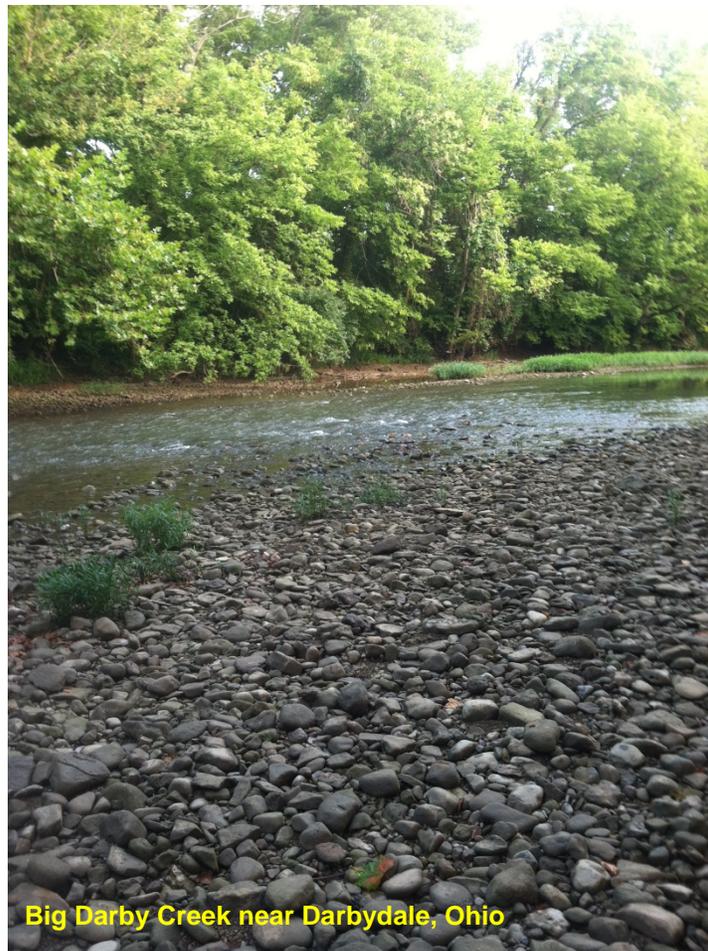




Study Plan – Biological and Water Quality Survey for Big Darby Creek and Selected Tributaries

Logan, Champaign, Union, Madison, Franklin and Pickaway Counties, Ohio



Big Darby Creek near Darbydale, Ohio

Division of Surface Water
April 25, 2014

**Biological and Water Quality Survey Study Plan for
Big Darby Creek and Selected Tributaries
April 25, 2014**

Logan, Champaign, Union, Madison, Franklin and Pickaway Counties, Ohio

Hydrologic Unit Codes (HUC)

05060001 19

05060001 20

05060001 21

05060001 22

Ohio Environmental Protection Agency
Division of Surface Water
50 W. Town Street, Suite 700
Columbus Ohio 43215

Monitoring and Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125

Central District Office
Division of Surface Water
50 W. Town Street, Suite 700
Columbus Ohio 43215

Southwest District Office
Division of Surface Water
401 East Fifth Street
Dayton, Ohio 45402

INTRODUCTION

As part of the TMDL process and in support of the basin approach for NPDES permitting, an intensive ambient assessment will be conducted during the 2014 field sampling season within the Big Darby Creek basin. The study area is composed of all or portions of 17 HUC 12 watershed assessment units. A total of 129 stream sampling stations are allocated to this effort. (Figure 1 and Table 1). Ambient biology, macrohabitat quality, water column chemistry, and bacteriological data will be collected concurrently from most of these sites. Diel water quality (DO, pH, conductivity, and temperature), sediment chemistry (metals, organics, and particle size), pesticides, nutrients, and fish tissue will be evaluated at selected sampling locations.



Sampling Objectives

- 1) Systematically sample and assess the principal drainage network of the Big Darby Creek in support of both the TMDL process and NPDES permits,
- 2) Gather ambient environmental information (biological, chemical, and physical) from undesignated water bodies, so as to recommend an appropriate suite of Beneficial Uses (e.g., aquatic life, recreational, water supply),
- 3) Verify the appropriateness of existing, unverified, Beneficial Use Designations, and recommend appropriate use designation to undesignated waters.
- 4) Establish and evaluate baseline ambient biological conditions at selected reference stations to evaluate the effectiveness of past, on-going and future pollution abatement efforts,
- 5) Document any changes in the biological, chemical, and physical conditions of the study areas where historical information exists, thus expanding the Ohio EPA data base for statewide trends analysis (e.g., 305[b]).

Issues

Total Maximum Daily Load (TMDL)

Information collected as part of this survey will support TMDL development for the study area. The objectives of the TMDL process are to estimate pollutant loads from the various sources within the basin, define or characterize allowable loads to support the various beneficial uses, and to allocate pollutant loads among different pollutant sources through appropriate controls (e.g., NPDES permitting, storm water management, 319 proposals, NPS controls or other abatement strategies).

The components of the TMDL process supported by this survey are primarily the identification of impaired waters, verification (and re-designation if necessary) of beneficial use designations, gathering ambient information that will factor into the wasteload allocation, and ascribing causes and sources of use impairment. These data are necessary precursors to the development of effective control or abatement strategies.

Aquatic Life Use Designations

The Big Darby Creek watershed was intensively surveyed in 2001-02. Consequently, the majority of streams where biological data will be collected have been previously designated based on field data. The Ohio EPA is obligated to review, evaluate, or recommend (where appropriate) beneficial uses prior to basing any permitting actions on existing, unverified designations, or wholly unclassified water bodies. Much of the sampling effort for this survey is allocated to fulfill this obligation.

NPDES Permits

There are 41 individual NPDES permitted facilities within the Big Darby Creek watershed. These include both publically owned treatment works and private entities. A list of permitted facilities is presented in Table 2. Stream stations were selected to evaluate potential impacts from some of these facilities.

Nutrients

In support of the ongoing process of nutrient criteria development and to provide more objective and robust characterization of the sources and effects of nutrient loads, nutrient specific monitoring is scheduled for Big Darby Creek mainstem and selected tributaries. Nutrient sites are included in Table 2.

Lakes

There are no significant public lakes contained within the Big Darby Creek basin that are scheduled for monitoring and assessment in 2014.

Sampling Effort

Field and Laboratory Load

Summarized field and laboratory load (stations, number of samples, and parameters for analysis, etc.) can be found in Table 3. Adjustments to the study plan may be made based on field conditions and other factors.

Water Quality

Water column chemistry samples will be collected from 129 stream stations within the study areas. Water column grab samples and standard field parameters will be collected/measured five times from all locations. The collection of water samples for bacteriological analysis is scheduled for 31 stations (Table 1). Sampling frequency, station density, flow regime, and other field considerations shall comport with the most recent recreational use rule.

