

## Level 3 Project Study Plan

### *2011 Big Creek Environmental Monitoring*

#### (1) Objectives

The overall objective of this study will be to evaluate the impact of upstream NEORSD CSO discharges on the downstream macroinvertebrate community. The study at RM 0.15 on the Main Branch, the site downstream of the NEORSD CSO discharges, is required under Ohio Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Permit No. 3PA00002\*FD. Sampling at RM 0.15 will be conducted to determine the extent to which the downstream macroinvertebrate community is impacted by NEORSD CSO discharges and other environmental factors. Fish, habitat and water chemistry will also be evaluated at RM 0.15.

Another objective of this study is to evaluate fish and benthic macroinvertebrate communities, habitat, and water chemistry in Big Creek at RM 4.40 on the Main Branch. Quantitative electroshocking will be conducted at RM 4.40 because of the decrease in the collection of bigmouth shiners (*Notropis dorsalis*) in 2010. One bigmouth shiner was collected in 2010, compared to seven in 2009 and nine in 2008. The bigmouth shiner is very limited in its distribution in Ohio streams. Aside from its recent discovery at RM 4.40 on Big Creek, it currently inhabits only the Black and Rocky Rivers (Trautman, 1981). It is also listed as a threatened species by the Ohio Division of Wildlife.

Sampling will be conducted by the NEORSD's Environmental Assessment group in the Water Quality and Industrial Surveillance division (WQIS) and will occur from June 15 through October 15, 2011, as required in the OEPA *Biological Criteria for the Protection of Aquatic Life Volume III* (1987b)<sup>1</sup>. Quantitative and qualitative benthic macroinvertebrate sampling will be conducted at both sample sites. The benthic macroinvertebrate results will be compiled and used to calculate an Invertebrate Community Index (ICI) score for each site. Species assemblages and individual metrics will be analyzed. Water sampling data will be compared to applicable Ohio Water Quality Standards (2009b) to determine if there are excursions from the water quality criteria. An examination of the individual metrics that comprise the ICI will be used in conjunction with water quality data, the NEORSD Macroinvertebrate Field Sheet, and the Ohio EPA Qualitative Habitat Evaluation Index (QHEI) results in order to identify impacts to the macroinvertebrate communities. Results will also be compared to historic data to show temporal as well as spatial trends.

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<sup>1</sup> See Appendix I for a list of all references.

Fish community health will be evaluated through the use of Ohio EPA’s Index of Biological Integrity (IBI) and at RM 0.15, the Modified Index of Well-Being (MIwb). An examination of the individual metrics that comprise the IBI will be used in conjunction with water quality data and QHEI results in order to identify impacts to the fish community.

(2) Point/Nonpoint Sources

Point Sources	Nonpoint Sources
CSO(s) outside of NEORSD service area	Urban Runoff
Storm Sewer Outfalls	Landfill Leachate
Upstream Tributaries	Spills
Home Sewage Treatment Systems	Agriculture
NEORSD-owned CSOs	
Sanitary Sewer Overflows	

A map has been provided in Appendix A to show point sources that may be influencing the water quality at each sample location. These sources of pollution, along with the nonpoint sources listed in the table above, may be impacting the health of the fish and benthic macroinvertebrate communities. Other factors that may influence ecological conditions during the study include periods of drought and periods of precipitation.

(3) Parameters Covered

Fish specimens will be identified to species level, counted and examined for the presence of external anomalies including deformities, eroded fins, lesions and tumors, known as DELTs. Quantitative fish sampling will be conducted at all locations.

Macroinvertebrate community assemblages will be collected from each location and sent to a Benthic Macroinvertebrate Level 3 Qualified Data Collector (QDC) for identification and enumeration. The QDC, described in section (11), will identify the specimens to the lowest practical taxonomic level and whenever possible, to the level of taxonomy recommended in Ohio EPA’s *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b).

The NEORSD Macroinvertebrate Field Sheet (Appendix B) will be completed at each site during sampler retrieval. In addition, stream habitat will be measured by scoring components of the QHEI at all locations, including the substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle/run quality and gradient.

Water chemistry samples will be collected at all sites. Appendix C lists the parameters to be tested along with the detection limits and practical quantitation limits. At least once, at all sites sampled, chlorophyll *a* (method: EPA 445.0)

sampling will occur. Field measurements for dissolved oxygen, pH, temperature, conductivity and flow will also be performed. A NEORSD Surface Water Condition Sampling Field Data Form will be completed at each site during each sample collection (Appendix D).

(4) Field Collection and Data Assessment Techniques

Field collections for fish will be conducted at all sites. Sampling will be conducted using longline electrofishing techniques and will consist of shocking all habitat types within a sampling zone, which is 0.15 kilometers in length for the headwater site and 0.20 kilometers for the wading site, while moving from downstream to upstream. The stunned fish will be collected and placed into a live well for later identification.

Fish will be identified to species level, 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. Subsamples of difficult to identify species will be brought back to the laboratory for verification by NEORSD Level 3 Fish Qualified Data Collectors (QDC) 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.

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. 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 include installation of a Hester-Dendy multi-plate artificial substrate sampler (HD) that is colonized for a six-week period. Multiple HD samplers will be installed at one or all of the locations in case samplers are lost due to vandalism, burial, etc. 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. Midwest Biodiversity Institute (Columbus, Ohio) will identify the specimens to the lowest practical taxonomic level and when the condition of the specimen allows, to the level of taxonomy recommended in Ohio EPA's (1987b) *Biological Criteria for the Protection of Aquatic Life, Volume III*. Voucher

specimens will be collected as described in section (14). Stream flow will be measured with a Marsh-McBirney FloMate Model 2000 Portable Flow Meter or an Aquaflo Probe Model 6900 when the HD samplers are installed and retrieved.

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 (1987a) *Biological Criteria for the Protection of Aquatic Life, Volumes II and III* (1987b).

Water chemistry sampling will be completed at all locations. Techniques used for water chemistry sampling and chemical analyses will follow the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009). Chemical water quality samples from each site will be collected with two 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and two 473-mL plastic bottles. Bacteriological samples will be collected from each site in a 500-mL sterilized bottle treated with sodium thiosulfate. All water quality samples will be collected as grab samples. One duplicate sample and one field blank will be collected at a randomly selected site, at the frequency not less than 10% of the total samples collected, for this study plan. The acceptable relative percent difference (RPD) for field duplicate samples will be  $\leq 30$  percent; results outside this range will trigger further evaluation along with an investigation into causes for disparities. RPD values above 30 percent, with results less than ten times the practical quantitation limit, will be reviewed on a case-by-case basis to determine if there is any merit for further investigation. Acid preservation of the samples, as specified in the NEORSD laboratory's standard operating procedure for each parameter, will occur in the field. Appendix C lists the analytical method, detection limit and practical quantitation limit for each parameter analyzed. Field analyses include the use of either a YSI-556 MPS Multi-Parameter Water Quality Meter or YSI 600XL sonde to measure dissolved oxygen, water temperature, conductivity and pH; and when necessary, a Hanna HI 98129 meter to measure pH. Meter specifications have been included in Appendix E.

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 by Level 3 QDCs.

Benthic and water column chlorophyll a samples will be collected at least once under low-flow conditions. 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. 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.

