



Biological and Water Quality Study of Southern Ohio River Tributaries

Adams, Brown, and Scioto Counties



Mackletree Run RM 0.4, in Shawnee State Forest

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Adams, Brown, and Scioto Counties, Ohio (Sample Years 2013-2017)

August 2020

Ohio EPA Report DSW/AMS 2016-EAGLE-2

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Table of Contents

| | |
|--|-----|
| List of Acronyms | iii |
| Executive Summary | 1 |
| Overview: Southern Ohio River Tributaries (Straight, Eagle and Turkey Creeks) | 9 |
| Study Area Description..... | 15 |
| Land Use..... | 16 |
| Census Data | 16 |
| Wastewater Discharge Overview | 16 |
| Aquatic Life Use Results and Discussion | 20 |
| Water Chemistry Results..... | 20 |
| Nutrients | 26 |
| Organics..... | 31 |
| 2013/2015 Supplemental Project Field Chemistry Data | 33 |
| 2017 Sampling..... | 33 |
| Sediment Chemistry Results | 34 |
| Physical Habitat Results | 38 |
| Fish Community Results | 48 |
| Macroinvertebrate Community Results | 56 |
| Aquatic Life Use Discussion | 65 |
| White Oak Basin..... | 73 |
| Straight Creek Basin..... | 74 |
| Eagle Creek Basin..... | 76 |
| Miscellaneous Ohio River Tributaries in the Interior Plateau Ecoregion..... | 77 |
| Miscellaneous Ohio River Tributaries in the Western Allegheny Plateau Ecoregion..... | 77 |
| Aquatic Life Trends..... | 77 |
| Recreation Use Results and Discussion..... | 79 |
| Public Water Supply Results and Discussion..... | 81 |
| Waynoka Regional Water and Sewer District..... | 82 |
| Beneficial Use Designations and Recommendations | 84 |
| Beneficial Use Designations | 84 |
| Recommendations..... | 85 |
| Organic Enrichment and Bacteria | 85 |
| Eagle Creek Basin - Honey Creek..... | 86 |
| Straight Creek Basin - Sycamore Run | 86 |
| Acknowledgements..... | 90 |
| References..... | 91 |

Tables

| | |
|--|----|
| Table 1 — Aquatic life use (ALU) attainment status for sampling locations in the SORT study area, 2013-2017. Recommended ALU status is noted with (R). The Index of Biotic Integrity (IBI), Modified Index of well-being (MIwb), and Invertebrate Community Index (ICI) and macroinvertebrate narrative scores are based on the performance of the biological community. The Qualitative Habitat Evaluation Index (QHEI) is based on the ability of the stream habitat to support a biological community. The table is organized by assessment unit (12-digit hydrologic unit code (HUC-12)). Sites with ALU changes recommended are evaluated using the biocriteria for the recommended use, not the current use. For an explanation regarding recommended Aquatic Life Use designations, refer to Beneficial Use Designations and Recommendations within this report. | 3 |
| Table 2 — Sampling stations for the SORT study area, 2013-2017. | 11 |
| Table 3 — Major NPDES facilities and minor dischargers bracketed with biological monitoring sites. | 17 |
| Table 4 — Exceedances of Ohio EPA WQS criteria (OAC 3745-1) (and other chemicals not codified for which toxicity data is available) for chemical/physical water parameters measured in grab samples taken from the SORT study area, May-October 2016. Water parameters are assessed based on water quality criteria for the recommended ALU designations. Refer to Beneficial Use Designations and Recommendations within this report for details about use recommendations. | 23 |
| Table 5 — Exceedances of Ohio WQS criteria (OAC 3745-1) for chemical and physical parameters derived from diel monitoring between Aug. 30 and Sept. 1, 2016. Criteria are assessed based on the recommended ALU designations ^{a,b,c,d,e} . Refer to Beneficial Use Designations and Recommendations within this report for details about use recommendations. | 25 |
| Table 6 — Nutrient sampling results in the SORT, summer (June 15 – October 15) 2016. | 27 |
| Table 7 — Frequency of pesticides detected in stream water samples in the SORT watershed during 2016 (Number of water quality criteria exceedances/Number of detections). ¹ | 32 |
| Table 8 — Nutrient sampling results in the SORT, summer (June 15 – October 15) 2017. | 33 |
| Table 9 — Summarized results of QHEI scores for the SORT study area, 2013-2017. | 40 |
| Table 10 — Fish community status for stations sampled in the SORT study area based on data collected in 2013-2017. The IBI and MIwb are scores based on the performance of the fish community. The narrative fish evaluations (exceptional, very good, etc.) were based upon the corresponding IBI and MIwb scores relative to the drainage area, ecoregion and the assigned ALU. The QHEI is a measure of the ability of the physical habitat to support a biotic community. | 48 |
| Table 11 — Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the SORT basin, June to October, 2013-2016 (except Puntteney Run and Waggoner Run which were sampled in April 2013). | 57 |
| Table 12 — Uncommonly collected sensitive macroinvertebrate taxa and all freshwater mussel species collection locations in the SORT basin, June to October 2013-2016 (except Puntteney Run and Waggoner Run which were sampled in April 2013). Taxa listed with CW are also CWH-indicator taxa. Freshwater mussels were considered extant at the station if they were observed live or as fresh-dead shells. | 63 |
| Table 13 — Aquatic life use attainment status for sampling locations in the SORT study area, 2013-2017. The IBI, MIwb, and ICI and macroinvertebrate narrative scores are based on the performance of the biological community. The QHEI is based on the ability of the stream habitat to support a biological community. The SORT study area is in the IP and WAP ecoregions. If biological impairment has occurred, the causes and sources of the impairment are noted. | 65 |
| Table 14 — Copper concentrations in Lake Waynoka community water supply reservoir and in downstream locations in 2016. Water quality standards exceedances are designated with ** for OMZM and * for OMZA. | 74 |
| Table 15 — A summary of E. coli data for the 19 locations in the SORT sampled June through August, 2016. Recreation Use Attainment Status is determined by comparing samples collected within a 90-day period during the recreation season to the geometric mean criterion of 126 cfu/100 mL and to the statistical threshold value (STV) of 410 cfu/100 mL, which should not be exceeded by more than 10 percent of individual samples. ⁸⁰ | |
| Table 16 — Summary of available water quality data for parameters of interest near/at PWS intake. | 82 |

Table 17 — Water body use designation recommendations for streams sampled in the SORT study area, 2013-2017. Designations based on the 1978 and 1985 water quality standards appear as asterisks (*). A plus sign (+) indicates these designations have been field verified prior to this study, a triangle (▲) denotes a new recommended use based on the findings of this report, and current field verification of the 1978 and 1985 water quality standards based on biological sampling in this study are symbolized as (*/+). 87

Figures

| | |
|---|----|
| Figure 1 — Aquatic life use attainment for biological stations sampled in the SORT study labeled by station ID, 2013-2017. | 2 |
| Figure 2 — Sampling stations in the SORT study area outlined by HUC 12, 2013-2017..... | 10 |
| Figure 3 — 2016 SORT watersheds ecoregions..... | 18 |
| Figure 4 — Land use within the 2016 SORT study area (NLCD 2011)..... | 19 |
| Figure 5 — Daily average flow conditions in White Oak Creek at the USGS gage 03238495 above Georgetown in 2016 (USGS, 2016). Chemistry sampling activities are indicated on the plot..... | 21 |
| Figure 6 — Eutrophication risk at 2016 Southern Ohio River Tributaries sampling locations by ecoregion. | 30 |
| Figure 7 — Frequency of pesticide detections in May, June, and July, 2016..... | 32 |
| Figure 8 — Turkey Creek at Friendship at U.S. Rte. 52..... | 35 |
| Figure 9 — Upper Twin Creek at McGaw at U.S. Rte. 52. | 36 |
| Figure 10 — Lower Twin Creek northwest of Buena Vista, adjacent to Lower Twin Creek..... | 36 |
| Figure 11 — Eagle Creek downstream confluence with West Fork and East Fork Eagle Creek. | 37 |
| Figure 12 — Straight Creek at Centerpoint at Old U.S. Rte. 68..... | 37 |
| Figure 13 — Illustrated above is a well-used path to Redoak Creek from instream livestock watering which contributes to erosion and siltation. Out of stream livestock watering is encouraged where possible..... | 38 |
| Figure 14 — Mackletree Run (RM 0.43) along Mackletree Rd. in Shawnee State Park, Scioto County, scored the best available habitat for aquatic life out of all 90 sampling stations in the study area (QHEI=91)..... | 39 |
| Figure 15 — One of the multiple steep waterfalls within the sampling zone in Campbell Run at old U.S. Rte. 68, RM 0.20..... | 39 |
| Figure 16 — Copper concentrations in Lake Waynoka community water supply reservoir and in downstream locations on July 5 and 6, 2016. Water quality standards exceedances are highlighted in orange (OMZM) and yellow (OMZA)..... | 75 |
| Figure 17 — Trends of fish community IBI for nine SORT streams, 1997-2017..... | 78 |

List of Acronyms

| | |
|--------------|---|
| ALU | aquatic life use |
| CFR | Code of Federal Regulations |
| cfs | cubic feet per second |
| cfu | colony forming units |
| CSO | combined sewer overflow |
| CWA | Clean Water Act |
| CWH | coldwater habitat |
| DC | direct current |
| DELT | deformities, erosions, lesions, tumors |
| DO | dissolved oxygen |
| ECBP | Eastern Corn Belt Plains |
| EOLP | Erie/Ontario Lake Plains |
| EPT | Ephemeroptera, Plecoptera, Trichoptera |
| EWH | exceptional warmwater habitat |
| GIS | geographic information system |
| GPS | global positioning system |
| HELP | Huron/Erie Lake Plains |
| HHEI | headwater habitat evaluation index |
| HUC | hydrologic unit code |
| IBI | index of biotic integrity |
| ICI | invertebrate community index |
| IP | Interior Plateau |
| IPS | integrated prioritization system |
| LRAU | large river assessment unit |
| LRW | limited resource water |
| MGD | million gallons per day |
| MIwb | modified index of well-being |
| MWH | modified warmwater habitat |
| NPDES | National Pollutant Discharge Elimination System |
| OAC | Ohio Administrative Code |
| ODNR | Ohio Department of Natural Resources |
| ORC | Ohio Revised Code |
| PAH | polycyclic aromatic hydrocarbons |
| PCR | primary contact recreation |
| PEC | probable effects concentration |
| QHEI | qualitative habitat evaluation index |

| | |
|-------------|---------------------------------|
| RM | river mile |
| SCR | secondary contact recreation |
| SRV | sediment reference value |
| SSO | sanitary sewer overflow |
| TALU | tiered aquatic life use |
| TDS | total dissolved solids |
| TEC | threshold effects concentration |
| TKN | total Kjeldahl nitrogen |
| TMDL | total maximum daily load |
| TSS | total suspended solids |
| UAA | use attainability analysis |
| VOC | volatile organic compound |
| WAP | Western Allegheny Plateau |
| WAU | watershed assessment unit |
| WQS | water quality standards |
| WWH | warmwater habitat |
| WWTP | wastewater treatment plant |

Executive Summary

Rivers and streams in Ohio support a variety of uses, such as recreation, water supply, and aquatic life. Ohio EPA evaluates each stream to determine the appropriate beneficial use designations and also to determine if the uses are meeting the goals of the federal Clean Water Act. From 2013 through 2017, Ohio EPA evaluated 65 streams in the southern Ohio River tributaries (SORT) study area, located in Scioto, Adams, and Brown counties, for drinking water supply, aquatic life, and recreation use potential. During the years 2013-2015, stream sampling was conducted to either designate or verify aquatic life uses (ALUs) for streams for the first time. This helped elucidate many exceptional streams and a strong prevalence of coldwater habitat (CWH) macroinvertebrate taxa. Many exceptional warmwater habitat (EWH) and CWH use designations were recommended or verified as a result of this study (Beneficial Use Designations and Recommendations). The basin level survey and commensurate water chemistry sampling was completed primarily in 2016 with follow-up work at a few sites during 2017.

Of the 90 biological stations assessed, 66 sites (73.3 percent) were fully meeting the designated or recommended ALU, 13 (14.4 percent) were partially attaining, and 11 (12.2 percent) were not attaining (Figure 1 and Table 1). Twelve sites were impaired due to natural conditions relating to physical habitat limitations. These small drainages had natural limitations which decreased fish species richness and abundance within the sampling zones. Creek chubs (*Semotilus atromaculatus*), a pioneering species, were found to be the dominant fish species in these streams. Some headwaters had very steep bedrock waterfalls while others became completely desiccated during the summer which made fish passage and establishment very difficult. Downstream sampling collections were completed on these streams where practical. One site on Sycamore Run was impaired by sedimentation and siltation, organic enrichment, low DO, and copper exceedances from the Lake Waynoka drinking water reservoir. One site on Honey Creek was impaired due to ammonia exceedances from the Russellville WWTP lagoons. Impairment to the macroinvertebrate community in Town Run downstream from the Georgetown WWTP was caused by flow regime alterations from the WWTP and the fish community was impaired by natural causes. The cause for impairment at the remaining nine sites not meeting their designated ALU was unknown.

Water quality samples were collected from 46 sites in the SORT study area in 2016, with follow-up at an additional seven sites in 2017 (Table 1). Copper exceedances were collected at two sites, Straight Creek downstream of Sycamore Run and Sycamore Run. Copper sulfate treatments to control algae upstream on the impounded section of Sycamore Run (Lake Waynoka Water Supply Reservoir) were found to be the cause of the copper exceedances.

Public water supply beneficial use was evaluated for the Waynoka Regional Water and Sewer District water supply reservoirs, the Sycamore Run Reservoir and the Waynoka Upground Water Supply Reservoir. To assess the PWS beneficial use, samples were analyzed for nitrate, atrazine and cyanotoxins (microcystins, saxitoxins and cylindrospermopsin). Based on exceedances for saxitoxins, Headwaters Straight Creek (05090201 08 02) was listed as impaired for algae in the Ohio 2016 Integrated Report.

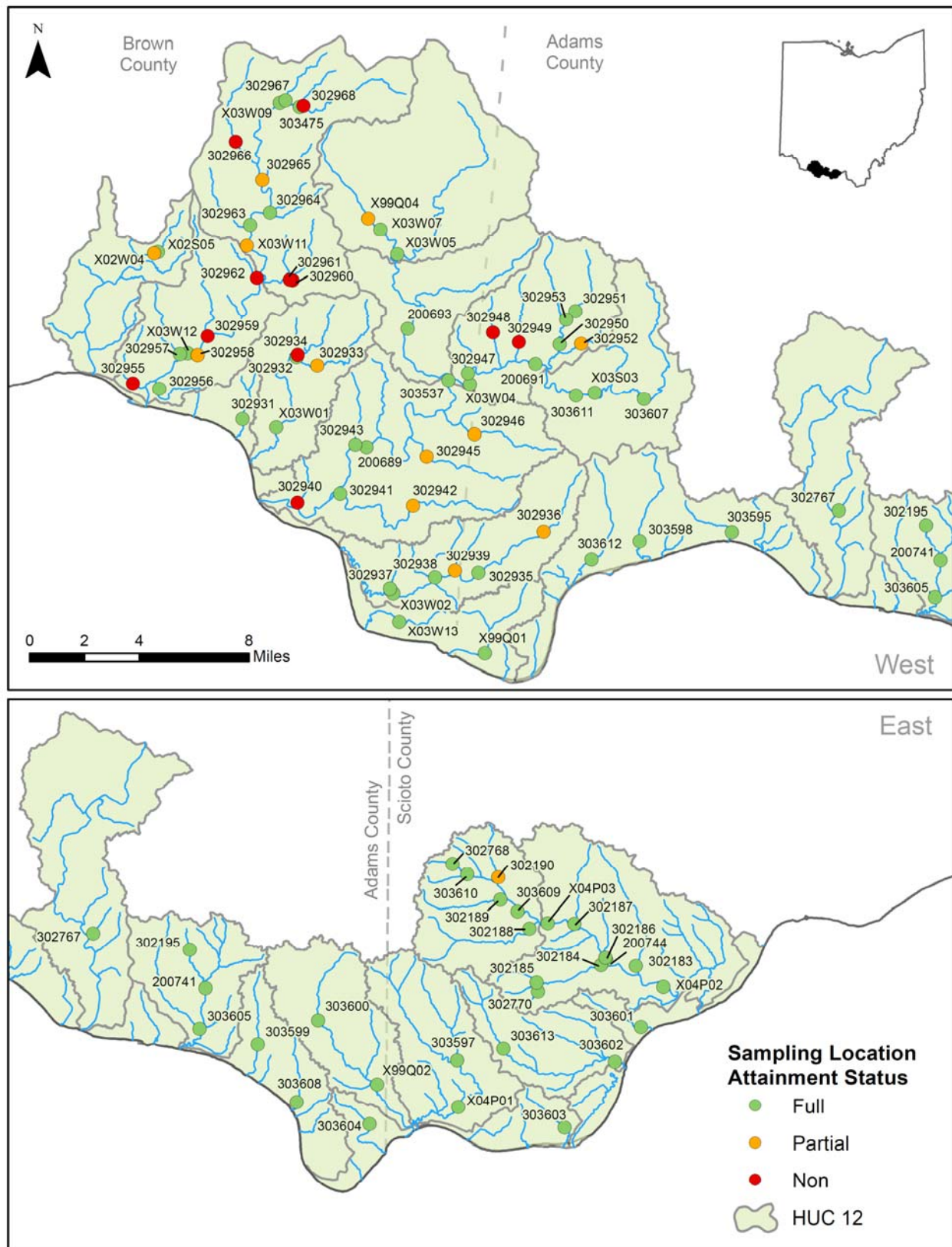


Figure 1 — Aquatic life use attainment for biological stations sampled in the SORT study labeled by station ID, 2013-2017.