Datasonde deployment is requested for 35 locations, at sentinel, nutrient, and a subset of ambient monitoring sites. The deployment of continuous monitors should coincide with typical low summer/fall flows (i.e., approaching $Q_{7/10}$). The Modeling section will be responsible for deployment of the Datasonde units.

Nutrients

Water column samples in support of nutrient monitoring and assessment efforts will be collected at 18 locations (Table 1). DSW Modeling staff is responsible for the collection of specific parameters supporting nutrient monitoring and assessment. Substrate and water column samples for the analysis of benthic and sestonic chlorophyll-a, dissolved phosphorus, alkalinity, and BOD_5 must be collected concurrently with either the Datasonde deployment or retrieval or the interval between these two activities.

Sediment Chemistry

Sediment samples are to be collected from 17 locations within the study area. One set of sediment samples will be collected at each of the sites indicated in the table of sampling locations (Table 4) using procedures outlined in the *Ohio EPA Sediment Sampling Guide and Methodologies*, 3rd edition (Ohio EPA, 2012c). Fine grained multi-incremental sediment samples will be collected in the upper four inches of bottom material using either clean stainless steel scoops or dredges. Samples will be homogenized and split into 500 ml amber glass jars with Teflon lined lids for organic compound testing, 250 ml HPDE containers for metals testing and gallon re-sealable plastic bags for particle size analysis. They will then be secured inside coolers with wet ice and delivered to the Ohio EPA Division of Environmental Services for analysis. Pollutants to be tested and their analytical methods are listed in the table of chemical/physical parameters (Table 4).

Data will primarily be used as a resource to assist in determining of causes and sources of aquatic life impairment. More detailed follow up studies may be recommended in some instances. To determine the potential for sediment contaminants to exert adverse

effects the data will first be compared to Ohio sediment reference values and consensus-based sediment quality guidelines. This constitutes a Tier I assessment as described in *Guidance on Evaluating Sediment Contaminant Results* (Ohio EPA, 2012c). No further assessment is needed if the sediment passes the screening. If not, further evaluation will be needed following the Tier II process which estimates bioavailability using total organic carbon to normalize pollutant concentrations.

Analysis will include a full organic scan (BNAs, PCBs, TOC, and Pesticides), a full metals scan (excluding mercury), and sediment particle size. Due to very limited practical benefit, demonstrated over many years, analysis for sediment VOCs is not recommended for any sediment samples. Given the limited laboratory allocation, sediment and metal-organic sampling stations were chosen to evaluate areas likely to demonstrate contamination, aid in elucidating longitudinal trends in sediment contamination relative to a known source(s), characterization of sentinel sites, and characterization ecoregional sediment reference sites. Locations of selected sediment sampling stations are listed in Table 1. The allocation and placement of additional sediment sampling within the study area will be at the discretion of CDO staff.

Benthic Macroinvertebrate Assessment

The condition of the macrobenthos will be evaluated at 92 locations. Artificial substrate samples (quantitative) will be deployed and retrieved by EAU staff at 53 stations within the study area. Qualitative benthic macroinvertebrate samples (natural substrates) will be collected at 39 stations. Locations of benthic macroinvertebrate sampling stations and type of sample required are listed in Table 1.

Fish Community Assessment

The condition of the fish assemblages within the study area will be evaluated at 92 locations. Multiple pass fish community samples will be collected at 51 sites by Ohio EPA EAU staff. Single pass fish community samples will be collected at 41 stations. Single pass evaluations are limited to headwaters, baring reference sites or significant permit issues. The locations of all fish sampling stations are listed in Table 1.

Fish Tissue

In support of the consumption advisory program, fish tissue samples are to be collected from 19 of the 92 fish monitoring stations within the Big Darby Creek study area. As indicated in Table 1, 13 tissue stations are allocated to the Big Darby Creek mainstem and 6 are located on Little Darby Creek.

Sentinel Sites

To aid in potential TMDL modeling, sentinel sites have been established at 17 designated locations. At each sentinel site, samples are collected monthly beginning prior to the beginning of the summer sampling season. Analyses measure routine water chemistry parameters, pesticides (atrazine and glyphosate) and E. coli and the corresponding stream stage is measured to the nearest 100th of a foot, usually from a fixed point on a bridge railing above. Sampling events at sentinel sites should cover the range of stream flow from the 10th to 90th percentiles. If conditions warrant,

bacteriological sampling at all sentinel sites may be expanded beyond five runs. The locations of sentinel sites are indicated in Table 1.

QUALITY ASSURANCE

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), 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 2012c), and Ohio EPA Fish Collection Guidance Manual (Ohio EPA 2012b). All methods are summarized in Table 3

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 integrity of the fish community, and the Invertebrate Community Index (ICI), a measure of the stream macro invertebrate community.

Performance expectations for the basic aquatic life use designations (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.

Recreational use attainment will be determined using *E. coli* bacteria. *E. coli* is the primary indicator organism for the potential presence of pathogens in surface water resulting from the presence of untreated human or animal wastes, and is 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 in-stream 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 from their natural habitats. Quantitative sampling will be conducted at reference sites and at sites with drainage areas in excess of 20 mi². Qualitative sampling will be conducted in headwater sites with drainages smaller than 20 mi². The artificial substrate collection provides quantitative data and consists of a composite sample of 5 modified Hester-Dendy (HD) multiple-plate samplers colonized for six weeks. At the time of the artificial substrate collection, a qualitative multi-habitat composite sample is also collected. This sampling effort consists of an inventory of all observed macroinvertebrate taxa from the natural 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, and margin). Fish will be sampled at each sampling location with pulsed DC current. Two passes will be conducted at sites larger than 20 mi² and at reference sites. Detailed biological sampling protocols are documented in the Ohio EPA manual Biological Criteria for the Protection of Aquatic Life, Volume III (1989).

Fish Tissue

The collection, field processing, and short-term storage of fish tissue samples shall adhere to the methods and protocol specified in the agency's current fish tissue guidance manual (Ohio EPA 2012b).

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 4°C) and shipped to the Ohio EPA lab. Sampling and decontamination protocols will follow those listed in the Ohio EPA Sediment Sampling Guide and Methodologies, November, 2001.

Surface Water

Surface water grab samples will be collected from the upper 12 inches of river water into appropriate containers. Collected water will be preserved using appropriate methods, as outlined in Parts II and III of the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2012a) and delivered directly or shipped overnight via courier to the Ohio EPA lab for analysis. Field measurements of dissolved oxygen, pH, temperature, and conductivity will be made using YSI 556MPS or Eureka M2 meters along with all grab samples for surface water chemistry. Datasonde[®] continuous recorders will be placed at select locations to evaluate diurnal measurements of dissolved oxygen, pH, temperature, and conductivity.