Species assemblages and individual metrics will be analyzed. Graphs that show current QHEI, IBI, MIwb and ICI scores and how these scores compare to attainment status of biocriteria may 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. Comparisons between water quality and biological community health will only be made if at least three water quality samples have been collected from a particular site.

(5) Sampling Locations

The following locations will be surveyed on Big Creek during the 2011 field season for general watershed monitoring as outlined in this study plan. HD and water chemistry collection sites are located near the mid point of each electrofishing zone, indicated by river mile, unless otherwise noted. GPS coordinates are recorded at the downstream end of each electrofishing zone.

Site Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Big Creek – Main Branch	N41.4460°	W81.6865°	0.15	Downstream of Jennings Road	Cleveland South	Evaluate chemistry, habitat, fish, & macroinvertebrates in support of Ohio EPA Permit #3PA00002*FD
Big Creek – Main Branch	N41.4460°	W81.7540°	4.40	Memphis/Tiedeman Park	Lakewood	Evaluate chemistry, habitat, fish & macroinvertebrates

(6) Schedule

At least one electrofishing survey will be conducted at RM 4.4, a headwater site, between June 15<sup>th</sup> and October 15<sup>th</sup>, 2011. Two electrofishing surveys will be conducted at RM 0.15 a wading site, at least four to five weeks will separate assessments. 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 once at each site, between June 15<sup>th</sup> and August 19<sup>th</sup>, 2011, at all of the sites and retrieved six weeks later. Specific dates have not been scheduled. River flow and weather conditions will be assessed weekly to determine when the HD sampler installations and retrievals will be conducted.

Water chemistry samples will be collected a minimum of three times at each site between June 15<sup>th</sup> and October 15<sup>th</sup>, 2011.

QHEI habitat evaluations will be conducted one time at each site between June 15<sup>th</sup> and October 15<sup>th</sup>, 2011. These evaluations will be conducted around the same time as one of the electrofishing surveys.

(7) 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) and *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006).

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 the problem as soon as possible, whether by repairing in the field, at the NEORSD Environmental & Maintenance Services Center (EMSC), or by contacting the supplier or an appropriate service company.

Subsamples of difficult to identify fish species will be brought back to the laboratory for verification by NEORSD Level 3 Fish Qualified Data Collectors (QDC), 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 that particular species.

All macroinvertebrate community assemblages will be collected and sent to MBI for identification and enumeration. MBI will identify specimens to the lowest practical taxonomic level as recommended in Ohio EPA's (1987b) *Biological Criteria for the Protection of Aquatic Life, Volume III*. The MBI QA/QC manual is attached (Appendix F). All macroinvertebrate specimens will be returned to NEORSD. Voucher specimens for each site will be separated into individual vials and collected as described in section (14). The remaining specimens for each site will be returned in a single container labeled with the site number, collection method and date. All specimens and accompanying chain-of-custody documentation will be retained by NEORSD and stored at EMSC 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 NEORSO 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.

Three filtrations will be completed for each benthic and water column chlorophyll a sample. In addition, a field filtration blank will be submitted for every 20 samples.

(8) Work Products

Within one year of completion of the project, fish data (species, numbers, pollution tolerances, the incidence of DELT anomalies and IBI scores), macroinvertebrate data (types and numbers of macroinvertebrates collected and ICI scores), habitat data (QHEI raw data and scores) and water chemistry results will be submitted to the Ohio EPA. Additionally, reports summarizing, interpreting, graphically presenting and discussing the IBI, ICI and QHEI scores and any excursions from water quality standards may be prepared for internal use.

(9) Qualified Data Collectors

The following Level 3 QDCs may be involved with these studies:

Name	Address	Email Address	Phone Number	QDC Specialty(s)
<sup>1</sup> John W. Rhoades	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	QDC - 008 CWQA/FCB/SHA/ BMB
Catherine Zamborsky	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	QDC - 009 CWQA/SHA
Jill Novak	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	novakj@neorsd.org	216-641-6000	QDC - 512 CWQA/SHA
Seth Hothem	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 010 CWQA/FCB/SHA
Kristina Granlund	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	granlundk@neorsd.org	216-641-6000	QDC - 511 CWQA/FCB/SHA
Kathryn Crestani	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	crestanik@neorsd.org	216-641-6000	QDC - 011 CWQA/SHA
<sup>2,3,6</sup> Thomas Zablontny	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	zablontnyt@neorsd.org	216-641-6000	QDC - 018 CWQA/FCB/SHA
<sup>4</sup> Ronald Maichle	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 145 CWQA/SHA/BMB
Francisco Rivera	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000	QDC - 262 CWQA
<sup>5</sup> Martin Knapp	Midwest Biodiversity Institute (MBI) P.O. Box 21561 Columbus, Ohio 43221	martygator@hotmail.com	614-457-6000	QDC - 300 BMB
<sup>1</sup> Lead Project Manager	<sup>4</sup> Benthic Macroinvertebrate Biology (BMB) Project Manager			

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<sup>2</sup>Fish Community Biology (FCB) Project Manager  
<sup>3</sup>Stream Habitat Assessment (SHA) Project Manager

<sup>5</sup>Benthic Macroinvertebrate Identification  
<sup>6</sup>Chemical Water Quality Assessment (CWQA) Project Manager

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

Name	Address	Email Address	Phone Number
Nick Barille	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Barillen@neorsd.org	216-641-6000
Joseph Broz	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Brozj@neorsd.org	216-641-6000
Tim Dobriansky	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Dobrianskyt@neorsd.org	216-641-6000
Kyle Frantz	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Frantzk@neorsd.org	216-641-6000
Rae Grant	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Grantr@neorsd.org	216-641-6000
Eric Hinton	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Hintone@neorsd.org	216-641-6000
Mark Matteson	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Mattesonm@neorsd.org	216-641-6000
Denise Phillips	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Phillipsd@neorsd.org	216-641-6000
Amy Erzen	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Erzena@neorsd.org	216-641-6000
Kevin Roff	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Roffk@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Schuschuf@neorsd.org	216-641-6000
Wolfram von Kiparski	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	Vonkiparskiw@neorsd.org	216-641-6000
Amy Erzen Summer Co-op	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	erzena@neorsd.org	216-641-6000
Summer Co-op	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
Summer Co-op	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
Summer Co-op	4747 East 49 <sup>th</sup> Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000

- (10) Documentation of approval of project managers and other personnel as Level 3 Qualified Data Collectors

See attached (Appendix G).

- (11) Contract laboratory contact information



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Any fish that is not positively identified in the field or NEORS laboratory 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.

The Ohio State University Museum of Biological Diversity  
Dr. Ted Cavender, Curator of Fish / Mr. Marc Kibbey, Associate Curator of Fish  
1315 Kinnear Road, Columbus, Ohio 43212  
[cavender.1@osu.edu](mailto:cavender.1@osu.edu) / [kibbey.3@osu.edu](mailto:kibbey.3@osu.edu)  
(614) 292-7873

Identification of macroinvertebrates will be completed by MBI (Columbus, Ohio). Benthic macroinvertebrates will be identified to the lowest practical level as recommended in Ohio EPA's (1987b) *Biological Criteria for the Protection of Aquatic Life, Volume III*.

Mr. Chris Yoder  
Midwest Biodiversity Institute  
P.O. Box 21561  
Columbus, Ohio 43221  
[yoder@rrohio.com](mailto:yoder@rrohio.com)  
614-457-6000

(12) Copy of Ohio Division of Natural Resources (ODNR) collector's permit

To be submitted electronically when issued by ODNR (Appendix H).

