

Level 3 Project Study Plan

2009 Pepper Pike/Moreland Hills Publicly Owned Treatment Works (POTW's) Baseline Assessment Study Prior to Decommissioning

(1) Objectives

Beginning in March 2010, the Jackson Valley Wastewater Treatment Plant (WWTP), Quail Hollow WWTP, Creekside WWTP, and Woodland Glen WWTP will be decommissioned. The average daily flow in million gallons per day from the above WWTPs is 0.36, 0.02, 0.34 and 0.08, respectively. The effluent flows from these facilities will be redirected to Northeast Ohio Regional Sewer District's (NEORS) Easterly WWTP via the SOM Relief Sewer. These plants do not consistently meet the National Pollutant Discharge Elimination System (NPDES) permit limits. Therefore, by removing these effluent flows and conveying them to NEORS, the water quality in the streams downstream of these WWTPs is expected to improve. The purpose of this study is to survey fish communities, macroinvertebrate communities, habitat, and water chemistry downstream of each WWTP's effluent discharge and in the Chagrin River upstream and downstream of these tributary creeks. The results obtained from sampling will be evaluated using Ohio EPA's Qualitative Habitat Evaluation Index (QHEI), Index of Biotic Integrity (IBI), Modified Index of Well Being (MIwb) and Invertebrate Community Index (ICI) prior to decommissioning. An examination of the individual metrics that comprise these indices will be used in conjunction with water quality data to identify impacts to the biotic communities. NEORS intends to reevaluate water quality conditions in the future following decommissioning.

(2) Nonpoint/Point Sources

Point Sources	Nonpoint Sources
Jackson Valley WWTP (RM 2.01)	Urban runoff
Quail Hollow WWTP (RM 0.86)	Spills
Woodland Glen WWTP (RM 0.34)	Agriculture
Creekside WWTP (RM 3.43)	
Storm Sewer Outfalls	
Septic Tanks	

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 in the Chagrin River

and tributary creeks and will need to be taken into account when evaluating changes to these communities following decommissioning of the POTWs

Other point sources include additional WWTP discharges to the Chagrin River and other tributary streams in the study area. More information on these point sources may be found in Ohio EPA's *Biological and Water Quality study of the Chagrin River and Selected Tributaries*, (2003-2004).

(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). Quantitative fish sampling is expected to be conducted at all locations.

Macroinvertebrate community assemblages will be collected from each location and shipped to EA Engineering, Science and Technology¹ for identification and enumeration. EA Engineering, Science and Technology 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* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008)

The Ohio EPA Macroinvertebrate Field Sheet 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 each electrofishing/macroinvertebrate site. Appendix B lists the parameters to be tested along with the detection limits and practical quantitation limits. Field measurements for dissolved oxygen, pH, temperature, specific conductance and flow will also be performed. A Surface Water Condition Sampling Field Data Form will be completed at each site during each sample collection (Appendix C).

(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

¹ It is anticipated that EA Engineering, Science and Technology will be contracted to complete all macroinvertebrate identification. However, awarding of the contract is dependent upon approval by the Northeast Ohio Regional Sewer District Board of Trustees, which, to date, has not occurred. An amended study plan will be submitted if someone else is awarded the contract.

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habitat types within a sampling zone, which is 0.15 kilometers in length for the headwater sites and 0.20 kilometers in length for the wading sites 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 NEORS 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. 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 include installation of a five Hester-Dendy multi-plate artificial substrate sampler assemblage (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. and for the purposes of providing a duplicate sample. Qualitative sampling will be conducted using a D-frame dip net when HD samplers are retrieved. The Ohio EPA Macroinvertebrate Field Sheet will be completed during each HD retrieval. EA Engineering, Science and Technology 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 *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008). 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 when the HD samplers are installed and retrieved.

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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* (1987, updated January 1, 1988; November 8, 2006; and August 26, 2008) and *III* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008).

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 one 4-liter disposable polyethylene cubitainer with disposable polypropylene lid and two 473 mL plastic bottles. 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 ≤ 30 percent; results outside this range will trigger further evaluation and 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 base 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 B 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, specific conductivity and pH; and when necessary, a Hanna HI 98129 meter to measure pH. Meter specifications have been included in Appendix D.

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.

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 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. 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

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The following electrofishing and macroinvertebrate sample locations, listed from upstream to downstream on the Chagrin River and adjoining tributary creeks in the study plan, will be surveyed during the 2009 field season. 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.

Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Miles Road and Bentleville Road	N41.4250°	W81.4176°	26.70	Chagrin River Upstream of Willey Creek	Chagrin Falls	Background data for fish, habitat and macroinvertebrates
37855 Jackson Road	N41.4360°	W81.4242°	1.00	Willey Creek Downstream of Jackson Valley WWTP	Chagrin Falls	Evaluate Willey Creek and Jackson Valley WWTP discharge on fish, habitat and macroinvertebrates
3780 Chagrin River Road	N41.4553°	W81.4066°	0.20	Unnamed tributary Creek to Chagrin River Downstream of Quail Hollow WWTP	Chagrin Falls	Evaluate Unnamed Creek and Quail Hollow WWTP discharges on fish, habitat and macroinvertebrates
South Woodland Road West of Windrush Drive	N41.4610°	W81.4318°	0.30	Unnamed tributary Creek to Chagrin River Downstream of Woodland Glen WWTP	Chagrin Falls	Evaluate Unnamed Creek and Woodland Glen WWTP discharges on fish, habitat and macroinvertebrates
3226 S.O.M. Center Road	N41.4719°	W81.4401°	3.30	Pepper-Luce Creek Downstream of Creekside WWTP	Chagrin Falls	Evaluate Pepper-Luce Creek and Creekside WWTP discharges on fish, habitat and macroinvertebrates
3051 Chagrin River Road	N41.4764°	W81.3982°	22.00	Chagrin River Downstream of Pepper-Luce Creek	Chagrin Falls	Evaluate Creeks and WWTP discharges on fish, habitat and macroinvertebrates

(6) Schedule

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One or two electrofishing surveys will be conducted between June 15 and October 15, 2009. Surveys will be conducted at least four to five 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 once, between June 15 and July 15, 2009, 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 and October 15, 2009.

QHEI habitat evaluations will be conducted one time between June 15 and October 15, 2009. These evaluations will be collected 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* (1987, updated January 1, 1988; November 8, 2006; and August 26, 2008) and *III* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008) 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, 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 Level 3 Fish Qualified Data Collectors (QDC) NEORSD personnel, 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.

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All macroinvertebrate community assemblages will be collected and sent to the EA Engineering, Science and Technology for identification and enumeration. EA Engineering, Science and Technology will identify 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 *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008). The EA Engineering, Science and Technology QA/QC manual is attached (Appendix E). 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 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 (EMSC) for a period not less than ten years.

Water samples obtained for chemical analyses will be collected, 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 QDC 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 Service will send updates, revisions and any information on document control to Ohio EPA as needed.

(8) Work Products

Within one year of completion of the project, fish data (species, numbers, weights, pollution tolerances, the incidence of DELT anomalies, IBI and MIwb 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, MIwb, ICI and QHEI scores and any excursions from water quality standards will be prepared for internal use.

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(9) 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)
¹ John W. Rhoades	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	rhoadesj@neorsd.org	216-641-6000	QDC - 008 CWQA/FCB/SHA/ BMB
Cathy Zamborsky	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	zamborskyc@neorsd.org	216-641-6000	QDC - 009 CWQA/SHA
^{2,3} Seth Hothem	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	hothems@neorsd.org	216-641-6000	QDC - 010 CWQA/FCB/SHA
Kathryn Crestani	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	crestanik@neorsd.org	216-641-6000	QDC - 011 CWQA/SHA
⁶ Tom Zabloutny	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	zabloutnyt@neorsd.org	216-641-6000	QDC - 018 CWQA/FCB/SHA
⁴ Ron Maichle	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	maichler@neorsd.org	216-641-6000	QDC - 145 CWQA
Francisco Rivera	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	riveraf@neorsd.org	216-641-6000	QDC - 262 CWQA
⁵ Marty Sneen	EA Engineering, Science and Technology 444 Lake Cook Road, Suite #18 Deerfield, IL 60015	msneen@eaest.com	847-945-8010	QDC - 026 BMB
¹ Lead Project Manager		⁴ Benthic Macroinvertebrate Biology (BMB) Project Manager		
² Fish Community Biology (FCB) Project Manager		⁵ Benthic Macroinvertebrate Identification		
³ Stream Habitat Assessment (SHA) Project Manager		⁶ 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 of these and any other individuals the proper methods for electrofishing and macroinvertebrate collections, water quality sampling and QHEI evaluation. 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
Joseph Broz	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	brozj@neorsd.org	216-641-6000
Tim Dobriansky	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	dobrianskyt@neorsd.org	216-641-6000
Kristina Granlund	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	granlundk@neorsd.org	216-641-6000
Rae Grant	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	grantr@neorsd.org	216-641-6000
Eric Hinton	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	hintone@neorsd.org	216-641-6000
Cathy O'Grady	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	ogradyc@neorsd.org	216-641-6000