Table 1 — Aquatic life use (ALU) attainment status for sampling locations in the SORT study area, 2013-2017. Recommended ALU status is noted with (R). The Index of Biotic Integrity (IBI), Modified Index of well-being (MIwb), and Invertebrate Community Index (ICI) and macroinvertebrate narrative scores are based on the performance of the biological community. The Qualitative Habitat Evaluation Index (QHEI) is based on the ability of the stream habitat to support a biological community. The table is organized by assessment unit (12-digit hydrologic unit code (HUC-12)). Sites with ALU changes recommended are evaluated using the biocriteria for the recommended use, not the current use. For an explanation regarding recommended Aquatic Life Use designations, refer to Beneficial Use Designations and Recommendations within this report.

| Station | Location | Ecoregion ¹ / ALU ² | (Year) RM ^a | IBI | MIwb ^b | ICI ^c | QHEI | Attain. Status | Causes | Sources |
|--|--|--|---------------------------|------------------|-------------------|------------------|------|-------------------|---------------------------|-----------------|
| 05090201 02 01 – Headwaters Turkey Creek | | | | | | | | | | |
| 303610 | Turkey Creek dst. Wolfden Run adj. St. Rte. 125 | WAP/CWH (R) | (2016) 12.90 ^H | 40 | - | E | 82.5 | Full | | |
| 303609 | Turkey Creek dst. Turkey Creek Lake | WAP/WWH (R) | (2016) 10.70 ^H | 42 ^{NS} | - | G | 74.0 | Full | | |
| 302188 | Mackletree Run just upst. Roosevelt Lake at Mackletree Rd. | WAP/EWH | (2013) 0.43 ^H | 48 ^{NS} | - | VG ^{NS} | 91.0 | Full | | |
| 302189 | Lampblack Run just upst. Turkey Creek Lake at parking lot | WAP/CWH | (2013) 0.10 ^H | 42 | - | G | 78.0 | Full | | |
| 302190 | Old Lade Run near mouth, adj. Big Run Rd. | WAP/WWH | (2013) 0.20 ^H | 36* | - | E | 77.3 | Partial | Natural (flow or habitat) | Natural sources |
| 302768 | Wolfden Run upst. Wolfden Lake | WAP/CWH | (2014) 0.50 ^H | 30 | - | G | 53.0 | Full | | |
| 05090201 02 02 – Odell Creek – Turkey Creek | | | | | | | | | | |
| X04P03 | Turkey Creek dst. Roosevelt Lake at St. Rte. 125 | WAP/WWH (R) | (2016) 9.58 ^H | 54 | - | G | 80.5 | Full | | |
| 200744 | Turkey Creek upst. Pond Lick Run at St. Rte. 125 | WAP/WWH (R) | (2016) 6.70 ^W | 46 | 8.79 | E | 78.0 | Full | | |
| X04P02 | Turkey Creek at Friendship at U.S. Rte. 52 | WAP/WWH (R) | (2016) 4.13 ^W | 54 | 8.67 | VG | 81.5 | Full | | |
| 302183 | Odell Creek W of Friendship at driveway off Odell Creek Rd. | WAP/WWH | (2013) 0.30 ^H | 44 | - | VG | 81.5 | Full | | |
| 302184 | Pond Lick Run NW of Friendship, near mouth adj. Shawnee Rd. | WAP/EWH | (2013) 0.20 ^H | 46 ^{NS} | - | E | 79.0 | Full | | |
| 302770 | Rock Lick | WAP/CWH | (2013) 0.50 ^H | 12 | - | VG | 79.0 | Full | | |
| 302185 | Brush Fork just W of Pond Lick Lake at mouth | WAP/CWH | (2013) 0.01 ^H | 26 | - | G | 80.8 | Full | | |
| 302186 | Wes Run NW of Friendship, near mouth adj. Odell Cemetery Rd. | WAP/CWH | (2013) 0.01 ^H | 24 | - | F | 76.0 | Full | | |
| 302187 | Harber Fork near Camp Oyo and mouth at Shawnee Rd. | WAP/CWH | (2013) 0.07 ^H | 26 | - | E | 78.8 | Full | | |

| Station | Location | Ecoregion ¹ / ALU ² | (Year) RM ^a | IBI | MIwb ^b | ICI ^c | QHEI | Attain. Status | Causes | Sources |
|---|--|--|---|------------------|-------------------|------------------|------|-------------------|--------|---------|
| 05090201 02 03 – Pond Run | | | | | | | | | | |
| 303613 | Pond Run off state forest Rd. 1 (Pond Run Rd.) at Backpack Trail | WAP/CWH (R) | (2016) 4.64 ^H | 48 | - | E | 77.5 | Full | | |
| 303602 | Pond Run at U.S. Rte. 52 SW of Friendship | WAP/CWH (R) | (2016) 0.38 ^H | 44 | - | E | 77.5 | Full | | |
| 05090201 02 04 – Briery Branch – Ohio River | | | | | | | | | | |
| 303601 | Nace Run at Shawnee State Park Marina upst. dam | WAP/CWH (R) | (2016) 0.43 ^H | 40 | - | VG | 70.0 | Full | | |
| 05090201 02 05 – Upper Twin Creek | | | | | | | | | | |
| X04P01 | Upper Twin Creek at McGaw at U.S. Rte. 52 | WAP/CWH (R) | (2016) 2.55 ^H | 44 | - | E | 80.0 | Full | | |
| 303597 | E. Fork Upper Twin Creek at Upper Twin Creek Rd. | WAP/EWH/ CWH (R) | (2016) 0.10 ^H | 50 | - | E | 79.3 | Full | | |
| 05090201 02 06 – Lower Twin Creek | | | | | | | | | | |
| 303600 | Lower Twin Creek (RM 5.2) adj. Lower Twin Creek Rd. | WAP/CWH (R) | (2016) 5.20 ^H | 40 | - | E | 74.3 | Full | | |
| X99Q02 | Lower Twin Creek NW of Buena Vista, adj. Lower Twin Creek Rd. | WAP/EWH/ CWH (R) | (2016) 1.65 ^H | 46 ^{ns} | - | E | 73.0 | Full | | |
| 05090201 02 07 – Rock Run – Ohio River | | | | | | | | | | |
| 303603 | Mcatee Run at U.S. Rte. 52 | WAP/CWH (R) | (2016) 0.66 ^H | 36 | - | E | 66.5 | Full | | |
| 303604 | Rock Run | WAP/CWH (R) | (2016/ 2017) 0.30 ^H / 1.80 ^H | 46 | - | E | 65.5 | Full | | |
| 05090201 02 09 – Stout Run | | | | | | | | | | |
| 303605 | Russell Fork at Point Cemetery Rd. | WAP/WWH | (2016) 0.10 ^H | 52 | - | G | 68.8 | Full | | |
| 200741 | Stout Run N of Rome, adj. Blue Creek Rd., upst. Puntenney Run | WAP/EWH/ CWH (R) | (2016) 3.00 ^H | 56 | - | E | 67.3 | Full | | |
| 302195 | Puntenney Run | WAP/CWH (R) | (2016) 1.35 ^H | 24 | - | G | 63.8 | Full | | |
| 05090201 02 10 – Quicks Run – Ohio River | | | | | | | | | | |
| 303599 | Long Lick Run at Ford dst. Owl Hollow | WAP/EWH/ CWH (R) | (2016) 1.23 ^H | 58 | - | E | 80.0 | Full | | |
| 303608 | Sulphur Creek at Sulphur Creek Rd. | WAP/CWH (R) | (2016) 0.35 ^H | 42 | - | E | 64.5 | Full | | |
| 05090201 05 06 – Soldiers Run – Ohio Brush Creek | | | | | | | | | | |
| 302194 | Waggoner Run | IP/EWH/CWH (R) | (2014) 1.04 ^H | - | - | VG | - | - | | |
| 302767 | Mackenzie Run upst. Waggoner Riffle Rd. | IP/CWH | (2015) 0.20 ^H | 44 | - | VG | 52.0 | Full | | |

| Station | Location | Ecoregion ¹ / ALU ² | (Year) RM ^a | IBI | MIwb ^b | ICI ^c | QHEI | Attain. Status | Causes | Sources |
|--|--|--|--|------------------|-------------------|------------------|------|-------------------|---------------------------|---------------------------|
| 05090201 06 01 – Crooked Creek – Ohio River | | | | | | | | | | |
| 303612 | Isaacs Creek in Manchester at Broadway St. | IP/WWH | (2016/2017) 1.43 ^H | 38 ^{ns} | - | G | 74.0 | Full | | |
| 303598 | Island Creek at Island Creek Rd. | IP/WWH | (2016) 1.10 ^H | 38 ^{ns} | - | VG | 71.0 | Full | | |
| 303595 | Donaldson Creek at U.S. Rte. 52 | IP/WWH | (2016) 0.45 ^H | 48 | - | G | 72.3 | Full | | |
| 05090201 06 04 – Big Threemile Creek | | | | | | | | | | |
| 302936 | Big Threemile Creek at Roush Hill Rd. (Rd. 20) | IP/WWH | (2015) 11.12 ^H | 34* | - | G | 74.8 | Partial | Unknown | Unknown |
| 302935 | Big Threemile Creek at St. Rte. 41 | IP/WWH | (2015) 8.07 ^H | 36 ^{ns} | - | G | 56.0 | Full | | |
| X03W02 | Big Threemile Creek NE of Aberdeen at St. Rte. 763 | IP/WWH | (2015) 4.18 ^H | 54 | - | E | 75.5 | Full | | |
| 302937 | Slickaway Run at Stringtown Rd. (Rd. 251) | IP/WWH | (2015) 0.10 ^H | 42 | - | G | 82.3 | Full | | |
| 302938 | Ellis Run at Ellis Run Rd. (Rd. 44) near Ellsberry | IP/WWH | (2015) 0.05 ^H | 48 | - | G | 76.5 | Full | | |
| 302939 | Meffords Run adj. Meffords Run Rd. (Rd. 248) | IP/WWH | (2015) 0.05 ^H | 32* | - | G | 80.0 | Partial | Natural (flow or habitat) | Natural sources |
| 05090201 06 05 – Lawrence Creek – Ohio River | | | | | | | | | | |
| X03W13 | Fishing Gut Creek E of Aberdeen, Near Old St. Rte. 249 | IP/WWH | (2016/2017) 1.00 ^H /1.70 ^H | 46 | - | G | 72.8 | Full | | |
| X99Q01 | L. Threemile Creek E of Maysville at U.S. Rte. 52 | IP/WWH | (2016) 1.30 ^H | 36 ^{ns} | - | G | 90.5 | Full | | |
| 05090201 07 01 – Headwaters West Fork Eagle Creek | | | | | | | | | | |
| X03W05 | West Fork Eagle Creek SE of Russellville at St. Rte. 125 | IP/EWH (R) | (2016) 7.38 ^W | 48 ^{ns} | 9.54 | 46 | 88.8 | Full | | |
| X03W07 | Trib. to West Fork Eagle Creek (7.05) at Russellville-Winchester Rd. | IP/WWH | (2016) 1.80 ^H | 38 ^{ns} | - | G | 64.3 | Full | | |
| X99Q04 | Honey Creek E of Russellville at Mouth | IP/WWH | (2016) 0.10 ^H | 52 | - | LF* | 70.3 | Partial | Ammonia | Russellville WWTP Lagoons |
| 05090201 07 02 – Headwaters East Fork Eagle Creek | | | | | | | | | | |
| 303607 | E. Fk. Eagle Creek SW of West Union off St. Rte. 41 at farm ford | IP/WWH | (2016) 10.95 ^H | 44 | - | G | 78.8 | Full | | |
| X03S03 | E. Fk. Eagle Creek W of West Union at Twp. Rd. 231 | IP/WWH | (2016) 7.90 ^H | 46 | - | G | 83.5 | Full | | |
| 303611 | Trib. to E. Fk. Eagle Creek (RM 6.92) adj. Eagle Creek Rd. | IP/WWH (R) | (2016) 0.10 ^H | 50 | - | G | 80.3 | Full | | |
| 302954 | Hannah Run | IP/WWH | (2015) 0.01 ^H | - | - | MG ^{ns} | - | - | | |

| Station | Location | Ecoregion ¹ / ALU ² | (Year) RM ^a | IBI | MIwb ^b | ICI ^c | QHEI | Attain. Status | Causes | Sources |
|---|--|--|---------------------------|------------------|-------------------|------------------|------|-------------------|---------------------------|-----------------|
| 05090201 07 03 – Hills Fork – East Fork Eagle Creek | | | | | | | | | | |
| 200691 | E. Fk. Eagle Creek S of Fairview at Brier Ridge Rd. | IP/WWH | (2016) 4.30 ^W | 46 | 9.47 | 52 | 89.8 | Full | | |
| X03W04 | E. Fk. Eagle Creek at end of East Fork Rd. | IP/WWH | (2016) 0.82 ^W | 44 | 8.77 | 56 | 81.0 | Full | | |
| 302947 | Town Branch adj. East Fork Rd. (Rd. 221) | IP/WWH | (2015) 0.15 ^H | 40 | - | G | 73.0 | Full | | |
| 302948 | Washburn Run dst. St. Rte. 125 | IP/WWH | (2015) 1.40 ^H | 24* | - | G | 66.3 | Non | Unknown | Unknown |
| 302949 | Adas Run dst. St. Rte. 125 | IP/WWH | (2015) 0.70 ^H | 26* | - | G | 83.3 | Non | Unknown | Unknown |
| 302951 | Hills Fork at Eckmansville Rd. (Rd. 2) | IP/WWH | (2015) 3.05 ^H | 38 ^{ns} | - | G | 81.5 | Full | | |
| 302950 | Hills Fork at St. Rte. 125 | IP/WWH | (2015) 1.30 ^H | 46 | - | G | 78.5 | Full | | |
| 302952 | Lick Run at Old Cincinnati Pike (Rd. 21) | IP/WWH | (2015) 0.95 ^H | 32* | - | G | 74.3 | Partial | Natural (flow or habitat) | Natural sources |
| 302953 | Gordon Run at Deatley Rd. | IP/WWH | (2015) 0.05 ^H | 40 | - | MG ^{ns} | 77.8 | Full | | |
| 05090201 07 04 – Rattlesnake Creek – West Fork Eagle Creek | | | | | | | | | | |
| 200693 | West Fork Eagle Creek W of Decatur, upst. St. Rte. 353 | IP/EWH (R) | (2016) 3.30 ^W | 50 | 9.56 | 50 | 87.5 | Full | | |
| 05090201 07 05 – Eagle Creek | | | | | | | | | | |
| 303537 | Eagle Creek dst. Confluence with W. Fk. and E. Fk. Eagle Creek | IP/WWH | (2016) 14.43 ^W | 44 | 9.58 | 42 | 88.3 | Full | | |
| 200689 | Eagle Creek E of Ripley at North Pole Rd. | IP/EWH (R) | (2016) 6.20 ^W | 48 ^{ns} | 10.05 | E | 88.0 | Full | | |
| 302940 | Baylor Run at Scoffield Rd. | IP/WWH | (2015) 0.15 ^H | 22* | - | G | 68.0 | Non | Natural (flow or habitat) | Natural sources |
| 302942 | Beetle Creek adj. E. Fk. Rd. | IP/WWH | (2015) 4.85 ^H | 32* | - | G | 75.0 | Partial | Unknown | Unknown |
| 302941 | Beetle Creek at Griffith Rd. | IP/WWH | (2015) 0.45 ^H | 42 | - | G | 69.3 | Full | | |
| 302943 | Lafferty Run at North Pole Rd. (Rd. 13b) | IP/EWH | (2015) 0.05 ^H | 52 | - | E | 74.0 | Full | | |
| 302944 | Indian Lick at Upper Eagle Creek Rd. | IP/WWH | (2015) 0.05 ^H | - | - | G | - | - | | |
| 302945 | Brushy Fork at Brushy Fork Rd. (Rd. 241) | IP/WWH | (2015) 1.00 ^H | 28* | - | G | 57.3 | Partial | Natural (flow or habitat) | Natural sources |
| 302946 | Suck Run at Ebenezer Rd. (Rd. 33) | IP/WWH | (2015) 1.70 ^H | 32* | - | E | 65.5 | Partial | Unknown | Unknown |
| 05090201 08 01 – Redoak Creek | | | | | | | | | | |
| 302933 | Redoak Creek at Rd. 231a | IP/WWH | (2015) 7.20 ^H | 30* | - | G | 47.5 | Partial | Unknown | Unknown |
| 302932 | Redoak Creek dst. W. Fk. Redoak Creek | IP/WWH | (2015) 6.30 ^H | 36 ^{ns} | - | G | 66.5 | Full | | |

