



2013 Study Plan for the Bokes Creek Watershed

Logan, Union,
and Delaware Counties, Ohio



Division of Surface Water
Ecological Assessment Section
May 30, 2013

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and Delaware Counties, Ohio**

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May 30, 2013

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- Logan Co.: (937) 592-5731 (Dial 911 for emergency help)
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- Mary Rutan Hospital 205 Palmer Avenue Bellefontaine 43311 (937) 592-4015
- Grady Memorial Hospital 561 West Central Avenue Delaware 43015 (740) 369-8711
- Memorial Hospital of Union County 500 London Avenue Marysville 43040 (937) 644-6115

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INTRODUCTION

During the 2013 field season (June through October) chemical, physical, and biological sampling will be conducted in the Bokes Creek watershed to assess and characterize water quality conditions. A Total Maximum Daily Load report for the Bokes Creek watershed was completed in 2002 based primarily on a 1999 biological water quality survey (Figure 1). The 2013 survey will largely mirror work done in 1999 with additional sampling as needed to address site specific issues. The study area involves one HUC 10 and four watershed assessment units: 0506000107 (01 – 04).

“Results of the 1999 water quality survey indicate that the entire Bokes Creek watershed is impacted by excessive concentrations of nutrients along with suspended solids, oxygen demanding substances, and bacteria which are often at overwhelming concentrations in the watershed. Manure spreading on agricultural fields is widespread in the basin, and runoff to streams via surface drainage or through field tiles in the area has negatively affected ambient water quality. Tile drainage has accelerated delivery of excess nutrients from agricultural fields where either waste manure application has occurred or inorganic fertilizers have been applied.

