 lbs (0.335 kg)

2100P and 2100P IS Portable Turbidimeter

Turbidimetry

Features and Benefits

Laboratory Quality in a Portable Unit

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

Two Models for Specific Requirements

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

Two-detector Optical System

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



The Hach 2100P and 2100P IS Portable Turbidimeters bring laboratory-level performance on-site, offering fast, accurate results and the ease-of-use analysts demand in the field.

With a measurement range of 0 to 1000 NTU and a resolution of 0.01 NTU, the 2100P turbidimeter is ideal for regulatory monitoring, process control or field studies.

Specifications*

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

*Specifications subject to change without notice.

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



Be Right™



2100Q and 2100Q is Portable Turbidimeter



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

D

W

P

I

F

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

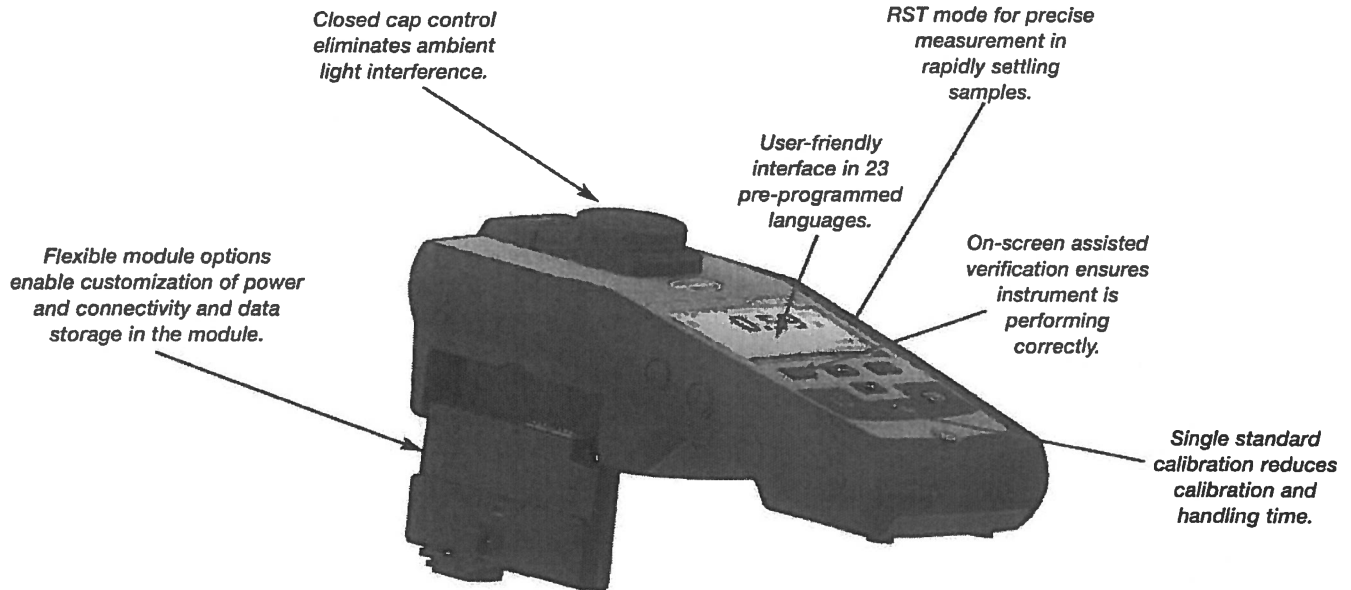
- 2100Q Turbidimeter—Compliant with USEPA Method 180.1 design criteria.
- 2100Q is Turbidimeter—Compliant with ISO 7027 design criteria.

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



Be Right™

Key Features



Specifications*

Measurement Method

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

Regulatory

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

Light Source

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

Range

0 to 1000 NTU (FNU)

Accuracy

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

Repeatability

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

Resolution

0.01 NTU on lowest range

Stray Light

<0.02 NTU (FNU)

Signal Averaging

Selectable on/off

Detector

Silicon photovoltaic

Reading Modes (user selectable)

Normal (Push to Read)
Signal Averaging
Rapidly Settling Turbidity

Data Logger

500 records

Power Requirement

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

Operating Conditions

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

Storage Conditions

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

Languages

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

Interface

Optional USB

Instrument Enclosure Rating

IP67 (closed lid, battery compartment excluded)

Protection Class

Power Supply: Class II

Certification

CE certified

Sample Required

15 mL (0.3 oz.)

Sample Cells

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

Dimensions

22.9 x 10.7 x 7.7 cm (9.0 x 4.2 x 3.0 in.)

Weight

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

Warranty

1 year

*Specifications subject to change without notice.

Sondes: EXO1 EXO2

Removable Bail

6-Pin Cable Connector

High-impact Xenoy Housing

Pressure Transducer Opening

Red LED Indicator - Status

Blue LED Indicator - Bluetooth

On/Off Magnetic Switch for Power and Bluetooth

4-Pin Wet-Mateable Connectors

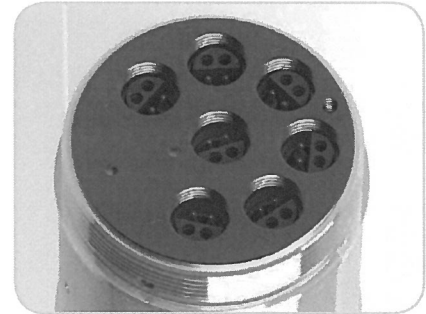
Port Plug

Anti-fouling Wiper

EXO2



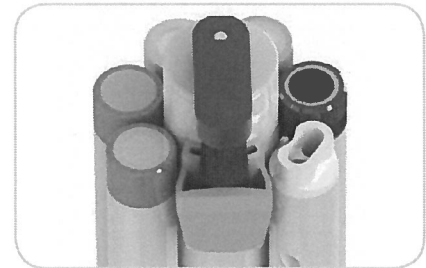
Cable connector, battery valve, and expansion port for an additional sensor



