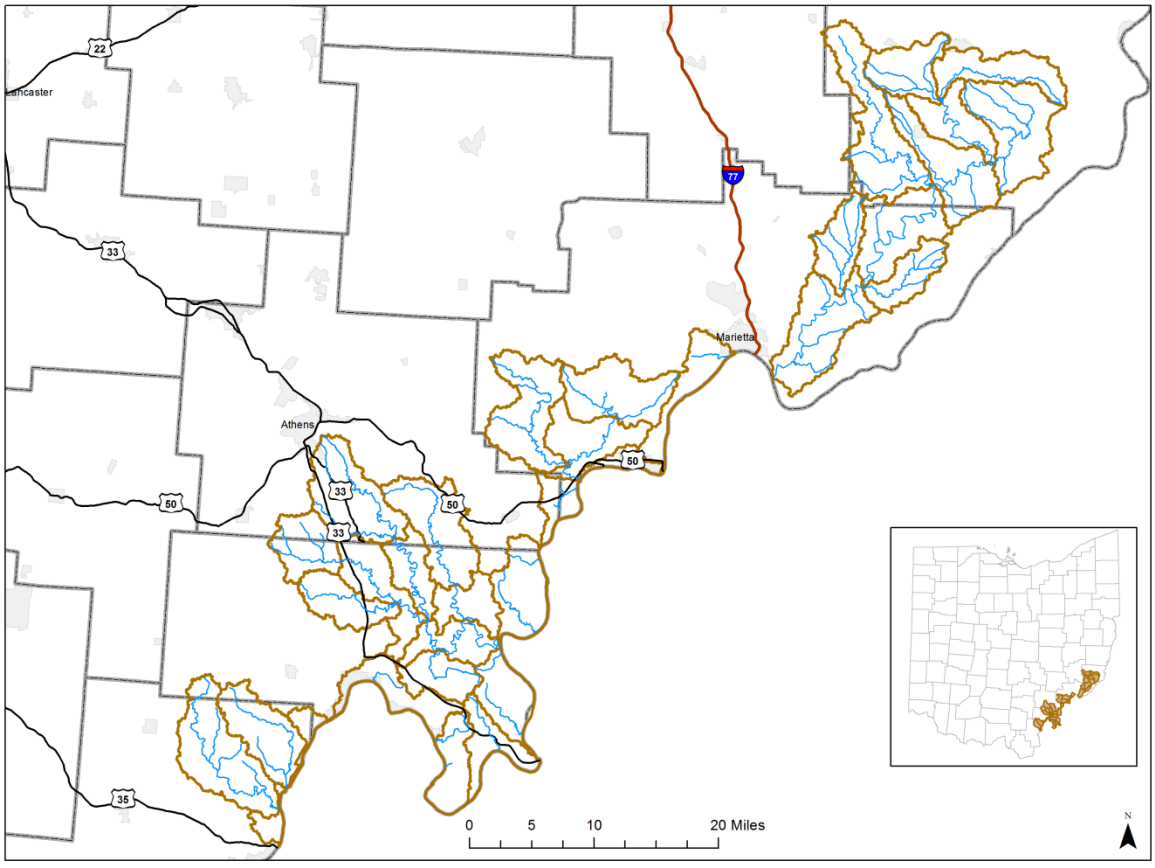
Ohio Environmental Protection Agency

Study Plan
to the
Biological and Water Quality Study of the Southeast Ohio River Tributaries - 2015

(Little Muskingum River, Little Hocking River, Shade River)

Athens, Gallia, Meigs, Monroe, Noble, and Washington Counties



Division of Surface Water
Ecological Assessment Section
June 10, 2015

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(Little Muskingum River, Little Hocking River, Shade River)

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Prepared by
State of Ohio Environmental Protection Agency

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Introduction

As part of the Total Maximum Daily Load (TMDL) process and in support of the basin approach for National Pollution Discharge Elimination System (NPDES) permitting, an intensive ambient assessment will be conducted during the 2015 field sampling season within the southeast Ohio River Tributaries (SEORT), including the Little Muskingum River, Little Hocking River, and Shade River (Table 3). The study area is composed of all or portions of 32 HUC12 watershed assessment units (WAUs). Data from a total of 112 sampling stations will be collected in the SEORT study area. 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), nutrients, and fish tissue will be evaluated at selected sampling locations (Tables 2 and 3).

Sampling Objectives

1. Systematically sample and assess the principal drainage networks of selected Southeast Ohio River tributaries in support of the TMDL process; including the Little Muskingum River, the Little Hocking River, and the Shade River,
2. Gather ambient environmental information (biological, chemical, and physical) from designated water bodies, to assess current beneficial uses (e.g., aquatic life, recreational, water supply), Tables 2 and 3,
3. Collect fish tissue samples at selected stations as listed under sample types in Tables 2 and 3,
4. Verify the appropriateness of existing, unverified, and beneficial use designations,
5. Establish baseline ambient biological conditions at selected reference stations to evaluate the effectiveness of future pollution abatement efforts, and
6. Document any changes in biological, chemical, and physical conditions of the study areas where historical information exists, thus expanding the Ohio EPA database for statewide trends analysis (e.g., 305[b]).

Total Maximum Daily Load

Information collected as part of this survey will support TMDL development for this 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, non-point pollution 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, and sources of use impairment. These data are necessary precursors to the development of effective control or abatement strategies.

Aquatic Life Use Designations (ALU)

Many of the streams contained within the study area are designated Exceptional Warmwater Habitat (EWH) or Warmwater Habitat (WWH). For some of the streams, this will be the first time that they will be sampled and assessed. 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 entirely unclassified water bodies. Much of the sampling effort for this survey is allocated to fulfill this obligation.

SAMPLING ACTIVITIES

Chemical/Physical Water and Sediment

Chemical sampling locations within the study area are listed in Tables 2 and 3. Conventional chemical and physical water quality samples will be collected 5 times at each designated location. Sediment samples will be collected at 13 locations. A total of 29 sondes will be deployed at designated locations, 13 of which will overlap with sentinel sites. 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.

Bromide will be analyzed in chemistry runs 1, 3, and 5 for the Little Muskingum River watershed. Bromide is strongly associated with flowback from hydraulic-fracturing operations, and is used as an indicator for surface and groundwater contamination from hydraulic-fracturing operations (Siegel and Kight 2011).

Temperature data loggers will be deployed from June – October, 2015, at 22 headwater sites. These loggers—HOBO U22-001 or UA-002-64—will record water temperature at 30-minute intervals over the four-month period. Equipment will be deployed in pools of sufficient depth to remain submerged during low flow conditions. In order to obtain accurate measurements, the loggers will shielded from potential solar radiation and sedimentation, and locked to fixed stream structures (i.e. trees).

Bacteriological Sampling

Water samples will be collected at 45 sites for bacteriological analyses to determine the attainment status of the Primary Contact recreational use of streams in 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 and sestonic chlorophyll a samples are to be collected at 29 designated wadeable and headwater sites noted in Tables 2 and 3. Benthic chlorophyll samples are to be collected at least once, and should be timed to coincide with deployment of sonde automated data loggers during stable, baseflow conditions (i.e., typically the second deployment).

Biological Assemblage and Physical Habitat

Fish and macroinvertebrate assemblage samples will be collected as listed in Tables 2 and 3. Qualitative Habitat Evaluation Index (QHEI) scores will be calculated by evaluating habitat at all fish sampling locations.