Bacteria

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

Chlorophyll

Benthic and sestonic 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 2012a) 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.

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 2012a). Matrix spike duplicates will be collected for organic water samples at a minimum of 5 percent.

Field Staff and Other Contacts

Ohio EPA-Central Office

Jeff DeShon: (614) 836-8780
Holly Tucker: (614) 836-8777
Chris Skalski: (614) 644-2144
Jordan Jenkins: (614) 836-8786
Andrew Phillips: (614) 836-8773
Ed Moore: (614) 836-8785
Angela Defenbaugh: (614) 728-2384

Ohio EPA-SWDO

Joshua Jackson: (937) 285-6029

Ohio EPA-CDO

Erin Sherer: Study Plan Coordinator (614) 728-3839
Jeff Lewis: (614) 728-3852
Eric Saas: (614) 728-3855

Metro Parks (Columbus and Franklin County)

Staff Park Ranger: (614) 878-1076

County Sheriffs, Phone Contact

Logan Co.: (937) 592-5731
Union Co.: (937) 645-4100
Champaign Co.: (937) 484-6091
Madison Co.: (740) 852-1332
Franklin Co.: (614) 525-3360
Pickaway Co.: (740) 474-2176

Police Departments, Phone Contact

Plain City: (614) 873-2921
Marysville: (937) 645-7300
Mechanicsburg: (937) 834-3303
West Jefferson: (614) 879-7672
Harrisburg: (614) 462-3333

County Wildlife Officers

Logan Co.: Adam Smith (614) 644-3929 x1208
Union Co.: Josh Shields (614) 644-3929 x1213
Champaign Co.: Jeffrey Tipton (614) 644-3929 x1201
Madison Co.: Matt Teders (614) 644-3929 x1209
Franklin Co.: Brad Kiger (614) 644-3929 x1205
Pickaway Co.: (614) 644-3929 x1212

Figure 1. Big Darby Creek Watershed Stream Sampling Locations (2014).

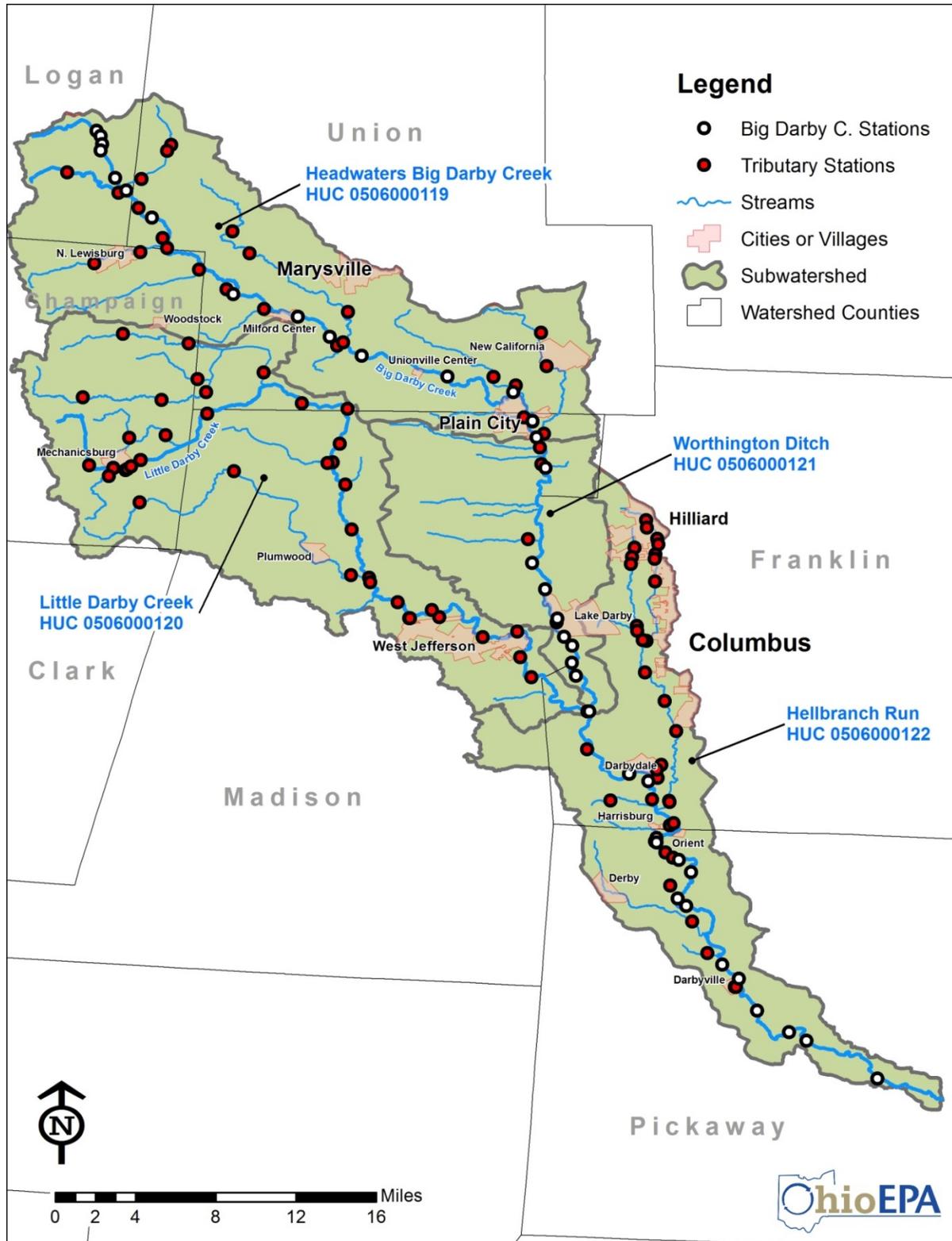


Table 1. Big Darby Creek Watershed Stream Sampling Locations (2014).