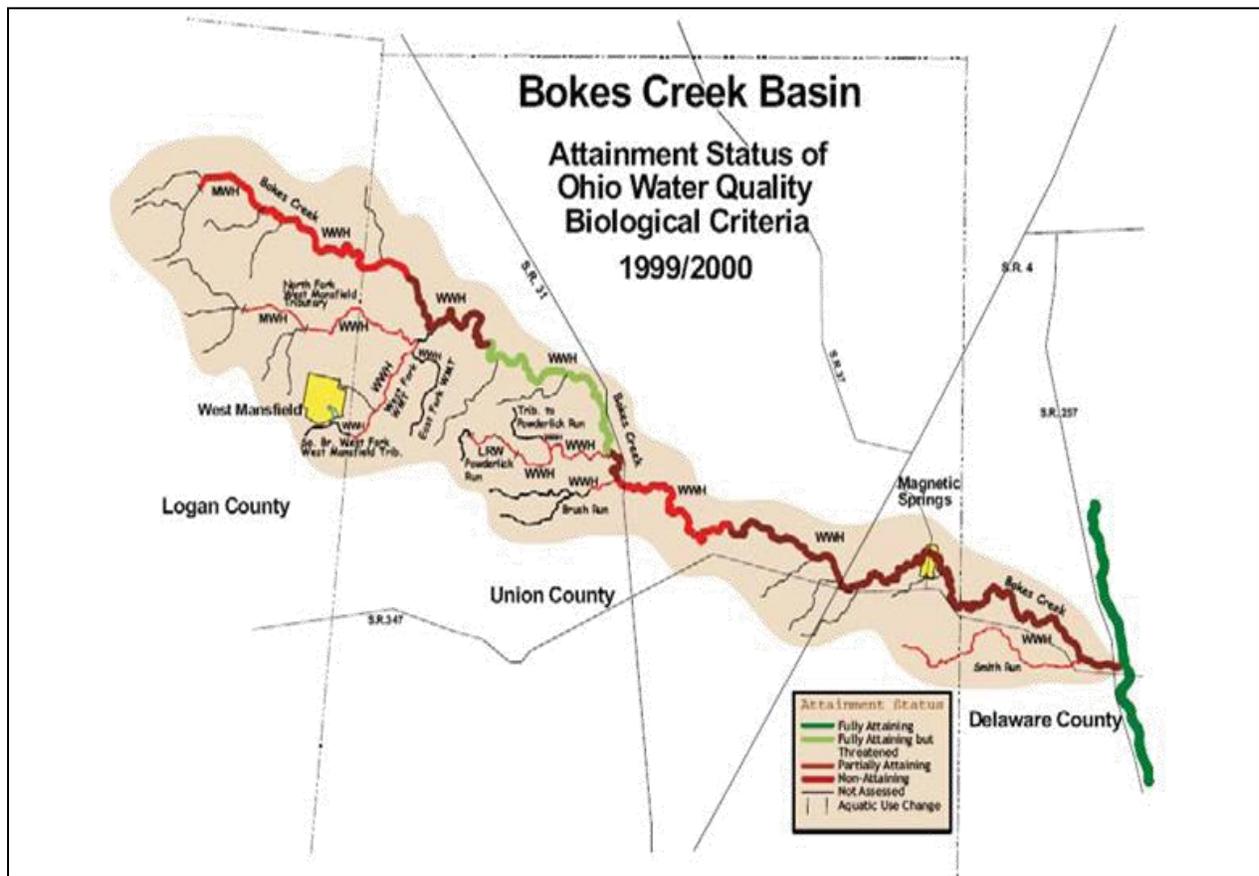


Figure 1. Bokes Creek watershed biological attainment status based on 1999/2000 sampling.

The Day Lay Egg Farms were a major source of nutrient and bacterial input to Powderlick Run and subsequently Bokes Creek. Storm water was particularly contaminated as it ran off of the Day Lay fields and facilities. This contamination was documented in the Powderlick Run headwaters from sampling during or soon after rain event(s).

Organic fertilizers/manure from two other concentrated animal feeding operations owned by Weaver's Heartland Egg Farm (one in eastern Logan County in headwaters of North Fork West Mansfield Tributary and another outside of the basin) likely have contributed to nutrient enrichment through land application of manure in the Bokes Creek drainage basin.

Headwaters and tributary areas are severely influenced by agricultural runoff including inorganic fertilizers from grain producing fields and manure from livestock operations. Failing on-site wastewater treatment systems are also problematic in the watershed (e.g., Magnetic Springs area). Modifications to the stream channels themselves (e.g., channelization, straightening, deepening) and the surrounding watershed (e.g., riparian corridor and wetland removal) have severely diminished the natural assimilative capabilities of this watershed." (Ohio EPA, 2002).

The 2013 sampling effort is structured to characterize point source and nonpoint source impacts, including those from, unsewered communities and agricultural activities. Table 1 contains a list of NPDES facilities in the basin. Sampling locations with geographical coordinates and types of sampling scheduled for the study area are listed in Table 2. Proposed sampling types at each site are included in Table 3.

Sampling Objectives:

- Monitor and assess the chemical, physical, and biological integrity of the water bodies within the Bokes Creek watershed study area.
- Assess physical habitat influences on stream biotic integrity.
- Determine recreational water quality.
- Evaluate the appropriateness of existing use designations and assign uses to undesignated streams (Moors Run and Prairie Run, both of which are direct tributaries to Scioto River).
- Characterize the amount of aquatic resource degradation attributable to various land uses, including agricultural practices, and urbanization.
- Determine any aquatic impacts from known potential sources, including point source dischargers, and from unsewered communities.
- Collect fish samples for the Ohio Sport Fish Tissue Monitoring Program (used to assess chemical contaminant levels in fish).

SAMPLING ACTIVITIES

Chemical/Physical Water and Sediment

Chemical sampling locations within the study area are listed in Table 2. Conventional chemical/physical water quality samples will be collected 5 times at each designated location. Sediment samples will be collected at seven locations. Datasondes® will be deployed at 16 locations. Chemical parameters to be tested are listed in Table 4. Surface water sampling will occur across a variety of flow conditions, from lower flows to moderate and higher flows.

Bacteriological Sampling

Water samples will be collected at nine chemistry sites for bacteriological analyses to determine the attainment status of the Primary Contact recreational use of the streams within the study area. Testing

will include *Escherichia coli* (*E. coli*) bacteria. Each site will be sampled at least 5 times, while sentinel sites may have 5-10 bacteriological samples.