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Name	Address	Email Address	Phone Number
Jillian Novak	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	novakj@neorsd.org	216-641-6000
Mike Pavlik	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	pavlikm@neorsd.org	216-641-6000
Kevin Roff	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	roffk@neorsd.org	216-641-6000
Frank Schuschu	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	schuschuf@neorsd.org	216-641-6000
Elizabeth Toot-Levy	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	toot-levye@neorsd.org	216-641-6000
Wolfram von Kiparski	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	vonkiparskiw@neorsd.org	216-641-6000
Summer Co-op	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
Summer Co-op	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000
Summer Co-op	4747 East 49 th Street Cuyahoga Hts., Ohio 44125	To Be Determined	216-641-6000

- (10) Documentation of approval of project manager and other personnel as level 3 qualified data collectors

See attached (Appendix F).

- (11) Contract laboratory contact information

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

Dr. Ted Cavender, Curator of Fish / 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 will be completed by EA Engineering, Science and Technology. The EA Engineering, Science and Technology QA/QC manual is attached in Appendix E. Benthic macroinvertebrates will be identified to the lowest practical level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008).

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Marty Sneen, Benthic Specialist (QDC# 026)
EA Engineering, Science and Technology
444 Lake Cook Road Suite #18
Deerfield, IL 60015
msneen@eaest.com
847-945-8010 ext. 108

- (12) Copy of ODNR collector's permit

To be submitted electronically when issued to NEORSD by ODNR.

- (13) (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 within the NEORSD's service area. When benthic macroinvertebrate 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: _____

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(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: Cathy Zamborsky / Date: _____

Print/Signature: Seth Hothem / Date: _____

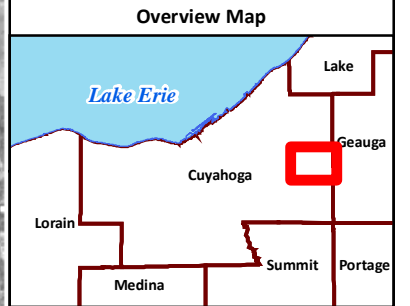
Print/Signature: Kathryn Crestani / Date: _____