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

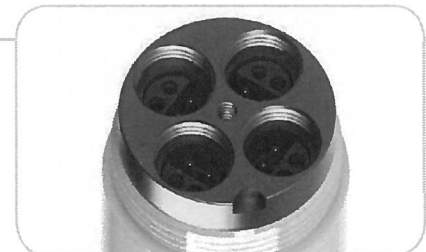
Battery Compartment

Cutaway: Reinforced internal structure



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

Welded Titanium Housing



EXO1 sonde contains 4 universal sensor ports

Instrument Specifications*

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

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

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

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

Sensor Specifications*

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

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

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

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

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

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

⁵ Relative to calibration gases

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

⁷ When transferred from water-saturated air to Zobell solution

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

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

¹⁰ Temperature accuracy traceable to NIST standards

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

¹² Specification is defined in AMCO-AEPA Standards



FH950 Portable Velocity Meter with 20' Cable



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

Reduce manhours 50%

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

Automatically calculates total discharge based on USGS and ISO methods

Reduces time to manually calculate and likelihood of errors

Real-time velocity graphed on color display

Visualize velocity trends quickly

Lowest maintenance solution on the market

Electromagnetic velocity sensor with no moving parts never requires mechanical maintenance

Lightweight, rugged portable meter

Only 1.5 pounds

What's in the box

FH950.1 System Includes:

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

Specifications

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

Appendix D. Chlorophyll *a* Field Form

NEORSD Chlorophyll a Sampling Field Sheet

Stream: _____
 Location: _____
 RM: _____
 Lat/Long: _____

Collectors: _____
 Date: _____
 Time: _____

Number of Rocks: _____

Total Area Scraped: _____ cm²

Diameter of individual scrape

- 1 _____
- 2 _____
- 3 _____
- 4 _____
- 5 _____
- 6 _____
- 7 _____
- 8 _____
- 9 _____
- 10 _____
- 11 _____
- 12 _____
- 13 _____
- 14 _____
- 15 _____
- 16 _____
- 17 _____
- 18 _____
- 19 _____
- 20 _____
- 21 _____
- 22 _____
- 23 _____
- 24 _____
- 25 _____

Area of individual scrape

- 1 _____
 - 2 _____
 - 3 _____
 - 4 _____
 - 5 _____
 - 6 _____
 - 7 _____
 - 8 _____
 - 9 _____
 - 10 _____
 - 11 _____
 - 12 _____
 - 13 _____
 - 14 _____
 - 15 _____
 - 16 _____
 - 17 _____
 - 18 _____
 - 19 _____
 - 20 _____
 - 21 _____
 - 22 _____
 - 23 _____
 - 24 _____
 - 25 _____
- Total: _____

Diameter to Area Conversion	
Diameter (cm)	Area (cm ²)
1.6	2.011
1.7	2.27
1.8	2.545
1.9	2.835
2.0	3.142
2.1	3.464
2.2	3.801
2.3	4.155

Total Sample Volume _____ ml

Filter 1 LABLynx ID _____
 Vol _____ ml

Filter 2 LABLynx ID _____
 Vol _____ ml

Filter 3 LABLynx ID _____
 Vol _____ ml

Water Column Chlorophyll Sample

Filter 1 LABLynx ID _____
 Vol _____ ml

Filter 2 LABLynx ID _____
 Vol _____ ml

Filter 3 LABLynx ID _____
 Vol _____ ml

Flow: None Low Normal Elevated High

Turbidity: Clear Low Moderate* High*

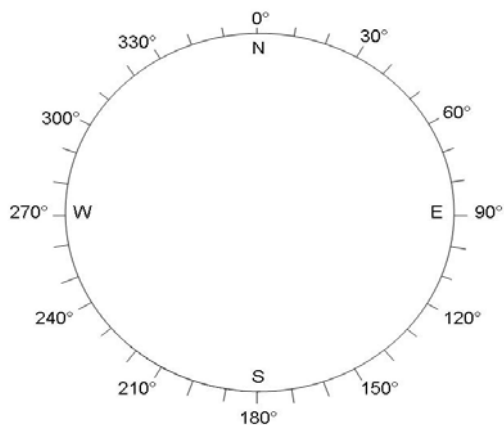
*Explain _____

Sky: Overcast Cloudy Partly Cloudy Mostly Clear Clear

Canopy: Open Mostly Open Partly Closed Closed

Riparian None Narrow L R Moderate L R Wide L R

Downstream Channel Direction



Clinometer

Left Bank _____°

Right Bank _____°

Left Bank _____°

Right Bank _____°

Left Bank _____°

Right Bank _____°

Stream Widths

_____m _____m _____m

Record two most predominate substrates with an X, and check all present.