| Station | Location | Ecoregion ¹ / ALU ² | (Year) RM ^a | IBI | MIwb ^b | ICI ^c | QHEI | Attain. Status | Causes | Sources |
|--|--|--|-------------------------------|------------------|-------------------|------------------|------|-------------------|--|--|
| X03W01 | Redoak Creek at Stringtown at Ripley Rd. | IP/WWH | (2015) 2.32 ^H | 48 | - | E | 84.0 | Full | | |
| 302934 | W. Fk. Redoak Creek at end of Bealer Rd. (Rd. 231) | IP/WWH | (2015) 0.05 ^H | <u>26</u> * | - | MG ^{ns} | 65.8 | Non | Unknown | Unknown |
| 05090201 08 02 – Headwaters Straight Creek | | | | | | | | | | |
| 303475 | Straight Creek Ash Ridge Arnheim Rd. | IP/WWH | (2016) 17.70 ^H | 40 | - | - | 70.5 | Full | | |
| X03W09 | Straight Creek at Arnheim at Brownstown-Arnheim Rd. | IP/WWH | (2016) 16.75 ^H | 46 | - | G | 70.8 | Full | | |
| X03W11 | Straight Creek WSW of Russellville at St. Rte. 125 | IP/WWH | (2016) 9.45 ^W | 34* | 7.54* | E | 72.3 | Partial | Unknown | Unknown |
| 302960 | Washburn Run about 100 yds. dst. Hockman Rd. (Rd. 68) | IP/WWH | (2015) 1.25 ^H | <u>26</u> * | - | MG ^{ns} | 71.0 | Non | Natural (flow or habitat) | Natural sources |
| 302961 | Bull Run near Mouth | IP/WWH | (2015) 0.05 ^H | <u>26</u> * | - | G | 73.5 | Non | Natural (flow or habitat) | Natural sources |
| 302962 | Scott Run at U.S. Rte. 68 | IP/WWH | (2015) 0.20 ^H | <u>12</u> * | - | G | 69.5 | Non | Natural (flow or habitat) | Natural sources |
| 302963 | Camp Run at Day Hill-Arnheim Rd. | IP/WWH | (2015) 0.10 ^H | 36 ^{ns} | - | G | 60.8 | Full | | |
| 302964 | Myers Run at Martin-Hollow Rd. (Rd. 68) | IP/WWH | (2015) 0.05 ^H | 36 ^{ns} | - | MG ^{ns} | 60.0 | Full | | |
| 302965 | Honey Run adj. Day Hill-Arnheim Rd. | IP/WWH | (2015) 0.10 ^H | 30* | - | MG ^{ns} | 67.8 | Partial | Natural (flow or habitat) | Natural sources |
| 302966 | West Fork Straight Creek at Westfork Rd. (Rd. 66a) | IP/WWH | (2015) 1.25 ^H | <u>24</u> * | - | G | 68.5 | Non | Unknown | Unknown |
| 302967 | Buck Run at Ash Ridge Arnheim Rd. (Rd. 17b) | IP/WWH | (2015) 0.05 ^H | 38 ^{ns} | - | MG ^{ns} | 74.5 | Full | | |
| 302968 | Sycamore Run near Fite-Hauck Rd. and Ash Ridge Arnheim Rd. | IP/WWH | (2015/2017) 0.05 ^H | 30* | - | F* | 71.5 | Non | Sedimentation/ siltation ----- Organic enrichment ----- DO ----- Copper sulfate | Upstream impoundment - Lake Waynoka drinking water reservoir |
| 05090201 08 03 – Evans Run – Straight Creek | | | | | | | | | | |
| X03W12 | Straight Creek at Centerpoint at Old U.S. Rte. 68 | IP/WWH | (2015) 2.78 ^W | 42 | 8.37 | 50 | 76.8 | Full | | |
| 302955 | Sink Creek adj. Old A and P Rd. (Rd. 67a) | IP/WWH | (2015) 0.15 ^H | <u>24</u> * | - | G | 58.8 | Non | Natural (flow or habitat) | Natural sources |

| Station | Location | Ecoregion ¹ / ALU ² | (Year) RM ^a | IBI | MIwb ^b | ICI ^c | QHEI | Attain. Status | Causes | Sources |
|--|---|--|-------------------------------|-------------|-------------------|------------------|------|-------------------|---|---|
| 302956 | Rangle Run adj. Rangle Run Rd. (Rd. 541) | IP/CWH (R) | (2015) 0.30 ^H | 46 | - | G | 73.8 | Full | | |
| 302957 | Sheep Run upst. Centerpoint Rd. (Rd. 67b) | IP/WWH | (2015) 0.10 ^H | 46 | - | VG | 69.3 | Full | | |
| 302958 | Campbell Run at Old U.S. Rte. 68 (Rd. 30) | IP/WWH | (2015) 0.20 ^H | 32* | - | G | 74.5 | Partial | Natural (flow or habitat) | Natural sources |
| 302959 | Evans Run adj. Straight Creek Rd. (Rd. 255) at confluence | IP/WWH | (2015) 0.05 ^H | <u>22</u> * | - | G | 77.3 | Non | Natural (flow or habitat) | Natural sources |
| 05090201 08 04 – Lee Creek – Ohio River | | | | | | | | | | |
| 302931 | Cornick Run adj. old U.S. Rte. 68 (Rd. 30) | IP/WWH | (2015/2017) 0.70 ^H | 44 | - | G | 70.8 | Full | | |
| 05090201 10 03 – Big Run – Whiteoak Creek | | | | | | | | | | |
| X02S05 | Town Run just upst. Georgetown WWTP | IP/CWH | (2016) 0.81 ^H | 20 | - | G | 77.0 | Full | | |
| X02W04 | Town Run dst. Georgetown WWTP | IP/CWH | (2016) 0.63 ^H | 20 | - | LF* | 77.0 | Partial | Natural (flow or habitat) Flow regime alternations | Natural sources Municipal point source |

1 Level III Ecoregions: Interior Plateau (IP), Western Allegheny Plateau (WAP)

2 Aquatic life use (ALU) designations: exceptional warmwater habitat (EWH), warmwater habitat (WWH), modified warmwater habitat (MWH). ALU designations for listed waters are located in OAC 3745-1 (sections 08 -32)

a River mile (RM) represents the point of record (POR) for the station, and may not be the actual sampling RM.

b MIwb is not applicable to headwater streams with drainage areas < 20 mi².

c A narrative evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa, and community composition was used when quantitative data was not available or considered unreliable. VP=Very Poor, P=Poor, LF=Low Fair, F=Fair, MG=Marginally Good, G=Good, VG=Very Good, E=Exceptional

H Headwater site (draining ≤20 miles²)

ns Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

W Wading site (non-boat site draining >20 miles²)

* Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

3 Biological criteria presented in OAC 3745-1-07, Table 7-1

| Index – Site Type | Biological Criteria ³ - IP | | Biological Criteria ³ - WAP | |
|-------------------|---------------------------------------|-----|--|-----|
| | WWH | EWH | WWH | EWH |
| IBI – Wading | 40 | 50 | 44 | 50 |
| IBI – Headwater | 40 | 50 | 44 | 50 |
| MIwb – Wading | 8.1 | 9.4 | 8.4 | 9.4 |
| ICI | 30 | 46 | 36 | 46 |

Overview: Southern Ohio River Tributaries (Straight, Eagle and Turkey Creeks)

As part of the TMDL process and in support of the basin approach for National Pollutant Discharge Elimination System (NPDES) permitting, an intensive ambient assessment was conducted during the 2013-2017 field sampling seasons within the SORT, including Turkey, Straight, and Eagle Creeks. The study area is composed of all or portions of 23 HUC 12 watershed assessment units (WAUs) (Figure 2). Data from a total of 93 sampling stations was collected in the SORT study area. Ambient biology, macrohabitat quality, water column chemistry, and bacteriological data was collected from most of these sites. Diel water quality (DO, pH, conductivity, and temperature) and nutrients were evaluated at selected sampling locations (Table 2).

Specific objectives of the evaluation were to:

- ascertain the present biological conditions at the selected sites in the SORT study area by evaluating fish and macroinvertebrate communities;
- identify the relative levels of organic, inorganic, and nutrient parameters in the sediments and surface water;
- evaluate influences from NPDES outfall discharges;
- assess physical habitat influences on stream biotic integrity;
- determine recreational water quality;
- compare present results with historical conditions;
- determine the attainment status of ALU; and
- recommend beneficial use designations to undesignated streams, verify current designations of designated streams and recommend revisions to designations where appropriate.

The findings of this evaluation may factor into regulatory actions taken by Ohio EPA (for example, NPDES permits, Director's Final Findings and Orders or the Ohio Water Quality Standards – Ohio Administrative Code 3745-1), and may eventually be incorporated into State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, TMDLs, and the biennial Integrated Water Quality Monitoring and Assessment Report (305[b] and 303[d] reports).

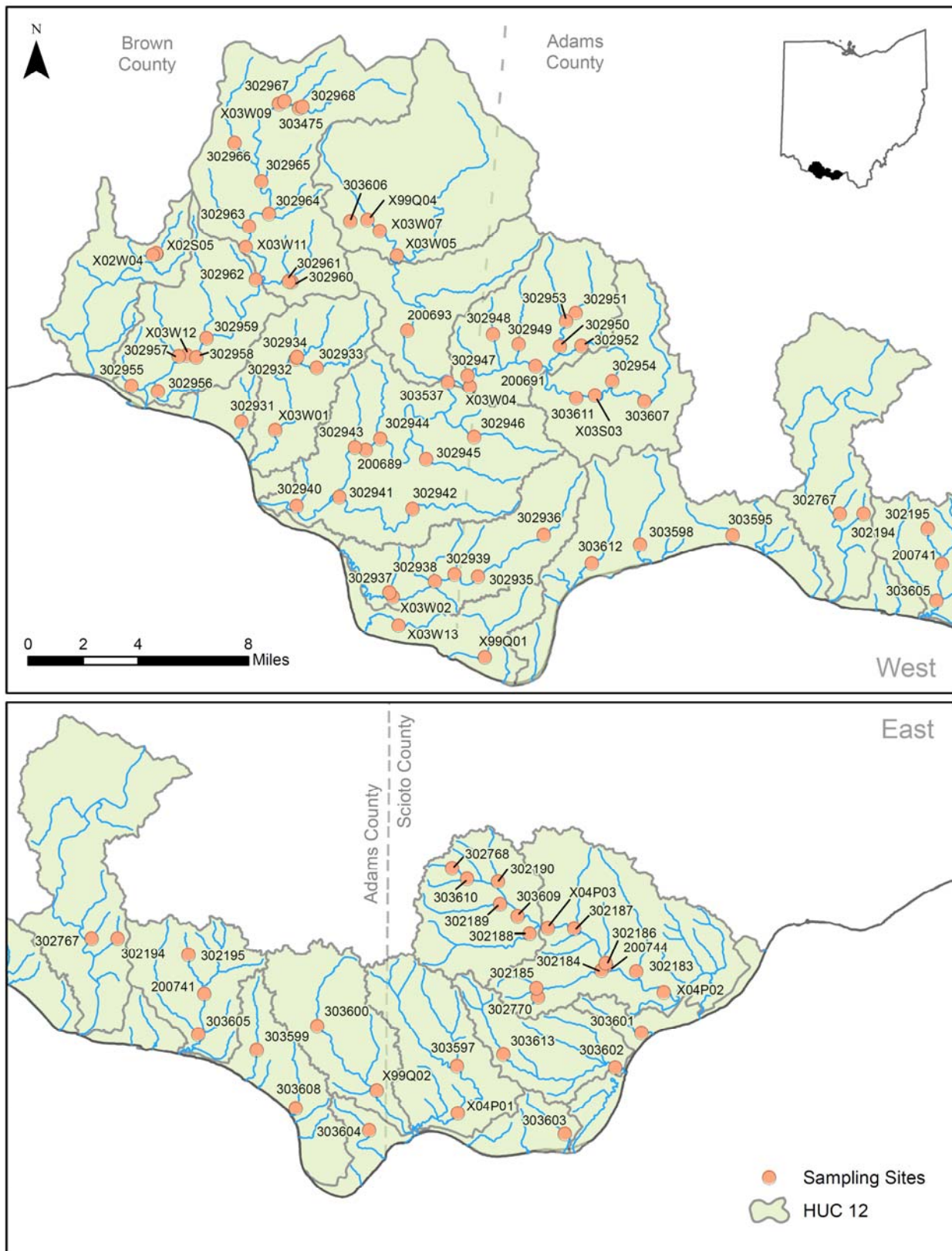


Figure 2 — Sampling stations in the SORT study area outlined by HUC 12, 2013-2017.