Print/Signature: Tom Zabloutny / Date: _____

Print/Signature: Ron Maichle / Date: _____

Print/Signature: Francisco Rivera / Date: _____

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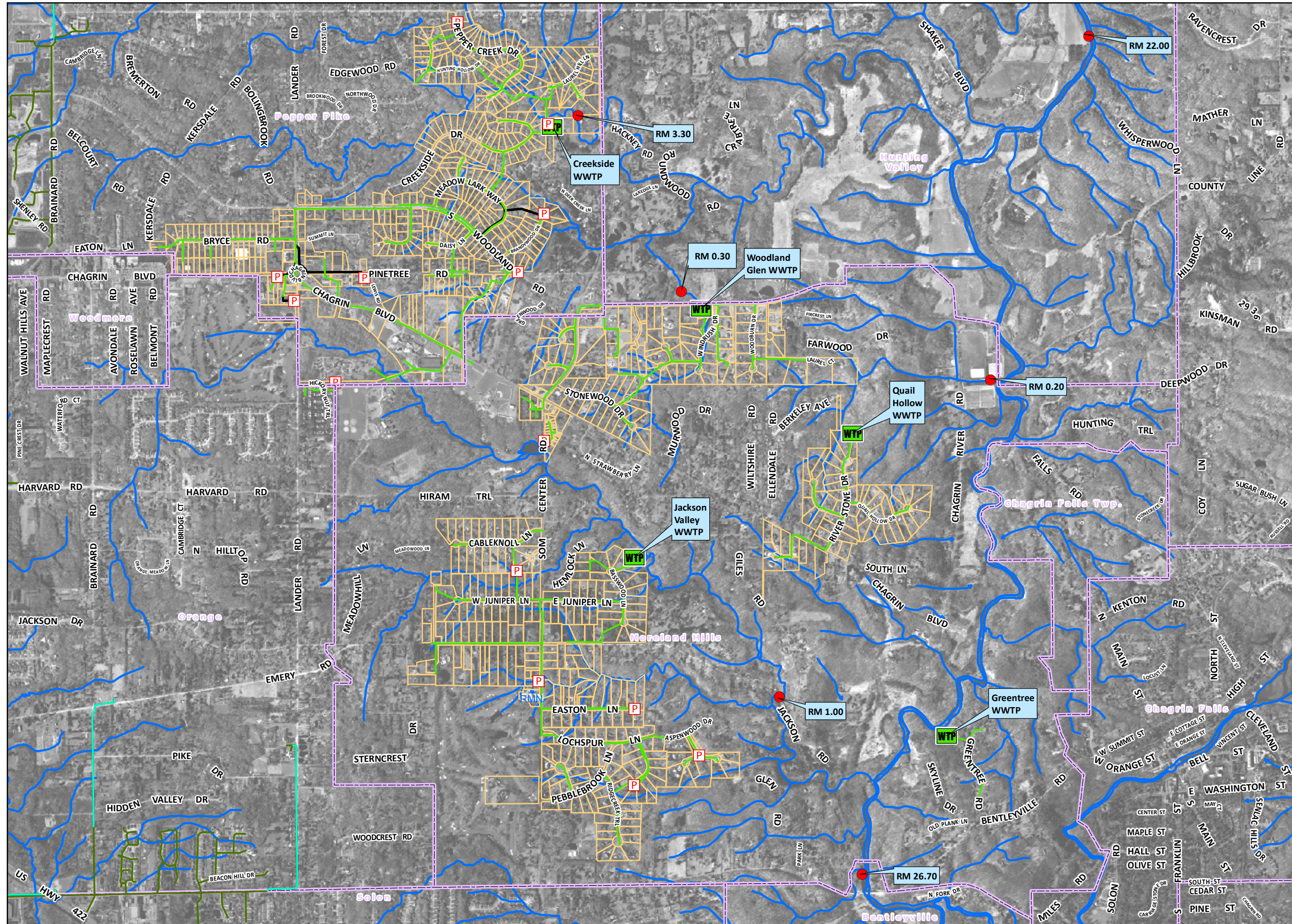


Pepper Pike Moreland Hills POTW Study

- Study Site
- WTP Wastewater Treatment Plant
- P Pump Station
- Rain Gauges
- ~ Stream
- NEORSD Interceptor Sewer
- NEORSD Intercommunity Relief Sewer
- NEORSD CSO Control Sewer
- NEORSD CSO Responsibility Sewer
- Local Combined Sewer
- Local Sanitary Sewer
- Local Storm Sewer
- Local Culverted Stream
- Local Force Main
- Area Tributary to the District
- Community Boundary



Date: February, 2009
Sources: Orthophotos, Street Centerline (2006), Cuyahoga County GIS; Streams(2005), SSURGO; Environmental Assessment Zones (2009), Collection System, NEORSD GIS;



This map/data 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/data 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/data 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. (Engineering Information & Technology) 3900 Euclid Avenue, Cleveland, Ohio 44115 (216-881-6600).