Chlorophyll

Benthic chlorophyll a samples are to be collected at designated wadeable and headwater sites noted in Table 2. Benthic chlorophyll samples are to be collected at least once, and should be timed to coincide with deployment of Datasonde® automated data loggers during stable, baseflow conditions (i.e., typically the second deployment).

Macroinvertebrate and Fish Assemblages

Macroinvertebrate sampling methods will be used as listed in Table 2. Fish assemblages will be sampled as listed in Table 2. QHEI scores will be calculated on the habitat at all fish sampling locations.

Fish Tissue

Fish tissue samples will be collected from two locations as part of the Ohio Fish Tissue Consumption Monitoring Program. Fillet samples of edible size sport fish will be tested for organochlorinated pesticides, PCBs, mercury, lead, cadmium, arsenic, and selenium. Results will be used in the Ohio Sport Fish Consumption Advisory Program.

QUALITY ASSURANCE/SAMPLING METHODS

Ohio EPA Manuals

All biological, chemical, data processing, and data analysis methods and procedures adhere to those specified in the Surface Water Field Sampling Manual for water column chemistry, bacteria and flows (Ohio EPA 2013a), Biological Criteria for the Protection of Aquatic Life, Volumes II - III (Ohio EPA 1987, 1989a, 1989b, 2013b, 2013c), and The Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Ohio EPA 1989c, 2006) for habitat assessment, Ohio EPA Sediment Sampling Guide and Methodologies (Ohio EPA 2012a), and Ohio EPA Fish Tissue Collection Guidance Manual (Ohio EPA 2012b).

Use Attainment

Attainment/non-attainment of aquatic life uses will be determined by using biological criteria codified in Ohio Administrative Code (OAC) 3745-1-07, Table 7-17. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MiwB), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Performance expectations for the basic aquatic life uses (Warmwater Habitat [WWH], Exceptional Warmwater Habitat [EWH], and Modified Warmwater Habitat [MWH]) were developed using the regional reference site approach (Hughes et al. 1986; Omernik 1987). This fits the practical definition of biological integrity as the biological performance of the natural habitats within a region (Karr and Dudley 1981). Attainment of an aquatic life use is FULL if all three indices (or those available) meet the applicable criteria, PARTIAL if at least one of the indices did not attain and performance did not fall below the fair category, and NON if all indices either fail to attain or any index indicates poor or very poor performance. The results will be compared to WWH biocriteria for the Western Allegheny Plateau (WAP) ecoregion.

Recreational use attainment will be determined using fecal coliform bacteria and *E. coli* bacteria. Both types of organisms are indicator organisms for the potential presence of pathogens in surface water resulting from the presence of untreated human or animal wastes, and they are the basis for recreational use water quality criteria in Rule 3745-1-07 of the Ohio Administrative Code (OAC).

Stream Habitat Evaluation

Physical habitat is evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Evaluations of type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient are among the metrics used to evaluate the characteristics of a stream segment, not just the characteristics of a single sampling site. As such, individual sites may have much poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values higher than 60 were generally conducive to the establishment of warmwater faunas while those which scored in excess of 75-80 often typify habitat conditions which have the ability to support exceptional faunas.

Biological Community Assessment

Macroinvertebrates will be collected from artificial substrates and/or natural stream habitats. Artificial substrate collections will be collected at all sites with greater than 20 mi² drainage areas or at reference site locations. This sample provides quantitative data and consists of a composite sample of five modified Hester-Dendy multiple-plate artificial substrate samplers colonized for six weeks. Qualitative sampling will be conducted at all sampling locations. This sampling effort consists of an inventory of all observed macroinvertebrate taxa from the natural stream habitats at each site with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major macrohabitat types (e.g., riffle, run, pool, margin). Detailed macroinvertebrate assemblage sampling protocols are documented in Biological Criteria for the Protection of Aquatic Life, Volume III (1989b, 2013c).