	Riffle	Run	Reach
Boulder/Slabs	_____	_____	_____
Bedrock	_____	_____	_____
Boulder/Slabs	_____	_____	_____
Cobble	_____	_____	_____
Gravel	_____	_____	_____
Sand	_____	_____	_____
Silt	_____	_____	_____
Hardpan	_____	_____	_____
Detritus	_____	_____	_____
Artificial	_____	_____	_____

Substrate Origin

Limestone Tills Rip-rap
 Sandstone Shale Wetlands
 Lacustrine Hardpan Coal Fines

Silt

Heavy Moderate Normal None

Embeddedness

Extensive Moderate Normal None

Notes: _____

Length of Reach: _____m

Stream Drawing

Appendix E. Laboratory Certifications



State of New Hampshire
Environmental Laboratory Accreditation Program
Awards

PRIMARY NH ELAP ACCREDITATION

to

NORTHEAST OHIO REGIONAL SEWER DISTRICT ANALYTICAL SERVICES

of

CUYAHOGA HEIGHTS, OH

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

Certificate Number: 223820

Effective Date: 12/1/2020

Expiration Date: 11/30/2021

Laboratory ID: 2238



Bill Hall
NORTHEAS12/28/2020

Bill Hall
NH ELAP Program Manager

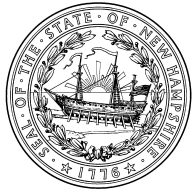
Method accreditation does not imply acceptance for NHDES compliance testing. Laboratory is required to use EPA-approved methods required by regulation. Continuing accreditation status is dependent on successful ongoing participation in the program. Customers may verify the laboratory's current accreditation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

NEW HAMPSHIRE ENVIRONMENTAL LABORATORY ACCREDITATION PROGRAM

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PRIMARY ACCREDITATION ANALYTE LIST

ANALYTE LIST NUMBER: 223820-C



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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	11/30/2021	D	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2021	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	11/30/2021	D	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2021	D	MIC	NE
Method Code: 20214431 Method Ref: SM 9223 B (COLILERT®-18)			Revision: 23RD ED		Date: 2016	
2525	ESCHERICHIA COLI	03/23/2021	11/30/2021	D	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2021	D	MIC	NE
Method Code: 20214442 Method Ref: SM 9223 B (COLILERT®)			Revision: 23RD ED		Date: 2016	
2525	ESCHERICHIA COLI	03/23/2021	11/30/2021	D	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2021	D	MIC	NE
Method Code: 10013806 Method Ref: EPA 200.7			Revision: 4.4		Date: 1994	
1000	ALUMINUM	03/23/2021	11/30/2021	D	MET	NE
1015	BARIUM	03/23/2021	11/30/2021	D	MET	NE
1020	BERYLLIUM	03/23/2021	11/30/2021	D	MET	NE
1030	CADMIUM	03/23/2021	11/30/2021	D	MET	NE
1035	CALCIUM	03/23/2021	11/30/2021	D	MET	NE
1040	CHROMIUM	03/23/2021	11/30/2021	D	MET	NE
1055	COPPER	03/23/2021	11/30/2021	D	MET	NE
1070	IRON	03/23/2021	11/30/2021	D	MET	NE
1085	MAGNESIUM	03/23/2021	11/30/2021	D	MET	NE
1090	MANGANESE	03/23/2021	11/30/2021	D	MET	NE
1105	NICKEL	03/23/2021	11/30/2021	D	MET	NE
1150	SILVER	03/23/2021	11/30/2021	D	MET	NE
1155	SODIUM	03/23/2021	11/30/2021	D	MET	NE
1190	ZINC	03/23/2021	11/30/2021	D	MET	NE
Method Code: 10014605 Method Ref: EPA 200.8			Revision: 5.4		Date: 1994	
1000	ALUMINUM	03/23/2021	11/30/2021	D	MET	NE
1005	ANTIMONY	03/23/2021	11/30/2021	D	MET	NE
1010	ARSENIC	03/23/2021	11/30/2021	D	MET	NE
1015	BARIUM	03/23/2021	11/30/2021	D	MET	NE
1030	CADMIUM	03/23/2021	11/30/2021	D	MET	NE
1040	CHROMIUM	03/23/2021	11/30/2021	D	MET	NE
1075	LEAD	03/23/2021	11/30/2021	D	MET	NE

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1090	MANGANESE	03/23/2021	11/30/2021	D	MET	NE
1105	NICKEL	03/23/2021	11/30/2021	D	MET	NE
1140	SELENIUM	03/23/2021	11/30/2021	D	MET	NE
1150	SILVER	03/23/2021	11/30/2021	D	MET	NE
1165	THALLIUM	03/23/2021	11/30/2021	D	MET	NE
1190	ZINC	03/23/2021	11/30/2021	D	MET	NE
Method Code: 10036609 Method Ref: EPA 245.1				Revision: 3	Date: 1994	
1095	MERCURY	03/23/2021	11/30/2021	D	MET	NE
Method Code: 10011800 Method Ref: EPA 180.1				Revision: 2	Date: 1993	
2055	TURBIDITY	03/23/2021	11/30/2021	D	NMI	NE
Method Code: 10013806 Method Ref: EPA 200.7				Revision: 4.4	Date: 1994	
1755	TOTAL HARDNESS AS CaCO3	03/29/2021	11/30/2021	D	NMI	NE
Method Code: 10014605 Method Ref: EPA 200.8				Revision: 5.4	Date: 1994	
1755	TOTAL HARDNESS AS CaCO3	03/29/2021	11/30/2021	D	NMI	NE
Method Code: 10053200 Method Ref: EPA 300.0				Revision: 2.1	Date: 1993	
1575	CHLORIDE	03/23/2021	11/30/2021	D	NMI	NE
1810	NITRATE AS N	03/23/2021	11/30/2021	D	NMI	NE
1840	NITRITE AS N	03/23/2021	11/30/2021	D	NMI	NE
1870	ORTHOPHOSPHATE AS P	03/23/2021	11/30/2021	D	NMI	NE
2000	SULFATE	03/23/2021	11/30/2021	D	NMI	NE
Method Code: 10067604 Method Ref: EPA 353.2				Revision: 2	Date: 1993	
1810	NITRATE AS N	03/23/2021	11/30/2021	D	NMI	NE
1820	NITRATE PLUS NITRITE AS N	03/23/2021	11/30/2021	D	NMI	NE
1840	NITRITE AS N	03/23/2021	11/30/2021	D	NMI	NE
Method Code: 10070005 Method Ref: EPA 365.1				Revision: 2	Date: 1993	
1870	ORTHOPHOSPHATE AS P	03/23/2021	11/30/2021	D	NMI	NE
1910	TOTAL PHOSPHORUS	03/23/2021	11/30/2021	D	NMI	NE
Method Code: 20048617 Method Ref: SM 2510 B-2011				Revision:	Date: 2011	
1610	CONDUCTIVITY	03/23/2021	11/30/2021	D	NMI	NE
Method Code: 20050457 Method Ref: SM 2540 C				Revision: 23RD ED	Date: 2015	
1955	RESIDUE-FILTERABLE (TDS)	03/23/2021	11/30/2021	D	NMI	NE
Method Code: 20053127 Method Ref: SM 2550 B				Revision: 22ND ED	Date: 2010	
2030	TEMPERATURE	03/23/2021	11/30/2021	D	NMI	NE
Method Code: 20102414 Method Ref: SM 4500-F C-2011				Revision:	Date: 2011	
1730	FLUORIDE	03/23/2021	11/30/2021	D	NMI	NE
Method Code: 20105220 Method Ref: SM 4500-H+ B-2011				Revision:	Date: 2011	
1900	PH	03/23/2021	11/30/2021	D	NMI	NE