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Parameter	Test	Minimum Detection Limit	Practical Quantitation Limit
Alkalinity	EPA 310.2	3.3 mg/L	10 mg/L
COD	EPA 410.4	5 mg/L	10 mg/L
Hex Chrome	SM 3500 Cr D. *	1 ug/L	10 ug/L
Mercury	EPA 245.1	0.005 ug/L	0.050 ug/L
NH3	EPA 350.1	0.004 mg/L	0.010 mg/L
NO2 + NO3	EPA 353.2 or 300.0	0.003 mg/L	0.010 mg/L
NO2	SM 4500-NO ₂ ⁻ B. * or EPA 300.0	0.002 mg/L	0.010 mg/L
NO3	EPA 353.2 or 300.0	0.003 mg/L	0.010 mg/L
Soluble-P	EPA 365.2	0.002 mg/L	0.010 mg/L
Total-P	EPA 365.2	0.001 mg/L	0.010 mg/L
BOD	EPA 405.1 (5 Day)	2 mg/L	
Ag	EPA 200.7	0.12 µg/L	1.00 µg/L
Al	EPA 200.7	3.0 µg/L	10.0 µg/L
As	EPA 200.7	0.38 µg/L	2.00 µg/L
Be	EPA 200.7	0.12 µg/L	1.00 µg/L
Ca	EPA 200.7	14 µg/L	275 µg/L
Hardness (calc.)	SM 2340 B *	CaCO ₃ mg/L =(2.497*Ca mg/L)+(4.118*Mg mg/L)	
Cd	EPA 200.7	0.15 ug/L	1.00 µg/L
Co	EPA 200.7	0.12 ug/L	1.00 µg/L
Cr	EPA 200.7	0.51 ug/L	1.00 µg/L
Cu	EPA 200.7	0.17 ug/L	1.00 µg/L
Fe	EPA 200.7	1.5 ug/L	1.00 µg/L
K	EPA 200.7	30 ug/L	275 µg/L
Mg	EPA 200.7	5 ug/L	150 µg/L
Mn	EPA 200.7	0.17 ug/L	1.00 µg/L
Mo	EPA 200.7	0.18 ug/L	2.00 µg/L
Na	EPA 200.7	23 ug/L	275 µg/L
Ni	EPA 200.7	0.22 ug/L	2.00 µg/L
Pb	EPA 200.7	0.28 ug/L	3.00 ug/L
Sb	EPA 200.7	0.43 ug/L	5.00 ug/L
Se	EPA 200.7	0.86 ug/L	5.00 ug/L
Sn	EPA 200.7	4.6 ug/L	25.0 ug/L
Total Metals	EPA 200.7	µg/L =(Cr µg/L)+(Cu µg/L)+(Ni µg/L)+(Zn µg/L)	
Ti	EPA 200.7	0.64 ug/L	2.00 ug/L
TI	EPA 200.7	1.1 ug/L	5.0 ug/L
V	EPA 200.7	0.24 ug/L	1.00 ug/L
Zn	EPA 200.7	0.8 ug/L	10.0 ug/L
TS	SM 2540 B	0.5 mg/L	1.0 mg/L
TSS	SM 2540 D	0.5 mg/L	1.0 mg/L
TDS	SM 2540 C	0.5 mg/L	1.0 mg/L
Turbidity	EPA 180.1	0.1 NTU	0.2 NTU
pH	SM 4500H-B *	(value reported in standard units)	
Field Parameter			
	Test	(Value Reported in)	
pH	EPA 150.1	s.u.	
Specific Conductivity	SM 2510 A *	µs/cm	
Dissolved Oxygen	SM 4500-0 G *	mg/L	
Temperature	EPA 170.1	°C	
Flow at Hester-Dendy		fps	

* Standard Methods for the Examination of Water and Wastewater, 19th Edition

NEORSD Surface Water Condition Sampling Field Data Form

Stream: _____ Collectors: _____

Date: _____ Cuyahoga River Daily Mean Discharge*: _____ ft³/sec

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

If yes, when and how much rain occurred? _____

Water Quality Meters Used: _____

Time: _____ Site Location (RM): _____

Flow: Low Normal High Other: _____

HD Status: OK Buried Out of Water H-D was Reset

Unknown (river to high) Missing Not Installed Flow: _____ fps

Clarity: Clear Murky Turbid Other: _____

Color: None Green Brown Other: _____

Field Parameters: Dissolved Oxygen (mg/L): _____ Temperature (°C): _____

Specific Conductance (µmhos/cm): _____ pH (s.u.): _____

General Comments: _____

Field Blank Site / Sample Duplicate Site

Time: _____ Site Location (RM): _____

Flow: Low Normal High Other: _____

HD Status: OK Buried Out of Water H-D was Reset

Unknown (river to high) Missing Not Installed Flow: _____ fps

Clarity: Clear Murky Turbid Other: _____

Color: None Green Brown Other: _____

Field Parameters: Dissolved Oxygen (mg/L): _____ Temperature (°C): _____

Specific Conductance (µmhos/cm): _____ pH (s.u.): _____

General Comments: _____

Field Blank Site / Sample Duplicate Site

Sample ID: (Label Here)

Sample ID:

Sample ID: (Label Here)

Sample ID:

NEORSD Surface Water Condition Sampling Field Data Form

Stream: _____ Collectors: _____

Date: _____ Cuyahoga River Daily Mean Discharge*: _____ ft³/sec

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

If yes, when and how much rain occurred? _____

Water Quality Meters Used: _____

Time: _____ Site Location (RM): _____

Flow: Low Normal High Other: _____

HD Status: OK Buried Out of Water H-D was Reset

Unknown (river to high) Missing Not Installed Flow: _____ fps

Clarity: Clear Murky Turbid Other: _____

Color: None Green Brown Other: _____

Field Parameters: Dissolved Oxygen (mg/L): _____ Temperature (°C): _____

Specific Conductance (µmhos/cm): _____ pH (s.u.): _____

General Comments: _____

Field Blank Site / Sample Duplicate Site

Time: _____ Site Location (RM): _____

Flow: Low Normal High Other: _____

HD Status: OK Buried Out of Water H-D was Reset

Unknown (river to high) Missing Not Installed Flow: _____ fps

Clarity: Clear Murky Turbid Other: _____

Color: None Green Brown Other: _____

Field Parameters: Dissolved Oxygen (mg/L): _____ Temperature (°C): _____

Specific Conductance (µmhos/cm): _____ pH (s.u.): _____

General Comments: _____

Field Blank Site / Sample Duplicate Site

Sample ID: (Label Here)

Sample ID:

Sample ID: (Label Here)

Sample ID:

.....'Crr gplz'F

YSI 556 Meter Specifications

14.1 Sensor Specifications

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



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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Yellow Springs, Ohio Facility

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YSI incorporated
 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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Yellow Springs, Ohio Facility

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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?[®]

YSI 600XL & 600XLM Sensor Specifications

	Range	Resolution	Accuracy
Dissolved Oxygen % Saturation 6562 Rapid Pulse™ Sensor* ET ✓	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* ET ✓	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* ET ✓	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* ET ✓	-5 to +50°C	0.01°C	±0.15°C
pH 6561 Sensor* ET ✓	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 (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.)

Appendix E

Standard Operating Procedures

Laboratory Processing of Benthic Samples

Upon arrival at the laboratory, the Hester-Dendy (H-D) and qualitative samples were logged in and accounted for. Prior to sorting and identification, each sample was rinsed on a No. 60 (0.250 mm openings) U.S. Standard Testing Sieve to remove the preservative and the H-D plates were scraped to remove the organisms. Sorting of each H-D sample was conducted in a white enamel pan first under a magnifier lamp and finally under a compound dissecting scope. If necessary, a Folsom sample splitter was used to subsample the H-Ds until a more manageable number of organisms was achieved. Prior to splitting, the sample was pre-picked to remove any large and/or rare taxa. In all a minimum of 250 organisms were removed from the fractionated samples. Organisms were sorted to higher taxonomic levels (generally Class or Order level) and preserved separately in labeled vials containing 70% ethyl alcohol. To assure a consistent level of quality and sorting efficiency, senior EA personnel checked all samples. The qualitative samples contained very little detrital matter and therefore were simply rinsed prior to identification.

Macroinvertebrate identifications were made to the lowest practical taxonomic level using the most current literature available (see attached list of taxonomic literature). Whenever possible, the level of identifications followed those recommended by Ohio EPA (2006). Chironomidae larvae were cleared in warm 10% potassium hydroxide and mounted in CMC-10 prior to identification. Approximately 100 chironomids from any single sample were mounted for identification. For all sample types, specimens were enumerated, coded and recorded on a standard laboratory bench sheet for data processing.

Data Analyses

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the Ohio EPA, the ICI is a modification of the Index of Biotic Integrity for fish (Ohio EPA 1987). The ICI consists of ten individually scored structural community metrics:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayflies
6. Percent caddisflies
7. Percent Tanytarsini midges
8. Percent other dipterans and non-insects
9. Percent tolerant organisms
10. Total number of qualitative EPT taxa.

Scoring criteria for all ten metrics is dependent upon drainage area. The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from 232 reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by Ohio EPA (1989a). The sum of the individual metric scores resulted in the ICI score for that particular location.

For H-D samples with a total count of less than 50 organisms, low-end scoring is used. For low-

end scoring, the proportional ICI metrics five through nine automatically default to a score of zero. This prevents metric scores from being biased due to meaningless proportions of few individuals and taxa (OEPA 2006).