(13) Catalog Statement

A digital photo catalog of all sampling locations will be maintained for 10 years and will include photos of the specific sampling location(s), 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: John W. Rhoades / Date: \_\_\_\_\_

(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. 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 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: John W. Rhoades / Date: \_\_\_\_\_

(15) Trespassing Statement

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

Print/Signature: John W. Rhoades / Date: \_\_\_\_\_

Print/Signature: Kristina Granlund / \_\_\_\_\_

Print/Signature: Cathy Zamborsky / Date: \_\_\_\_\_

Print/Signature: Seth Hothem / Date: \_\_\_\_\_

Print/Signature: Kathryn Crestani / Date: \_\_\_\_\_

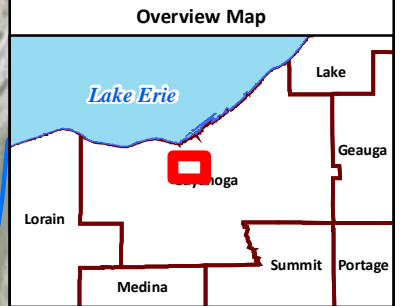
Print/Signature: Tom Zablony / Date: \_\_\_\_\_

Print/Signature: Ron Maichle / Date: \_\_\_\_\_

Print/Signature: Francisco Rivera / Date: \_\_\_\_\_

Print/Signature: Jill Novak / Date: \_\_\_\_\_

## Appendix A



### Big Creek 2011 Environmental Assessment

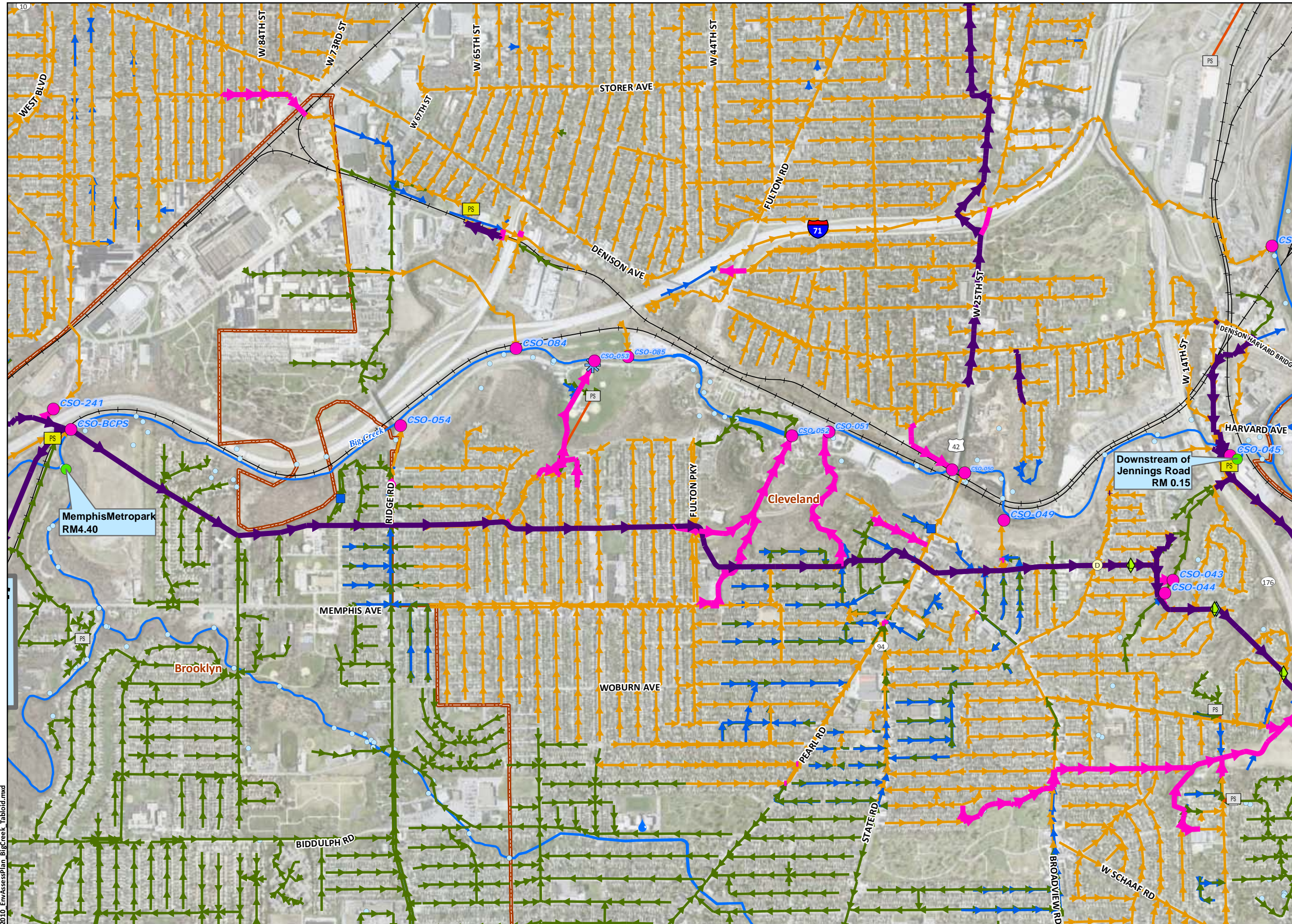
- Outfalls
- Stream
- District CSO Permit Point
- District Facility
- Flow Meter
- Level Monitor
- Rain Gauge
- Interceptor
- CSO Responsibility
- Sludge Force Main
- Combined Sewer
- CSO Overflow Sewer
- Culverted Stream
- Sanitary Sewer
- Storm Sewer
- Force Main

- Study Sites
- Downstream of Jennings Road  
-Lat.41.4460 Long.-81.6865
  - Memphis Metropark  
-Lat. 41.4460 Long.-81.7540



0.3  
Miles

Date: March 2011  
Sources: Orthophotos(2008), Street Centerline (2006), Cuyahoga County GIS; Streams(2010), Environmental Assessment Zones (2011), Collection System(2011), NEORS GIS;



2010\_EnvAssessPlan\_BigCreek\_Tabloid.mxd

This map was compiled by the Northeast Ohio Regional Sewer District ("District") which makes every effort to produce and publish the most current and accurate information possible. This map was created and compiled to serve the District for planning and analysis purposes. The District makes no warranties, expressed or implied, with respect to the accuracy of this map and its use for any specific purpose. The District and its employees expressly disclaim any liability that may result from the use of this map/data. For more information, please contact: Jeffrey Duke, P.E., GISP (Engineering Technical Services) 3900 Euclid Avenue, Cleveland, Ohio 44115 (216-881-6600).