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Method Code	Method Ref	Revision	Date	Parameter	Result	Unit
Method Code: 20211443	Method Ref: SM 9223 B (COLILERT® QUANTI-TRAY®)	Revision: 23RD ED	Date: 2016			
2525	ESCHERICHIA COLI	03/23/2021	11/30/2021	N	MIC	NE
2500	TOTAL COLIFORMS	03/23/2021	11/30/2021	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	11/30/2021	N	MIC	NE
2500	TOTAL COLIFORMS	03/16/2021	11/30/2021	N	MIC	NE
Method Code: 10013806	Method Ref: EPA 200.7	Revision: 4.4	Date: 1994			
1000	ALUMINUM	12/01/2019	11/30/2021	N	MET	NE
1005	ANTIMONY	12/01/2019	11/30/2021	N	MET	NE
1010	ARSENIC	12/01/2019	11/30/2021	N	MET	NE
1015	BARIUM	12/01/2019	11/30/2021	N	MET	NE
1020	BERYLLIUM	12/01/2019	11/30/2021	N	MET	NE
1030	CADMIUM	12/01/2019	11/30/2021	N	MET	NE
1035	CALCIUM	12/01/2019	11/30/2021	N	MET	NE
1040	CHROMIUM	12/01/2019	11/30/2021	N	MET	NE
1050	COBALT	12/01/2019	11/30/2021	N	MET	NE
1055	COPPER	12/01/2019	11/30/2021	N	MET	NE
1070	IRON	12/01/2019	11/30/2021	N	MET	NE
1075	LEAD	12/01/2019	11/30/2021	N	MET	NE
1085	MAGNESIUM	12/01/2019	11/30/2021	N	MET	NE
1090	MANGANESE	12/01/2019	11/30/2021	N	MET	NE
1100	MOLYBDENUM	12/01/2019	11/30/2021	N	MET	NE
1105	NICKEL	12/01/2019	11/30/2021	N	MET	NE
1125	POTASSIUM	12/01/2019	11/30/2021	N	MET	NE
1140	SELENIUM	12/01/2019	11/30/2021	N	MET	NE
1150	SILVER	12/01/2019	11/30/2021	N	MET	NE
1155	SODIUM	12/01/2019	11/30/2021	N	MET	NE
1160	STRONTIUM	12/01/2019	11/30/2021	N	MET	NE
1165	THALLIUM	12/01/2019	11/30/2021	N	MET	NE
1175	TIN	12/01/2019	11/30/2021	N	MET	NE
1180	TITANIUM	12/01/2019	11/30/2021	N	MET	NE
1185	VANADIUM	12/01/2019	11/30/2021	N	MET	NE
1190	ZINC	12/01/2019	11/30/2021	N	MET	NE
Method Code: 10014605	Method Ref: EPA 200.8	Revision: 5.4	Date: 1994			
1000	ALUMINUM	12/01/2019	11/30/2021	N	MET	NE
1005	ANTIMONY	12/01/2019	11/30/2021	N	MET	NE
1010	ARSENIC	12/01/2019	11/30/2021	N	MET	NE