STATION ID	STATION NAME	LATITUDE	LONGITUDE	RIVER MILE	DRAINAGE MI ²	SAMPLE TYPE
V06K07	BIG DARBY CREEK IN HEADWATERS @ PRIVATE RESIDENCE	40.31560	-83.59190	83.20	1.5	F,MQ,C
300621	BIG DARBY CREEK S OF E LIBERTY, UPST LANE OFF OLD U.S. 33	40.31240	-83.57296	81.90	2.2	F,MQ,C
V06K05	BIG DARBY CREEK @ LANE OFF OLD U.S. RT. 33 (SHOWE PROPERTY)	40.30870	-83.57020	81.60	3.0	F,MQ,C
300620	BIG DARBY CREEK NE OF MIDDLEBURG, 0.4 MI UPST ST. RT. 287	40.30293	-83.56897	81.10	3.2	F,MQ,C
V07P62	BIG DARBY CREEK NE OF MIDDLEBURG @ ST. RT. 287	40.29830	-83.57000	80.75	4.5	F,MQ,C
V07S57	BIG DARBY CREEK SE OF MIDDLEBURG @ CO. RD. 157	40.27860	-83.55970	79.23	5.6	F2,MQ,C,R
V07P61	BIG DARBY CREEK SE OF MIDDLEBURG @ CO. RD. 153	40.26940	-83.55170	78.44	19.4	F,MQ,C,N
V07P59	BIG DARBY CREEK NE OF NORTH LEWISBURG @ NORTH LEWISBURG RD.	40.24970	-83.53310	76.53	32.0	F2,MQ,C,N,R,B,T
V06K03	BIG DARBY CREEK NW OF MILFORD CENTER @ COLLINS RD.	40.19470	-83.47440	69.50	71.0	F2,MQ,C,B
V07P54	BIG DARBY CREEK @ MILFORD CENTER CEMETERY	40.17830	-83.42780	66.10	85.0	F2,MQ,C
V06W16	BIG DARBY CREEK UPST BUCK RUN, ADJ. MIDDLEBURG-PLAIN CITY RD	40.16390	-83.40470	64.38	86.0	F2,MQ,C
V07S12	BIG DARBY CREEK SE OF BRIDGEPORT @ ST. RT. 38	40.15030	-83.38190	62.60	121.0	F2,MQ,C,R,B
V07P51	BIG DARBY CREEK SE OF UNIONVILLE CENTER, ADJ. ROBINSON RD.	40.13530	-83.32000	58.80	131.0	F2,MQ,C
V06W04	BIG DARBY CREEK AT PLAIN CITY, UPST. U.S. RT. 42 AND RANCO	40.12400	-83.27250	54.10	138.0	F2,MQ,C,H,R,B,T
V06W06	BIG DARBY CREEK JUST UPST. PLAIN CITY WWTP	40.10310	-83.25860	52.11	151.0	C
V07S09	BIG DARBY CREEK S OF PLAIN CITY @ CEMETERY PIKE	40.09131	-83.25552	51.10	157.0	F2,MQ,C,N,SN,B,SD
V06W08	BIG DARBY CREEK AT AMITY @ AMITY PIKE	40.06940	-83.24920	49.46	193.0	F2,MQ,C,B,T
V06K01	BIG DARBY CREEK 1.0 MI. DST. LUCAS RD, ADJ METROPARK LEVEE	40.00080	-83.25890	43.50	225.0	C
603100	BIG DARBY CREEK N OF WEST JEFFERSON @ HUBBARD RD.	39.98170	-83.24940	41.75	239.0	F2,MQ,C,H,R,SN,B,SD,T
302723	BIG DARBY CREEK UPST LAKE DARBY ESTATES WWTP OUTFALL	39.96050	-83.24060	39.76	246.0	C
600830	BIG DARBY CREEK E OF WEST JEFFERSON @ U.S. RT. 40	39.94739	-83.23593	38.90	247.0	F2,MQ,C,T
V06W19	BIG DARBY CREEK E OF WEST JEFFERSON, DST. DARBYCREST	39.94110	-83.23000	38.33	248.0	F2,MQ,C,N,B
302724	BIG DARBY CREEK UPSTREAM DARBY DAN DAM AT DARBY HOUSE	39.92860	-83.23020	37.50	248.0	C,D,N
601140	BIG DARBY CREEK AT GARDNER RD	39.89360	-83.21750	34.20	253.0	F2,MQ,C,B,T
V07S06	BIG DARBY UPST. DARBYDALE AT SR 665	39.84530	-83.19360	30.17	448.0	F2,MQ,R
V07S05	BIG DARBY CREEK AT DARBYDALE @ MCKINLEY BRIDGE	39.84860	-83.18890	29.20	449.0	C,B,H
V07G70	BIG DARBY CREEK DST. DARBYDALE, UPST. TRIB @ POWER LINES	39.84330	-83.17510	27.95	450.0	F2,MQ,C, T
V07G73	BIG DARBY CREEK UPST GAY RUN, ADJ HARRISBURG-GEORGESVILLE RD	39.83610	-83.17080	26.80	454.0	F2,MQ,C,N,R,SN,B,SD
601110	BIG DARBY CREEK 0.5 MI. DST. HELLBRANCH RUN AND I-71	39.81820	-83.16195	25.70	495.0	F2,MQ,R
V07P43	BIG DARBY CREEK NEAR HARRISBURG @ U.S. RT. 62	39.81820	-83.16195	25.23	496.0	C
V07S03	BIG DARBY CREEK W OF ORIENT @ ST. RT. 762	39.80220	-83.16920	23.75	501.0	F2,MQ,C,R,B,T,CP
V07G78	BIG DARBY CREEK APPROX. 200' UPST. PCI OUTFALL	39.79260	-83.16370	22.97	503.0	C,D,CP
V07W56	BIG DARBY CREEK DST. PCI WWTP, UPST. SNAKE ISLAND	39.78640	-83.15310	22.45	503.0	F2,MQ,C,N,CP
V07P42	BIG DARBY CREEK NEAR GRAVEL PIT @ END OF LANE	39.77750	-83.14420	21.35	506.0	F2,MQ,C,N,CP

Table 1. Big Darby Creek Watershed Stream Sampling Locations (2014).