## Appendix B

**NEORSD Macroinvertebrate Field Sheet**

Stream: \_\_\_\_\_ River Mile: \_\_\_\_\_ Year: \_\_\_\_\_

Location: \_\_\_\_\_ Project: \_\_\_\_\_

Drainage Area (mi<sup>2</sup>): \_\_\_\_\_ Latitude (°N)/Longitude (°W): \_\_\_\_\_

**Hester-Dendy Deployment Information**

Install Date: \_\_\_\_\_ Crew Initials (QDC Circled): \_\_\_\_\_

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

Reinstall Date: \_\_\_\_\_ Crew Initials (QDC Circled): \_\_\_\_\_

Current (fps): \_\_\_\_\_ Depth (cm): \_\_\_\_\_ Reason: \_\_\_\_\_

Reinstall Date: \_\_\_\_\_ Crew Initials (QDC Circled): \_\_\_\_\_

Current (fps): \_\_\_\_\_ Depth (cm): \_\_\_\_\_ Reason: \_\_\_\_\_

**Sampling/Retrieval Information**

Sampling Method: Hester-Dendy Dipnet Surber Grab Other: \_\_\_\_\_

Sampling ID: HD: \_\_\_\_\_ Qualitative: \_\_\_\_\_ Other: \_\_\_\_\_

Sampling Date: \_\_\_\_\_ Crew Initials (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

Samples Analyzed By: \_\_\_\_\_ QDC #: \_\_\_\_\_ Date: \_\_\_\_\_

**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:* Open 75 % 50 % 25 % Closed

**Comment Section:** \_\_\_\_\_

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### 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	
Grass		Water Willow	
Shallows		Clay/Hardpan	
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
	Other _____
/	Zygoptera, Anisoptera
	Plecoptera
	Hemiptera
/	Megaloptera, Neuroptera
	Trichoptera
	Hydropsychidae
	Other _____
	Coleoptera
	Elimidae
	Other _____
	Diptera
	Chironomidae
	Other _____
/	Gastropoda, Bivalvia
	Other _____
	Other _____
	Other _____



## Appendix C

Parameter	Additional Name	Test	Minimum Detection Limit	Practical Quantitation Limit
Alkalinity		EPA 310.2	1.5 mg/L	10 mg/L
Chemical Oxygen Demand	COD	EPA 410.4	5 mg/L	10 mg/L
Hexavalent Chromium	Hex Chrome	SM 3500 Cr D. <sup>1</sup>	1 µg/L	5 µg/L
Mercury	Hg	EPA 245.1	0.005 µg/L	0.050 µg/L
Ammonia *	NH <sub>3</sub>	EPA 350.1	0.002 mg/L	0.010 mg/L
Nitrite + Nitrate	NO <sub>2</sub> + NO <sub>3</sub>	EPA 353.2	0.001 mg/L	0.010 mg/L
Nitrite	NO <sub>2</sub>	SM 4500-NO <sub>2</sub> <sup>-</sup> B. <sup>1</sup>	0.002 mg/L	0.010 mg/L
Nitrate	NO <sub>3</sub>	EPA 353.2	0.001 mg/L	0.010 mg/L
Soluble Phosphorus	Soluble-P	EPA 365.1	0.004 mg/L	0.010 mg/L
Total Phosphorus	Total-P	EPA 365.1	0.002 mg/L	0.010 mg/L
Chlorophyll <i>a</i>	Chlorophyll <i>a</i>	EPA 445.0	To be determined	2.0 µg/L
Chloride	Chloride by IC	EPA 300.0	0.057 mg/L	5.000 mg/L
Sulfate	Sulfate by IC	EPA 300.0	0.046 mg/L	5.000 mg/L
Biological Oxygen Demand	BOD	SM 5210 <sup>1</sup>	2 mg/L	5 mg/L
Silver	Ag	EPA 200.7	0.12 µg/L	1.00 µg/L
Aluminum	Al	EPA 200.7	3.7 µg/L	10.0 µg/L
Arsenic	As	EPA 200.7	0.31 µg/L	2.00 µg/L
Barium	Ba	EPA 200.7	0.12 µg/L	2.00 µg/L
Beryllium	Be	EPA 200.7	0.12 µg/L	1.00 µg/L
Calcium	Ca	EPA 200.7	11.2 µg/L	275.0 µg/L
Cadmium	Cd	EPA 200.7	0.022 µg/L	1.00 µg/L
Cobalt	Co	EPA 200.7	0.15 µg/L	1.00 µg/L
Chromium	Cr	EPA 200.7	0.25 µg/L	2.00 µg/L
Copper	Cu	EPA 200.7	0.17 µg/L	1.00 µg/L
Iron	Fe	EPA 200.7	1.5 µg/L	10.00 µg/L
Potassium	K	EPA 200.7	31.4 µg/L	275.0 µg/L
Magnesium	Mg	EPA 200.7	40.9 µg/L	100.0 µg/L
Manganese	Mn	EPA 200.7	0.038 µg/L	1.00 µg/L
Molybdenum	Mo	EPA 200.7	0.31 µg/L	1.00 µg/L
Sodium	Na	EPA 200.7	59.5 µg/L	500.0 µg/L
Nickel	Ni	EPA 200.7	0.17 µg/L	2.00 µg/L
Lead	Pb	EPA 200.7	0.39 µg/L	3.00 µg/L
Antimony	Sb	EPA 200.7	0.61 µg/L	5.00 µg/L
Selenium	Se	EPA 200.7	0.63 µg/L	5.00 µg/L
Tin	Sn	EPA 200.7	13.4 µg/L	50.00 µg/L
Titanium	Ti	EPA 200.7	0.22 µg/L	2.00 µg/L
Thallium	Tl	EPA 200.7	1.10 µg/L	5.00 µg/L
Vanadium	V	EPA 200.7	0.15 µg/L	1.00 µg/L
Zinc	Zn	EPA 200.7	1.6 µg/L	10.00 µg/L
Total Metals	Total Metals (calc.)	EPA 200.7	µg/L =(Cr µg/L)+(Cu µg/L)+(Ni µg/L)+(Zn µg/L)	
Hardness	Hardness (calc.)	SM 2340 B <sup>1</sup>	CaCO <sub>3</sub> mg/L =(2.497*Ca mg/L)+(4.118*Mg mg/L)	
Total Solids	TS	SM 2540 B <sup>1</sup>	0.5 mg/L	1.0 mg/L
Total Suspended Solids	TSS	SM 2540 D <sup>1</sup>	0.5 mg/L	1.0 mg/L
Total Dissolved Solids	TDS	SM 2540 C <sup>1</sup>	0.5 mg/L	1.0 mg/L
Turbidity **		EPA 180.1	0.1 NTU	0.2 NTU
<i>Escherichia coli</i>	<i>E. coli</i>	EPA 1603 D	1 colony	--
Field Parameter		Test	(Value Reported in)	
pH		SM 4500H-B <sup>1</sup>	s.u.	
Conductivity		SM 2510A <sup>1</sup>	µs/cm	
Dissolved Oxygen	DO	SM 4500-0 G <sup>1</sup>	mg/L	
Temperature	Temp	SM 2550B <sup>1</sup>	°C	
Turbidity **		EPA 180.1	NTU	

\*NOTE: Listed MDL/PQL is for undistilled samples. Any samples that are required to be distilled will have a MDL = 0.044 mg/L, PQL = 0.100 mg/L

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

<sup>1</sup> Standard Methods for the Examination of Water and Wastewater, 19th Edition

## Appendix D

## NEORSD Surface Water Condition Sampling Field Data Form

Stream: \_\_\_\_\_ Date: \_\_\_\_\_ Collectors: \_\_\_\_\_

Gage Station and ID: \_\_\_\_\_ Daily Mean Discharge: \_\_\_\_\_ ft<sup>3</sup>/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 Buried Out of Water H-D was Reset  
Unknown (river too high) Missing Not Installed Flow: \_\_\_\_\_ fps