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1015	BARIUM	12/01/2019	11/30/2021	N	MET	NE
1020	BERYLLIUM	12/01/2019	11/30/2021	N	MET	NE
1030	CADMIUM	12/01/2019	11/30/2021	N	MET	NE
1035	CALCIUM	12/01/2019	11/30/2021	N	MET	NE
1040	CHROMIUM	12/01/2019	11/30/2021	N	MET	NE
1050	COBALT	12/01/2019	11/30/2021	N	MET	NE
1055	COPPER	12/01/2019	11/30/2021	N	MET	NE
1070	IRON	12/01/2019	11/30/2021	N	MET	NE
1075	LEAD	12/01/2019	11/30/2021	N	MET	NE
1085	MAGNESIUM	12/01/2019	11/30/2021	N	MET	NE
1090	MANGANESE	12/01/2019	11/30/2021	N	MET	NE
1100	MOLYBDENUM	12/01/2019	11/30/2021	N	MET	NE
1105	NICKEL	12/01/2019	11/30/2021	N	MET	NE
1125	POTASSIUM	12/01/2019	11/30/2021	N	MET	NE
1140	SELENIUM	12/01/2019	11/30/2021	N	MET	NE
1150	SILVER	12/01/2019	11/30/2021	N	MET	NE
1155	SODIUM	12/01/2019	11/30/2021	N	MET	NE
1160	STRONTIUM	12/01/2019	11/30/2021	N	MET	NE
1165	THALLIUM	12/01/2019	11/30/2021	N	MET	NE
1175	TIN	12/01/2019	11/30/2021	N	MET	NE
1180	TITANIUM	12/01/2019	11/30/2021	N	MET	NE
1185	VANADIUM	12/01/2019	11/30/2021	N	MET	NE
1190	ZINC	12/01/2019	11/30/2021	N	MET	NE
Method Code: 10036609 Method Ref: EPA 245.1			Revision: 3	Date: 1994		
1095	MERCURY	12/01/2019	11/30/2021	N	MET	NE
Method Code: 10237204 Method Ref: EPA 1631E			Revision:	Date: 2002		
1095	MERCURY	12/01/2019	11/30/2021	N	MET	NE
Method Code: 20066266 Method Ref: SM 3500-CR B-2011			Revision:	Date: 2011		
1045	CHROMIUM VI	12/01/2019	11/30/2021	N	MET	NE
Method Code: 10011800 Method Ref: EPA 180.1			Revision: 2	Date: 1993		
2055	TURBIDITY	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10013806 Method Ref: EPA 200.7			Revision: 4.4	Date: 1994		
1755	TOTAL HARDNESS AS CaCO3	03/29/2021	11/30/2021	N	NMI	NE
Method Code: 10014605 Method Ref: EPA 200.8			Revision: 5.4	Date: 1994		
1755	TOTAL HARDNESS AS CaCO3	03/29/2021	11/30/2021	N	NMI	NE
Method Code: 10053200 Method Ref: EPA 300.0			Revision: 2.1	Date: 1993		
1540	BROMIDE	12/01/2019	11/30/2021	N	NMI	NE

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1575	CHLORIDE	12/01/2019	11/30/2021	N	NMI	NE
1810	NITRATE AS N	12/01/2019	11/30/2021	N	NMI	NE
1840	NITRITE AS N	12/01/2019	11/30/2021	N	NMI	NE
1870	ORTHOPHOSPHATE AS P	12/01/2019	11/30/2021	N	NMI	NE
2000	SULFATE	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10055206 Method Ref: EPA 310.2			Revision:	Date: 1974		
1505	ALKALINITY AS CaCO3	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10063602 Method Ref: EPA 350.1			Revision: 2	Date: 1993		
1515	AMMONIA AS N	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10065404 Method Ref: EPA 351.2			Revision: 2	Date: 1993		
1795	TOTAL KJELDAHL NITROGEN (TKN)	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10067604 Method Ref: EPA 353.2			Revision: 2	Date: 1993		
1810	NITRATE AS N	12/01/2019	11/30/2021	N	NMI	NE
1820	NITRATE PLUS NITRITE AS N	03/09/2020	11/30/2021	N	NMI	NE
1840	NITRITE AS N	03/23/2021	11/30/2021	N	NMI	NE
Method Code: 10070005 Method Ref: EPA 365.1			Revision: 2	Date: 1993		
1870	ORTHOPHOSPHATE AS P	12/01/2019	11/30/2021	N	NMI	NE
1910	TOTAL PHOSPHORUS	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10077404 Method Ref: EPA 410.4			Revision: 2	Date: 1993		
1565	CHEMICAL OXYGEN DEMAND (COD)	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10079400 Method Ref: EPA 420.1			Revision:	Date: 1978		
1905	TOTAL PHENOLICS	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10081400 Method Ref: EPA 445			Revision: 1.2	Date: 1997		
9345	CHLOROPHYLLS	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 10261617 Method Ref: EPA 1664B			Revision:	Date: 2010		
1803	N-HEXANE EXTRACTABLE MATERIAL (O&G)	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 20048617 Method Ref: SM 2510 B-2011			Revision:	Date: 2011		
1610	CONDUCTIVITY	03/23/2021	11/30/2021	N	NMI	NE
Method Code: 20049416 Method Ref: SM 2540 B-2011			Revision:	Date: 2011		
1950	RESIDUE-TOTAL (TS)	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 20050457 Method Ref: SM 2540 C			Revision: 23RD ED	Date: 2015		
1955	RESIDUE-FILTERABLE (TDS)	03/23/2021	11/30/2021	N	NMI	NE
Method Code: 20051212 Method Ref: SM 2540 D-2011			Revision:	Date: 2011		
1960	RESIDUE-NONFILTERABLE (TSS)	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 20053127 Method Ref: SM 2550 B			Revision: 22ND ED	Date: 2010		
2030	TEMPERATURE	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 20080426 Method Ref: SM 4500-CL E-2011			Revision:	Date: 2011		
1940	TOTAL RESIDUAL CHLORINE	12/01/2019	11/30/2021	N	NMI	NE