Calculation of the ICI was conducted using a computer program written for the software SAS[®] by EA in 1994. This program is continuously tested and updated to ensure its accuracy.

The only other statistical comparison used was the relative abundance (or percent composition) of individual taxa from each site and sample type. Relative abundance was calculated for both sample types as:

$$\text{Rel. Abund.(\%)} = 100 \times \frac{\text{\# Individuals of a Taxa}}{\text{Total \# of Individuals in Sample}}$$

All sample processing and data analysis were completed by permanent and full-time EA Engineering, Science, & Technology, Inc. staff working in our Deerfield, Illinois office and laboratory. Specific staff members that worked on this project and relevant years of experience are listed below by task:

<u>Task</u>	<u>EA Personnel</u>	<u>Years of Experience</u>
Login, Sorting, Mounting	Conrad Zack	3
Identification	Marty Sneen	20
Data Analysis	Joe Vondruska	25
	Marty Sneen	20

Selected Ohio EPA Reporting Requirements

Item 12-Taxonomic literature

Although EA's taxonomic library contains substantially more references than are listed here, the following list only includes taxonomic literature used to identify the benthos in samples from Big Creek, Doan Brook, Euclid Creek, Mill Creek, and the Cuyahoga River.

Bednarik, A.F. and W.P. McCafferty. 1979. Biosystematic revision of the genus Stenonema (Ephemeroptera: Heptageniidae). Canadian Bulletins of Fisheries and Aquatic Sciences 201:1-73.

Bode, R.W. 1983. Larvae of North American Eukiefferiella and Tvetenia (Diptera: Chironomidae). New York State Museum Bulletin 452:1-40.

Bolton, M.J. 2007. Ohio EPA supplemental keys to the larval Chironominae (Diptera) of Ohio and Ohio Chironomidae checklist. Ohio EPA, Division of Surface Water, Ecological Assessment Section, Columbus, Ohio.

Brown, H.P. 1976. Aquatic dryopoid beetles (Coleoptera) of the United States. Water

Pollution Control Series 18050 ELDO4/72. 2nd edition. U.S. Environmental Protection Agency, Cincinnati, OH.

Burch, J.B. 1982. Freshwater snails (Mollusca: Gastropoda) of North America. EPA-600/3-82-026. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH.

Epler, J.H. 1987. Revision of the Nearctic Dicrotendipes Kieffer, 1913 (Diptera: Chironomidae). Evolutionary Monographs No. 9:1-102.

_____. 1995. Identification manual for the larval Chironomidae (Diptera) of Florida. Florida DEP, Division of Water Facilities, Tallahassee, FL.

_____. 2001. Identification manual for the larval Chironomidae (Diptera) of North and South Carolina. North Carolina DENR, Division of Water Quality, Raleigh, NC.

Grodhaus, G. 1987. Endochironomus Kieffer, Tribelos Townes, Synendotendipes new genus, and Endotribelos new genus (Diptera: Chironomidae) of the Nearctic region. Journal of the Kansas Entomological Society 60(2):167-247.

Jezerinac, R.F., G.W. Stocker, and D.C. Tarter. 1995. The crayfishes (Decapoda: Cambaridae) of West Virginia. Bulletin of the Ohio Biological Survey 10(1):1-193.

Larson, D.J., Y. Alarie, and R.E. Roughley. 2000. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Nearctic Region: with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa, Canada.

Klemm, D.J. 1985. Guide to the freshwater Annelida (Polychaeta, nauid, and tubificid Oligochaeta, and Hirudinea) of North America. Kendall/Hunt Publishing Co., Dubuque, IA.

Maschwitz, D.E. and E.F. Cook. 2000. Revision of the Nearctic species of the genus *Polypedilum* Kieffer (Diptera:Chironomidae) in the subgenera *P. (Polypedilum)* Kieffer and *P. (Uresipedilum)* Oyewo and Saether. Bulletin of the Ohio Biological Survey. New Series 12(3): 1-135.

McCafferty, W.P. and R.D. Waltz. 1990. Revisionary synopsis of the Baetidae (Ephemeroptera) of North and Middle America. Transactions of the American Entomological Society 116(4):769-799.

Merritt, R.W., K.W. Cummins, and M.B. Berg, eds. 2007. An introduction to the aquatic insects of North America. 4th edition. Kendall/Hunt Publishing Co., Dubuque, IA.