Fish Tissue

Fish tissue samples will be collected from 7 potential locations as part of the Ohio Fish Tissue Consumption Monitoring Program. Sampling locations may vary based on the availability of sport fish

collected at each location. 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 2015a), Biological Criteria for the Protection of Aquatic Life, Volumes II - III (Ohio EPA 1987, 1989a, 2015b), 2015 Updates to the Biological Criteria for the Protection of Aquatic Life, Volume II (Ohio EPA 2015c), The Qualitative Habitat Evaluation Index (QHEI) - Rationale, Methods, and Application (Ohio EPA 1989b, 2006) for habitat assessment, Surface Water Field Sampling Manual – Appendix III for sediment sampling (Ohio EPA 2015a), and Ohio EPA Fish Tissue Collection Guidance Manual (Ohio EPA 2012) for fish tissue sampling.

Use Attainment

The attainment status 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 multi-metric 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 *E. coli* bacteria, which are indicator organisms for the potential presence of pathogens in surface water. *E. coli* can originate from untreated human or animal wastes, and they are the basis for recreational use water quality criteria in Rule 3745-1-07 of the (OAC).

Stream Habitat Evaluation

Physical habitat is evaluated using the (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Ohio EPA 1989b). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable and diverse aquatic faunas. Evaluations of the 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. 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

Quantitative macroinvertebrate sample will be collected from artificial substrates, and qualitative samples from natural stream habitats. Artificial substrate collections will be collected at all sites with greater than 20 mi^2 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 which are allowed to colonize 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, and margin). Detailed macroinvertebrate assemblage sampling protocols are documented in Ohio EPA (2015b).

Fish will be sampled at each sampling location using pulsed DC headwater, wading, or boat electrofishing methods depending on watershed size at each sampling location. Sites with drainage areas greater than 20 mi^2, and 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 Ohio EPA (2015b).

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^{o}C) and shipped to the Ohio EPA Division of Environmental Services (DES) lab. Sampling and decontamination protocols will follow those listed in Ohio EPA (2015a Appendix III).

Chlorophyll

Benthic and sestonic chlorophyll-a samples will be collected and preserved using appropriate methods, as outlined in Ohio EPA (2015a Volume II), and delivered to the Ohio EPA DES lab for analysis. 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 Ohio EPA (2015a), 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 Professional Plus 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 Ohio EPA DES lab in Reynoldsburg, Ohio 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, buffalo, 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 collected via electrofishing samplers. Sampling locations are listed in Tables 2 and 3. 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 wet or dry ice. Sampling and decontamination protocols will follow those listed in the *Ohio EPA Fish Collection Guidance Manual* (2012). 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 and field blanks; approximately 5% will be duplicates and 5 % will be blanks. One sonde 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 Ohio EPA (2015a). Matrix spike duplicates will be collected for organic water samples at a minimum of 5 percent of the samples.

Field Staff and Other Contacts

Ohio EPA

DSW Central Office

EAS

Jordan Jenkins: (614) 836-8786-Fish
Bob Miltner: (614) 836-8796-Fish
Laura Hughes: (614) 839-8783-Macrobenthos
Chuck McKnight: (614) 836-8784-Macrobenthos
Jeff DeShon: (614) 836-8780 (Manager)
Holly Tucker: (614) 836-8777 (Supervisor)

TMDL

Gregg Sablak: (614) 644-4132

Modeling

Sarah Becker: (614) 728-2385

Standards

Chris Skalski: (614) 644-2144 - Rules
Gary Klase: (614) 644-2865 - Fish Tissue

DSW Southeast District Office

Kelly Capuzzi: (740) 380-5283-Water Quality
Randy Spencer: (740) 380-5240-Water Quality

Contact Jordan Jenkins regarding study plan.

Hospitals

(see attached maps)

O'Bleness Memorial Hospital
55 Hospital Dr
Athens, OH 45701
(740) 593-5551

Holzer Medical Center
100 Jackson Pike
Gallipolis, OH 45631
(740) 446-5000

Marietta Memorial Hospital
401 Matthew St
Marietta, OH 45750
(740) 374-1400

Camden-Clark Memorial Hospital
800 Garfield Ave
Parkersburg, WV 26101
(304) 424-2111

Wetzel County Hospital
3 E Benjamin Dr
New Martinsville, WV 26155
(304) 455-8000

Ohio DNR

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Meigs: Chris Gilkey
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Monroe: Wes Feldner
(740) 589-9989
Noble: Brad St. Clair
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County Sheriffs

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HUC 12 Watersheds in Survey Area

HUC 12	Name	Area	Sampling Locations
050302010601	Rich Fork	22.41	6
050302010602	Cranenest Fork	26.31	7
050302010603	Wolfpen Run-Little Muskingum River	21.25	5
050302010604	Witten Fork	42.36	13
050302010605	Straight Fork-Little Muskingum River	36.70	7
050302010701	Clear Fork Little Muskingum River	48.82	9
050302010702	Archers Fork	18.55	5
050302010703	Wingett Run-Little Muskingum River	36.34	7
050302010704	Fifteen Mile Creek	20.52	6
050302010705	Eightmile Creek-Little Muskingum River	41.68	9
050302020102	Mile Run-Ohio River	20.80	1
050302020103	Headwaters Little Hocking River	35.55	3
050302020104	West Branch Little Hocking River	39.45	5
050302020105	Little West Branch Little Hocking River-Little Hocking River	27.31	2
050302020106	Sandy Creek-Ohio River	18.18	1
050302020201	Headwaters West Branch Shade River	22.19	2
050302020202	Kingsbury Creek	21.45	2
050302020203	Headwaters Middle Branch Shade River	40.09	5
050302020204	Elk Run-Middle Branch Shade River	17.57	3
050302020205	Walker Run-West Branch Shade River	27.69	3
050302020301	Horse Cave Creek	18.40	2
050302020302	Headwaters East Branch Shade River	37.53	3
050302020303	Big Run-East Branch Shade River	17.49	1
050302020304	Spruce Creek-Shade River	18.80	3
050302020404	Forked Run-Ohio River	27.89	1
050302020802	Groundhog Creek-Ohio River	22.08	1
050302020803	Oldtown Creek-Ohio River	17.70	2
050302020804	West Creek-Ohio River	19.69	3
050302020805	Broad Run-Ohio River	22.64	2
050302020901	Kyger Creek	30.49	4
050302020902	Campaign Creek	46.61	7
050302020904	Crooked Creek-Ohio River	11.64	1

NPDES Facilities

Facility	NPDES	Receiving Water	Latitude	Longitude
Tara Estates Subdiv WWTP	0PG00049	Campaign Creek	38.889630	-82.155670
Christman Quarry	0IJ00047	Clear Fork Little Muskingum River	39.779658	-81.296224
KRATON Polymers US LLC	0IF00008	Davis Creek and Ohio River	39.284000	-81.645230
ODOT Bartlett Outpost	0PP00084	Drainage Ditch along Township Road 77	39.413890	-81.805560
Eastern Local School Dist	0PT00046	East Branch of Shade River	39.122830	-81.881020
Martin Marietta Aggregates Apple Grove Plant	0IJ00015	John's Run and Ohio River	38.885870	-81.880680
Ohio Valley Electric Corp Kyger Creek Station	0IB00005	Kyger Creek and Ohio River	38.915820	-82.129510
Stacy Meadowcrest WWTP	0PG00057	Little Hocking River	39.281120	-81.705020
Deerfield Estates WWTP	0PG00064	Little Muskingum River	39.392760	-81.380010
Rocksprings Rehab Ctr	0PX00014	U.T. OF PEACH FORK CREEK	39.097300	-81.999130
Southern Ohio Coal Co - Danville Portal	0IM00030	UNNAMED TRIBUTARY TO CAMPAIGN CREEK	39.019342	-82.260467
Par Mar Store No 14	0PR00097	Unnamed Tributary to Little Hocking	39.279000	-81.686370
Little Hocking Service Center DBA Estep Recovery	0IQ00023	Unnamed Tributary to Little Hocking River	39.279120	-81.686250
Gallia County Landfill	0IN00121	UT OF WHITE OAK CREEK	38.980627	-82.238648
Torch Estates Wastewater Facility	0PW00026	Whites Run	39.235424	-81.748447
Gatling Ohio LLC - Yellowbush Mine	0IL00145	Yellowbush Creek	38.957491	-81.901564

Sampling Locations

Table 1. Summary of the main 2015 Southeast Ohio River Tributaries survey.