Fish will be sampled at each sampling location using pulsed DC headwater, wading, or boat electrofishing methods depending on watershed size at each sampling zone. Sites with drainage areas greater than 20 mi² or at reference site locations will be sampled twice during the sampling index period. Fish are processed in the field which includes identifying each individual to species, counting individuals at all sites, weighing individuals at wading and boat sites, and recording any external abnormalities. Detailed fish assemblage sampling protocols are documented in Biological Criteria for the Protection of Aquatic Life, Volume III (1989b, 2013c).

Sediment

Fine grained multi-incremental sediment samples will be collected in the upper 4 inches of bottom material using either decontaminated stainless steel scoops or Ekman dredges. Collected sediment will be placed into appropriate containers, placed on ice (to maintain 4oC) and shipped to the Ohio EPA lab. Sampling and decontamination protocols will follow those listed in the Ohio EPA Sediment Sampling Guide and Methodologies (2012a)

Chlorophyll

Benthic chlorophyll a samples will be collected and preserved using appropriate methods, as outlined in Appendix II of Surface Water Field Sampling Manual for water column chemistry, bacteria and flows (Ohio EPA 2013a) and delivered to the Ohio EPA Division of Environmental Services lab for analyses. Alkalinity must be requested as a routine water quality parameter at all study sites along with the routine field parameters, especially temperature and pH.

Surface Water

Surface water grab samples will be collected and preserved using appropriate methods, as outlined in Surface Water Field Sampling Manual for water column chemistry, bacteria and flows (Ohio EPA 2013a) and delivered to the Ohio EPA Division of Environmental Services lab for analyses. Field measurements of dissolved oxygen, pH, temperature, and conductivity will be made using YSI 556MPS meters along with all grab samples for surface water chemistry. Datasonde® continuous recorders will be placed at select locations to evaluate diel measurements of dissolved oxygen, pH, temperature, and conductivity.

Bacteria

Water samples will be collected into appropriate containers, cooled to 4°C, and transported to the OEPA DES laboratory within 6 hours of sample collection. All samples will be analyzed for *E. coli* bacteria using U.S.EPA approved methods (STORET Parameter Code 31648).

Fish Tissue

Tissue fillet samples will be collected from fish of edible size, and species preferred for analysis may include spotted bass, largemouth bass, smallmouth bass, flathead catfish, walleye, saugeye, white bass, common carp, freshwater drum, and channel catfish. When possible, composite samples (by species) will be collected using a minimum of three fish and a minimum of 150 grams of material. At each sampling location, an attempt will be made to collect five fish species for fillet tissue analysis. Fish will be sampled using electrofishing boat methods at the reservoir and wading method at the remainder sites. Sampling locations are listed in Table 2. Fish used for tissue analysis will be filleted in the field using decontaminated stainless steel fillet knives. Filleted samples will be wrapped in aluminum foil, placed in a sealed plastic bag, and placed on dry ice. Sampling and decontamination protocols will follow those listed in the Ohio EPA Fish Collection Guidance Manual (2012b). Fish tissue samples will be stored in chest freezers at the Ohio EPA Groveport Field Facility prior to delivery to DES.

Field Quality Control Samples

Ten percent of the sediment, water, and bacteria samples will be submitted to the lab as field duplicates. One Datasonde® recorder site will have two instruments placed in the river as field duplicates. Field blanks will occur at a minimum of 5 percent of the water samples. Field instruments will be calibrated daily, using manufacturer guidelines and requirements noted in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2013a). Matrix spike duplicates will be collected for organic water samples at a minimum of 5 percent.

Table 1. Facilities regulated by the National Pollution Elimination System in the Bokes Creek watershed study area.