Table 2 — Sampling stations for the SORT study area, 2013-2017.

| River code | RM | Station ID | Stream Name | Lat. | Long. | HUC 12 | Drainage Area | Sampling |
|------------|------|------------|--|---------|----------|-------------|---------------|------------------------------|
| 10-038-000 | 0.70 | 302931 | Cornick Run adj. old U.S. Rte. 68 (Rd. 30) | 38.7640 | -83.8512 | 50902010804 | 2.1 | F, Mq |
| 10-040-000 | 7.20 | 302933 | Redoak Creek at Rd. 231a | 38.7931 | -83.8012 | 50902010801 | 16.2 | F, Mq, C |
| 10-040-000 | 6.30 | 302932 | Redoak Creek dst. W. Fk. Redoak Creek | 38.7975 | -83.8153 | 50902010801 | 8.7 | F, Mq |
| 10-040-000 | 2.32 | X03W01 | Red Oak Creek at Stringtown at Ripley Rd. | 38.7598 | -83.8284 | 50902010801 | 4.0 | F, Mq |
| 10-041-000 | 0.05 | 302934 | W. Fk. Redoak Creek at end of Bealer Rd. (Rd. 231) | 38.7987 | -83.8145 | 50902010801 | 3.9 | F, Mq, C |
| 10-043-000 | 11.1 | 302936 | Big Threemile Creek at Roush Hill Rd. (Rd. 20) | 38.7067 | -83.6471 | 50902010604 | 19.7 | F, Mq, C |
| 10-043-000 | 8.07 | 302935 | Big Threemile Creek at St. Rte. 41 | 38.6842 | -83.6907 | 50902010604 | 11.3 | F, Mq |
| 10-043-000 | 4.18 | X03W02 | Big Threemile Creek NE of Aberdeen at St. Rte. 763 | 38.6729 | -83.7478 | 50902010604 | 5.8 | F, Mq |
| 10-044-000 | 0.10 | 302937 | Slickaway Run at Stringtown Rd. (Rd. 251) | 38.6753 | -83.7500 | 50902010604 | 1.3 | F, Mq |
| 10-047-000 | 0.05 | 302938 | Ellis Run at Ellis Run Rd. (Rd. 44) near Ellsberry | 38.6814 | -83.7198 | 50902010604 | 2.1 | F, Mq |
| 10-048-000 | 0.05 | 302939 | Meffords Run adj. Meffords Run Rd. (Rd. 248) | 38.6852 | -83.7065 | 50902010604 | 1.1 | F, Mq |
| 10-049-000 | 1.70 | X03W13 | Fishing Gut Creek Near old St. Rte. 249 E of Aberdeen | 38.6597 | -83.7469 | 50902010605 | 1.9 | F, Mq, C |
| 10-050-000 | 1.30 | X99Q01 | L. Threemile Creek E of Maysville at U.S. Rte. 52 | 38.6421 | -83.6854 | 50902010605 | 4.7 | F, Mq, C, B |
| 10-056-000 | 1.43 | 303612 | Isaacs Creek at Broadway St., Manchester | 38.6919 | -83.6145 | 50902010601 | 4.9 | F, Mq, C, B |
| 10-057-000 | 1.10 | 303598 | Island Creek at Island Creek Rd. | 38.7022 | -83.5822 | 50902010601 | 6.8 | F, Mq, C |
| 10-060-000 | 0.45 | 303595 | Donaldson Creek at U.S. 52 | 38.7077 | -83.5201 | 50902010601 | 2.8 | F, Mq, C |
| 10-067-000 | 3.00 | 200741 | Stout Run N of Rome, adj. Blue Creek Rd., dst. Puntteney Run | 38.6936 | -83.3793 | 50902010209 | 5.4 | F, Mq, C, N, D, B |
| 10-069-000 | 0.1 | 303605 | Russell Fork at Point Cemetery Rd. | 38.6742 | -83.3826 | 50902010209 | 5.1 | F, Mq, C |
| 10-071-000 | 1.35 | 302195 | Puntteney Run N. of Squirrel Town, adj. Puntteney Run Rd. | 38.7123 | -83.3890 | 50902010209 | 0.5 | F, Mq |
| 10-075-000 | 1.23 | 303599 | Long Lick Run at Ford dst. Owl Hollow | 38.6670 | -83.3470 | 50902010210 | 2.8 | F, Mq, C |
| 10-077-000 | 0.35 | 303608 | Sulphur Creek at Sulphur Creek Rd. | 38.6394 | -83.3230 | 50902010210 | 2.4 | F, Mq, C, B |
| 10-081-000 | 1.80 | 303604 | Rock Run in Shawnee S.F. off Tram Road | 38.6291 | -83.2784 | 50902010207 | 0.8 | F, Mq, C |
| 10-082-000 | 5.20 | 303600 | Lower Twin Creek (RM 5.2) adj. Lower Twin Creek Rd. | 38.6787 | -83.3102 | 50902010206 | 6.1 | F, Mq, C |
| 10-082-000 | 1.65 | X99Q02 | Lower Twin Creek adj. Upper Twin Creek-Rocky Fork Rd. | 38.6426 | -83.2722 | 50902010206 | 15.1 | F, Mq, C, Sn, N, D, O, Sd, B |
| 10-085-000 | 2.60 | X04P01 | Upper Twin Creek at U.S. Rte. 52 at Mcgaw | 38.6381 | -83.2248 | 50902010205 | 12.8 | F, Mq, C, Sn, N, D, O, Sd, B |
| 10-089-000 | 0.10 | 303597 | E. Fk. Upper Twin Creek at Upper Twin Creek-Rocky Rd. (C-96) | 38.6601 | -83.2253 | 50902010205 | 3.9 | F, Mq, C |
| 10-096-000 | 0.66 | 303603 | Mcatee Run at U.S. 52 | 38.6282 | -83.1594 | 50902010207 | 1.6 | F, Mq, C, B |

| River code | RM | Station ID | Stream Name | Lat. | Long. | HUC 12 | Drainage Area | Sampling |
|------------|-------|------------|--|---------|----------|-------------|---------------|----------------------------------|
| 10-099-000 | 4.64 | 303613 | Pond Run off state forest Rd. 1 (Pond Run Rd.) at backpack trail | 38.6623 | -83.1973 | 50902010203 | 3.2 | F, Mq, C |
| 10-099-000 | 0.38 | 303602 | Pond Run at U.S. 52 | 38.6601 | -83.1292 | 50902010203 | 11.4 | F, Mq, C, N, D, B |
| 10-100-000 | 14.40 | 303537 | Eagle Creek dst. Confluence West Fork and East Fork Eagle Creek | 38.7864 | -83.7131 | 50902010705 | 108.0 | F2, T, MQ, C, Sn, N, D, O, Sd, B |
| 10-100-000 | 6.20 | 200689 | Eagle Creek E of Ripley at North Pole Rd. (Covered Bridge) | 38.7501 | -83.7731 | 50902010705 | 129.0 | F2, T, MQ, C, N, D |
| 10-101-000 | 0.15 | 302940 | Baylor Run at Scoffield Rd. | 38.7200 | -83.8133 | 50902010705 | 0.9 | F, Mq |
| 10-102-000 | 4.85 | 302942 | Beetle Creek adj. East Fork Rd. | 38.7193 | -83.7354 | 50902010705 | 10.9 | F, Mq, C |
| 10-102-000 | 0.45 | 302941 | Beetle Creek at Griffith Rd. | 38.7250 | -83.7845 | 50902010705 | 5.1 | F, Mq |
| 10-103-000 | 0.05 | 302943 | Lafferty Run at North Pole Rd. (Rd. 13b) | 38.7513 | -83.7747 | 50902010705 | 2.7 | F, Mq |
| 10-104-000 | 0.05 | 302944 | Indian Lick at Upper Eagle Creek Rd. | 38.7560 | -83.7577 | 50902010705 | 2.8 | Mq |
| 10-105-000 | 1.00 | 302945 | Brushy Fork at Brushy Fork Rd. (Rd. 241) | 38.7455 | -83.7266 | 50902010705 | 4.0 | F, Mq, C |
| 10-106-000 | 1.70 | 302946 | Suck Run at Ebenezer Rd. (Rd. 33) | 38.7576 | -83.6945 | 50902010705 | 5.2 | F, Mq, C |
| 10-110-000 | 11.00 | 303607 | East Fork Eagle Creek S of West Union at Farm Ford | 38.7773 | -83.5805 | 50902010702 | 9.9 | F, Mq, C |
| 10-110-000 | 7.90 | X03S03 | East Fork Eagle Creek W of West Union at Twp. Rd. 231 | 38.7803 | -83.6136 | 50902010702 | 15.1 | F, Mq, C, N, D, B |
| 10-110-000 | 4.30 | 200691 | East Fork Eagle Creek S of Fairview at Brier Ridge Rd. | 38.7955 | -83.6539 | 50902010703 | 36.0 | F2, MQ, C |
| 10-110-000 | 0.82 | X03W04 | East Fork Eagle Creek at end of East Fork Rd. | 38.7848 | -83.6980 | 50902010703 | 48.0 | F2, T, MQ, C, N, D |
| 10-110-002 | 0.10 | 303611 | Trib. to East Fork Eagle Creek at RM 6.92 adj. Eagle Creek Rd. at driveway | 38.7788 | -83.6264 | 50902010702 | 5.1 | F, Mq, C |
| 10-111-000 | 0.15 | 302947 | Town Branch adj. East Fork Rd. (Rd. 221) | 38.7900 | -83.6995 | 50902010703 | 1.8 | F, Mq |
| 10-112-000 | 1.40 | 302948 | Washburn Run dst. St. Rte. 125 | 38.8119 | -83.6828 | 50902010703 | 1.4 | F, Mq, C |
| 10-113-000 | 0.70 | 302949 | Adas Run dst. St. Rte. 125 | 38.8070 | -83.6655 | 50902010703 | 3.3 | F, Mq, C |
| 10-114-000 | 3.05 | 302951 | Hills Fork at Eckmansville Rd. (Rd. 2) | 38.8239 | -83.6273 | 50902010703 | 10.1 | F, Mq |
| 10-114-000 | 1.30 | 302950 | Hills Fork at St. Rte. 125 | 38.8061 | -83.6378 | 50902010703 | 5.3 | F, Mq |
| 10-115-000 | 0.95 | 302952 | Lick Run at Old Cincinnati Pike (Rd. 21) | 38.8064 | -83.6232 | 50902010703 | 0.7 | F, Mq, C |
| 10-116-000 | 0.05 | 302953 | Gordon Run at Deatley Rd. | 38.8194 | -83.6337 | 50902010703 | 3.1 | F, Mq |
| 10-117-000 | 0.30 | 302954 | Hannah Run at Mcclanahan Rd. (Rd. T-110) | 38.7881 | -83.6020 | 50902010702 | 2.1 | Mq, C |
| 10-120-000 | 7.38 | X03W05 | West Fork Eagle Creek at St. Rte. 125 SW of Russellville | 38.8529 | -83.7484 | 50902010701 | 28.0 | F2, MQ, C, N, D |
| 10-120-000 | 3.30 | 200693 | W. Fk. Eagle Creek SW of Decatur upst. St. Rte. 353 | 38.8133 | -83.7406 | 50902010704 | 54.0 | F2, T, MQ, C, N, D, B |
| 10-120-001 | 1.80 | X03W07 | Northwest Fork (Trib. to W. Fork Eagle Creek (RM 7.05)) at Russellville-Winchester Rd. | 38.8659 | -83.7599 | 50902010701 | 7.2 | F, Mq, C, N, D |

| River code | RM | Station ID | Stream Name | Lat. | Long. | HUC 12 | Drainage Area | Sampling |
|------------|-------|------------|---|---------|----------|-------------|---------------|----------------------------------|
| 10-120-002 | 0.10 | X99Q04 | Honey Creek E of Russellville at mouth (trib. to N.W. Fork at RM 2.32) | 38.8716 | -83.7684 | 50902010701 | 0.9 | F, Mq, C |
| 10-120-002 | 0.72 | 303606 | Russellville WWTP outfall to Honey Creek | 38.8707 | -83.7799 | 50902010701 | 0.9 | C,B |
| 10-202-000 | 1.04 | 302194 | Waggoner Run SW of Tulip, upst. Abner Hollow Rd. | 38.7197 | -83.4322 | 50902010506 | 0.3 | Mq |
| 10-203-000 | 0.20 | 302767 | Mackenzie Run upst. Waggoner Riffle Rd. | 38.7195 | -83.4480 | 50902010506 | 0.6 | F, Mq |
| 10-300-000 | 17.7 | 303475 | Straight Creek near Fite-Hauck Rd. and Ash Rdige-Arnheim Rd. | 38.9299 | -83.8156 | 50902010802 | 8.9 | F |
| 10-300-000 | 16.8 | X03W09 | Straight Creek at Arnheim at Brownstown-Arnheim Rd. | 38.9319 | -83.8292 | 50902010802 | 12.5 | F, Mq, C, N, D |
| 10-300-000 | 9.45 | X03W11 | Straight Creek WSW of Russellville at Day Hill Arnheim Rd. (Old St. Rte. 125) | 38.8561 | -83.8500 | 50902010802 | 34.0 | F2, MQ, C, N, D, B |
| 10-300-000 | 2.78 | X03W12 | Straight Creek at Centerpoint at Old U.S. Rte. 68 | 38.7986 | -83.8889 | 50902010803 | 57.0 | F2, T, MQ, C, Sn, N, D, O, Sd, B |
| 10-301-000 | 0.15 | 302955 | Sink Creek adj. Old A and P Rd. (Rd. 67a) | 38.7819 | -83.9256 | 50902010803 | 1.7 | F, Mq |
| 10-302-000 | 0.30 | 302956 | Rangle Run adj. Rangle Run Rd. (Rd. 541) | 38.7793 | -83.9077 | 50902010803 | 1.0 | F, Mq |
| 10-303-000 | 0.10 | 302957 | Sheep Run upst. Centerpoint Rd. (Rd. 67b) | 38.7981 | -83.8940 | 50902010803 | 3.7 | F, Mq |
| 10-304-000 | 0.20 | 302958 | Campbell Run at Old U.S. Rte. 68 (Rd. 30) | 38.7976 | -83.8821 | 50902010803 | 2.0 | F, Mq |
| 10-305-000 | 0.05 | 302959 | Evans Run adj. Straight Creek Rd. (Rd. 255) at confluence | 38.8077 | -83.8756 | 50902010803 | 5.3 | F, Mq |
| 10-307-000 | 1.25 | 302960 | Washburn Run about 100 yards dst. Hockman Rd. (Rd. 68) | 38.8381 | -83.8188 | 50902010802 | 5.1 | F, Mq |
| 10-308-000 | 0.05 | 302961 | Bull Run near mouth | 38.8386 | -83.8206 | 50902010802 | 1.3 | F, Mq |
| 10-309-000 | 0.2 | 302962 | Scott Run at U.S. Rte. 68 | 38.8391 | -83.8430 | 50902010802 | 1.2 | F, Mq |
| 10-310-000 | 0.10 | 302963 | Camp Run at Day Hill-Arnheim Rd. | 38.8672 | -83.8480 | 50902010802 | 2.9 | F, Mq |
| 10-311-000 | 0.05 | 302964 | Myers Run at Martin-Hollow Rd. (Rd. 68) | 38.8741 | -83.8346 | 50902010802 | 1.3 | F, Mq |
| 10-313-000 | 0.10 | 302965 | Honey Run adj. Day Hill-Arnheim Rd. | 38.8911 | -83.8401 | 50902010802 | 3.0 | F, Mq |
| 10-314-000 | 1.25 | 302966 | West Fork Straight Creek at Westfork Rd. (Rd. 66a) | 38.9112 | -83.8586 | 50902010802 | 4.3 | F, Mq, C |
| 10-315-000 | 0.05 | 302967 | Buck Run at Ash Ridge Arnheim Rd. (Rd. 17b) | 38.9333 | -83.8254 | 50902010802 | 2.2 | F, Mq |
| 10-316-000 | 0.05 | 302968 | Sycamore Run near Fite-Hauck Rd. and Ash Ridge Arnheim Rd. | 38.9306 | -83.8134 | 50902010802 | 1.6 | F, Mq, C |
| 10-407-000 | 0.81 | X02S05 | Town Run just upst. Georgetown WWTP | 38.8522 | -83.9100 | 50902011003 | 1.4 | F, Mq, C, N, D, B |
| 10-407-000 | 0.63 | X02W04 | Town Run dst. Georgetown WWTP | 38.8514 | -83.9125 | 50902011003 | 1.4 | F, Mq, C, N, D, B |
| 10-407-000 | 0.80 | X02S03 | Georgetown WWTP outfall to Town Run | 38.8522 | -83.9103 | 50902011003 | 1.4 | C, B |
| 10-507-000 | 0.43 | 303601 | Nace Run at Shawnee State Park Marina dst. dam | 38.6768 | -83.1133 | 50902010204 | 1.5 | F, Mq, C, B |
| 10-508-000 | 12.90 | 303610 | Turkey Creek dst. Wolfden Run, adj. St. Rte. 125 | 38.7494 | -83.2201 | 50902010201 | 1.6 | F, Mq, C |

| River code | RM | Station ID | Stream Name | Lat. | Long. | HUC 12 | Drainage Area | Sampling |
|------------|-------|------------|--|---------|----------|-------------|---------------|-------------------------------|
| 10-508-000 | 10.70 | 303609 | Turkey Creek dst. Turkey Creek Lake | 38.7319 | -83.1892 | 50902010201 | 8.7 | F, Mq, C, N, D, B |
| 10-508-000 | 9.58 | X04P03 | Turkey Creek dst. Roosevelt Lake at Mackletree Rd. | 38.7252 | -83.1740 | 50902010202 | 16.5 | F, Mq, C, N, D |
| 10-508-000 | 6.70 | 200744 | Turkey Creek upst. Pond Lick Run at St. Rte. 125 | 38.7086 | -83.1350 | 50902010202 | 26.4 | F2, MQ, C |
| 10-508-000 | 4.10 | X04P02 | Turkey Creek at Friendship dst. U.S. Rte. 52 | 38.6962 | -83.0993 | 50902010202 | 39.0 | F2, MQ, C, Sn, N, D, O, Sd, B |
| 10-516-000 | 0.30 | 302183 | Odell Creek W of Friendship at driveway off Odell Creek Rd. | 38.7060 | -83.1169 | 50902010202 | 5.3 | F, Mq |
| 10-517-000 | 0.20 | 302184 | Pond Lick Run NW of Friendship, near mouth adj. Shawnee Rd. | 38.7063 | -83.1381 | 50902010202 | 5.3 | F, Mq |
| 10-518-000 | 0.50 | 302770 | Rock Lick upst. state forest Rd. 1 | 38.6934 | -83.1765 | 50902010202 | 0.4 | F, Mq |
| 10-519-000 | 0.01 | 302185 | Brush Fork just W of Pond Lick Lake at mouth | 38.6978 | -83.1774 | 50902010202 | 1.1 | F, Mq |
| 10-520-000 | 0.01 | 302186 | Wes Run NW of Friendship, near mouth adj. Odell Cemetery Rd. | 38.7099 | -83.1354 | 50902010202 | 1.0 | F, Mq |
| 10-523-000 | 0.07 | 302187 | Harber Fork near Camp OYO, near mouth at Shawnee Rd. | 38.7263 | -83.1545 | 50902010202 | 4.7 | F, Mq |
| 10-524-000 | 0.43 | 302188 | Mackletree Run just upst. Roosevelt Lake at Mackletree Rd. | 38.7237 | -83.1818 | 50902010201 | 5.8 | F, Mq |
| 10-526-000 | 0.10 | 302189 | Lampblack Run just upst. Turkey Creek Lake at parking lot | 38.7375 | -83.1997 | 50902010201 | 2.7 | F, Mq |
| 10-527-000 | 0.20 | 302190 | Old Lade Run near mouth, adj. Big Run Rd. | 38.7482 | -83.2012 | 50902010201 | 2.2 | F, Mq |
| 10-530-000 | 0.50 | 302768 | Wolfden Run upst. Wolfden Lake | 38.7544 | -83.2292 | 50902010201 | 0.4 | F, Mq |

| Code | Sample Type | Count |
|------|----------------------|-------|
| F | Fish - 1 Pass | 80 |
| F2 | Fish - 2 Pass | 10 |
| MQ | Macro - Quantitative | 10 |
| Mq | Macro - Qualitative | 82 |
| C | Chemistry | 46 |

| Code | Sample Type | Count |
|------|------------------------|-------|
| N | Chemistry w/ nutrients | 19 |
| Sn | Sentinel | 5 |
| Sd | Sediment | 5 |
| B | Bacteria | 20 |
| D | Datasonde | 19 |