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): \_\_\_\_\_ Temperature (°C): \_\_\_\_\_

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

Turbidity (NTU): \_\_\_\_\_

General Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

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 Buried Out of Water H-D was Reset  
Unknown (river too high) Missing Not Installed Flow: \_\_\_\_\_ fps

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): \_\_\_\_\_ Temperature (°C): \_\_\_\_\_

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

Turbidity (NTU): \_\_\_\_\_

General Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Sample ID: \_\_\_\_\_

Sample ID: \_\_\_\_\_

## Appendix E



**Hach<sub>2</sub>O** Your formula for water analysis.

View Order 0 item(s), Total: \$0

**Username:**   
Register

**Password:**   
Reminder

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## 2100P IS Portable Turbidimeter

### Specifications

**2100P Portable Turbidimeter Specifications:**

- Ranges:** 0-1000 NTU with automatic decimal point placement or manual range selection of 0-9.99, 0-99.9 and 0-1000 NTU selection.
- Accuracy:** ± 2% of reading plus stray light from 0 to 1000 NTU (stray light: <0.02 NTU)
- Repeatability:** ± 1% of reading or ± 0.01 NTU, whichever is greater
- Resolution:** 0.01 NTU on lowest range
- Sample Required:** 15 mL
- Power Requirement:** Four AA alkaline batteries or optional 120 or 230 Vac battery eliminator.
- Construction:** High-impact ABS plastic shell
- Dimensions:** 22.2 x 9.5 x 8.9 cm (8.75 x 3.75 x 3.5")
- Shipping Weight:** 3.6 kg (8 lb)
- Warranty:** Two years

Specifications subject to change.

### MAIN PRODUCT PAGE

- » [2100P IS Portable Turbidimeter](#)

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## 2020we & 2020wi Portable Turbidity Meters

### The Clear Choice for Turbidity Measurement!

Industry-leading precision, sensitivity, and dependability in one of the most innovative **handheld meters** available on the market!

- **Waterproof** to IP67
- Lithium rechargeable battery
- USB port
- 7 languages
- Backlit display
- EPA and ISO versions

- 2020we** Complies with USEPA 180.1 Standard
- 2020wi** Complies with ISO 7027 Standard



Kit supplied with 0, 1, and 10 NTU standard, sample bottle, 4 sample tubes, USB cable, USB computer/wall adapter, and waterproof carrying case.

Order Codes	
1970-EPA	<b>2020we Kit:</b> Portable turbidity meter complies with USEPA 180.1 Standard
1970-ISO	<b>2020wi Kit:</b> Portable turbidity meter complies with ISO 7027 Standard

Turbidity Specifications

Meter Features

Order Codes

Turbidity Specifications:	
Unit of Measure:	2020we: NTU, AU, ASBC, EBC 2020wi: FNU, FAU, ASBC, EBC
Range:*	0-4000 NTU/FNU, 0-10,500 ASBC, 0-150 EBC
Resolution:*	0.01 NTU/FNU 10.00-10.99 0.1 NTU/FNU 11.00-109.9 1 NTU/FNU 110-4000
Accuracy:*	From 0-2.5 NTU the accuracy is ±0.05 NTU From 2.5-100 NTU the accuracy is ±2% From 100 NTU the accuracy is ±3%
Detection Limit:	0.05 NTU/FNU
Range Selection:	Automatic
Reproducibility:*	0.02 NTU/FNU or 1%
Light Source:	Tungsten (EPA) complies with EPA 180.1 Standard 860 LED (ISO) complies with ISO 7027

\*Over 600 NTU/FNU units expressed as AU/FAU

## Water Quality Turbidity Meter

### Orion AQUAfast AQ4500 Turbidimeter

Thermo Electron introduces the Orion AQ4500 Turbidimeter which offers advanced features not available on any other benchtop or portable turbidimeter. The AQ4500 offers a dual source LED which allows readings that comply with both EPA 180.1 and ISO 7027. Turbidity can be read in the range of 0 - 1000 NTU with a choice of units: NTU, FTU, FNU, ASBC, and EBC. In the range of 0 - 40 NTU the AQ4500 offers a ratiometric range which will give EPA, GLI method 2 equivalent numbers. This portable field unit is truly IP67 waterproof with typical battery life of over 1000 hours on one set of batteries and datalog capacity of 100 points which can later be downloaded to a printer or computer. The AQ4500 accepts 24 mm cuvettes and comes with a two year warranty.

#### FEATURES

- Nephelometric and Ratiometric measurements with Autoranging
- Data log capacity of up to 100 data points
- Readings in the range of 0 - 1000 NTU with a choice of units: NTU, FTU, FNU, ASBC, or EBC
- Includes Turbidity Standards kit, rugged carrying case, and replacement cuvettes
- Orion AQ4500 is truly IP67 waterproof to a depth of 3 meters



#### SPECIFICATIONS

<b>Type</b>	Turbidity Meter	<b>Repeatability</b>	± 1% of reading or 0.01 NTU
<b>Principle of Operation</b>	Nephelometric	<b>Response Time</b>	< 8 seconds
<b>Operating Modes</b>	Automatic	<b>Calibration</b>	1, 10, 100, 1000 NTU
<b>Measurement Modes</b>	Automatic	<b>Signal Averaging</b>	Yes
<b>Ranges</b>		<b>Sample Cell Size</b>	24 mm
	<b>NTU</b> 0 - 2000	<b>Sample Size</b>	-12 mL
	<b>Nephelometric</b> 0 - 4000	<b>Display</b>	Custom LED
	<b>EPA</b> 0 - 4000 NTU	<b>RTC</b>	Yes
	<b>ISO - NEPH (7027)</b> 0 - 150 FNU	<b>Input/Output</b>	RS-232 Serial Port
	<b>ISO - ABSB</b> 40 - 4000 FAU	<b>Power</b>	Battery - four AA's (2,500 hours Alkaline, 10, 000 lithium)
	<b>IR RATIO</b> 0 - 4000 NTU	<b>Environmental Conditions</b>	
	<b>EBC</b> 0 - 24.5	<b>Operating Temperature</b>	-40° to 140°F (-40° to -60°C)
	<b>ASBC</b> 0 - 236	<b>Humidity</b>	90% RH at 30.0C max
<b>Accuracy</b>	± 2% of reading plus 0.01 NTU (0 - 500 NTU)	<b>Light Source</b>	White, IR
	± 3% of reading (500 - 1000 NTU)	<b>Warranty</b>	2 years
	± 5% of reading (1000 - 2000 NTU)	<b>Weight</b>	8 lbs (3.63 kg)
<b>Resolution</b>	0.01 NTU (0 - 9.99)	<b>Safety Rating</b>	UL, CSA, CE, FCC
	0.1 NTU (10 - 99.9)		
	1 NTU (100 - 1000)		

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## 6600EDS Extended Deployment System

Measure over 10 parameters in severe fouling environments  
Featuring Patented Clean Sweep® Anti-fouling Technology



Profile of the 6600EDS depicting (clockwise from bottom) temperature/conductivity, turbidity, Rapid Pulse™ dissolved oxygen, chlorophyll and pH/ORP—all of which (except conductivity) are kept free of fouling by the patented Clean Sweep® universal wiper assembly, as well as individual optical wipers.