Regulated Facilities in the Bokes Creek Watershed							
Name	Permit	Type	Stream	River Mile	County	Bokes Creek Hydrologic Unit	Comments
West Mansfield WWTP	NPDES	Non Discharging	W.F. West Mansfield Trib.	0.9	Logan	07 01 Headwaters	Land apply all effluent
Heartland Egg Farm	ODA	CAFO	N.F. West Mansfield Trib.	0.7	Logan	07 01 Headwaters	1.75 million animal units
The Shelly Co. York Center Plant	4IJ001007	IND NPDES	Bokes Creek	25.2	Union	07 02 Brush Run	Quarry
New Day Farms #3	4IK00032	IND NPDES	U.T. Powderlick Run	NA	Union	07 02 Brush Run	CAFO with an OEPA NPDES Industrial Permit
New Day Farms #3	ODA	CAFO					800,000 animal units
New Day Farms Mad R	4IK00005	IND NPDES	U.T. Powderlick Run	NA	Union	07 02 Brush Run	CAFO with an OEPA NPDES Industrial Permit
New Day Farms Mad R	ODA	CAFO					1.6 million animal units
Topaz Farm #2	ODA	CAFO	Powderlick Run	NA	Union	07 02 Brush Run	
Nature Pure Farm #1	4IK00029	IND NPDES	U.T. Powderlick Run	NA	Union	07 02 Brush Run	CAFO with an OEPA NPDES Industrial Permit
Nature Pure farm #1	ODA	CAFO					380,000 animal units
Hi-Q Egg Farm	ODA	CAFO	U.T. Mill C. (RM 26.0)	NA	Union	07 02 Brush Run	CAFO / NOT BUILT 600,000 animal units ODA proposed to deny (2010)
Camp Christian WWTP	4GS00010	GEN NPDES	Bokes Creek	6.2	Union	07 03 Smith Run	Small Sanitary Discharger
National Lime Warrensburg Plant	4IJ00103	IND NPDES	Scioto R.	160.6	Delaware	07 04 Moors Run	Quarry
National Lime Delaware Plant	4IJ00029	IND NPDES	U.T. Scioto R. (RM 158.2)	1.0 1.1	Delaware	07 04 Moors Run	Quarry / 2 outfalls

Table 2. Sampling locations and types of sampling scheduled for the study area.

<u>ID</u>	<u>Name</u>	<u>River Mile</u>	<u>Drainage Area</u>	<u>Use</u>	<u>Lat.</u>	<u>Long.</u>	<u>Sampling</u>	<u>Issue</u>
<u>V02K08</u>	BOKES CREEK NW OF HORTON @ CO. RD. 292	36.30	4.7	MWH	40.46420	-83.5811	F,M,WQ	TMDL resampling
<u>V02K07</u>	BOKES CREEK NEAR HORTON @ CO. RD. 120	35.10	7.1	WWH	40.45610	-83.5669	F,M,WQ,D,O	TMDL resampling
<u>V02K06</u>	BOKES CREEK @ WEST MANSFIELD-MT. VICTORY RD.	31.80	11.4	WWH	40.44060	-83.5278	F,M,WQ,D	TMDL resampling
<u>V02W04</u>	BOKES CREEK @ HOOVER MOFFIT RD.	28.40	34.0	WWH	40.425	-83.4844	F2,MT,Sn,CA,WQ,B,D,Sd,O	Sentinel Site
203100	BOKES CREEK @ BITLER RD.	23.2	43.8	WWH	40.408000	-83.427500	F2,MT,WQ,D	Spacial coverage
<u>V02S22</u>	BOKES CREEK SE OF YORK CENTER @ YEARSLEY RD.	21.29	46.0	WWH	40.39080	-83.4125	F2,MT,WQ,D,O,FT	TMDL resampling
<u>V02K05</u>	BOKES CREEK ADJ. S.R. 31, UPST BRUSH RUN/DST POWDER LICK RUN	20.20	51.0	WWH	40.38080	-83.4074	F2,MT,WQ,D,Sd,O	TMDL resampling
<u>V02K04</u>	BOKES CREEK @ FORD REED RD.	16.58	58.0	WWH	40.36220	-83.3747	F2,MT,Sn,CA,WQ,B,D,Sd,O	Sentinel Site / TMDL resampling
<u>V06P10</u>	BOKES CREEK N OF MARYSVILLE @ ST. RT. 4	11.37	63.0	WWH	40.34837	-83.303785	F2,MT,WQ,B,D,O	TMDL resampling
<u>V02S20</u>	BOKES CREEK DST. MAGNETIC SPRINGS @ BROWN RD.	5.55	72.0	WWH	40.33920	-83.24390	F2,MT,WQ,B,D,Sd,O	TMDL resampling
<u>302241</u>	BOKES CREEK @ TYLER RD.	2.78	75.0	WWH	40.33485	-83.21264	FT	Fish Tissue Only
<u>V06P09</u>	BOKES CREEK W OF DELAWARE @ ST. RT. 257	0.25	83.1	WWH	40.37440	-83.4169	F2,MT,Sn,CA,WQ,B,D,Sd,O	Sentinel Site / TMDL resampling
<u>V02W27</u>	BRUSH RUN S OF SOMERSVILLE @ YEARSLEY RD.	0.60	2.6	WWH	40.37440	-83.4169	F,M,WQ	TMDL resampling
V02W25	POWDER LICK RUN NEAR MOUTH, 100 YDS. DST. YEARSLEY RD.	0.17	4.1	WWH	40.38560	83.4139	F,M,Sn,CA,WQ,B,D,Sd,O	Sentinel Site
<u>V02K14</u>	N. FK. WEST MANSFIELD DITCH @ FARM LANE OFF CO. RD. 26	5.58	3.7	MWH	40.42890	-83.5706	F,M,WQ	Sentinel Site / TMDL resampling
<u>V02K13</u>	N. FK. WEST MANSFIELD DITCH @ CO. RD. 142	3.96	8.0	WWH	40.42140	-83.5433	F,M,WQ,D	TMDL resampling