Study Area Description

The SORT study area covered portions of Adams, Brown, and Scioto counties in southern Ohio. The larger streams, Straight, Eagle, and Turkey Creeks, have drainage areas of 66.8, 152 and 47.5 square miles (mi²), and average gradients of 24.9, 17.9 and 39.6 feet per mile, respectively. Medium streams, Upper and Lower Twin Creek, have drainage areas of 17.3 and 16.0 mi², and average gradients of 58.4 and 62.9 feet per mile, respectively. The other streams are smaller with drainage areas generally less than 10 mi² and generally higher gradients which range up to 128 and 150 feet per mile in Nace Run and Rock Run, respectively (ODNR, 2001).

The study area included tributaries to the Ohio River between the Scioto River and White Oak Creek. Ohio Brush Creek, while not included in this survey, roughly divides the area in half through the center of Adams County. East of Ohio Brush Creek to the Scioto River, the study area covered southeastern Adams County and southern Scioto County. This area included Turkey Creek as well as smaller direct Ohio River tributaries Nace, Pond, McAtee, Rock, Long Lick and Stout runs, and Upper Twin, Lower Twin, and Sulphur creeks.

The western portion of the study area covered southeastern Brown County and southern Adams County. This area included Straight and Eagle creeks and their tributaries and additional small direct Ohio River tributaries Donaldson, Island, Isaacs, Little Three Mile, and Fishing Gut creeks.

Lakes were sampled in the eastern and western portions of the study area. In the eastern area, in Scioto County, the study included Turkey Creek Lake, a 50-acre lake located in Shawnee State Park. The Turkey Creek headwaters area feeding Turkey Creek Lake is approximately 98 percent forested and drains 8.7 mi². Presently, the lake is used for small boat recreation (electric, paddle and pedal) and has a swimming beach.

To the west, in northern Brown County, Lake Waynoka is a private, gated community. It features an approximately 300-acre recreational lake, Lake Waynoka, created by damming the headwaters of Straight Creek. The lake has a drainage area of approximately 6.3 mi². In addition to the recreational lake, there are two water bodies associated with the public water supply system serving the lake community. Lake Waynoka's Water Supply Reservoir, also known as Sycamore Run Reservoir, is an approximately 11-acre impoundment of Sycamore Run Creek and has a drainage area of approximately 1.0 mi². Water from this reservoir is pumped to a man-made upground reservoir that the water treatment plant draws from. There is also a treated sanitary wastewater storage lagoon that discharges to Straight Creek downstream of the Lake Waynoka dam in coordination with controlled releases from the lake.

Lake reports for the Turkey Creek Lake and Lake Waynoka and reservoir sampling are presented in Appendix K. Sampling results from the lake sampling are presented in Appendix P. Results from the Sycamore Run Reservoir and the upground water supply reservoir sampling are discussed in the Public Water Supply section.

The east portion of the study area is in the unglaciated Western Allegheny Plateau (WAP) ecoregion. The western area is in the Interior Plateau (IP) ecoregion (Omernik, 1987). The hilly and wooded terrain of the WAP is rugged and dissected with steep to very steep hills with narrow ridges and narrow stream valleys. The Scioto County region is underlain by horizontally-bedded shale and sandstone. On uplands, the soils are mostly deep, steep to very steep, and well drained. Most of this area is within the Shawnee State Forest (Figure 3).

The IP is a diverse ecoregion that includes both glaciated and unglaciated areas. In the study area, a line from Ripley to Decatur to West Union approximates the glaciation boundary in southern Ohio. The eastern

unglaciated IP area has greater relief and is deeply dissected. Soils on unglaciated uplands are mostly moderately deep to deep, strongly sloping to very steep, and well drained. Eagle Creek is located within this area.

The surface relief of the glaciated western area is that of a broad plain that has been dissected by numerous streams. The soils in this area are generally deep, gently sloping to very steep, and moderately well drained to well drained. Straight Creek is located within this area.

According to ODNR, Ohio River tributaries of the IP drain “an area in which the surface material is dense glacial till of Illinoian age. The underlying bedrock, which is exposed at many places in the valley, is the impervious shale and limestone of Ordovician age. With such a geologic environment, it is reasonable to expect extremely low dry-weather flows in the streams” (Schiefer, 2002).

Land Use

Land use and land cover have an important influence on water quality conditions found in the watershed. In general, steep areas are wooded, and livestock and general farming occur in less rugged areas. Until recently, tobacco farming was common in this area. Very little (less than five percent) of the area is developed (Figure 4). In the east portion of the study area, the land cover is 81 percent forested, including the Shawnee State Forest, and 10 percent agricultural. The west portion is 49 percent forested and 30 percent agricultural, with 14 percent row crop and 26 percent hay/pasture. The forested areas are to the south in the steeper areas closer to the river.

Census Data

According to the 2010 census, the counties encompassing the SORT study area are home to approximately 152,895 people. The study area is mostly rural with a few small towns. After Georgetown, with a population of 4,331, the next largest town is West Union, population 3,241. Total population across the three counties (Adams, Brown, and Scioto) is estimated to drop 2.4 percent (nearly 3,600 people) between 2010 and 2030. The greatest population decline is expected in Scioto County (five percent).

Wastewater Discharge Overview

A total of 12 NPDES-permitted facilities discharge sanitary wastewater, industrial process water, and/or industrial storm water into the SORT watersheds or discharge directly to the Ohio River within Adams, Brown, and Scioto counties. Each facility is required to monitor their discharges according to sampling and monitoring conditions specified in their NPDES permit and report results to Ohio EPA in a Discharge Monitoring Report (DMR).

Certain NPDES facilities are considered major dischargers based on the volume (more than one million MGD) and type of waste they discharge. All other individual NPDES-permitted facilities are considered minor dischargers. All major NPDES facilities in the SORT watersheds, as well as minor dischargers that were bracketed with biological monitoring sites, are listed in Table 3. Additional details on NPDES-permitted facilities in this study area can be found in Appendix L.

Ohio EPA provides an online interactive map with NPDES facility locations. Once a facility is selected within the interactive map, the user will have access to basic information about the facility, such as a links to the associated NPDES permit and compliance information through U.S. EPA’s website. The interactive map can be found at

<http://oepa.maps.arcgis.com/apps/webappviewer/index.html?id=25cf405adc3444139f4b410e69a2bbc9>.

General NPDES permits are a potential alternative for facilities that have a minimal effect on the environment, have similar operations, and meet certain eligibility criteria. There are several different types of general permits, including, but not limited to, small sanitary sewer discharges, petroleum bulk storage, and non-contact cooling water. A list of facilities covered under each type may be found at epa.ohio.gov/dsw/permits/NonStormgplist.aspx. There are also several types of general permits specific to storm water, including, but not limited to, small municipal separate storm systems (MS4s), construction sites, industries, and marinas. A list of facilities covered under each type may be found at epa.ohio.gov/dsw/permits/gplist.aspx.

Table 3 — Major NPDES facilities and minor dischargers bracketed with biological monitoring sites.

| Ohio EPA Permit Number | Facility Name | Design Discharge (MGD) | Wastewater Type, Treatment System | Stream and River Mile at Discharge | County |
|--|--|------------------------|--|------------------------------------|--------|
| 05090201 02 01 – Headwaters Turkey Creek | | | | | |
| OPP00029 | ODNR - Shawnee State Park Lodge and Cabins | 0.04 | Package plant | Turkey Creek (11.83) | Scioto |
| OH0037877 | ODNR - Shawnee State Park Campground WWTP | 0.025 | Package plant | Turkey Creek (10.28) | Scioto |
| 05090201 07 01 – Headwaters West Fork Eagle Creek | | | | | |
| 1PA00104 | Russellville WWTP | | Lagoons with spray irrigation and controlled discharge | Honey Creek (0.82) | Brown |
| 05090201 08 02 – Headwaters Straight Creek | | | | | |
| 1PS00013 | Waynoka Regional Water and Sewer District | | Oxidation ditch with clarification, controlled discharge | Straight Creek (18.45) | Brown |
| 05090201 10 03 – Big Run – White Oak Creek | | | | | |
| 1PB00101 | Georgetown WWTP | 1.1 | Bar screen, grit removal, flow equalization, sequencing batch reactor, chemical addition for phosphorus, tertiary clarifiers if needed, ultraviolet disinfection and post aeration | Town Run (0.8) | Brown |

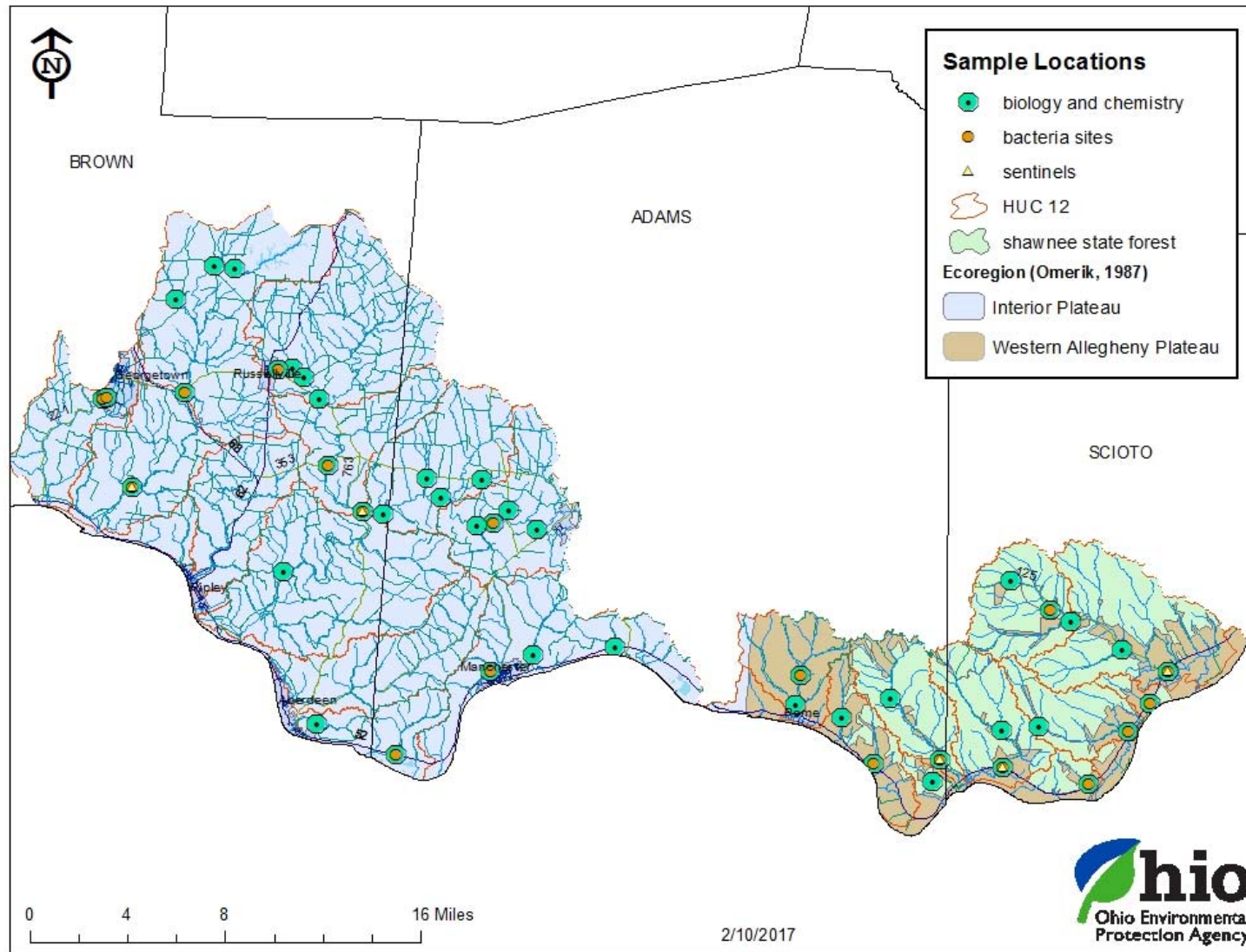


Figure 3 — 2016 SORT watersheds ecoregions.

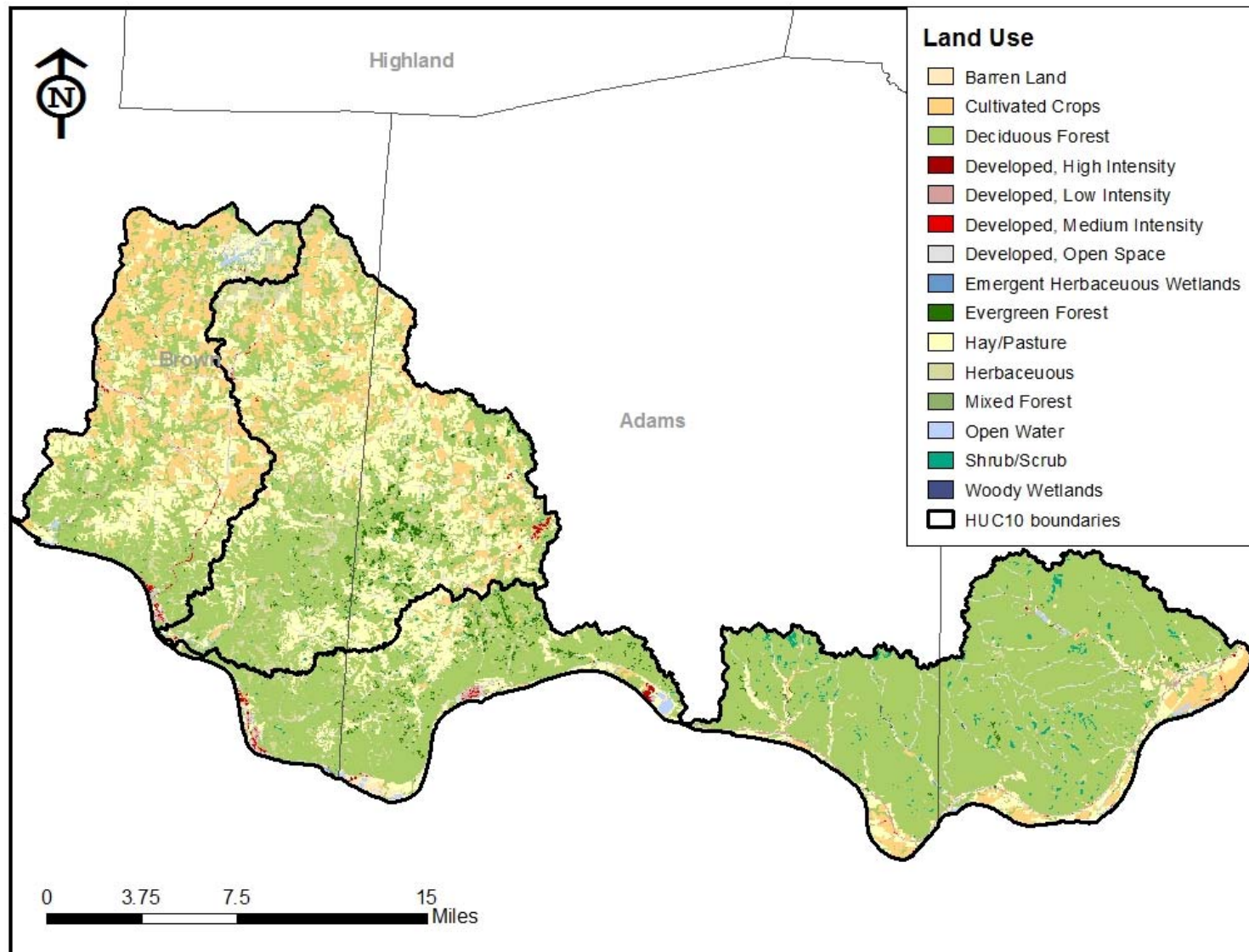


Figure 4 — Land use within the 2016 SORT study area (NLCD 2011).