Code	Sample Type	Count
F	Fish - 1 Pass	66
F2	Fish - 2 Pass	43
T	Fish Tissue	7
MQ	Macro - Quantitative	43
Mq	Macro - Qualitative	66
C	Chemistry	78
N	Chemistry w/ nutrients	29
Sn	Sentinel	13
S	Sediment	13
R	Reference	6
H	HOBO Temperature	18
B	Bacteria	45
D	Datasonde	29

Table 2. Main sampling locations for the 2015 Southeast Ohio River Tributaries survey.

Station ID	River Mile	Stream	Area	Sample Type	Location	Lat	Long
C01K50	57.8	Little Muskingum River	48	F2,MQ,C,B	at footbridge, dst Rich Fork/ TR 42 Stonehouse Rd	39.693188	-81.13
C01K49	51.8	Little Muskingum River	62	F2,MQ,N,D,B,Sn,S	Plainview Rd	39.655300	-81.12
303045	48.83	Little Muskingum River	66.75	F2,MQ,C,B	Township Road 1003/1004, adj Mechanicsburg Rd	39.646140	-81.08
609350	47.2	Little Muskingum River	70	F2,T,MQ	at ford, ust Witten Fork	39.633900	-81.06
C01K48	42.5	Little Muskingum River	120	F2,MQ,N,D,B	TR 600, dst Biglick Run	39.616985	-81.10
204033	40.9	Little Muskingum River	130	B	Ring Mill @ TR 575 near Poulton	39.607149	-81.12
C01K47	37.5	Little Muskingum River	149	F2,T,MQ,C,B	TR 38A, ust Clear Fork (Knowlton Bridge)	39.593600	-81.15
C01K45	34.6	Little Muskingum River	201	F2,MQ,C,B	TR 403	39.566900	-81.15
609380	30.2	Little Muskingum River	210	F2,MQ,N,D,B,Sn,S	At gage, St. Rt. 260	39.563100	-81.20
C01K43	25.8	Little Muskingum River	217	F2,MQ,C,B	CR 406 (Rinard Covered Bridge) Tice Rd	39.536900	-81.22
C01K41	22.2	Little Muskingum River	230	F2,T,MQ,C,B	TR 34 (Hune Covered Bridge)	39.511100	-81.24

C01S01	17.2	Little Muskingum River	253	F2,MQ,N,D,B,R,Sn,S	at Dart, dst Archers Fork @ ford	39.483952	-81.27
C01K40	9.5	Little Muskingum River	287	F2,MQ,C,B	at Sitka, at TR 19 Cow Rd	39.448100	-81.33
609340	5.43	Little Muskingum River	303	F2,T,MQ,N,D,B	at CR 9	39.409400	-81.35
C01S14	0.5	Little Muskingum River	315	T	at Mouth	39.379400	-81.40
C01K51	0.1	Eightmile Creek	5.8	F,Mq,C	at Dell, at Mouth	39.415300	-81.34
C01K52	0.1	Moss Run	4.6	F,Mq,C,H	at mouth,TR 584 Alexander Rd	39.461601	-81.32
C01K56	3.8	Fifteenmile Creek	11	F,Mq,C,H	at Helsop, TR 12	39.516400	-81.28
609410	0.1	Fifteenmile Creek	20.5	F2,MQ,N,D,B,Sn,S	at mouth, St Rt 26	39.477800	-81.29
C01K57	0.1	Goss Fork	4	F,Mq,C	at mouth, adj TR 24	39.498900	-81.29
C01K58	0.1	Deans Fork	4.1	F,Mq,C	at CR 12	39.524700	-81.28
C01K59	0.4	Sycamore Fork	4.5	F,Mq,C	at mouth, at town of Fifteen	39.530600	-81.28
C01K60	0.3	Bear Run	3.9	F,Mq,C,H	SW of Dart, at mouth, at Martin Rd	39.473100	-81.28
C01K61	0.3	Wingett Run	5.3	F,Mq,C	at St Rt 26	39.538600	-81.24
C01K67	7.4	Archers Fork	5.8	F,Mq,C,H	Dst Irish and Jackson Runs/ dst TR 14	39.502500	-81.18
C01K66	5	Archers Fork	9.3	F,Mq,C	ust Cady Run, TR36	39.483546	-81.20
C01K64	1.83	Archers Fork	16	F2,MQ,N,D,B,R,Sn,S	adj CR 14 @ Oxbow Lane TR 604	39.475000	-81.24
609420	0.05	Archers Fork	18.6	C	at Dart, at Footbridge	39.481400	-81.26
204057	0.7	Irish Run	3.3	F,Mq,C,H	Adj TR 58	39.512017	-81.17
C01K68	0.3	Oldcamp Run	4.2	F,Mq,C,H	lane near mouth, gas well, TR 319/38A	39.593300	-81.13
C01K70	5.6	Straight Fork	5.8	F,Mq,C,H	lane off Straight Fork Rd, dst Long Run	39.658300	-81.18
204061	3.1	Straight Fork	9.8	F,Mq,N,D,H	adj St Rt 26, dst Adams Hollow	39.641700	-81.17
C01K77	23.3	Clear Fork	5	F,Mq,C	adj Swazey Rd	39.762500	-81.28
204066	20.8	Clear Fork	9.9	F,Mq,C	at TR 834	39.733900	-81.27
609370	13.7	Clear Fork	19.4	F,Mq,N,D	ust Quail Run, at Sycamore Valley, St Rt 260	39.662800	-81.24
609360	0.1	Clear Fork	48	F2,MQ,N,D,B,Sn,S	at St Rt 26	39.602500	-81.16
C01K82	0.1	Indian Run	5.8	F,Mq,C,H	at Marr, at St Rt 260	39.629400	-81.22
C01K83	0.2	Biglick Run	4.4	F,Mq	gravel rd at mouth, TR 562	39.612500	-81.10
204074	9.2	Witten Fork	4.9	F,Mq,C,H	adj to St Rt 255, dst trib at RM 9.3	39.688900	-81.00
609400	7.2	Witten Fork	8.9	F,Mq,C	ust Millers Fork	39.675600	-81.00
204072	6.2	Witten Fork	18.2	F,Mq,C	at ford dst Alum Run	39.658600	-81.00
609390	1.1	Witten Fork	42	F2,MQ,N,D,B,R,Sn,S	at St Rt 800, dst Trail Run	39.631100	-81.05
204068	3.6	Witten Run	5	F,Mq,C	adj Witten Creek Rd, dst trib	39.596400	-81.23
C01S04	2.2	Witten Run	7.5	F2,MQ,C,R,H	adj Witten Creek Rd, near CR 105C	39.600600	-81.20
C01K86	1	Trail Run	4.9	F,Mq,C,H	TR 526 dst Little Trail Run, adj St Rt 800	39.619700	-81.05
C01K88	1.8	Dismal Creek	5.7	F,Mq,C,H	at TR 470	39.666400	-81.04
204080	3.4	Millers Fork	5.5	F,Mq,C,H	at TR 470	39.694400	-81.06