Building upon the unprecedented accuracy and reliability of YSI's stirring-independent Rapid Pulse™ dissolved oxygen system, as well as on the improved and proven wiped optical sensors, YSI offers the YSI 6600EDS (Extended Deployment System).

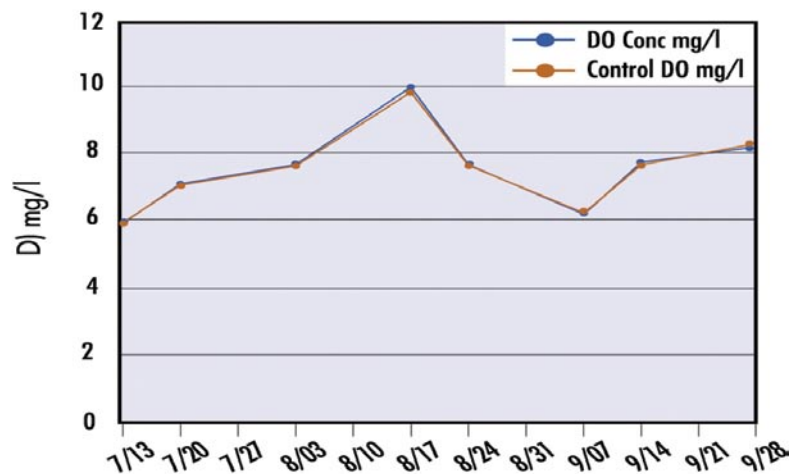
- Provides unprecedented DO accuracy and longevity in aggressive fouling environments
- Patented wiped fouling protection for turbidity, chlorophyll, DO, BGA, pH, and ORP sensors
- Ideal for extended, long-term deployments
- Virtually maintenance free
- Sensors are field-replaceable
- Integrates with DCPs (via RS-232 or SDI-12)



A prototype 6600EDS after continuous deployment for 80 days in Buzzards Bay, MA. The sensor in the foreground is the active DO sensor. The sensor at top-right was used as a non-wiped fouling reference. Note extensive fouling by plant and animal species on the non-wiped sensor.

Initial field studies of the YSI 6600EDS show that the system provides unprecedented DO accuracy and longevity in aggressive fouling environments. The 6600EDS was inspected after 80 days of an ongoing deployment performance evaluation. The Rapid Pulse™ DO sensor performed within specifications throughout this deployment without the need for recalibration or cleaning. During this deployment, the instrument was removed once for battery replacement; none of the sensors was cleaned or recalibrated.

### 6600 EDS 80-Day DO Performance Evaluation



Remarkably close agreement (mean error 0.16mg/l) between the continuously deployed sonde and the control measurements was observed throughout an 80-day deployment.

Pure  
Data for a  
Healthy  
Planet.®

Sensor Performance verified  
by the EPA Environmental  
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\*Sensors with listed with the ETV logo were submitted to the ETV program on the YSI 6600EDS. Information on the performance characteristics of YSI water quality sensors can be found at www.epa.gov/etv, or call YSI at 800.897.4151 for the ETV verification report. Use of the ETV name or logo does not imply approval or certification of this product nor does it make any explicit or implied warranties or guarantees as to product performance.

## Sensor performance verified\*

The 6600EDS uses sensor technology that was performance-verified through the US EPA's Environmental Technology Verification Program (ETV). For information on which sensors were performance-verified, look for the ETV logo.



### YSI 6600EDS 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 Deep Medium Shallow Vented Level	0 to 656 ft, 200 m 0 to 200 ft, 61 m 0 to 30 ft, 9.1 m 0 to 30 ft, 9.1 m	0.001 ft, 0.001 m 0.001 ft, 0.001 m 0.001 ft, 0.001 m 0.001 ft, 0.001 m	±1 ft, ±0.3 m ±0.4 ft, ±0.12 m ±0.06 ft, ±0.02 m ±0.01 ft, 0.003 m
Turbidity* 6136 Sensor* ETV	0 to 1,000 NTU	0.1 NTU	±2% of reading or 0.3 NTU, whichever is greater**
Rhodamine* 6025 Sensor* ETV	0-200 µg/L	0.1 µg/L	±5% reading or 1 µg/L, whichever is greater

\* Maximum depth rating for all standard optical sensors is 200 feet, 61 m. Also available in Deep Depth option: 656 feet, 200 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).

\*\* In YSI AMCO-AEPA Polymer Standards.

	Range	Detection Limit	Resolution	Linearity
BGA - Phycocyanin* 6025 Sensor* ETV	~0 to 280,000 cells/mL† 0 to 100 RFU	~220 cells/mL§	1 cell/mL 0.1 RFU	R <sup>2</sup> > 0.9999**
BGA - Phycoerythrin* 6025 Sensor* ETV	~0 to 200,000 cells/mL† 0 to 100 RFU	~450 cells/mL§§	1 cell/mL 0.1 RFU	R <sup>2</sup> > 0.9999***
Chlorophyll* 6025 Sensor* ETV	~0 to 400 µg/L 0 to 100 RFU	~0.1 µg/L§§§	0.1 µg/L Chl 0.1% RFU	R <sup>2</sup> > 0.9999****

\* Maximum depth rating for all standard optical probes is 200 feet, 61 m. Also available in Deep Depth option 656 ft 200 m.  
BGA = Blue-Green Algae  
RFU = Relative Fluorescence Units  
~ = Approximately

† Explanation of Ranges can be found in the 'Principles of Operation' section of the 6-Series Manual.

§ Estimated from cultures of *Microcystis aeruginosa*.  
§§ Estimated from cultures *Synechococcus sp.*  
§§§ Determined from cultures of *Isochrysis sp.* and chlorophyll *a* concentration determined via extractions.

\*\*Relative to serial dilution of Rhodamine WT (0-400 µg/L).  
\*\*\*Relative to serial dilution of Rhodamine WT (0-8 µg/L).  
\*\*\*\*Relative to serial dilution of Rhodamine WT (0-500 µg/L).

### YSI 6600EDS Sonde Specifications

Medium	Fresh, sea or polluted water	Software	EcoWatch®
Temperature	Operating Storage -5 to +50°C -10 to +60°C	Dimensions	Diameter Length, no depth Length, depth Weight, depth and batteries
Communications	RS-232, SDI-12	Power	External Internal 12 V DC 8 C-size alkaline batteries

## YSI 556 Meter Specifications

### 14.1 Sensor Specifications

<b><i>Dissolved Oxygen</i></b>	
<b>Sensor Type:</b>	Steady state polarographic
<b>Range:</b> % air sat'n mg/L	<ul style="list-style-type: none"> <li>▪ 0 to 500% air saturation</li> <li>▪ 0 to 50 mg/L</li> </ul>
<b>Accuracy:</b> % air sat'n mg/L	<ul style="list-style-type: none"> <li>▪ 0 to 200% air saturation: ±2% of the reading or 2% air saturation; whichever is greater</li> <li>▪ 200 to 500% air saturation: ±6% of the reading</li> <li>▪ 0 to 20 mg/L: ±2% of the reading or 0.2 mg/L; whichever is greater</li> <li>▪ 20 to 50 mg/L: ±6% of the reading</li> </ul>
<b>Resolution:</b> % air sat'n mg/L	<ul style="list-style-type: none"> <li>▪ 0.1% air saturation</li> <li>▪ 0.01 mg/L</li> </ul>
<b><i>Temperature</i></b>	
<b>Sensor Type:</b>	YSI Precision™ thermistor
<b>Range:</b>	-5 to 45°C
<b>Accuracy:</b>	±0.15°C
<b>Resolution:</b>	0.01°C
<b><i>Conductivity</i></b>	
<b>Sensor Type:</b>	4-electrode cell with auto-ranging
<b>Range:</b>	0 to 200 mS/cm
<b>Accuracy:</b>	±0.5% of reading or ±0.001 mS/cm; whichever is greater—4 meter cable ±1.0% of reading or ±0.001 mS/cm; whichever is greater—20 meter cable
<b>Resolution:</b>	0.001 mS/cm to 0.1 mS/cm (range-dependent)
<b><i>Salinity</i></b>	
<b>Sensor Type:</b>	Calculated from conductivity and temperature
<b>Range:</b>	0 to 70 ppt
<b>Accuracy:</b>	±1.0% of reading or 0.1 ppt; whichever is greater
<b>Resolution:</b>	0.01 ppt