ID	Name	River Mile	Drainage Area	Use	Lat.	Long.	Sampling	Issue
<u>V02K12</u>	N. FK. WEST MANSFIELD DITCH @ JANUARY RD.	1.28	11.4	WWH	40.41920	-83.5075	F,M,Sn,CA,WQ,B,D,O	Sentinel Site / TMDL resampling
<u>601160</u>	W. FK. WEST MANSFIELD DITCH NEAR YORK CENTER @ ST. RT. 47	0.78	6.1	WWH	40.41250	-83.5075	F,M,WQ,D	TMDL resampling
<u>203120</u>	SMITH RUN @ BRINDLE RD.	0.80	5.6	WWH	40.32190	-83.2025	F,M,WQ,D,Sd,O	TMDL resampling
302208	MOORS RUN N OF WARRENSBURG @ ST. RT. 257	0.32	5.6	WWH*	40.31829	-83.17459	F,M,WQ,B	HUC 12 Assessment
302209	PRAIRIE RUN N OF WARRENSBURG @ ST. RT 37	0.07	5.6	WWH*	40.32203	-83.16781	F,M,WQ,B	HUC 12 Assessment

WWH*- unverified use

Table 3. Summary of proposed sampling.

Type of Sample	Total number of sites sampled
Total Sites	21
Water Chemistry	20
Bacteria	9
Fish - 1 Pass	12
Fish -2 Pass	8
Macroinvertebrate - Qual	12
Macroinvertebrate- Quant	8
Fish Tissue	2
Sediment	7
Datasonde©	15
Sentinel	5
Chlorophyll A	5
Water Column Organics	11

Table 4. Chemical/physical water quality parameters to be analyzed/measured in surface water, sediment, and fish tissue from the Bokes Creek watershed sampling locations. Not all sites will be sampled for all parameters. Water samples will be collected 5 times (organics once), sediment once. Bacteria samples will be collected 5 times during the recreation season (5– 10 times at sentinel sites). Select sampling locations will be monitored for dissolved oxygen, pH, temperature, and conductivity using Datasonde® continuous recorders (Table 2).