609300	0.1	Town Fork	9.6	F,Mq,C,H	TR 263	39.708900	-81.15
C01K96	4.2	Rich Fork	5.1	F,Mq,C,H	adj Edwina Rd	39.725800	-81.19
C01K94	2.7	Rich Fork	9.7	F,Mq,C,H	adj Edwina Rd, dst Left Prong	39.713100	-81.17
C01K93	0.1	Rich Fork	22.4	F2,MQ,N,D,B	St. Rt. 26 at mouth	39.700600	-81.14
204084	0.1	Left Prong Rich Fork	4	F,Mq,C	adj TR 263	39.713100	-81.18
204090	11.9	Cranenest Fork	5.2	F,Mq,C,H	adj TR 8	39.715000	-80.98
609320	10.5	Cranenest Fork	8.9	F,Mq,C	, dst Pratts Run CR 28	39.723900	-81.01
C01L03	4	Cranenest Fork	20.1	F2,MQ,N,D,B	TR 358 Cranest Rd ford DST Wolfpen Run	39.736769	-81.10
W03K05	16.6	Campaign Creek	6.8	F,Mq,C	at Morgan Center, Mogan Center Rd	38.982577	-82.26
301794	11.5	Campaign Creek	21.7	F2,MQ,C	dst White Oak Creek, adj Campaign Rd	38.934740	-82.24
303029	6.25	Campaign Creek	35.4	F2,MQ,N,D,B,Sn,S	Bullaville Pike	38.897316	-82.19
W03S28	5.56	Campaign Creek	37	F2,MQ	at Bulaville, at CR 4	38.899986	-82.18
301795	0.37	Little Campaign Creek	4.7	F,Mq,C	Brick School Rd	38.906861	-82.16
301796	0.2	L. White Oak Creek	5.1	F,Mq,C	E of Porter, adj Campaign Rd	38.927600	-82.23
303121	0.38	White Oak Creek	4.68	F,Mq,C	at White Oak Rd	38.941609	-82.24
W03S13	8.42	Kyger Creek	6.8	F,Mq,C	Ust Kyger, at St Rt 554 (Lane across from Van Zant)	38.982484	-82.16
300593	4	Kyger Creek	20.3	F2,MQ,N,D,B,Sn,S	Adj SR 554 at Roush Ln and OH 554	38.953121	-82.12
W03S26	1	Kyger Creek	30.1	F2,MQ,C	near Addison, Little Kyger Rd	38.918968	-82.13
W03P51	0.01	L. Kyger Creek	5.8	F,Mq,N,D	at mouth, Little Kyger Rd	38.920079	-82.13
301805	1.1	Forest Run	2.5	F,Mq,C	N of Welshtown, just ust Kerr Run	39.038700	-81.99
303117	0.42	Bowman Run	4.85	F,Mq,C,B	Bowmans Run Rd, near Pine Grove Rd	38.995928	-81.93
W04W11	1.5	Yellowbush Creek	5.5	F2,MQ,C,B	E of Racine, at Yellowbush Rd	38.960680	-81.89
303120	0.85	Yellowbush Creek	6.97	F2,MQ,C	Powerline Access off Yellowbush Rd, dst mine	38.960965	-81.90
303119	1.4	Johns Run	4.08	F,Mq,C	Rowe Rd	38.893051	-81.87
303116	4	Oldtown Creek	2.68	F,Mq,C	Portland Rd CR 35	38.986138	-81.84
W04W12	1.65	Oldtown Creek	5.4	F,Mq,C,B	near Rolandus, CR 124 (Tornado Rd)	38.963680	-81.82
303115	2.3	Groundhog Creek	6.16	F,Mq,C,B	Sellers Ridge Rd	38.983708	-81.80
303114	4.7	Forked Run	6.1	F,Mq,C,B	Rd #9, Shade River St. Forest, dst Trib (RM 4.74)	39.118781	-81.79
303118	1.2	Georges Creek	3	F,Mq,C,B	Unnamed Rd off Ohio 7, Addison, Ohio	38.852383	-82.15
W04S01	17.13	Shade River	131	F2,T,MQ,C,R	at Chester, at St Rt 248	39.087339	-81.92
W04S02	11.64	Shade River	156	F2,T,MQ,N,D,B,Sn,S	Dst Chester, at gage, TR 112	39.063378	-81.88
609170	5.84	Shade River	215	F2,MQ,C	Near Keno, adj TR 114 Mt. Olive Rd	39.094478	-81.85
303112	4.88	Horse Cave Creek	5.49	F,Mq,C	Van Meter Hill Rd, dst trib (RM 4.9)	39.033507	-81.89
W04S04	0.35	Horse Cave Creek	9.8	F,Mq,N,D,B	SE of Chester, Garen Rd	39.062995	-81.90
W04K07	15	East Branch Shade River	10.4	F,Mq,C	W of Lottridge, CR 57	39.222276	-81.91
W04S08	11.84	East Branch Shade River	18.6	F,Mq,N,D,B	NE of Alfred, at CR 53	39.188976	-81.91