## YSI 650 Multiparameter Display System

### *Rugged and Reliable Display and Data Logging System*



*The YSI 650 Multiparameter Display System*

Easily log real-time data, calibrate YSI 6-Series sondes, set up sondes for deployment, and upload data to a PC with the feature-packed YSI 650MDS (Multiparameter Display System). Designed for reliable field use, this versatile display and data logger features a waterproof IP-67, impact-resistant case.

- Compatible with EcoWatch® for Windows® data analysis software
- User-upgradable software from YSI's website
- Menu-driven, easy-to-use interface
- Multiple language capabilities
- Graphing feature
- Three-year warranty

### **Feature-Packed Performance**

#### *Battery Life*

With the standard alkaline battery configuration of 4 C-cells, the YSI 650 will power itself and a YSI 6600 sonde continuously for approximately 30 hours. Or, choose the rechargeable battery pack option with quick-charge feature.

#### *Optional Barometer*

Temperature-compensated barometer readings are displayed and can be used in dissolved oxygen calibration. Measurements can be logged to memory for tracking changes in barometric pressure.

#### *Optional GPS Interface*

Designed to NMEA protocol, the YSI 650 MDS will display and log real-time GPS readings with a user supplied GPS interfaced with YSI 6-Series sondes.

#### *Memory Options*

Standard memory with 150 data sets, or a high-memory option (1.5 MB) with more than 50,000 data sets; both options with time and date stamp.

Pure  
Data for a  
Healthy  
Planet.®

*A powerful logging  
display for your data  
collection processes*

*The 650MDS can be  
used with YSI sondes  
for spot sampling as  
well as short-term data  
logging.*

*Supply a GPS with  
NMEA 0183 protocol,  
connect with the YSI  
6115 kit, and collect  
GPS data along with  
water quality data.*

*Upload data from the  
650 to EcoWatch® for  
instant data viewing.*





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**ISO 9001**  
**ISO 14001**

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 Who's Minding the Planet?

## YSI 650MDS Specifications

Temperature	Operating Storage	-10 to +60°C for visible display -20 to +70°C
Waterproof Rating		IP-67 for both the standard alkaline battery configuration and for the rechargeable battery pack option
Connector		MS-8; meets IP-67 specification
Dimensions	Width Length Weight with batteries	4.7 in, 11.9 cm 9 in, 22.9 cm 2.1 lbs, 0.91 kg
Display		VGA; LCD with 320 by 240 pixels with backlight
Power	Standard Optional	4 alkaline C-cells with detachable battery cover Ni metal hydride battery pack with attached battery cover and 110/220 volt charging system
Communications		RS-232 to all sondes, for data transfer to PC, and for software updates
Optional GPS		NMEA 0183; requires user-supplied GPS and YSI 6115 Y-cable
Backlight		4 LEDs illuminating LCD; user-selectable
Keypad		20 keys, including instrument on/off, backlight on/off, enter, esc, 10 number/letter entry keys, 2 vertical arrow keys, 2 horizontal arrow keys, period key, and minus key
Warranty		3 years

## Ordering Information

650-01	Instrument, standard memory
650-02	Instrument, high memory
650-03	Instrument, standard memory, barometer
650-04	Instrument, high memory, barometer
6113	Rechargeable battery pack kit with 110 volt charger and adapter cable
616	Charger, cigarette lighter
4654	Tripod
614	Ultra clamp, C-clamp mount
5081	Carrying case, hard-sided
5085	Hands-free harness
5065	Form-fitted carrying case
6115	Y-cable for interface with user-supplied GPS system



The 650MDS can interface with any YSI sonde for

- spot sampling
- short-term studies
- surface and ground water monitoring
- water level monitoring

Packaged together, the 600QS system includes a 600R conductivity sonde, 650MDS, field cable, and additional sensor options such as pH, dissolved oxygen, ORP, and vented level.



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

YSI incorporated  
Who's Minding  
the Planet?<sup>®</sup>

## YSI 600XL & 600XLM Sensor Specifications

	Range	Resolution	Accuracy
Dissolved Oxygen % Saturation 6562 Rapid Pulse™ Sensor* <b>ET</b> ✓	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* <b>ET</b> ✓	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* <b>ET</b> ✓	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* <b>ET</b> ✓	-5 to +50°C	0.01°C	±0.15°C
pH 6561 Sensor* <b>ET</b> ✓	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 to 30 ft, 9.1 m 0 to 30 ft, 9.1 m	0.001 ft, 0.001 m 0.001 ft, 0.001 m 0.001 ft, 0.001 m	±0.4 ft, ±0.12 m ±0.06 ft, ±0.02 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 Storage	-5 to +50°C -10 to +60°C
Communications		RS-232, SDI-12
Software		EcoWatch®
Dimensions	Diameter Length Weight	1.65 in, 4.19 cm   1.65 in, 4.9 cm 16 in, 40.6 cm   21.3 in, 54.1 cm 1.3 lbs, 0.59 kg   1.5 lbs, 0.69 kg
Power	External Internal (600XLM only)	12 V DC 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.

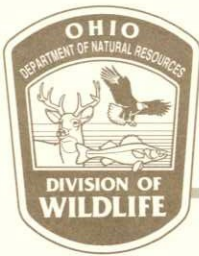
The EC/TDS conversion factor is user selectable as is the temperature compensation coefficient ( $\beta$ ). Fast, efficient, accurate and portable, the Combo pH, EC/TDS and temperature tester brings you all the features you've asked for and more!

### 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 T	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 T	DS	1 ppm
Resolution	Temperature	0.1°C / 0.1°F
Accuracy pH		$\pm 0.05$ pH
Accuracy EC/T	DS	$\pm 2\%$ F.S.
Accuracy	Temperature	$\pm 0.5^\circ\text{C}$ / $\pm 1^\circ\text{F}$
Temperature Compensation		pH: automatic; EC/TDS: automatic with $\beta$ 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.)



## Appendix H



# DIVISION OF WILDLIFE

Ohio Department of Natural Resources

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

**WILD ANIMAL PERMIT: 12-108**  
SCIENTIFIC COLLECTION

JOHN W. RHOADES  
NEORS  
4747 EAST 49TH ST.  
CUYAHOGA HEIGHTS, OH 44125-1

**Vicki J. Mountz**      **DATE ISSUED**  
Acting Chief, Division of Wildlife      3/14/2011

Others authorized on permit

YES      (SEE ATTACHMENT)

SOCIAL SECURITY NUMBER:      XXX-XX-7681

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:      3/16/2011      to:      3/15/2012

This permit must be carried while collecting wild animals and be exhibited to any person on demand.