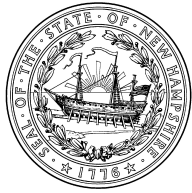
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Method Code: 20085216	Method Ref: SM 4500-CL C-2011		Revision:	Date: 2011		
1575	CHLORIDE	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 20097023	Method Ref: SM 4500-CN⁻ G		Revision: 23RD ED	Date: 2016		
1510	AMENABLE CYANIDE	03/23/2021	11/30/2021	N	NMI	NE
Method Code: 20105220	Method Ref: SM 4500-H+ B-2011		Revision:	Date: 2011		
1900	PH	12/01/2019	11/30/2021	N	NMI	NE
Method Code: 20135039	Method Ref: SM 5210 B-2016		Revision:	Date: 2016		
1530	BIOCHEMICAL OXYGEN DEMAND (BOD)	03/23/2021	11/30/2021	N	NMI	NE
1555	CARBONACEOUS BOD (CBOD)	03/23/2021	11/30/2021	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	11/30/2021	N	NMI	NE
Method Code: 20138630	Method Ref: SM 5310 C-2014		Revision: 23RD ED	Date: 2014		
2040	TOTAL ORGANIC CARBON (TOC)	03/23/2021	11/30/2021	N	NMI	NE
Method Code: 60007161	Method Ref: LACHAT 10-204-00-1-X		Revision:	Date: 2005		
1645	TOTAL CYANIDE	03/23/2021	11/30/2021	N	NMI	NE
Method Code: 60031450	Method Ref: OIA 1677-09		Revision:	Date: 2010		
1523	AVAILABLE CYANIDE	03/23/2021	11/30/2021	N	NMI	NE
Method Code: 10133207	Method Ref: SW-846 3005A		Revision: UPDATE I	Date: 1992		
1438	PRECONCENTRATION UNDER ACID	12/01/2019	11/30/2021	N	PRE	NE
Method Code: 10133605	Method Ref: SW-846 3010A		Revision: UPDATE I	Date: 1992		
1420	HOT PLATE ACID DIGESTION (HNO ₃ + HCL)	12/01/2019	11/30/2021	N	PRE	NE
Method Code: 10134006	Method Ref: SW-846 3015A		Revision:	Date: 1998		
1430	MICROWAVE-ASSISTED ACID DIGESTION OF TCLP EXTRACTS	03/23/2021	11/30/2021	N	PRE	NH
Method Code: 10214207	Method Ref: EPA 1000.0 - FATHEAD MINNOW, 7-DAY CHRONIC, DAILY		Revision:	Date: 2002		
3470	IC25 (ON) GROWTH	12/01/2019	11/30/2021	N	TOX	NE
3475	NOEC (GROWTH)	12/01/2019	11/30/2021	N	TOX	NE
3465	NOEC (SURVIVAL)	12/01/2019	11/30/2021	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	11/30/2021	N	TOX	NE
3465	NOEC (SURVIVAL)	12/01/2019	11/30/2021	N	TOX	NE
3485	NOEC REPRODUCTION	12/01/2019	11/30/2021	N	TOX	NE
Method Code: 10013806	Method Ref: EPA 200.7		Revision: 4.4	Date: 1994		
1000	ALUMINUM	12/01/2019	11/30/2021	SC	MET	NE
1005	ANTIMONY	12/01/2019	11/30/2021	SC	MET	NE
1010	ARSENIC	12/01/2019	11/30/2021	SC	MET	NE
1015	BARIUM	12/01/2019	11/30/2021	SC	MET	NE
1020	BERYLLIUM	12/01/2019	11/30/2021	SC	MET	NE

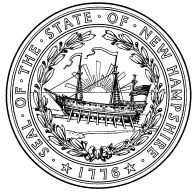
This analyte list supersedes all previously issued analyte lists. Method accreditation does not imply acceptance for NHDES compliance testing. Laboratory is required to use EPA-approved methods required by regulation. Continuing accreditation status is dependent on successful ongoing participation in 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>).

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: 223820-C



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

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



1030	CADMIUM	12/01/2019	11/30/2021	SC	MET	NE
1035	CALCIUM	12/01/2019	11/30/2021	SC	MET	NE
1040	CHROMIUM	12/01/2019	11/30/2021	SC	MET	NE
1050	COBALT	12/01/2019	11/30/2021	SC	MET	NE
1055	COPPER	12/01/2019	11/30/2021	SC	MET	NE
1070	IRON	12/01/2019	11/30/2021	SC	MET	NE
1075	LEAD	12/01/2019	11/30/2021	SC	MET	NE
1085	MAGNESIUM	12/01/2019	11/30/2021	SC	MET	NE
1090	MANGANESE	12/01/2019	11/30/2021	SC	MET	NE
1100	MOLYBDENUM	12/01/2019	11/30/2021	SC	MET	NE
1105	NICKEL	12/01/2019	11/30/2021	SC	MET	NE
1125	POTASSIUM	12/01/2019	11/30/2021	SC	MET	NE
1140	SELENIUM	12/01/2019	11/30/2021	SC	MET	NE
1150	SILVER	12/01/2019	11/30/2021	SC	MET	NE
1155	SODIUM	12/01/2019	11/30/2021	SC	MET	NE
1160	STRONTIUM	12/01/2019	11/30/2021	SC	MET	NE
1165	THALLIUM	12/01/2019	11/30/2021	SC	MET	NE
1175	TIN	12/01/2019	11/30/2021	SC	MET	NE
1180	TITANIUM	12/01/2019	11/30/2021	SC	MET	NE
1185	VANADIUM	12/01/2019	11/30/2021	SC	MET	NE
1190	ZINC	12/01/2019	11/30/2021	SC	MET	NE
Method Code: 10036609 Method Ref: EPA 245.1				Revision: 3		Date: 1994
1095	MERCURY	12/01/2019	11/30/2021	SC	MET	NE
Method Code: 10063602 Method Ref: EPA 350.1				Revision: 2		Date: 1993
1515	AMMONIA AS N	12/01/2019	11/30/2021	SC	NMI	NE
Method Code: 10065404 Method Ref: EPA 351.2				Revision: 2		Date: 1993
1795	TOTAL KJELDAHL NITROGEN (TKN)	12/01/2019	11/30/2021	SC	NMI	NE
Method Code: 10070005 Method Ref: EPA 365.1				Revision: 2		Date: 1993
1910	TOTAL PHOSPHORUS	12/01/2019	11/30/2021	SC	NMI	NE
Method Code: 10198455 Method Ref: SW-846 9045D				Revision: UPDATE IIIB		Date: 2004
1900	PH	03/23/2021	11/30/2021	SC	NMI	NE
Method Code: 20005270 Method Ref: SM 2540 G-2011				Revision:		Date: 2011
1947	RESIDUE, FIXED	12/01/2019	11/30/2021	SC	NMI	NE
1950	RESIDUE-TOTAL (TS)	12/01/2019	11/30/2021	SC	NMI	NE
1970	RESIDUE-VOLATILE	12/01/2019	11/30/2021	SC	NMI	NE
Method Code: 10136002 Method Ref: SW-846 3051A				Revision:		Date: 1998
1426	MICROWAVE DIGESTION OF SOLIDS	03/23/2021	11/30/2021	SC	PRE	NE