303028	0.87	East Branch Shade River	45	F2,MQ,N,D,B,Sn,S	St Rt 248 UST Spicer Creek	39.103105	-81.86
303113	2.5	Dog Hollow Run	3.1	F,Mq,C	Warner Rd at Dog Hollow Rd	39.223406	-81.93
303105	28.2	Middle Branch Shade River	2.75	F,Mq,C,B	Old Rt 33	39.278949	-82.07
303110	25.8	Middle Branch Shade River	9.07	F,Mq,C,B	dst Old 33, dst trib (RM 25.85) Near Angel Ridge Rd.	39.252989	-82.05
303106	22.5	Middle Branch Shade River	20.3	F2,MQ,N,D,B	Fossil Rock Rd CR 42	39.249700	-82.01
W04K10	14.8	Middle Branch Shade River	40.1	F2,MQ,C	Dst Pratts Fork, at TR 227	39.196476	-81.97
W04K09	8.1	Middle Branch Shade River	49.7	F2,MQ,C	SW of Alfred, at CR 444 (Keebaugh-Follrod)	39.160877	-81.94
W04S06	0.42	Middle Branch Shade River	57.5	F2,MQ,N,D,B	N of Chester, at St Rt 7	39.103977	-81.92
W04S09	0.02	Pratts Fork	10.8	F,Mq,N,D,B	at mouth, Blackwood Rd	39.196855	-81.97
303109	1.4	Long Run	4.5	F,Mq,C	Long Run Rd	39.267887	-82.03
303104	16.5	W Br Shade River	10.94	F,Mq,N,D,B	Frederick Rd, Road 618, ust Trib (16.4)	39.170327	-82.08
303111	13.8	W Br Shade River	23.99	F2,MQ,C	Burlingham Rd, at Rt 33	39.171791	-82.04
W04K11	7.8	W Br Shade River	36	F2,MQ,C,B	at Clark-Midkiff Rd	39.135599	-81.99
W04S05	0.16	W Br Shade River	71	F2,MQ,N,D,B	N of Chester, at St Rt 7	39.101199	-81.93
303103	0.1	Unnamed Trib to W Br Shade R (RM 16.35)	8.25	F,Mq,C	Ohio 681	39.169967	-82.07
301809	6.75	Kingsbury Creek	12.2	F,Mq,C	NW of Town of Kingsbury, at Kingsbury Rd	39.125700	-82.03
W04S10	2.08	Kingsbury Creek	19.7	F,Mq,N,D,B	S of Hemlock Grove at TR 82	39.113377	-81.98
303102	1.4	Dunfee Run (Whites Run)	3.5	F,Mq,C,B	TR 297, Little Hocking, OH	39.244614	-81.71
303098	15.2	Little Hocking River	7.66	F,Mq,C	ust Lake Veto, Brackenridge Rd	39.350472	-81.67
303026	9.89	Little Hocking River	37.5	F2,MQ,N,D,B,Sn,S	CR 85	39.318545	-81.64
W04S15	7.5	Little Hocking River	45	F2,MQ,C,R	North of Porterfield, at St Rt 339	39.297800	-81.66
303096	1.1	Mile Run	5.5	F,Mq,C,B	adj Ohio 550	39.405618	-81.48
303100	8.7	W Br Little Hocking RIver	19.9	F,Mq,C	at TR 256, ust Gilbert Run control site	39.333722	-81.76
303099	4.8	W Br Little Hocking RIver	30.33	F2,MQ,C	at CR 111, ust Laurel Run	39.302968	-81.75
303027	2.87	W Br Little Hocking RIver	37.5	F2,MQ,N,D,B,Sn,S	CR 248 (Ross Rd)	39.289621	-81.74
R19P01	0.01	W Br Little Hocking RIver	39.4	F2,MQ,C	at town to Twin Bridges, at mouth	39.277522	-81.73
303101	1.3	Gilbert Run	6.2	F,Mq,C	Turkey Hollow Rd, Cutler, OH	39.324966	-81.78
R19P03	0.01	E Br L. Hocking River	13	F,Mq,N,D,B	SE of Veto Lake, at Mouth Oxbow Rd	39.334700	-81.63
303097	1.42	Tupper Creek	8.25	F,Mq,C	dst Buffalo Run, ust Veto Lake, adj Lake Rd	39.363621	-81.65

Code	Sample Type	Code	Sample Type	Code	Sample Type	Code	Sample Type	Code	Sample Type
F	Fish - 1 Pass	MQ	Macro - Quantitative	N	Chemistry w/ nutrients	H	HOBO Temperature	S	Sediment
F2	Fish - 2 Pass	Mq	Macro - Qualitative	Sn	Sentinel	B	Bacteria		
T	Fish Tissue	C	Chemistry	R	Reference	D	Datasonde		

Table 3. Secondary sites, only to be sampled after main sites have been completed, for the 2015 Southeast Ohio River Tributaries survey.

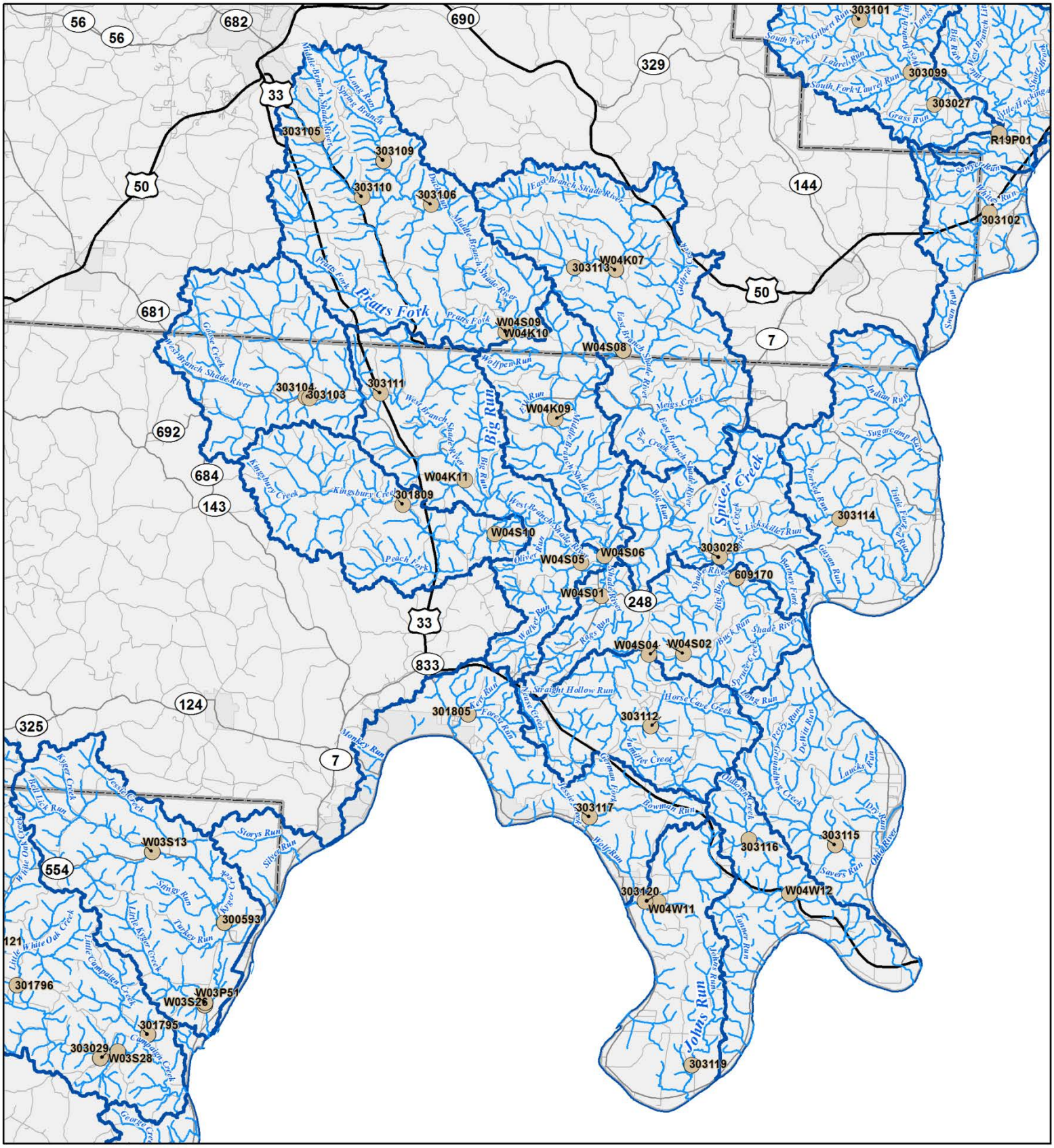
Station ID	River Mile	Stream	Area	Sample Type	Location	Lat	Long
204059	0.3	Wilson Run	3.4	F,Mq	Adj Wilson Run Rd (TR 136)	39.55900	-81.16800
204077	0.5	Dogskin Run	3.6	F,Mq,H	Adjacent Barnes Run Road (CR 11)	39.63600	-81.03100
204079	0.2	Wildcat Run	1.4	F,Mq	Barnes Run Rd (CR 11)	39.64300	-81.04200
204806	0.1	Brister Fork	2.9	F,Mq,H	Barber Ridge Road (CR 77)	39.72800	-81.17100
C01K80	0.2	Rias Run	2.3	F,Mq	Death Ridge-Rias Run Rd (CR 13)	39.64200	-81.21200
C01K90	0.44	Walnutcamp Run	2.3	F,Mq	Township Road 503 at Ford	39.66000	-81.02200
C01K91	0.12	Woods Run	2	F,Mq	upstr Benwood Road (CR 10)	39.68500	-81.00100
C01L02	0.32	Wolfpen Run	3.3	F,Mq	Adjacent Wolfpen Road (CR 72)	39.68700	-81.14400
New1	0.1	Wolfpen Run	1.6	F,Mq	Cranes Nest Road (TR 358) or adjacent TR 350	39.73600	-81.10700
New2	0.3	Wilson Run	1.7	F,Mq	Adj Wilson Run Rd (TR 102)	39.71600	-81.14200
New3	0.1	Laurel Run	1.1	F,Mq	Cranes Nest Road (TR 358)	39.72600	-81.03900
New4	0.1	Un Trib at Cranenest Fork RM 7.27	2.1	F,Mq	Sixpoints Road (CR 9)	39.72500	-80.99700
New5	0.17	Buhrs Run	2	F,Mq	Stonehouse Road (CR 42)	39.66300	-81.12700
New6	0.17	Alum Run	1.8	F,Mq	Benwood Road (CR 10)	39.66200	-81.00700
New7	0.75	Little Trail Run	2	F,Mq,H	TR 530 crossing	39.61300	-81.03700
New8	0.2	Brown Run	2.8	F,Mq	Adj TR 592	39.62000	-81.12100
New9	0.2	Little Indian Run	2	F,Mq	Adj Little Injun Road (CR 59)	39.62700	-81.24300
New10	0.6	Mill Fork	2	F,Mq,H	Adj. Mill Fork Road (TR 37)	39.49700	-81.30800
New11	0.15	Hog Run	0.76	F,Mq	State Route 26 (upstream side)	39.48600	-81.27100
New12	0.95	Little Eightmile Creek	1.5	F,Mq	Adj Little Eightmile Road (TR 131)	39.45700	-81.34700