Aquatic Life Use Results and Discussion

Water Chemistry Results

Surface water chemistry samples were collected from the SORT study area from June through September 2016 at 46 locations (Table 2). Stations were established in free-flowing sections of the streams and samples were collected directly from the stream. Samples were alternatively collected from bridge crossings when high flows or other barriers made for unsafe wading conditions. Surface water samples were collected in appropriate containers, preserved and delivered to Ohio EPA's Environmental Services laboratory. Collected water was preserved using appropriate methods, as outlined in Ohio EPA's *Surface Water Field Sampling Manual*, July 31, 2015 (Ohio EPA, 2015).

A subset of 17 sites that were sampled for chemistry were also sampled with water quality sondes that monitor temperature, dissolved oxygen (DO), pH, and specific conductance (conductivity) hourly over multiple days (Appendix I). Temperature, DO, and pH are influenced by diel (24-hour) patterns. These diel patterns have the greatest impact on streams during a critical condition that includes stable, low stream flow. Specific conductance is not influenced by the same diel triggers but is monitored to evaluate water quality exceedances and as an indicator of changes in stream flow. The water quality sondes collect readings hourly to monitor these parameters throughout the diel cycle. Grab readings differ because they only represent one point on the diel cycle. While they are effective at characterizing water quality parameters that change based on hydrologic regime or season, they can miss or not fully characterize parameters that exhibit diel patterns.

Critical conditions for temperature and DO are times when flows are low, temperatures are high, and daylight is long. These are the times that streams are most sensitive to organic and nutrient enrichment. To capture these conditions, sondes are typically deployed during low-flow conditions from June to September. Sondes were deployed at sites in this study area from August 30 to September 1, 2016. Sonde sites were chosen primarily for geographic coverage, as there are few point sources or historic issues. Some watersheds within the study area did not receive sonde coverage due to small drainage area size. Also, while not part of the HUC coverage, sites were added in the White Oak Creek basin around the Georgetown WWTP to evaluate facility upgrades.

USGS gage data from White Oak Creek above Georgetown were used to show flow trends in the SORT watersheds during the 2016 survey (Figure 5). Dates when water samples and bacteria samples were collected and sondes were deployed in the study area are noted on the graph. Flow conditions during the summer field season were typically lower than the historic median. After a wetter than normal spring, low flow conditions were recorded from July through November. Water samples captured a variety of flow conditions in the study area during the field season. Bacteria samples were collected during the recreation use season (May 1 through October 31) and were typically collected during lower flows.

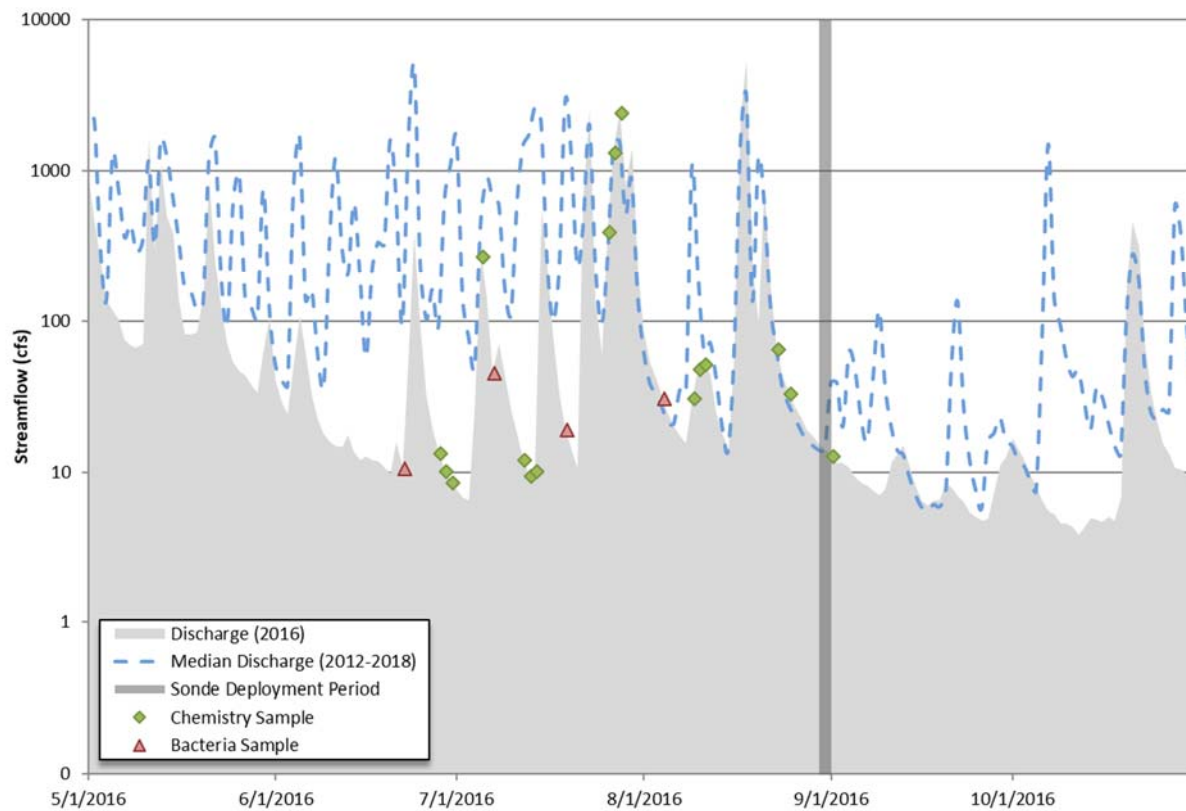


Figure 5 — Daily average flow conditions in White Oak Creek at the USGS gage 03238495 above Georgetown in 2016 (USGS, 2016). Chemistry sampling activities are indicated on the plot.

Surface water samples were analyzed for metals, nutrients, organic pesticides, bacteria, pH, temperature, conductivity, DO, and suspended and dissolved solids (Appendices G and H). Parameters that exceeded criteria in the Ohio WQS are reported in Table 4. Bacteriological samples were collected from 20 locations during the 2016 survey. The bacteriological results are reported in the Recreation Use section.

Water quality sondes were placed at 17 locations to monitor hourly levels of DO, pH, temperature, and conductivity. The data collected during the sonde deployments are sufficient to evaluate exceedances of the standards for the protection of aquatic life for: maximum daily temperature; minimum DO; 24-hour average DO; pH; and specific conductivity. Absolute minima or maxima exceedances are compared directly to hourly readings reported from the water quality sondes. The 24-hour average for DO is calculated as a rolling 24-hour average of the hourly data. A summary of the exceedances is presented in Table 5. Surface water and substrate samples from these locations were also analyzed for chlorophyll-*a* (Appendix N).

Sites on these tributaries to the Ohio River are generally clear and shallow with bedrock or slab/boulder streambeds. Characteristics such as these typically lead to an increased likelihood of temperature exceedances and high primary productivity, although those effects can be mitigated by riparian shading, ground water influence, or low nutrient levels. At many sites in these tributaries, the latter seems to hold true.

Field meter instantaneous DO reading levels were below the minimum water quality criteria at six sites a total of nine times during the 2016 sampling season. Eight of the nine DO levels below the minimum criteria occurred in August and September. The low DO streams (Turkey Creek, Nace Run, Town Run, Donaldson Run, and Sycamore Run) are very small streams and the low DO readings were measured during

very low or interstitial flow conditions. DO fluctuates in a stream due to biological activity, flow, reaeration, pollution, and temperature. During summer months, flow is decreased, pollutant sources are less diluted, water temperatures are higher and biological activities increase. These conditions result in generally lower DO in the stream and larger daily variability.

Six sites had temperatures exceeding water quality criteria. Similar to DO, water quality standards exceedances for temperature were mostly found in the smaller streams. Three of the sites, West Fork Straight Creek, Hannah Run, and Pond Run, are all small streams with little to no riparian cover to shade the streams at mid-day. Two of the remaining sites with temperature exceedances are on Eagle Creek. This is a slightly larger stream, however, it is wide and shallow under low flow conditions. The low flow and shallower water could create warmer temperatures, particularly at mid-day when the readings were collected.

The last site with temperature exceedances was Turkey Creek downstream of Turkey Creek Lake. This site had temperature exceedances during three of five sampling events. The stream water downstream of the lake was significantly warmer than upstream of the lake during the summer survey period. An example was the July 27 sampling event when the stream temperature upstream was 23.0° C and the temperature downstream of the lake was 29.9° C. The stream at that point is water from the Turkey Creek Lake surface that has flowed down over the spillway back into a stream bed. During the Turkey Creek Lake sampling that summer, surface water temperatures up to 30.4° C were recorded.

Temperature and/or DO exceedances were recorded at seven of the 17 sites monitored with water quality sondes. At each of those sites, exceedances can be attributed to low flow, low velocity conditions where reaeration and primary production were low and DO remained depressed throughout the diel cycle. This low primary production was further supported by low benthic chlorophyll-a concentrations.

The water quality standard for pH was exceeded by a grab measurement at one site during the 2016 survey. In West Fork Straight Creek, the pH measurement was 9.3 on July 12, 2016. The field notes for this day describe algae present in the stream and high DO readings. The West Fork Straight Creek site also exceeded the phosphorous target level during the survey, providing nutrients for algal growth. These conditions indicate high algae productivity. During periods of high productivity, carbon dioxide, which dissolves in water to form carbonic acid, is consumed during photosynthesis. This results in elevated pH values in the stream, exceeding 9.0, the upper limit of the WQS criteria range.

There was a single site on Lower Twin Creek that exceeded pH criteria during sonde deployment, however the exceeding values were recorded during high flow conditions immediately following a storm. Sustained pH measurements of 6.5-6.6 during low flow were affected by precipitation/runoff with a slightly lower pH, pushing the site just below criteria. This is likely due to a combination of geology and upstream land management practices, neither of which cause chronically low pH in the stream.

There was one water quality exceedance for ammonia during the study period. The exceedance, 2.53 mg/L, occurred in Honey Creek, a tributary to the Northwest Fork of West Fork Eagle Creek, on July 28, 2016. The Russellville WWTP, which is permitted for controlled discharges from its lagoons, discharges to Honey Creek 0.7 miles upstream from the sampling site. The sample with the ammonia exceedance was the only sample collected at a time when the WWTP was discharging to the creek. The effluent discharging that day had an ammonia concentration of 22.2 mg/L. The Russellville WWTP does not have a discharge limit for ammonia. Only monitoring is required by its NPDES permit. Other than this event, ammonia was only detected once in Honey Creek during the study. That sample from August 10, 2016 was just above detection at 0.052 mg/L ammonia. (Appendix H).

Metals were measured at the stream sampling locations in 2016 with 18 parameters tested (Appendix H). Iron exceeded the statewide water quality criteria for the protection of agricultural uses at four sites in 2016 (Table 4). The iron exceedances occurred on July 5, 2016, and July 28, 2016. Both sampling events were during high flow conditions. Those days the streams were muddy from surface runoff from preceding rainfall. The source of the isolated iron exceedances may have been suspended soil particles or sediment in the water. During water sample chemical analysis, metals associated with clay particles are released into solution, resulting in elevated metals concentrations in the water.

Copper exceeded water quality standards at two sites, both in the Straight Creek watershed. In a sample collected in July 5, 2016, copper exceeded the Outside Mixing Zone Maximum (OMZM) in Sycamore Run at 83.4 µg/L and exceeded the Outside Mixing Zone Average (OMZA) in Straight Creek at Arnheim at 15 µg/L. The Straight Creek site is just one mile downstream of the Sycamore Run site. Both sites are downstream of the Lake Waynoka Water Supply Reservoir which is an impoundment on Sycamore Run.

Table 4 — Exceedances of Ohio EPA WQS criteria (OAC 3745-1) (and other chemicals not codified for which toxicity data is available) for chemical/physical water parameters measured in grab samples taken from the SORT study area, May-October 2016. Water parameters are assessed based on water quality criteria for the recommended ALU designations. Refer to Beneficial Use Designations and Recommendations within this report for details about use recommendations.

| Stream (use designations ^a) | | | |
|---|---------------------------|-------|--|
| Station | 12-digit WAU ^b | RM | Parameter (value) – (units are µg/L for metals, C° for temperature, and mg/L for DO) |
| Turkey Creek (EWH, PCR, AWS, IWS) | | | |
| X04P02 | 02-02 | 4.1 | None |
| 200744 | 02-02 | 6.7 | None |
| X04P03 | 02-02 | 9.58 | DO (3.6‡) |
| 303609 | 02-01 | 10.70 | Temperature (29.6**, 29.9**) |
| 303610 | 02-01 | 12.90 | DO (3.7‡, 3.6‡) |
| Nace Run (WWH, PCR, AWS, IWS) | | | |
| 303601 | 02-04 | 0.43 | DO (4.0‡, 2.5‡) |
| Town Run (CWH, PCR, AWS, IWS) | | | |
| X02W04 | 10-03 | 0.63 | None |
| X02S05 | 10-03 | 0.81 | DO (5.7‡) |
| Sycamore Run (WWH, PCR, AWS, IWS) | | | |
| 302968 | 08-02 | 0.05 | DO (1.4‡) Copper-T (83.4**) |
| West Fork Straight Creek (WWH, PCR, AWS, IWS) | | | |
| 302966 | 08-02 | 1.25 | Temperature (30.9**) pH (9.3 Δ) |
| Straight Creek (WWH, PCR, AWS, IWS) | | | |
| X03W12 | 08-02 | 2.78 | None |
| X03W11 | 08-02 | 9.45 | Iron-T (7,800 ∞) |
| X03W09 | 08-02 | 16.75 | Copper-T (15*) |
| West Fork Eagle Creek (WWH, PCR, AWS, IWS) | | | |
| 200693 | 07-04 | 3.3 | None |
| X03W05 | 07-01 | 7.38 | None |
| Northwest Fork (Tributary to West Fork Eagle Creek (RM 7.05)) (WWH, PCR, AWS, IWS) | | | |
| X03W07 | 07-01 | 1.8 | None |
| Honey Creek (WWH, SCR, AWS, IWS) | | | |
| X99Q04 | 07-01 | 0.1 | Ammonia-N (2.53*) |