STATION ID	STATION NAME	LATITUDE	LONGITUDE	RIVER MILE	DRAINAGE MI ²	SAMPLE TYPE
V07G19	BIG DARBY CREEK @ SPORTSMAN'S CLUB, DST. CLARKS LAKE TRIB.	39.75850	-83.15380	19.83	513.0	MQ, C, SD
V07P41	BIG DARBY CREEK S OF ORIENT @ SCIOTO-DARBY RD.	39.75310	-83.14780	19.10	513.0	F2,MQ,C,H,SN,B,SD,N,CP,T
601300	BIG DARBY CREEK AT DARBYVILLE @ ST. RT. 316	39.70080	-83.10970	13.36	534.0	F2,MQ,C,R,SN,B,SD,T,CP
V07P39	BIG DARBY CREEK SE OF DARBYVILLE @ END OF DARBY RD.	39.67780	-83.09640	11.30	537.0	F2,MQ,C,CP
V07G17	BIG DARBY CREEK SE OF DARBYVILLE, DST. TRIB (8.80)	39.66220	-83.07360	8.70	544.0	F2,MQ,
203374	BIG DARBY CREEK SE OF DARBYVILLE, E OF RENICK CEMETERY	39.65610	-83.06080	7.40	545.0	F2,MQ,C,B,CP,T
600970	BIG DARBY CREEK NEAR FOX @ ST. RT. 104	39.62860	-83.00970	3.20	552.0	F2,Mq,C,H,N,R,B,T,CP
V06G34	FLAT BRANCH @ O'DELL RD.	40.30240	-83.51920	3.20	3.7	C
V06G41	HONDA R&D STORMWATER POND OUTFALL TO FLAT BRANCH	40.29800	-83.52210	2.84	4.1	C
V07P60	FLAT BRANCH SE OF MIDDLEBURG, NEAR U.S. RT. 33	40.27780	-83.54060	0.90	12.7	F2,Mq,C,N,R,SN,B,SD
V06G33	L. DARBY CREEK (B. DARBY HEADWATERS) @ ST. RT. 287	40.28238	-83.59415	3.61	3.1	F2,Mq,C,R
V06W15	L. DARBY CREEK (B. DARBY HEADWATERS) @ CRATTY RD.	40.26780	-83.55720	0.34	7.2	F2,Mq,C,R
302732	TRIB. TO BIG DARBY CREEK (77.32) @ INSKEEP CRATTY RD	40.25520	-83.54690	0.20	3.1	C
V06G31	SPAIN CREEK W OF NORTH LEWISBURG @ GILBERT RD.	40.21680	-83.57460	3.70	6.3	F2,Mq,C,R
V07P58	SPAIN CREEK E OF NORTH LEWISBURG @ MOUTH	40.22780	-83.52220	0.01	9.6	F2,Mq,C,N,R,SN,B,SD
V07P56	PLEASANT RUN NE OF WOODSTOCK @ MOUTH	40.21420	-83.48940	0.01	9.4	F2,Mq,C,H,R
V06G12	TRIB. TO BIG DARBY CREEK (69.40) @ MIDDLEBURG-PLAIN CITY RD.	40.19820	-83.47920	0.40	5.0	C
V06G11	HAY RUN W OF MILFORD CENTER @ MIDDLEBURG-PLAIN CITY RD.	40.18390	-83.45210	0.20	5.8	C
V06G09	BUCK RUN @ ALLEN CENTER-POTTERSBERG RD.	40.23990	-83.47490	10.40	4.8	F,MqQ,C
V06P05	BUCK RUN W OF MARYSVILLE @ ST. RT. 245	40.22420	-83.46260	7.80	9.0	F,Mq,C
V06P07	BUCK RUN S OF MARYSVILLE @ SAM REED RD.	40.18170	-83.39180	2.16	24.2	C,SN,B,SD
V07P53	BUCK RUN AT BRIDGEPORT @ MOUTH	40.15992	-83.39519	0.01	29.8	F2,MQ,C,N
V06G08	ROBINSON RUN N OF PLAIN CITY @ ST. RT. 736 (MIDDLE CROSSING)	40.12860	-83.28090	2.10	9.7	F,Mq,C
V06W05	ROBINSON RUN N OF PLAIN CITY @ U.S. RT. 42	40.12870	-83.27060	0.73	10.5	F,Mq,C,NSN,B,SD
V06G05	SWEENEY RUN AT PLAIN CITY, NEAR MOUTH	40.10580	-83.26470	0.20	3.9	F,Mq,C,N
V06K08	SUGAR RUN AT ARNOLD @ U.S. RT. 42	40.14280	-83.24830	5.40	11.4	F,Mq,C,H,R
V07S13	SUGAR RUN NEAR PLAIN CITY @ CEMETERY PIKE	40.09390	-83.25030	0.43	19.4	F,MQ,C,SN,B,SD,N
V06G04	WORTHINGTON DITCH N OF AMITY @ PLAIN CITY-GEORGESVILLE RD.	40.08400	-83.25330	0.24	4.6	F,Mq,C
V06G64	BALLENGER JONES DITCH @ PLAIN CITY-GEORGESVILLE RD.	40.07190	-83.25220	0.18	7.3	F,Mq,C
V06G02	FITZGERALD DITCH @ PLAIN CITY-GEORGESVILLE RD.	40.01790	-83.26190	0.55	5.9	F,Mq,C,N
302733	L. DARBY CREEK @ W. SANDUSKY ST	40.06890	-83.56093	40.10	8.2	F,Mq,C,N
V06G27	CLOVER RUN @ ROAD TO MAPLE GROVE CEMETERY	40.06336	-83.56412	0.60	1.9	F,Mq,C
302734	TRIB TO L. DARBY CREEK (39.58) JUST UPSTREAM ST. RT. 29	40.06769	-83.55224	0.10	2.1	C
V06E03	PIPE OUTFALL TO L DARBY CK, LEFT BANK, 200-400 FT DST SR 29	40.06860	-83.55080	39.50	12.0	C
V06Q07	L. DARBY CREEK UPST. MECHANICSBURG WWTP	40.07036	-83.54802	39.30	12.2	F,Mq,C
V06S10	L. DARBY CREEK DST. MECHANICSBURG WWTP @ WING RD.	40.07500	-83.54110	38.78	12.7	F,Mq,C,N,H,SN,B,SD
V06G26	JUMPING RUN N OF MECHANICSBURG @ ST. RT. 559	40.09096	-83.54953	0.27	1.8	F,Mq,C
V06G25	LAKE RUN NE OF MECHANICSBURG @ ST. RT. 4	40.09290	-83.52330	0.95	5.7	F,Mq,C

Table 1. Big Darby Creek Watershed Stream Sampling Locations (2014).