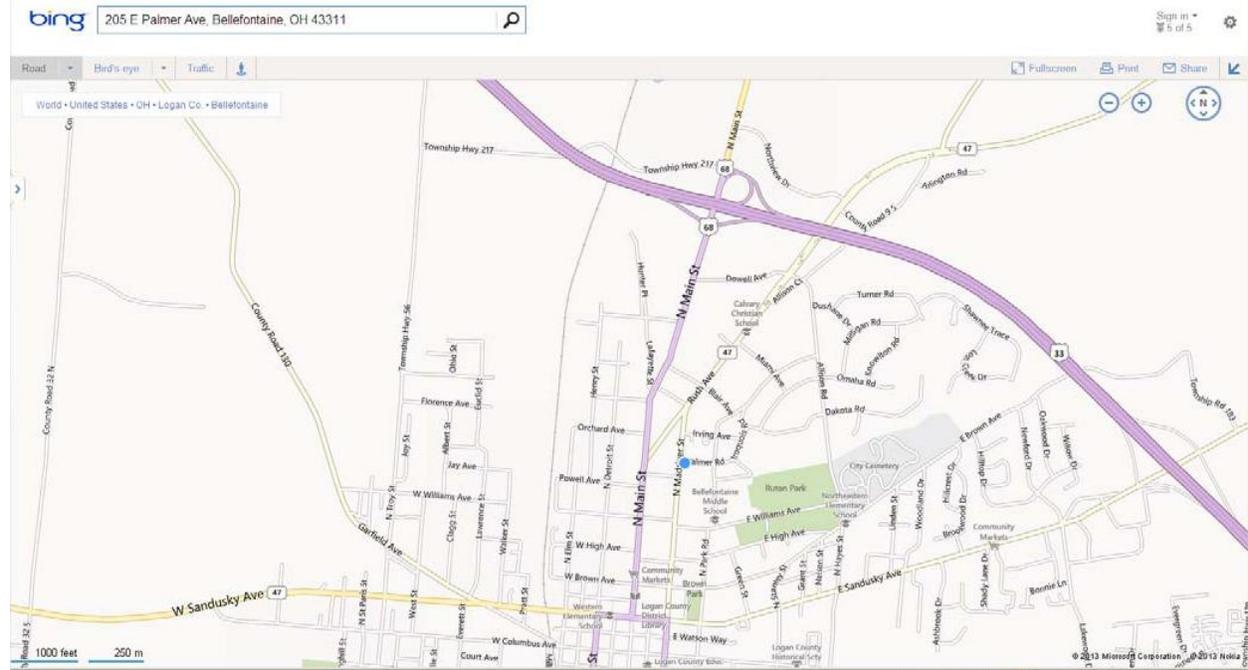
Parameters	Test Method	Water	Sediment	Fish Tissue
CBOD, 20 day	OEPA 310.2	X		
ALKALINITY, TOTAL	SM 2320B	X		
SOLIDS, DISSOLVED (TDS)	USEPA 160.1	X		
SOLIDS, SUSPENDED (TSS)	USEPA 160.2	X		
AMMONIA	USEPA 350.1 SM 4500-NH3 B+E	X	X	
TKN	USEPA 351.2	X		
NITRATE-NITRITE	USEPA 353.1	X		
Nitrite	USEPA 354.1	X		
Chloride	USEPA 325.1	X		
COD	USEPA 410.4	X		
TOTAL PHOSPHORUS	USEPA 365.4 USEPA 365.4	X	X	
ORTHOPHOSPHATE, Dissolved	USEPA 365.1	X		
SULFATE	ASTM 05160 92	X		
ICP 1 (Al,Ba,Ca, Fe, Mg, Mn, Na, Ni, K, Sr, Zn, Hardness)	USEPA 200.7	X		
ICP 3 (Al,Ba,Ca,Fe,Mg,Mn,Na,K,Sr,Zn)	USEPA 200.7		X	
ICPMS 1 (As,Cd,Cr,Cu,Ni,Pb,Se)	USEPA 200.9, SM 3113B	X		X
ICPMS 2 (As,Cd,Cr,Cu,Ni,Pb,Se)	USEPA 200.9, SM 3113B		X	
MERCURY, TOTAL	USEPA 245.1,7470A,7471A	X	X	X (245.1)
pH – grab	FIELD SONDE	X – field		
Conductivity – grab	FIELD SONDE/ USEPA 120.1	X – field / lab		
Dissolved Oxygen – grab	FIELD SONDE	X – field		
Temperature – grab	FIELD SONDE	X – field		
Herbicides	USEPA 525.2	X		
E.coli	USEPA 1103.1	X		
SVOCs (BNAS)	USEPA 625/USEPA 8270C	X	X	
Pesticides/PCBs/ Chlordane	USEPA 608/USEPA 8081A, 8082	X	X	X (OEPA 590.1)
Percent Solids	SM 2540G		X	X
Total Organic Carbon	OEPA 335.2		X	
Particle Size	OEPA 160.1		X	
Benthic Chlorophyll a	USEPA 445		OTHER	