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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: 223820-C



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

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



Bill Hall
NORTHEAST 3/29/2021

Bill Hall
NH ELAP Program Manager
Issue Date: 03/29/2021

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

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Appendix F. Acknowledgement Letters



March 17, 2021

Mr. Seth Hothem
Supervisor of Environmental Assessment
Northeast Ohio Regional Sewer District
4747 East 49th Street
Cuyahoga Heights, Ohio 44125

Dear Mr. Hothem:

This letter is to acknowledge that I am responsible for assisting the Northeast Ohio Regional Sewer District's Water Quality and Industrial Surveillance Division in conducting chemical water quality assessments for the 2021 Chagrin River Environmental Monitoring, Cuyahoga River Environmental Monitoring, Euclid/Dugway Storage Tunnels Post-Construction Monitoring, Euclid Creek Microbial Source Tracking Study, Euclid Creek Sediment Sampling, Woodland Central Green Infrastructure Water Quality Improvement Study, Stream Restoration Projects Pre- & Post-Construction Monitoring and the Lake Erie Nutrient Study.

It is understood that an Ohio Environmental Protection Agency Level 3 Qualified Data Collector Certification for Chemical Water Quality Assessment is required to perform these tasks and that I am responsible for maintaining my Level 3 QDC Certification during the term of these Study Plans.

In addition, I have not been convicted nor 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.

Sincerely,

A handwritten signature in blue ink, appearing to read "Kelsey Amidon", is written over a light blue circular stamp.

Kelsey Amidon
Stormwater Inspector
Northeast Ohio Regional Sewer District
4747 East 49th Street
Cuyahoga Heights, Ohio, 44125



June 6, 2021

Mr. Seth Hothem
Supervisor of Environmental Assessment
Northeast Ohio Regional Sewer District
4747 East 49th Street
Cuyahoga Heights, Ohio 44125

Re: 2021 Benthic Services

Dear Mr. Hothem:

This letter is to acknowledge that I am responsible for the identification of benthic macroinvertebrates for the following Northeast Ohio Regional Sewer District Study Plans:

- 2021 Chagrin River Environmental Monitoring
- 2021 Cuyahoga River Environmental Monitoring
- 2021 Euclid/Dugway Storage Tunnels Post Construction Monitoring
- 2021 Stream Restoration Projects Pre- & Post-Construction Monitoring

It is understood that an Ohio Environmental Protection Agency Level 3 Qualified Data Collector Certification for Benthic Macroinvertebrate, with the specialty of identification, is required to perform these tasks and that I am responsible for maintaining my Level 3 QDC Certification during the term of these Study Plans.

In addition, I have not been convicted nor 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.

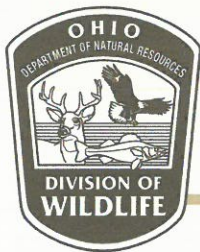
Sincerely,

A handwritten signature in blue ink that reads 'Bert Remley II'.

Bert Remley
Senior Taxonomist
Bremley@thirdrockconsultants.com

Appendix G. Wild Animal Collector's Permit

To be submitted when received.



DIVISION OF WILDLIFE

Ohio Department of Natural Resources

Division of Wildlife Headquarters
2045 Morse Road, Bldg. G
Columbus, Ohio 43229-6693
1-800-WILDLIFE

Chief, Division of Wildlife: **Kendra S. Wecker**

WILD ANIMAL PERMIT: 21-204

SCIENTIFIC COLLECTION

SETH HOTHEM
NORTHEAST OHIO REGIONAL SEWER DISTRICT
4747 EAST 49TH ST
CUYAHOGA HEIGHTS, OH 44125

DATE ISSUED

7/27/2020

Others authorized on permit

YES (SEE ATTACHMENT)

is hereby granted permission to take, possess, and transport at any time and in any manner specimens of wild animals, subject to the conditions and restrictions listed below or any documents accompanying this permit. This permit, unless revoked earlier by the Chief, Division of Wildlife, is effective from:

3/16/2020 to: 3/15/2021

The Chief of the Division of Wildlife will not issue permits for Dangerous Wild Animal (DWA) species (ORC 935.01) except native DWA, required for specific projects. The permit issued by the Chief does not relieve the permittee of any responsibility to obtain a permit pursuant to R.C. Chapter 935 except as specified for the animals and purposes permitted herein. The permittee must adhere to all additional requirements under R.C. Chapter 935.