STATION ID	STATION NAME	LATITUDE	LONGITUDE	RIVER MILE	DRAINAGE MI ²	SAMPLE TYPE
V06S05	L. DARBY CREEK NE OF MECHANICSBURG @ IRWIN RD.	40.10830	-83.49330	34.70	26.0	F2,MQ,C
V06G18	TREACLE CREEK NNW OF MECHANICSBURG @ PARKVIEW RD.	40.12026	-83.58293	11.80	6.9	F,Mq,C
V06G20	TREACLE CREEK NE OF MECHANICSBURG @ ST. RT. 161	40.12386	-83.49402	6.00	12.9	F,Mq,C,B
V06G24	HOWARD RUN SE OF WOODSTOCK @ MCMAHILL RD.	40.13336	-83.50022	0.60	2.6	C
V06G21	PROCTOR RUN SW OF WOODSTOCK @ PARK RD.	40.16606	-83.55393	4.90	8.8	F,Mq,C
V06G23	PROCTOR RUN SE OF WOODSTOCK @ MCMAHILL RD.	40.15896	-83.50653	1.60	9.9	F,Mq,C
V06S11	TREACLE CREEK @ WINGET RD. COVERED BRIDGE	40.13816	-83.45242	0.78	36.0	F2,MQ,C,N,H,SN,B,SD
V06S04	L. DARBY CREEK W OF CHUCKERY @ AXE HANDLE RD.	40.11580	-83.42500	29.46	70.0	F2,MQ,C,N,B,T,A
V06G62	L. DARBY CREEK AT CHUCKERY @ ST. RT. 161	40.11190	-83.39190	27.47	71.4	C
V06S03	L. DARBY CREEK E OF ROSEDALE @ ROSEDALE-PLAIN CITY RD.	40.07336	-83.40272	24.46	78.0	F2,MQ,C,T
V06G17	BARRON CREEK E OF ROSEDALE @ ST. RT. 38	40.07266	-83.40642	0.20	8.2	F,Mq,C
V06Q08	WAMP DITCH S OF CHUCKERY @ FINLEY GUY RD.	40.05726	-83.39352	0.10	5.5	F,Mq,C
V06Q01	L. DARBY CREEK NE OF PLUMWOOD @ BRADLEY RD.	40.02476	-83.38912	20.50	98.0	F2,Mq,C,H
V07G13	SPRING FORK S OF MECHANICSBURG @ WREN RD.	40.04426	-83.54192	15.90	4.8	F,Mq,C
V06G15	SPRING FORK SW OF ROSEDALE @ GUY CEMETERY RD.	40.06676	-83.47392	10.08	15.0	F,MQ,C
V06Q10	SPRING FORK SE OF ROSEDALE @ ROSEDALE-MILFORD CENTER RD.	40.04760	-83.44140	7.80	19.5	F,MQ,C,N,SN,B,SD
V07S36	SPRING FORK NEAR MOUTH @ LAFAYETTE-PLAIN CITY RD.	39.99196	-83.38962	0.75	37.5	F2,MQ,C
V07S34	L. DARBY CREEK SE OF PLUMWOOD @ LITTLE DARBY RD. FORD	39.98676	-83.37552	17.25	142.0	F2,MQ,C
V07P66	L. DARBY CREEK NW OF WEST JEFFERSON @ BEND IN GOODSON RD.	39.97226	-83.35572	14.90	147.0	F2,MQ,C,N,B,T,A
302736	TRIB TO L. DARBY CREEK (14.35) AT SNYDER LANE BY ST RT 29 TURNABOUT	39.96048	-83.34750	0.20	0.3	C
302730	TRIB TO L. DARBY CREEK (13.70) AT ST.RT.29 DST OF INDUSTRIAL COMPLEX	39.95690	-83.33700	0.50	1.3	C
302729	TRIB TO L. DARBY CREEK (12.88) AT SNYDER LANE EXT. ON ODNR PROP	39.96190	-83.32580	0.10	0.6	C
302704	L. DARBY DREEK AT UTILITY CROSS AT END OF SNYDER LN ON ODNR PROP	39.96660	-83.33120	13.35	149.0	F2,MQ,C
302727	TRIB TO L. DARBY CREEK (9.1) JUST DST OF JEFFERSON IND. SW POND	39.94710	-83.30430	0.10	0.3	C
302726	L. DARBY CREEK OFF OF JEFFERSON LODGE MHP LANE DST OF WWTP	39.94705	-83.29414	8.90	161.0	C
V07P65	L. DARBY AT WEST JEFFERSON @ TAYLOR BLAIR ROAD	39.94616	-83.28132	8.20	161.0	F2,MQ,T
V06G28	L. DARBY CREEK AT WEST JEFFERSON @ MIDDLE PIKE	39.95121	-83.26944	7.35	162.0	F2,MQ,C,SN,B,SD
V07P64	L. DARBY CREEK @ END OF ROBERTS RD.	39.91816	-83.25932	3.95	170.0	F2,MQ,C,N
601130	L. DARBY CREEK AT GEORGESVILLE @ ALKIRE RD.	39.89366	-83.21881	0.07	178.0	F2,MQ,C,H,B,T
V07K18	SMITH DITCH (31.67) NW OF DARBYDALE @ BIGGERT RD.	39.86630	-83.21910	0.20	7.8	F,Mq,C
302725	TRIB TO BIG DARBY CREEK (27.93) @ ST. RT. 665	39.85150	-83.16900	0.70	1.7	C,N,D
203265	GAY RUN SW OF DARBYDALE @ BOYD RD.	39.82920	-83.20220	2.20	1.5	C,B
203209	CLOVER GROFF RUN AT HILLIARD, DST. SCIOTO-DARBY CREEK RD.	40.03151	-83.17656	7.00	3.2	C
300736	CLOVER GROFF RUN UPST. GOLF PATH, UPST. HERITAGE LAKES	40.02625	-83.17607	6.60	5.5	C
300737	CLOVER GROFF RUN @ SHOAL CREEK LANE, BRIDGE IN GOLF COURSE	40.01810	-83.16862	5.85	3.6	C
300617	CLOVER GROFF RUN AT HILLIARD @ FRANKS PARK	40.01417	-83.16775	5.50	3.8	C
203358	CLOVER GROFF RUN @ PARK ADJ. FRAZELL RD.	40.00690	-83.17000	5.00	4.6	F,Mq,C
300685	HAMILTON RUN AT HILLIARD @ BROCTON RD.	40.01169	-83.18500	4.92	1.3	C

Table 1. Big Darby Creek Watershed Stream Sampling Locations (2014).

STATION ID	STATION NAME	LATITUDE	LONGITUDE	RIVER MILE	DRAINAGE MI²	SAMPLE TYPE
V07G05	CLOVER GROFF RUN @ ROBERTS RD.	40.00370	-83.17040	4.70	4.9	C
300739	HAMILTON RUN @ FARM ACCESS ROAD OFF ALTON DARBY RD.	40.00493	-83.18681	4.40	2.5	C
300684	HAMILTON RUN AT HILLIARD @ ROBERTS RD.	39.99990	-83.18763	4.05	2.7	C
V07G06	HAMILTON RUN S OF HILLIARD @ WALKER RD.	39.98970	-83.18800	3.40	3.6	F,Mq
300738	CLOVER GROFF RUN @ TIMBERBROOK WTP, HICKORY HILL DRIVE	39.98727	-83.17028	3.60	5.7	F,Mq,C
203345	HAMILTON RUN NEAR ALTON, UPST. MCCOY DITCH	39.95530	-83.18330	0.80	6.6	F,Mq,C
V07P14	CLOVER GROFF RUN AT ALTON @ ALTON RD.	39.94440	-83.17640	0.14	9.9	F,Mq,C,SN,SD
203348	MCCOY RUN NEAR ALTON @ MOUTH	39.95170	-83.18310	0.10	3.1	F,Mq,C
V07P15	HAMILTON RUN NEAR ALTON @ U.S. RT. 40	39.95000	-83.18080	0.41	9.7	F,Mq
203344	HAMILTON RUN NEAR ALTON @ MOUTH	39.94500	-83.17890	0.10	10.3	C,SN,SD
203243	HELLBRANCH RUN NW OF GALLOWAY, 0.6 MILES DST. ALTON RD.	39.92170	-83.17750	9.40	23.1	F2,MQ,C
V07S50	HELLBRANCH RUN S OF GALLOWAY @ KUNZ RD.	39.90110	-83.16310	7.29	27.8	F2,MQ,C
V07G01	HELLBRANCH RUN DST. OAKHURST KNOLLS WWTP	39.87930	-83.15490	5.80	32.0	F2,MQ,C
V07P11	HELLBRANCH RUN N OF HARRISBURG @ LAMBERT RD.	39.82890	-83.16000	0.98	37.4	F2,MQ,C,H,SN,B,SD,N
V07S47	HELLBRANCH RUN DST. TIMBERLAKE WWTP	39.82810	-83.15970	0.90	37.4	F2,MQ,C
203267	SPRINGWATER RUN @ HARRISBURG-GEORGESVILLE RD.	39.80810	-83.17170	0.35	1.8	F,Mq,C
203269	TRIB. TO BIG DARBY CREEK (23.77) S OF HARRISBURG @ MOUTH	39.79970	-83.17030	0.10	0.6	F,Mq,C
V07G04	TRIB. TO BIG DARBY CREEK (20.20) @ DARBY CREEK RD.	39.76790	-83.15920	0.80	5.0	C,N,D
V07G03	GREENBRIER CREEK @ BURROW RD.	39.74190	-83.14330	1.30	8.2	C