### THIS PERMIT IS RESTRICTED TO THE FOLLOWING

1. Permittee may collect fish and aquatic macro-invertebrates for survey and inventory purposes. All endangered species are to be released at site of capture.
2. 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) or 614/265-6631 (Becky Jenkins).
3. 24 hours prior to setting trap nets or gillnets, contact must be made with the local wildlife officer or nearest district office to advise location and duration of sampling. All vouchers are to be deposited at NEORS.
4. Collection is prohibited in Big Darby, Little Darby, Chagrin river and Fish Creek (Williams County) without explicit written permission from the Division of Wildlife.
5. Permittee must provide an annual report of collecting activities to the Division of Wildlife. Report shall provide species, quantity and locations of collection.

#### Locations of Collecting

STATEWIDE WITH NOTED EXCEPTIONS

#### Equipment and method used in collection:

SEINES, TRAP NETS AND ELECTROSHOCKER.

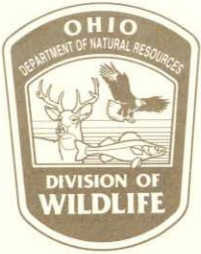
#### Name and number of each species to be collected:

FISH AND MACROINVERTEBRATES AS REQUIRED. ALL FISH (EXCEPT VOUCHER SPECIES) MUST BE RELEASED AT THE COLLECTION SITE.

#### RESTRICTIVE DOCUMENTS ACCOMPANYING THIS PERMIT? NO

This permit is not valid for collecting migratory birds, their nests, or eggs unless a current permit from the U.S. Fish and Wildlife Service has been obtained.

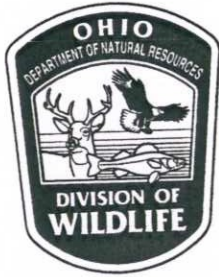
**NO ENDANGERED SPECIES MAY BE TAKEN WITHOUT WRITTEN PERMISSION FROM THE CHIEF**



**ATTACHMENT**

This attachment to Scientific Collecting Permit #12-108 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.

<u>Name</u>	<u>SSN or Driver License</u>
SETH HOTHEM	XXX-XX-6166
THOMAS ZABLOTNY	XXX-XX-6448
CATHERINE ZAMBORSKY	XXX-XX-6550
FRANCISO RIVERA	XXX-XX-5886
JILLIAN NOVAK	SA294701
KATHRYN CRESTANI	XXX-XX-1565
RON MAICHLE	XXX-XX-8924
KRISTINA GRANLUND	SJ501394
ADDITIONAL ON FILE	



## STANDARD CONDITIONS FOR SCIENTIFIC COLLECTING AND EDUCATION PERMITS (ORC 1533.08 AND 1533.09)

The standard conditions listed below apply to all permit holders unless otherwise stated on an issued permit. The standard conditions below are in addition to the provisions listed on the permit. Failure to comply with the conditions of the permit may result in the suspension or termination of your permit. If you need an amendment to your permit, or have questions regarding these conditions, contact the Division of Wildlife Permit Coordinator at (614)265-6315. Please allow a minimum of two weeks for amendments.

1. When collecting or sampling you and any subpermittees must carry a copy of your permit and present to any officer upon request.
2. Only persons listed on the permit may conduct permitted activities.
3. Collection on all Department of Natural Resources properties is prohibited without authorization from the appropriate landholding division.
4. Collection is prohibited in the Little Darby Creek, Big Darby Creek, Killbuck Creek, Fish Creek (Williams County) and the upper portions of the Grand River watershed without written authorization from the Chief.
5. The collection and possession of state endangered and threatened species is prohibited without prior approval from the Chief.
6. The possession of Aquatic Nuisance Species (ANS) for educational or scientific purposes is prohibited without authorization from the Chief.
7. A migratory bird permit issued by the United States Fish and Wildlife Service may be required for all persons collecting or in possession of migratory birds.
8. Twenty-four hours prior to all stream collection, the permit holder must contact the local wildlife officer or nearest district office to advise the location and duration of sampling. Messages are acceptable.
9. All voucher specimens must be ascensioned to the Cleveland Museum of Natural History, The Ohio State University, Museum of Biological Diversity or the Cincinnati Museum of Natural History.
10. Traps and nets must be checked and all animals removed every twenty-four hours.
11. Traps and nets must bear a durable waterproof tag bearing the name and address of the user in English letters, legible at all times.
12. Unless otherwise provided, all specimens must be released at the point of capture.
13. When sampling on public properties or over water, non-toxic shot shall be used.
14. Newly discovered Aquatic Nuisance Species (ANS) must be reported to the Division of Wildlife within twenty-four hours of capture.
15. All Starlings, house sparrows and aquatic nuisance species collected for laboratory use must be euthanized upon completion of project.

## Appendix I. References

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- 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)*(7<sup>th</sup> Revision). North Chelmsford, MA: The Office of Environmental Measurement and Evaluation, Ecosystem Assessment- Ecology Monitoring Team.
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- Ohio Environmental Protection Agency. (2008). State of Ohio Draft Water Quality Standards *Ohio Administrative Code Chapter 3745-1*. Columbus, OH: Division of Surface Water, Standards and Technical Support Section.
- Ohio Environmental Protection Agency. (2009a). *Ohio EPA manual of surveillance methods and quality assurance practices*. Columbus, OH: Divisions of Surface Water and Environmental Services.
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## Appendix J. NEORSD Chlorophyll a Sampling Field Sheet

Stream: \_\_\_\_\_  
 Location: \_\_\_\_\_  
 RM: \_\_\_\_\_  
 Lat/Long: \_\_\_\_\_

Collectors: \_\_\_\_\_  
 Date: \_\_\_\_\_  
 Time: \_\_\_\_\_

Number of Rocks: \_\_\_\_\_

Total Area Scraped: \_\_\_\_\_ cm<sup>2</sup>

Diameter of individual scrape

Area of individual scrape

- 1 \_\_\_\_\_
- 2 \_\_\_\_\_
- 3 \_\_\_\_\_
- 4 \_\_\_\_\_
- 5 \_\_\_\_\_
- 6 \_\_\_\_\_
- 7 \_\_\_\_\_
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- 24 \_\_\_\_\_
- 25 \_\_\_\_\_

Total: \_\_\_\_\_

Diameter to Area Conversion	
Diameter (cm)	Area (cm <sup>2</sup> )
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\*

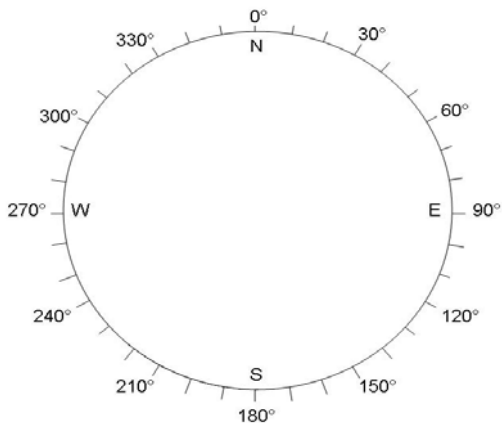
\*Explain \_\_\_\_\_

**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