| Stream (use designations ^a) | | | |
|---|---------------------------|-------|--|
| Station | 12-digit WAU ^b | RM | Parameter (value) – (units are µg/L for metals, C° for temperature, and mg/L for DO) |
| Hannah Run (WWH, PCR, AWS, IWS) | | | |
| 302954 | 07-02 | 0.3 | Temperature (29.9**) Iron-T (6,220 ∞) |
| Lick Run (WWH, PCR, AWS, IWS) | | | |
| 302952 | 07-03 | 0.95 | None |
| Adas Run (WWH, PCR, AWS, IWS) | | | |
| 302949 | 07-03 | 0.7 | None |
| East Fork Eagle Creek (WWH, PCR, AWS, IWS) | | | |
| X03W04 | 07-03 | 0.82 | None |
| 200691 | 07-03 | 4.3 | None |
| X03S03 | 07-02 | 7.90 | None |
| 303607 | 07-02 | 10.95 | None |
| Tributary to East Fork Eagle Creek at RM 6.92 (undesignated) | | | |
| 303611 | 07-02 | 0.1 | Iron-T (6,120 ∞) |
| Eagle Creek (WWH, PCR, AWS, IWS) | | | |
| 200689 | 07-05 | 6.2 | Temperature (29.4**) |
| 303537 | 07-05 | 14.43 | Temperature (25.8**) |
| Pond Run (CWH, PCR, AWS, IWS) | | | |
| 303602 | 02-03 | 0.38 | Temperature (30.2**) |
| 303613 | 02-03 | 4.64 | None |
| McAtee Run (WWH, PCR, AWS, IWS) | | | |
| 303603 | 02-07 | 0.66 | None |
| East Fork Upper Twin Creek (WWH, PCR, AWS, IWS) | | | |
| 303597 | 02-05 | 0.1 | None |
| Upper Twin Creek (WWH, PCR, AWS, IWS) | | | |
| X04P01 | 02-05 | 2.6 | None |
| Lower Twin Creek (WWH, PCR, AWS, IWS) | | | |
| X99Q02 | 02-06 | 1.65 | None |
| 303600 | 02-06 | 5.2 | None |
| Rock Run (WWH, PCR, AWS, IWS) | | | |
| 303604 | 02-07 | 1.8 | None |
| Sulphur Creek (WWH, PCR, AWS, IWS) | | | |
| 303608 | 02-10 | 0.35 | None |
| Long Lick Run (WWH, PCR, AWS, IWS) | | | |
| 303599 | 02-10 | 1.23 | None |
| Russell Fork (WWH, PCR, AWS, IWS) | | | |
| 303605 | 02-09 | 0.1 | None |
| Stout Run (WWH, PCR, AWS, IWS) | | | |
| 200741 | 02-09 | 3.0 | None |
| Donaldson Creek (WWH, PCR, AWS, IWS) | | | |
| 303595 | 06-01 | 0.45 | DO (3.7‡, 2.8‡) |
| Island Creek (WWH, PCR, AWS, IWS) | | | |
| 303598 | 06-01 | 1.1 | None |
| Issacs Creek (WWH, PCR, AWS, IWS) | | | |
| 303612 | 06-01 | 1.43 | None |
| Little Three Mile Creek (WWH, PCR, AWS, IWS) | | | |
| X99Q01 | 06-05 | 1.3 | None |
| Fishing Gut Creek (WWH, PCR, AWS, IWS) | | | |
| X03W13 | 06-05 | 1.7 | Iron-T (7,660 ∞) |

a Use designations:

| Aquatic Life Habitat | Water Supply | Recreation |
|-------------------------------------|---------------------------------|-------------------------|
| EWH - exceptional warmwater habitat | IWS - industrial water supply | PCR - primary contact |
| WWH - warmwater habitat | AWS - agricultural water supply | SCR - secondary contact |
| CWH - cold water habitat | PWS - public water supply | BWR - bathing water |

b Watershed Assessment Unit within 8-digit watershed assessment unit 05090201.

c Undesignated [WWH criteria apply to 'undesignated' surface waters].

‡ value is below the WWH minimum at any time DO criterion (4.0 mg/L) or value is below the EWH minimum at any time DO criterion (5.0 mg/L) as applicable.

* Exceedance of OMZA (outside mixing zone average) numerical criteria for prevention of chronic toxicity.

** Exceedance of OMZM (outside mixing zone maximum) numerical criteria for prevention of acute toxicity.

Exceedance of numerical criteria for the protection of human health (non-drinking-protective of people against adverse exposure to chemicals via eating fish), derived in accordance with OAC 3745-1-38.

☐ Exceedance of agricultural water supply criterion.

Δ Exceedance of the pH criteria (6.5-9.0)

Table 5 — Exceedances of Ohio WQS criteria (OAC 3745-1) for chemical and physical parameters derived from diel monitoring between Aug. 30 and Sept. 1, 2016. Criteria are assessed based on the recommended ALU designations^{a,b,c,d,e}. Refer to Beneficial Use Designations and Recommendations within this report for details about use recommendations.

| Stream (use designations ^b) | | | |
|---|---------------------------|-------|--|
| Station | 12-digit WAU ^a | RM | Parameter: duration (magnitude) – Duration is number of consecutive hourly readings and magnitude is most extreme value measured. Units are C° for temperature, mg/L for DO, and μS/cm for specific conductance. |
| Turkey Creek (EWH, PCR, AWS, IWS) | | | |
| X04P02 | 02-02 | 4.1 | DO min: 1 (3.9); 1 (3.8); 7 (3.3) DO avg: 25 (4.2) |
| X04P03 | 02-02 | 9.58 | DO min: 49 (2.2) DO avg: 26 (2.4) |
| 303609 | 02-01 | 10.70 | DO min: 50 (1.9) DO avg: 27 (2.6) |
| Town Run (CWH, PCR, AWS, IWS) | | | |
| X02W04 | 10-03 | 0.63 | none |
| Straight Creek (WWH, PCR, AWS, IWS) | | | |
| X03W12 | 08-02 | 2.78 | none |
| X03W11 | 08-02 | 9.45 | none |
| X03W09 | 08-02 | 16.75 | none |
| West Fork Eagle Creek (WWH, PCR, AWS, IWS) | | | |
| 200693 | 07-04 | 3.3 | none |
| X03W05 | 07-01 | 7.38 | none |
| Northwest Fork (Tributary to West Fork Eagle Creek (RM 7.05)) (WWH, PCR, AWS, IWS) | | | |
| X03W07 | 07-01 | 1.8 | none |
| East Fork Eagle Creek (WWH, PCR, AWS, IWS) | | | |
| X03W04 | 07-03 | 0.82 | none |
| X03S03 | 07-02 | 7.90 | DO min: 1 (3.4); 2 (2.8); 16 (2.8); 1 (3.8); 5 (2.2) DO avg: 21 (3.3) |
| Eagle Creek (WWH, PCR, AWS, IWS) | | | |
| 200689 | 07-05 | 6.2 | none |
| 303537 | 07-05 | 14.43 | none |
| Pond Run (CWH, PCR, AWS, IWS) | | | |
| 303602 | 02-03 | 0.38 | Temp. max: 2 (30.3) DO min: 11 (3.6); 1 (3.4) DO avg: 14 (4.3) |
| Upper Twin Creek (WWH, PCR, AWS, IWS) | | | |
| X04P01 | 02-05 | 2.6 | D.O. avg: 4 (6.8) |

| Stream (use designations ^b) | | | |
|--|---------------------------|------|--|
| Station | 12-digit WAU ^a | RM | Parameter: duration (magnitude) – Duration is number of consecutive hourly readings and magnitude is most extreme value measured. Units are C° for temperature, mg/L for DO, and µS/cm for specific conductance. |
| Lower Twin Creek (WWH, PCR, AWS, IWS) | | | |
| X99Q02 | 02-06 | 1.65 | pH: 11 (6.2) DO avg: 3 (6.9) |

a The General Ohio River basin daily maximum temperature criteria apply; See OAC 3745-1-35, Table 35-11(A).

b Applicable minimum 24-hour average DO criterion - WWH: 5.0 mg/L; EWH: 6.0 mg/L; CWH: 7.0 mg/L.

c Applicable minimum DO criterion - WWH: 4.0 mg/L; EWH: 5.0 mg/L; CWH: 6.0 mg/L.

d The criteria for pH is 6.5-9.0 S.U.

e The criteria for specific conductivity is 2,400 µS/cm.

Nutrients

Nutrients were measured at each water sampling location and included ammonia, nitrate+nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, and orthophosphate. In addition to nutrient monitoring, measurements were taken at a subset of locations to represent the algal biomass and associated DO production and consumption. The purpose of the nutrient monitoring summarized in this report is to consider the effect of nutrients on the biological conditions in the local streams.

Chlorophyll-*a* concentrations from benthic algae (attached to bottom substrates) are measured as a proxy for algal community biomass in wadeable streams and small rivers, while chlorophyll-*a* concentrations measured from sestonic algae (suspended in the water column) serve as a proxy for algal abundance in large rivers. Physical factors such as width-depth ratio, time of travel and longitudinal gradient may largely determine whether sestonic or benthic algae drive production and respiration. However, sestonic algae typically dominate streams defined as large rivers, and benthic algae typically dominate small streams. Miltner (2010) identified benthic chlorophyll-*a* levels that broadly demarcate enrichment status relative to Ohio. Streams with less than 90 mg/m² can be considered least disturbed and atypical for Ohio. Benthic chlorophyll-*a* levels between 90-183 mg/m² are typical for Ohio streams with modest amounts of agriculture or wastewater loadings. Levels between 183-320 mg/m² are typical of streams draining agricultural landscapes or that are effluent dominated. Chlorophyll-*a* levels exceeding 320 mg/m² characterize over-enrichment or nuisance conditions. A review of studies on sestonic chlorophyll-*a* by Dodds (2006), which included some Midwestern streams, suggest that concentrations of 40-100 µg/l sestonic chlorophyll-*a* identify eutrophic conditions while concentrations >100 µg/l indicate hyper-eutrophic conditions.

Of the sites sampled for benthic chlorophyll-*a* in the study area, all were well below the moderate threshold of 183 mg/m².

Ohio and other states have been developing nutrient reduction strategies in recent years to address cultural eutrophication (U.S. EPA 2015, Ohio EPA 2014, Ohio EPA 2015b, Miltner 2010, Heiskary and Markus 2003). Wide diel (24-hour) DO ranges associated with eutrophication are caused by excessive photosynthesis (O₂ production) during daylight hours and respiration (O₂ consumption) at night. The most recent investigations by Ohio EPA have identified a diel DO range of 6.5 mg/L as a threshold generally protective of biological and stream quality; diel DO ranges greater than 6.5 mg/L are indicative of eutrophication in Ohio streams and are likely over-enriched (Ohio EPA 2014).

Only one site with diel water quality readings measured a DO range greater than 6.5 mg/L. This site, Straight Creek at river mile 16.75, showed diel ranges up to 7.9 mg/L, but did not have accompanying elevated chlorophyll-*a* or nutrient levels.

Total phosphorus and dissolved inorganic nitrogen (DIN) usually represent the largest portion of these nutrients. In this study, DIN is calculated as ammonia plus nitrate+nitrite concentrations. The index period for nutrients impacting streams is June 15 – October 15. Ohio EPA assigns a risk category (Ohio EPA 2015b) using the geometric means of samples collected in the index period. Table 6 presents the risk category for all sites sampled in the study area. Most locations sampled in 2016 were placed in the low-risk category. Seven locations were placed in the moderate-risk category, meaning that especially in the presence of lower quality stream habitat, the threat of nutrient enrichment impacts to biology are elevated. All the moderate- and high-risk designations were due to total phosphorus concentrations, rather than nitrogen levels.

Table 6 — Nutrient sampling results in the SORT, summer (June 15 – October 15) 2016.

The seasonal geometric mean for each site was used to assign a site to a risk category (Ohio EPA 2015b). The risk categories do not directly translate to cause/source determinations for Aquatic Life Use impairment. Rather, this data serves as one of many lines of evidence in the cause/source determination process. However, this information does give one a general sense of how individual site nutrient levels compare to statewide data.

| Stream (Stream Code) | | | | Total Phosphorus | | Ammonia + (Nitrate + Nitrite) | | Risk Category ^b |
|---|------------|--------------------------|-------------------------|------------------|-----------------------|-------------------------------|-----------------------|----------------------------|
| Station | River Mile | Drainage AU ^a | Area (mi ²) | Samples (#) | Geometric Mean (mg/L) | Samples (#) | Geometric Mean (mg/L) | |
| Turkey Creek (10-508-000) | | | | | | | | |
| X04P02 | 4.1 | 02-02 | 39 | 10 | 0.01 | 10 | 0.21 | L |
| 200744 | 6.7 | 02-02 | 26.4 | 5 | 0.01 | 5 | 0.27 | L |
| X04P03 | 9.58 | 02-02 | 16.5 | 6 | 0.02 | 6 | 0.33 | L |
| 303609 | 10.70 | 02-01 | 8.72 | 6 | 0.01 | 6 | 0.19 | L |
| 303610 | 12.90 | 02-01 | 1.58 | 5 | 0.01 | 5 | 0.37 | L |
| Nace Run (10-507-000) | | | | | | | | |
| 303601 | 0.43 | 02-04 | 1.45 | 5 | 0.03 | 5 | 0.87 | L |
| Town Run (10-407-000) | | | | | | | | |
| X02W04 | 0.63 | 10-03 | 1.4 | 6 | 0.69 | 6 | 1.98 | H |
| X02S05 | 0.81 | 10-03 | 1.4 | 6 | 0.09 | 6 | 0.34 | L |
| Sycamore Run (10-316-000) | | | | | | | | |
| 302968 | 0.05 | 08-02 | 1.6 | 5 | 0.17 | 5 | 0.29 | M |
| West Fork Straight Creek (10-314-000) | | | | | | | | |
| 302966 | 1.25 | 08-02 | 4.3 | 5 | 0.20 | 5 | 0.27 | M |
| Straight Creek (10-300-000) | | | | | | | | |
| X03W12 | 2.78 | 08-02 | 57 | 10 | 0.11 | 10 | 0.33 | L |
| X03W11 | 9.45 | 08-02 | 34 | 6 | 0.12 | 6 | 0.34 | L |
| X03W09 | 16.75 | 08-02 | 12.5 | 6 | 0.08 | 6 | 0.30 | L |
| West Fork Eagle Creek (10-120-000) | | | | | | | | |
| 200693 | 3.3 | 07-04 | 54 | 6 | 0.09 | 6 | 0.31 | L |
| X03W05 | 7.38 | 07-01 | 28 | 6 | 0.08 | 6 | 0.53 | L |
| Northwest Fork (Tributary to West Fork Eagle Creek (RM 7.05)) (10-120-001) | | | | | | | | |
| X03W07 | 1.8 | 07-01 | 7.2 | 6 | 0.06 | 6 | 0.21 | L |
| Honey Creek (10-120-002) | | | | | | | | |
| X99Q04 | 0.1 | 07-01 | 0.9 | 5 | 0.14 | 5 | 0.22 | M |
| Hannah Run (10-117-000) | | | | | | | | |
| 302954 | 0.3 | 07-02 | 2.1 | 4 | 0.14 | 4 | 0.58 | M |
| Lick Run (10-115-000) | | | | | | | | |
| 302952 | 0.95 | 07-03 | 0.7 | 5 | 0.04 | 5 | 1.38 | L |
| Adas Run (10-113-000) | | | | | | | | |
| 302949 | 0.7 | 07-03 | 3.3 | 5 | 0.06 | 5 | 0.41 | L |