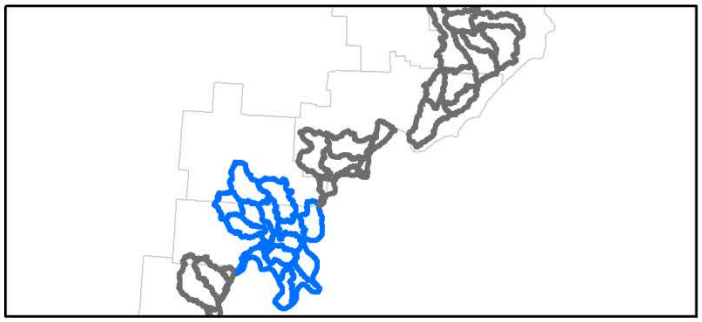
Code	Sample Type	Code	Sample Type	Code	Sample Type	Code	Sample Type	Code	Sample Type
F	Fish - 1 Pass	MQ	Macro - Quantitative	N	Chemistry w/ nutrients	H	HOBO Temperature	S	Sediment
F2	Fish - 2 Pass	Mq	Macro - Qualitative	Sn	Sentinel	B	Bacteria		
T	Fish Tissue	C	Chemistry	R	Reference	D	Datasonde		

Table 4. List of chemical/physical water quality parameters to be analyzed/measured in surface water, sediment, and fish tissue samples from the lower Auglaize River tributary sampling locations. The reporting limit or an "X" is placed in the column where samples will be collected. Not all sites will be sampled for all parameters.

Parameters	Test Method	Stream	Sediment	Fish Tissue	Lake
cBOD, 5 day	SM 5210B	2 mg/L			
cBOD, 20 day	OEPA 310.2	2 mg/L			
BOD, 5 day	SM 5210B	2 mg/L			
Solids Dissolved (TDS)	USEPA 160.1	10 mg/L			10 mg/L
Solids Suspended (TSS)	USEPA 160.2	5 mg/L			5 mg/L
Total Organic Carbon (TOC)	SM 5310B / OEPA 335.2	2 mg/L	0.1 %		
Alkalinity	USEPA 305.1	5 mg/L			5 mg/L
Chemical Oxygen Demand (COD)	USEPA 410.4	20 mg/L			
Ammonia	USEPA 350.1	0.05 mg/L			0.05 mg/L
Total Kjeldahl Nitrogen (TKN)	USEPA 351.2	0.2 mg/L			0.2 mg/L
Nitrate + Nitrite	USEPA 353.1	0.5 mg/L			0.5 mg/L
Nitrite	USEPA 353.2	0.02 mg/L			0.02 mg/L
Chloride	USEPA 325.1	5 mg/L			5 mg/L
Phosphorus, Total	USEPA 365.4	0.01 mg/L	50 mg/kg		0.01 mg/L
Orthophosphate (as P)	USEPA 365.4	0.01 mg/L			0.01 mg/L
Aluminum	USEPA 200.7	200 µg/L			200 µg/L
Barium	USEPA 200.7	15 µg/L			15 µg/L
Calcium	USEPA 200.7	2 mg/L			2 mg/L
Iron	USEPA 200.7	50 µg/L			50 µg/L
Magnesium	USEPA 200.7	1 mg/L			1 mg/L
Manganese	USEPA 200.7	10 µg/L			10 µg/L
Sodium	USEPA 200.7	5 mg/L			5 mg/L
Potassium	USEPA 200.7	2 mg/L			2 mg/L
Strontium	USEPA 200.7	300 µg/L			300 µg/L
Zinc	USEPA 200.7	10 µg/L	8 mg/kg		10 µg/L
Hardness	USEPA 200.7	10 mg/L			10 mg/L
Arsenic	USEPA 200.8 / SM 3113B	2.0 µg/L	0.8 mg/kg	X	2.0 µg/L
Cadmium	USEPA 200.8 / SM 3113B	0.2 µg/L	0.08 mg/kg	X	0.2 µg/L
Chromium	USEPA 200.8	2.0 µg/L			2.0 µg/L
Copper	USEPA 200.8	2.0 µg/L	0.8 mg/kg		2.0 µg/L
Nickel	USEPA 200.8	2.0 µg/L	0.8 mg/kg		2.0 µg/L
Lead	USEPA 200.8 / SM 3113B	2.0 µg/L	0.8 mg/kg	X	2.0 µg/L
Selenium	USEPA 200.8 / SM 3113B	2.0 µg/L		X	2.0 µg/L
Silver	USEPA 200.8		0.08 mg/kg		
Percent Solids	SM 2540G		0%		
pH	Field Meter	X			X
Conductivity	Field Meter / USEPA 120.1	X (2 µs/cm)			X
Dissolved Oxygen (mg/L and % sat)	Field Meter	X			X
Temperature	Field Meter	X			X
Mercury	USEPA 245.1, 7470A, 7471A		0.02 mg/kg	X	
Herbicides	USEPA 525.2	X			X
SVOCs (BNA)	USEPA 625 / USEPA 8270C	X	0.4-2.0 mg/kg		
PCBs / Pesticides / Chlordane	USEPA 8082 / OEPA 590.1			X	
E. coli	USEPA 1603	2 CFU			2 CFU
chlorophyll-a	USEPA 445.0	X			X
microcystins	OEPA 701.0				0.3 µg/L
Turbidity	OEPA 180.1				2 NTU
Volitile Suspended Solids	SM 2540 D/E				5 mg/L
Carbonate / Bicarbonate	SM 2320 B				5 mg/L
Sulfate	USEPA 375.2	10 mg/L			10 mg/L
Organic Carbon	SM 5310B			X	
Percent Lipids	OEPA 581.5			X	