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Appendix A Hospital Directions and Maps

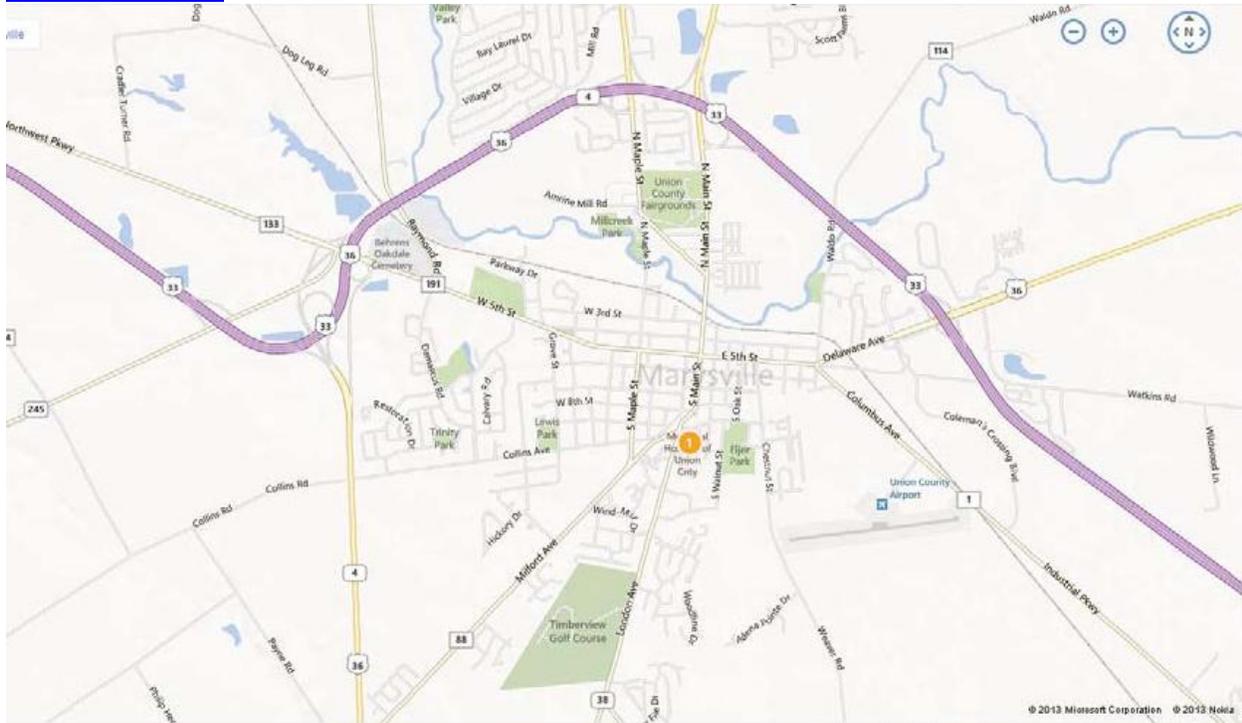
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<http://binged.it/ZP6Kgn>

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<http://www.bing.com/maps/?v=2&cp=40.230993~-83.368850&lvl=16&dir=0&sty=r&where1=500%20London%20Ave%2C%20Marysville%2C%20OH%2043040&form=LMLTSN>



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<http://binged.it/ZP7xhg>