THIS PERMIT IS RESTRICTED AS FOLLOWS:

1. Permittee may collect fish, macroinvertebrates, and amphibians for survey and inventory purposes. All non-target species are to be released at site of capture.
2. Fish may be collected for fish tissue study. Common species of fish may also be collected and displayed for educational purposes. Fish must be displayed at NEORS or the Greater Cleveland Aquarium or other public educational facility. They may not be maintained at a private residence. Sport fish >6 in. must be immediately released.
3. Qualified surveyors may survey freshwater mussels for reconnaissance purposes on Group 1 streams. Relic mussel shells may be collected and taken to NEORS. No more than two specimens per species.
4. Biosecurity measures must be taken at all times to minimize the potential transmission of diseases. Please follow the recommendations of the Northeast PARC (included) for all work with reptiles and amphibians.
5. Permittee must consult with Wildlife's Stream Conservation and Environmental Assessment Unit (SCEA) prior to conducting any wild animal work associated with compliance requirements of the Clean Water Act (CWA) Section 401 and/or 404. Contact the unit at 614/265-6346 (John Navarro).
6. Twenty-four (24) hours prior to collection, contact must be made with the local wildlife officer to advise location and duration of sampling.
7. All vouchers are to be deposited at NEORS or the Cleveland Museum of Biological Diversity.
8. Permittee must contact the Division of Wildlife if previously undocumented aquatic invasive species are discovered. Contact John Navarro at (614) 265-6346 or john.navarro@dnr.state.oh.us with information. If grass carp, silver carp, big head carp or black carp are captured, please retain and contact Eric Weimer at (419)625-8062 or at eric.weimer@dnr.state.oh.us.
9. Collection is prohibited in the Killbuck, Big Darby, Little Darby, including the tributaries to, the east branch of the Chagrin River above I-90, Fish Creek (Williams County) and Division of Wildlife property without explicit written permission from the Division of Wildlife. Sampling is further restricted in streams that may have federally listed mussels. See Appendix A of the Ohio Mussel Survey Protocol (April 2020 @ <https://ohiodnr.gov/wps/portal/gov/odnr-core/documents/wildlife-documents/mussel-survey-protocol>) for locations of federally listed mussels.
10. Permittee must provide an annual electronic report of collecting activities in the Diversity Database Excel spreadsheet format to the Division of Wildlife.

Locations of Collecting:

STATEWIDE WITH NOTED EXCEPTIONS

Equipment and method used in collection:

SEINES, TRAP NETS, ELECTROFISHING, AND HAND COLLECTION

Name and number of each species to be collected:

FISH, MACROINVERTEBRATES, AND AMPHIBIANS AS REQUIRED FOR RESEARCH AND MONITORING PURPOSES. MUSSELS FOR RECONNAISSANCE PURPOSES ON GROUP 1 STREAMS. DEAD MUSSEL SHELLS ONLY FOR IDENTIFICATION PURPOSES.

RESTRICTIVE DOCUMENTS ACCOMPANYING THIS PERMIT? YES

NO ENDANGERED SPECIES OR AQUATIC NUISANCE SPECIES MAY BE TAKEN WITHOUT WRITTEN PERMISSION FROM THE CHIEF

ATTACHMENT

This attachment to permit # 21-204 authorizes the following persons to conduct the activities listed on the permit, within the conditions and restrictions set forth. Each person must carry and exhibit upon request, a copy of the permit and this attachment when conducting any of the listed activities. The person named on the permit assumes full responsibility for the actions of the persons on this list and for completing and submitting all required reports.

Sub-permittee Name

JONATHAN BRAUER

HANNAH BOESINGER

KEVIN FITZGIBBONS

JILLIAN KNITTLE

RON MAICHLE

MARK MATTESON

DANIEL NEELON

DENISE PHILLIPS

JOHN RHOADES

JOSEPH SCHIEL

ERIC SOEHNLEN

JUSTIN TELEP

Appendix H. References

References

- Chlorophyll a Sampling and Field Filtering Standard Operating Procedure (SOP-EA001-00)
- EPA New England- Region 1. (2005). *Standard operating procedure for calibration and field measurement procedures for the YSI Model 6-Series Sondes and Data Logger (Including: temperature, pH, specific conductance, turbidity, dissolved oxygen, chlorophyll, rhodamine WT, ORP, and barometric pressure)* (7th Revision). North Chelmsford, MA: The Office of Environmental Measurement and Evaluation, Ecosystem Assessment- Ecology Monitoring Team.
- Ohio Environmental Protection Agency. (1987a). *Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters* (Updated January 1988; September 1989; November 2006; August 2008; May 2015). Columbus, OH: Division of Water Quality Monitoring and Assessment.
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- Ohio Environmental Protection Agency. (2003). *Total Maximum Daily Load for the Lower Cuyahoga River*. Columbus, OH: Division of Surface Water.
- Ohio Environmental Protection Agency. (2006). *Methods for assessing habitat in flowing waters: using the Qualitative Habitat Evaluation Index (QHEI)*. (Ohio EPA Technical Bulletin EAS/2006-06-1). Columbus, OH: Division of Surface Water; Division of Ecological Assessment Section.
- Ohio Environmental Protection Agency. (2010). *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1)*. Columbus, OH: Division of Surface Water.
- Ohio Environmental Protection Agency. (2015). *Proposed Stream Nutrient Assessment Procedure*. Columbus, OH: Division of Surface Water, Ohio EPA Nutrients Technical Advisory Group.
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