Campaign Creek
Kyger Creek
Crooked Creek-Ohio River
124
325
7
554
160
850
588
35
735
Campaign Creek
Bell Lick Run
Kyger Creek
Jessie Creek
Storys Run
Silver Run
White Oak Creek
Long Branch
Stingy Run
Little White Oak Creek
Little Kyger Creek
Turkey Run
Wolf Run
Little Campaign Creek
Blosser Creek
Flatfork Run
George Creek
W03K05
W03S13
303121
301794
301796
300593
W03P51
W03S26
301795
303029
W03S28
303118
Sampling Locations
Streams
Watershed
Sampling Location
Tier I
Tier II
N
0
0.75
1.5
3 Miles





Sampling Locations

Streams

Watershed

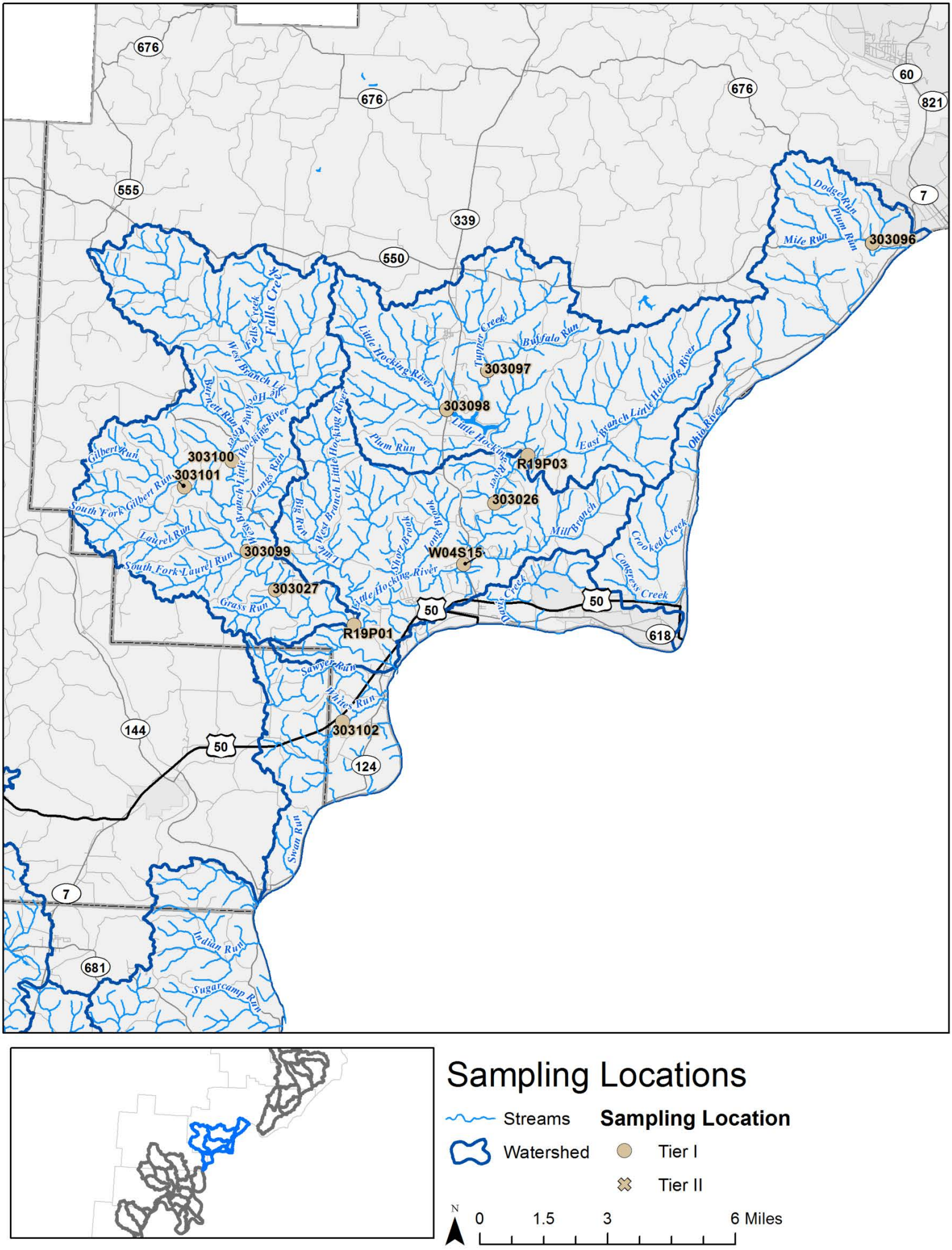
Sampling Location

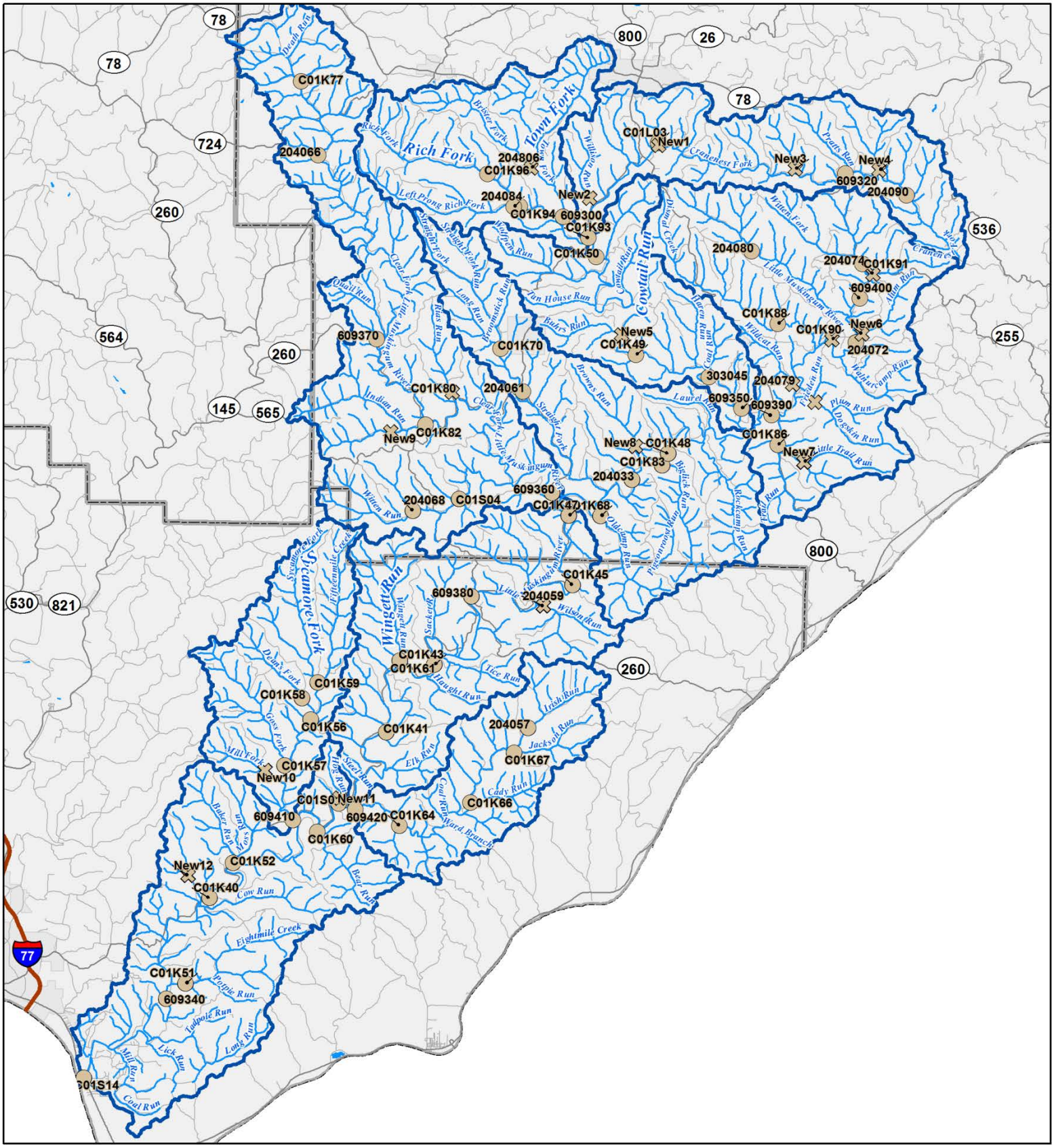
Tier I

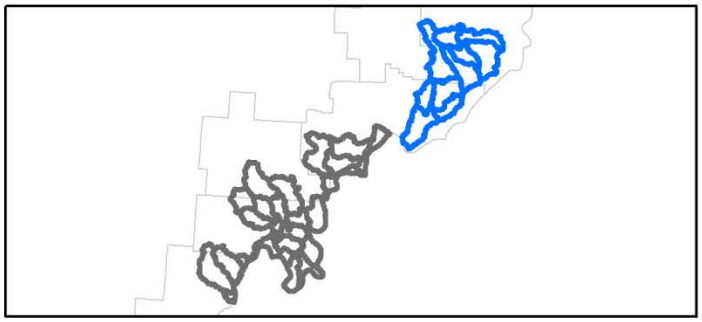
Tier II

N

0 2 4 8 Miles


676
676
676
60
821
555
339
550
7
Dodge Run
Plum Run
Mile Run
303096
Falls Creek
Falls Creek
West Branch Little Hocking River
Little Hocking River
Tupper Creek
Buffalo Run
303097
303098
Little Hocking River
Barnett Run
Gilbert Run
303100
303101
Longs Run