Morihara, D.K. and W.P. McCafferty. 1979. The Baetis larvae of North America (Ephemeroptera: Baetidae). Transactions of the American Entomological Society 105:139-221.

- Needham, J.G., M.J. Westfall, Jr., and M.L. May. 2000. Dragonflies of North America (Revised Edition). Scientific Publishers, Gainesville, Florida.
- Roback, S.S. 1985. The immature chironomids of the eastern United States VI. Pentaneurini-genus Ablabesmyia. Proceedings of The Academy of Natural Sciences of Philadelphia 137(2):153-212.
- Saether, O.A. 1977. Taxonomic studies on Chironomidae: Nanocladius, Pseudochironomus, and the Harnischia complex. Bulletin of the Fisheries Research Board of Canada 196:1-143.
- Simpson, K.W. and R.W. Bode. 1980. Common larvae of the Chironomidae (Diptera) from New York State streams and rivers with particular reference to the fauna of artificial substrates. New York State Museum Bulletin 439:1-105.
- Smith, D.G. 2001. Pennak's Freshwater Invertebrates of the United States: Porifera to Crustacea, Fourth Edition. John Wiley & Sons, New York, NY.
- Westfall, M.J., Jr. and M.L. May. 1996. Damselflies of North America. Scientific Publishers, Gainesville, Florida.
- Wiederholm, T., ed. 1983. Chironomidae of the Holarctic region. Keys and diagnoses. Part 1. Larvae. Entomologica Scandinavica Supplement 19:1-457.
- Wiggins, G.B. 1996. Larvae of the North American caddisfly genera (Trichoptera). 2nd edition. University of Toronto Press, Toronto, Canada.

Item 13-Voucher Collection

A voucher collection was developed containing two good specimens (when available) of each taxon identified from the samples. This voucher collection along with all sample specimens will be returned to NEORSD upon completion of all the sample analysis.

Outside expert specimen verification was not necessary for identification of these specimens. EA maintains a sizable macroinvertebrate voucher collection with over 1800 specimens representing over 700 taxa used for verification. If this taxonomic library proved to be insufficient, every reasonable attempt would be made to have the specimen(s) identified or verified by a noted authority.

Item 16-Chironomidae Identification

Chironomidae larvae were cleared in warm 10% potassium hydroxide and mounted in CMC-10 prior to identification. Generally, up to 100 chironomids from any single sample are mounted

for identification. Species level identifications generally follow those suggested by Ohio EPA.

Item 17-Copies of Raw Data

Copies of the laboratory bench sheets are appended to the hard copy of this document.

Item 18-ICI Calculation

The Invertebrate Community Index (ICI) was used as the principal measure of overall macroinvertebrate community condition. Developed by the Ohio EPA, the ICI is a modification of the Index of Biotic Integrity for fish (Ohio EPA 1987). The ICI consists of ten individually scored structural community metrics:

- | | |
|--------------------------------|--|
| 1. Total number of taxa | 3. Total number of caddisfly taxa |
| 2. Total number of mayfly taxa | 4. Total number of dipteran taxa |
| 5. Percent mayflies | 8. Percent other dipterans and non-insects |
| 6. Percent caddisflies | 9. Percent tolerant organisms |
| 7. Percent Tanytarsini midges | 10. Total number of qualitative EPT taxa. |

Scoring criteria for all ten metrics is dependent upon drainage area. The scoring of an individual sample was based on the relevant attributes of that sample compared to equivalent data from at least 232 plus reference sites throughout Ohio. Metric scores range from six points for values comparable to exceptional community structure to zero points for values that deviate strongly from the expected range of values based on scoring criteria established by Ohio EPA (1989a). The sum of the individual metric scores resulted in the ICI score for that particular location.

Calculation of the ICI was conducted using a computer program written for the software SAS® by EA in 1994. This program is continuously tested and updated to ensure its accuracy.

Item 20-Statistical Analyses

The only other statistical comparison used was the relative abundance (or percent composition) of individual taxa per site and sample type. Relative abundance was calculated for both sample types as:

$$\text{Rel. Abund.} = \frac{\# \text{ Individuals of a Taxa}}{\text{Total \# of Individuals in Sample}}$$

Item 21-Results

Complete results are appended to the hard copy of this document.

Item 25-Electronically Formatted Data

For convenience, the data and text are provided in electronic format as Word 2003[®] files via email and on the enclosed CD-RW.