Table 1 Notes. Adjustments to the study plan locations and sample types may be made based on field conditions and other factors.

Key

F-Single pass fish site
 F2-Two pass fish site
 MQ-Macroinvertebrate quantitative site
 Mq-Macroinvertebrate qualitative site
 C-Water chemistry site
 CP-Chlorophyll site
 D-Datasonde© site
 H-Pesticide Site
 N-Nutrient Site
 SN-Sentinel Site
 SD-Sediment Site

Table 2. Individual NPDES Permitted Facilities in the Big Darby Watershed (2014).

OEPA NO.	FACILITY NAME	DESIGN FLOW (gpd)	RECEIVING STREAM	COUNTY
1IW00270	Honda Mfg East Liberty Plant	NA	U.T. Flat Branch	Logan
1PP00006	Flat Branch District WWTP	100,000	Big Darby Creek	Logan
1PB00037	Mechanicsburg WWTP	230,00	Little Darby Creek	Champaign
1PB00039	North Lewisburg WWTP	420,00	Spain Creek	Champaign
1PT00099	Triad Local School WWTP	20,000	UT Brush Run	Champaign
1PX00047	Spring Meadows Care Center	15,000	Proctor Run	Champaign
4IC00008	Ranco North America	37,400	Big Darby Creek	Union
4IW00019	Honda Marysville (BRWP)	NA	UT Flat Branch	Union
4PG00003	Crottinger Estates WWTP	7,000	Sugar Run	Union
4PG00005	Darby Meadows WWTP	10,000	UT Robinson Run	Union
4PT00006	St John's Lutheran Church	3,500	UT Robinson Run	Union
4PT00123	Fairbanks Middle & HS	20,000	Buck Run	Union
4PW00008	Reflections Sub.	2,000	UT Buck Run	Union
4PX00017	Darby Creek Golf Course	7,600	Big Darby Creek	Union
4PV00004	Jefferson Lodge MHP	40,000	Little Darby Creek	Madison
4IJ00011	Tuffco Sand and Gravel	NA	Big Darby Creek	Madison
4IN00004	Battelle West Jefferson Site	NA	Big Darby Creek	Madison
4PB00016	Plain City WWTP	750,000	Big Darby Creek	Madison
4PB00024	West Jefferson WWTP	1.2 MGD	Little Darby Creek	Madison
4PG00048	Wissalohichan SSD	4,400	Big Darby Creek	Madison
4PR00031	Suburbans Community MHP	44,000	Ballenger-Jones Ditch	Madison
4PR00032	Canaan Community MHP	35,000	Fitzgerald Ditch	Madison
4PR00077	Countryside AKA Dutch Kitchen	8,000	Ballenger-Jones Ditch	Madison
4PT00104	Tolles Technical Center	20,000	UT Big Darby Creek	Madison
4PT00119	Jonathan Alder Jr. High School	12,500	Ballenger-Jones Ditch	Madison
4PT00122	Monroe Elem. School	7,000	Spring Fork	Madison
4PV00000	Green Meadows MHP	81,000	Spring Fork	Madison
4PV00107	B & B Lodge	2,200	Big Darby Creek	Madison
4PY00001	Green Tree MHP	23,700	U.T. Big Darby Creek	Madison
4PH00000	Oakhurst Knolls WWTP	100,000	Hellbranch Run	Franklin
4PH00012	Darbydale WWTP	300,000	U.T. Big Darby Creek	Franklin
4PR00000	Darby House WWTP	3,500	Big Darby Creek	Franklin
4PT00106	Pleasant View Middle School	20,000	Hellbranch Run	Franklin
4PU00001	Lake Darby Estates WWTP	500,000	Big Darby Creek	Franklin
4PV00008	Oak Hills MHP	69,000	Big Darby Creek	Franklin
4PV00101	Pleasant Acres MHP	39,000	U.T. Big Darby Creek	Franklin
4PX00029	Thornapple Country Club	2,000	Clover Groff Run	Franklin
4PX00041	Alton RV Park	4,000	U.T. Hamilton Ditch	Franklin
4PX00046	Hickory Hills Golf Club	3,000	U.T Big Darby Creek	Franklin
4PP00003	Pickaway Correctional Institute	2.3 MGD	Big Darby Creek	Pickaway
4PV00100	Whispering Pines MHP	9,000	U.T. Big Darby Creek	Pickaway

Table 3. List of chemical/physical water quality parameters to be analyzed/measured in surface water, sediment, and fish tissue samples from the Big Darby Creek basin (2014).