Plum Run
East Branch Little Hocking River
Ohio River
R19P03
South Fork Gilbert Run
303026
Laurel Run
Mill Branch
Crooked Creek
303099
W04S15
South Fork Laurel Run
Big Run
West Branch Little Hocking River
Long Branch
Congress Creek
303027
Little Hocking River
Grass Run
50
50
618
R19P01
Sawyer Run
Haines Run
303102
144
50
124
Swan Run
7
Indian Run
681
Sugarcamp Run
Sampling Locations
Streams
Watershed
Sampling Location
Tier I
Tier II
N
0
1.5
3
6 Miles





Sampling Locations

Streams

Watershed

Sampling Location

Tier I

Tier II

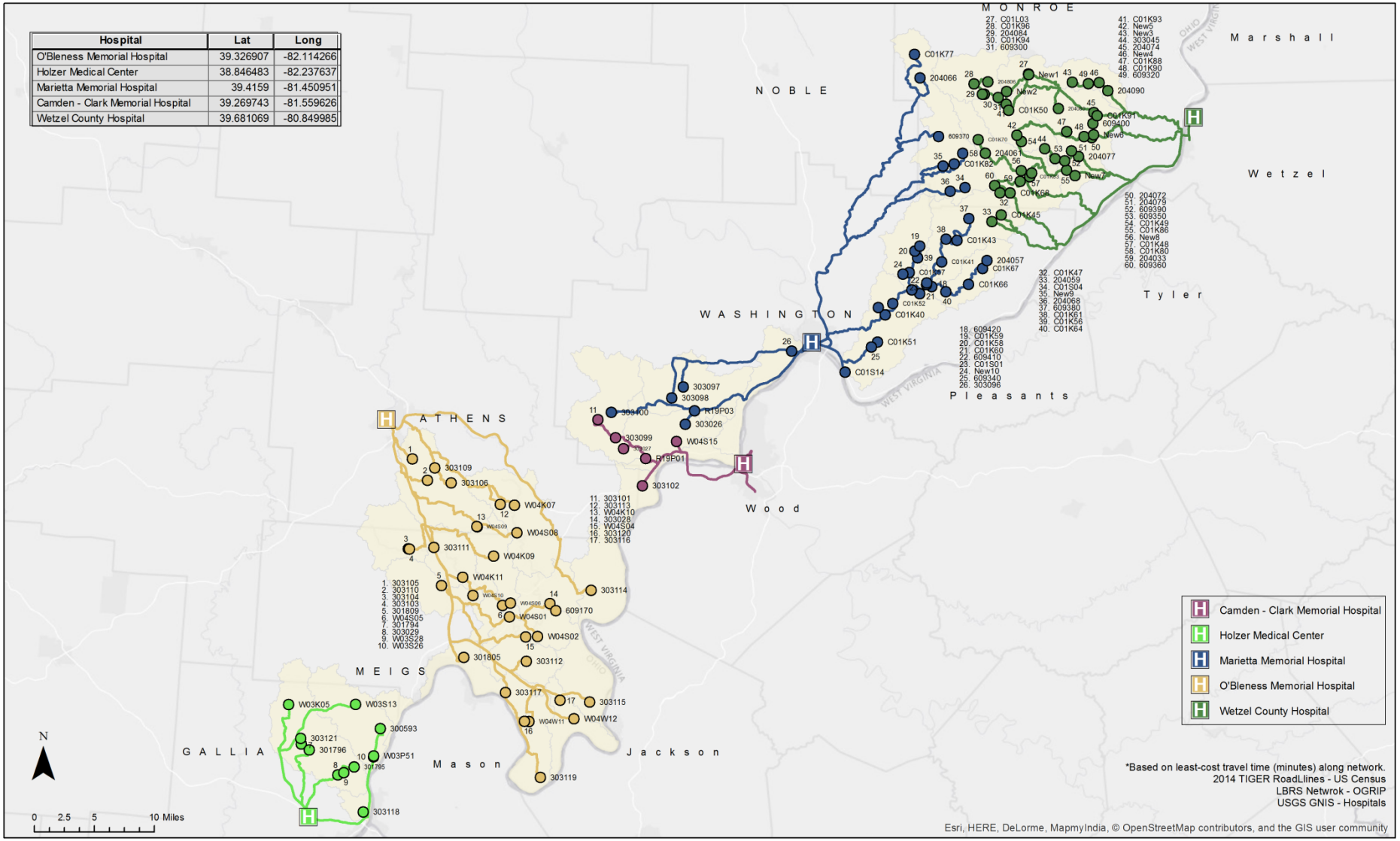
N

0 2 4 8 Miles

Nearest Hospitals by Site*

Southeast Ohio River Tributaries 2015

Hospital	Lat	Long
O'Bleness Memorial Hospital	39.326907	-82.114266
Holzer Medical Center	38.846483	-82.237637
Marietta Memorial Hospital	39.4159	-81.450951
Camden - Clark Memorial Hospital	39.269743	-81.559626
Wetzel County Hospital	39.681069	-80.849985



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