Parameters	Test Method	Water	Sediment	Fish Tissue
cBOD, 5 day	SM 5210B	X		
cBOD, 20 day	OEPA 310.2	X		
SOLIDS, DISSOLVED (TDS)	USEPA 160.1	X		
SOLIDS, SUSPENDED (TSS)	USEPA 160.2	X		
AMMONIA	USEPA 350.1	X		
Alkalinity	USEPA 305.1	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	X		
DISSOLVED PHOSPHORUS	USEPA 365.4	X		
ORTHOPHOSPHATE	USEPA 365.1	X		
GLYPHOSATE	USEPA 547	X		
ICP 1 (Al,Ba,Ca, Fe, Mg, Mn, Na, Ni, K, Sr, Zn, Hardness)	USEPA 200.7	X		
Water Column chlorophyll-a	USEPA 455	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	YSI 556MPS or Eureka M2 meter	X field		
Conductivity – grab	YSI 556MPS or Eureka M2 meter/ USEPA 120.1	X field/lab		
Dissolved Oxygen – grab	YSI 556MPS or Eureka M2 meter	X field		
Temperature – grab	YSI 556MPS or Eureka M2 meter	X field		
VOCs	USEPA 624/USEPA 8260		X	
SVOCs (BNAS)	USEPA 625/ USEPA 8270C		X	
Pesticides/PCBs/ Chlordane	USEPA 608/ USEPA 8081A, 8082		X	X (OEPA 590.1)
Atrazine	Ohio EPA 704.0	X		
<i>E. coli</i>	USEPA 1103.1/ 640.1	X		
Percent Solids	SM 2540G		X	X

Table 3 –Notes. Water samples will be collected 5 times, 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 4. Recommended sediment parameters, and required methods and reporting limits.		
Parameter	Method	Reporting Limit
Standard Suite		
% solids	SM 2540G	0%
total organic carbon	OEPA 335.2	0.1%
total phosphorus	USEPA 365.4	50 mg/kg
zinc	USEPA 200.7	8 mg/kg
copper, nickel, lead	USEPA 200.8	0.8 mg/kg
cadmium, silver	USEPA 200.8	0.08 mg/kg
mercury	USEPA 7471A	0.02 mg/kg
semi volatile organics	USEPA 8270	0.4-2.0 mg/kg

REFERENCES

Hughes, R. M., D. P. Larsen, and J. M. Omernik. 1986. Regional reference sites: a method for assessing stream pollution. *Env. Mgmt.* 10(5): 629-635.

Karr, J.R. and D.R. Dudley. 1981. Ecological perspective on water quality goals. *Env. Mgmt.* 5(1): 55-68.

Ohio Environmental Protection Agency. 2013a. Surface water field sampling manual for water column chemistry, bacteria and flows. Version 4.0, January 31, 2013. Div. of Surface Water, Columbus, Ohio. 41pp.
www.epa.ohio.gov/Portals/35/documents/SW_SamplingManual.pdf

Ohio Environmental Protection Agency. 2013b. Updates to Biological criteria for the protection of aquatic life: Volume II and Volume II Addendum. Users manual for biological field assessment of Ohio surface waters. Div. of Surface Water, Ecol.Assess. Sect., Columbus, Ohio

Ohio Environmental Protection Agency. 2013c. Updates to Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div.of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 2012a. Ohio EPA manual of surveillance methods and quality assurance practices, updated edition. Division of Environmental Services, Columbus, Ohio.
http://www.epa.ohio.gov/portals/35/documents/Field_Manual_4_13_12_revision.pdf

Ohio Environmental Protection Agency. 2012b. State of Ohio Cooperative Fish Tissue Monitoring Program, Fish Collection Guidance Manual. April 2012
<http://www.epa.state.oh.us/portals/35/fishadvisory/FishCollectionGuidanceManual12.pdf>

Ohio EPA. 2012c. Sediment sampling guide and methodologies, 3rd edition. March 2012. Division of Surface Water, Columbus, Ohio.
<http://epa.ohio.gov/portals/35/guidance/sedman2012.pdf>

Ohio Environmental Protection Agency. 2010a. Guidance on Evaluating Sediment Contaminant Results. Division of Surface Water, Standards and Technical Support Section, Columbus Ohio, January 2010. 30pp
www.epa.ohio.gov/portals/35/guidance/sediment_evaluation_jan10.pdf

Ohio Environmental Protection Agency. 2010b. Inland Lakes Sampling Procedure Manual. March 2010. Appendix to the Manual of Ohio EPA Surveillance Methods And Quality Assurance Practices Section: Inland Lakes Monitoring. Division of Surface Water, Columbus, Ohio. 65pp.
http://www.epa.ohio.gov/portals/35/inland_lakes/lake%20sampling%20proceduresfinal42910.pdf

Ohio Environmental Protection Agency. 2006. Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Tech. Bull. EAS/2006-06-1. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.
<http://epa.ohio.gov/portals/35/documents/QHEIManualJune2006.pdf>

Ohio Environmental Protection Agency. 2004. State of Ohio Cooperative Fish Tissue Monitoring Program, Fish Collection Guidance ManualFinal.March 2004

<http://www.epa.ohio.gov/dsw/fishadvisory/FishCollectionGuidanceManual05.pdf>

Ohio EPA. 1997. Draft. Biological Criteria for the Protection of Aquatic Life: Volume IV: Fish and Macroinvertebrate Indices for Ohio's Lake Erie Nearshore Waters, Harbors, and Lacustuaries. Division of Surface Water, Ecological Assessment Unit, Ohio EPA, Columbus, Ohio, USA.

Ohio EPA. 1989a. Addendum to biological criteria for the protection of aquatic life: Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Planning and Assessment, Surface Water Section, Columbus, Ohio.

Ohio EPA. 1989b. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning and Assessment, Columbus, Ohio.

<http://epa.ohio.gov/dsw/bioassess/BioCriteriaProtAqLife.aspx>

Ohio Environmental Protection Agency. 1989c. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Division of Water Quality Planning and Assessment, Columbus, Ohio.

<http://epa.ohio.gov/dsw/bioassess/BioCriteriaProtAqLife.aspx>

Ohio EPA. 1987a. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment. Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

<http://epa.ohio.gov/Portals/35/documents/Vol1.pdf>

Ohio EPA. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio

<http://epa.ohio.gov/Portals/35/documents/Vol2.pdf>

Ohio EPA. 1989b. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning and Assessment, Columbus, Ohio.

<http://epa.ohio.gov/portals/35/documents/Vol3.pdf>

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Ann. Assoc. Amer. Geogr. 77(1): 118-125.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Division of Water Quality Planning and Assessment, Columbus, Ohio.

http://epa.ohio.gov/Portals/35/documents/QHEI_1989.pdf

Medical Services

1. Memorial Hospital of Union County
500 London Avenue
Marysville, OH
(937) 644-6115
2. Mercy Memorial Hospital
904 Scioto Street
Urbana, OH
(937) 653-5231
3. Dublin Methodist Hospital
7500 Hospital Drive
Dublin, OH
(614) 544-8000
4. Doctors Hospital
5100 W Broad St.
Columbus, OH
(614) 544-1000
5. Urgent Care of West Jefferson
95 E. Main St.
West Jefferson, OH
(614) 879-7100
6. Mount Carmel Urgent Care
3000 Meadow Pond Ct.
Grove City, OH
(614) 871-7130
7. Berger Health Hospital
600 N. Pickaway Street
Circleville, OH
(740) 474-2126