| Stream (Stream Code) | | | | Total Phosphorus | | Ammonia + (Nitrate + Nitrite) | | Risk Category ^b |
|---|------------|--------------------------|-------------------------|------------------|-----------------------|-------------------------------|-----------------------|----------------------------|
| Station | River Mile | Drainage AU ^a | Area (mi ²) | Samples (#) | Geometric Mean (mg/L) | Samples (#) | Geometric Mean (mg/L) | |
| East Fork Eagle Creek (10-110-000) | | | | | | | | |
| X03W04 | 0.82 | 07-03 | 48 | 6 | 0.07 | 6 | 0.42 | L |
| 200691 | 4.3 | 07-03 | 36 | 5 | 0.08 | 5 | 0.63 | L |
| X03S03 | 7.90 | 07-02 | 15.1 | 6 | 0.16 | 6 | 0.73 | M |
| 303607 | 10.95 | 07-02 | 9.87 | 5 | 0.07 | 5 | 0.66 | L |
| Tributary to East Fork Eagle Creek at RM 6.92 (10-110-002) | | | | | | | | |
| 303611 | 0.1 | 07-02 | 5.1 | 5 | 0.10 | 5 | 0.69 | L |
| Eagle Creek (10-100-000) | | | | | | | | |
| 200689 | 6.2 | 07-05 | 129 | 6 | 0.08 | 6 | 0.54 | L |
| 303537 | 14.43 | 07-05 | 108 | 10 | 0.14 | 10 | 0.41 | M |
| Pond Run (10-099-000) | | | | | | | | |
| 303602 | 0.38 | 02-03 | 11.35 | 6 | 0.01 | 6 | 0.23 | L |
| 303613 | 4.64 | 02-03 | 3.19 | 4 | 0.01 | 4 | 0.35 | L |
| McAtee Run (10-096-000) | | | | | | | | |
| 303603 | 0.66 | 02-07 | 1.59 | 5 | 0.01 | 5 | 0.38 | L |
| East Fork Upper Twin Creek (10-089-000) | | | | | | | | |
| 303597 | 0.1 | 02-05 | 3.89 | 5 | 0.01 | 5 | 0.26 | L |
| Upper Twin Creek (10-085-000) | | | | | | | | |
| X04P01 | 2.6 | 02-05 | 12.8 | 10 | 0.01 | 10 | 0.35 | L |
| Lower Twin Creek (10-082-000) | | | | | | | | |
| X99Q02 | 1.65 | 02-06 | 15.1 | 10 | 0.01 | 10 | 0.46 | L |
| 303600 | 5.2 | 02-06 | 6.1 | 5 | 0.01 | 5 | 0.33 | L |
| Rock Run (10-081-000) | | | | | | | | |
| 303604 | 1.8 | 02-07 | 0.78 | 5 | 0.02 | 5 | 0.18 | L |
| Sulphur Creek (10-077-000) | | | | | | | | |
| 303608 | 0.35 | 02-10 | 2.4 | 5 | 0.02 | 5 | 0.37 | L |
| Long Lick Run (10-075-000) | | | | | | | | |
| 303599 | 1.23 | 02-10 | 2.8 | 5 | 0.01 | 5 | 0.36 | L |
| Russell Fork (10-069-000) | | | | | | | | |
| 303605 | 0.1 | 02-09 | 5.1 | 5 | 0.01 | 5 | 0.21 | L |
| Stout Run (10-067-000) | | | | | | | | |
| 200741 | 3.0 | 02-09 | 5.4 | 5 | 0.01 | 5 | 0.33 | L |
| Donaldson Creek (10-060-000) | | | | | | | | |
| 303595 | 0.45 | 06-01 | 2.8 | 5 | 0.02 | 5 | 0.27 | L |
| Island Creek (10-057-000) | | | | | | | | |
| 303598 | 1.1 | 06-01 | 6.8 | 5 | 0.04 | 5 | 0.13 | L |
| Issacs Creek (10-056-000) | | | | | | | | |
| 303612 | 1.43 | 06-01 | 4.9 | 5 | 0.06 | 5 | 0.16 | L |
| Little Three Mile Creek (10-050-000) | | | | | | | | |
| X99Q01 | 1.3 | 06-05 | 4.7 | 5 | 0.07 | 5 | 0.20 | L |
| Fishing Gut Creek (10-049-000) | | | | | | | | |
| X03W13 | 1.7 | 06-05 | 1.9 | 5 | 0.24 | 5 | 0.27 | M |

a AU – HUC-12 Assessment Unit – HUC-8: 05090201.

b Risk categories from Ohio EPA (2015b).

| Risk category | Total phosphorus | DIN |
|---------------|------------------|------|
| L (Low) | <0.131 | <3.6 |
| M (Medium) | ≥0.131 and <0.4 | <3.6 |
| H (High) | ≥0.4 | ≥3.6 |

As discussed in the Study Area section, the study area includes portions of two ecoregions, the Interior Plateau (IP) and the Western Allegheny Plateau (WAP). All the sites with moderate or high eutrophication risk were in the IP ecoregion. The IP has more area in agriculture with cultivated crops and pasture, as shown in Figure 4, which may have contributed to the phosphorus concentrations and higher risk. Two of the 12 sites were also downstream of wastewater treatment plants, Honey Creek in Russellville and Town Run in Georgetown. The only high-risk category location was located downstream of the Georgetown WWTP in Town Run.

All sites in the WAP region showed low eutrophication risk. As can be seen in Figure 6, the WAP portion of the sampling area was dominated by the Shawnee State Forest. Many of the sampling sites were in the Shawnee State Forest or in the adjoining Shawnee State Park. According to information from the Ohio Department of Natural Resources (ODNR 2017), Shawnee State Forest, also called "The Little Smokies of Ohio," is the largest of Ohio's state forests with more than 60,000 acres. Nearly 8,000 acres of the forest have been designated as wilderness area, including an area between Upper Twin Creek and Lower Twin Creek. With just pockets of agriculture and low population, streams in the state forest area would be expected to have lower nutrient levels.

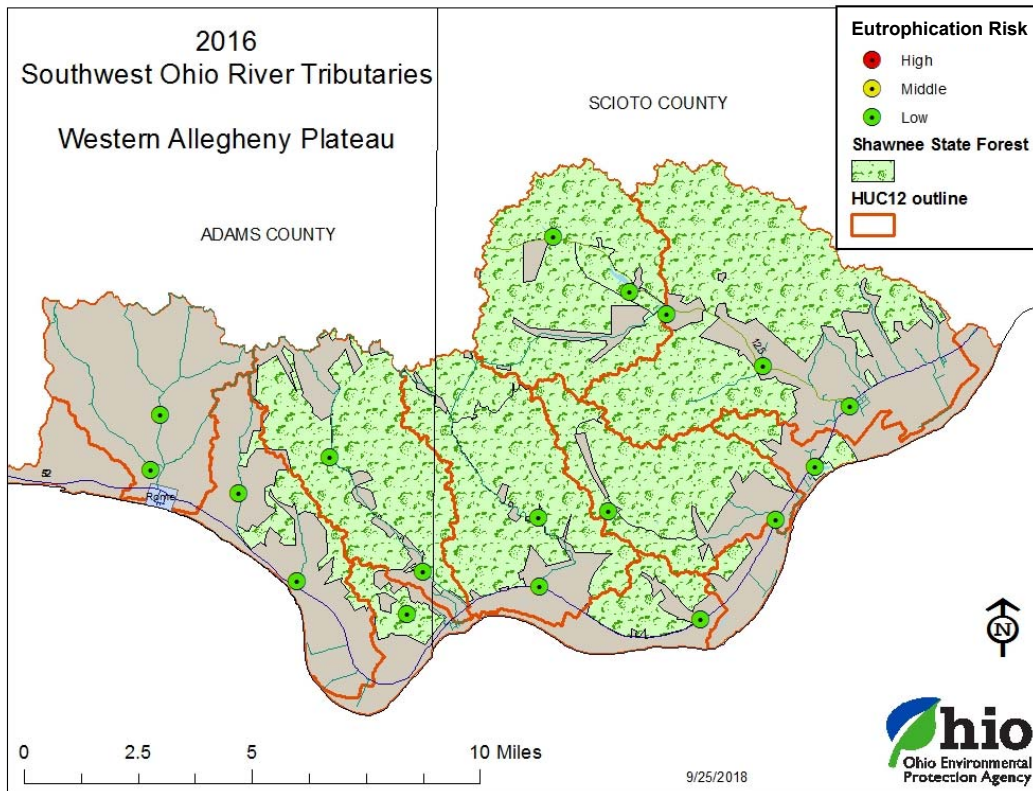
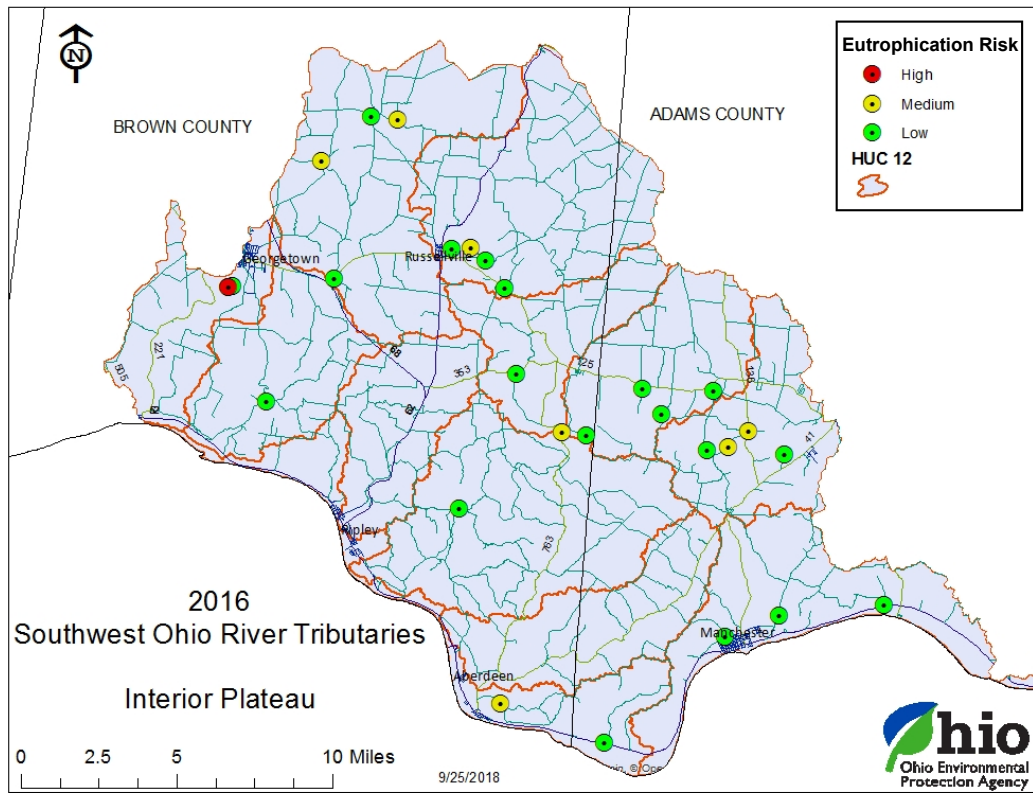


Figure 6 — Eutrophication risk at 2016 Southern Ohio River Tributaries sampling locations by ecoregion.

Organics

Organic parameters, including organochlorine pesticides, acid and chlorinated acid herbicides, and glyphosate, were measured at five sampling locations, one each in Turkey Creek (RM 4.13), Upper Twin Creek (RM 2.55), Lower Twin Creek (RM 2.10), Eagle Creek (RM 14.43), and Straight Creek (RM 2.78). (Appendix G). Organics were analyzed during three sampling events in May, June, and July. Thirteen herbicides and insecticides were detected in the organic samples. Only two of the detected pesticides have established water quality criteria, alpha-hexachlorocyclohexane and bis(2-ethylhexyl)phthalate. Concentrations of those two pesticides did not exceed the water quality criteria. (Table 7)

Upper Twin Creek and Turkey Creek each only had one pesticide detection during the study. At both sites the chemical detected was an isomer of hexachlorocyclohexane (HCH). The HCH isomers were also detected in the sample from Lower Twin Creek on the same day, July 13. HCH isomers were not detected in Straight Creek or Eagle Creek (Appendix G). HCH isomers historically were constituents of technical-grade HCH, an insecticide and fungicide banned for production and use in the U.S. in 1976. They are very stable in the environment and continue to be detected in soil, surface water and ground water in the U.S. (ATSDR, 2005).

Herbicides were detected each month in Straight Creek and Eagle Creek (Appendix G and Figure 7). One chlorinated herbicide, 2,4-D, was detected in both Straight and Eagle Creeks in May and June. Glyphosate (Roundup) was detected once in the survey, in Straight Creek on July 5. The greater number of herbicide detections in Straight and Eagle Creeks than the other streams is a reflection of the greater prevalence of agriculture in the western region of the survey area.

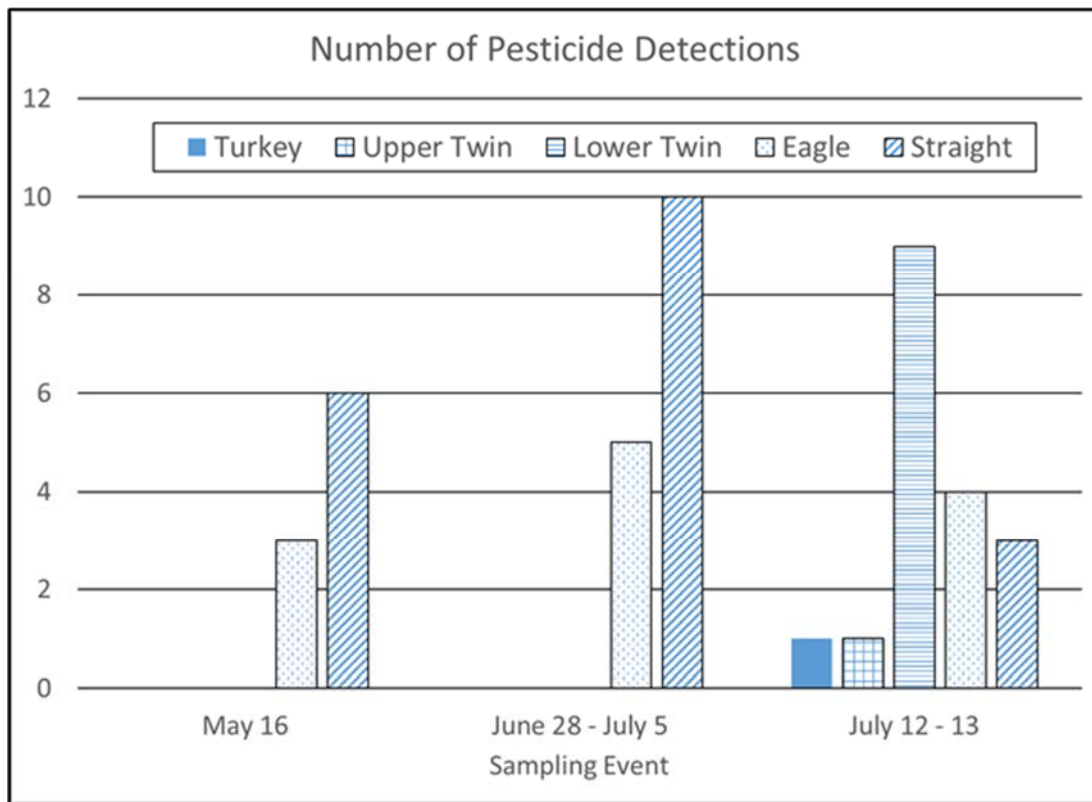


Figure 7 — Frequency of pesticide detections in May, June, and July, 2016.

Table 7 — Frequency of pesticides detected in stream water samples in the SORT watershed during 2016 (Number of water quality criteria exceedances/Number of detections).¹

| Southern Ohio River Tributaries Watersheds (WAU 05090201-__-__) | | | | | | |
|--|------------------------------|----------------------------|-----------------------------------|-----------------------------------|----------------------------|-------|
| Parameter | 03-08 | 07-05 | 02-06 | 02-05 | 02-02 | TOTAL |
| | Straight Creek RM 2.78 | Eagle Creek RM 14.43 | Lower Twin Creek RM 2.10 | Upper Twin Creek RM 2.55 | Turkey Creek RM 4.13 | |
| α-Hexachlorocyclohexane | - | - | 0/1 | - | 0/1 | 0/2 |
| δ-Hexachlorocyclohexane* | - | - | */1 | */1 | - | */2 |
| 2,4-D* | */2 | */2 | - | - | - | */4 |
| Acetechlor* | */2 | */1 | */1 | - | - | */4 |
| Alachlor* | - | - | */1 | - | - | */1 |
| Atrazine* | */3 | */3 | */1 | - | - | */7 |
| Bis(2-Ethylhexyl)adipate* | */1 | - | */1 | - | - | */2 |
| Bis(2-Ethylhexyl)phthalate | 0/2 | 0/1 | - | - | - | 0/3 |
| Butachlor* | */1 | - | */1 | - | - | */2 |
| Glyphosate* | */1 | - | - | - | - | */1 |
| Metribuzin* | */3 | */1 | - | - | - | */4 |
| Metolachlor* | */3 | */3 | */1 | - | - | */7 |
| Simazine* | */1 | */1 | */1 | - | - | */3 |
| Exceedances/Detections2 | 0/19 | 0/12 | 0/9 | 0/1 | 0/1 | 0/42 |

¹ Water samples for pesticides analysis were collected in May, June and July.

* Parameter was detected but no applicable water quality criteria are available.

The total number of possible detections per site is 120 (three sampling events x 40 analytes).
The total number of possible detections for the study is 600 (five sites x three sampling events x 40 analytes)

2013/2015 Supplemental Project Field Chemistry Data

Sampling was conducted from 2013 to 2015 to determine the appropriate tiered antidegradation category and aquatic life use for selected streams currently assigned to the State Resource Water (SRW) category. Most of the selected streams have unverified Coldwater Habitat (CWH) or Exceptional Warmwater Habitat (EWH) aquatic life uses. The streams were within several small watersheds draining directly to the Ohio River along the Ohio River from Brown County to Scioto County. Biological, both fish and macroinvertebrate, and habitat data were collected from streams in the Straight, Red Oak, Eagle, Big Three Mile, Ohio Brush, and Turkey Creek basins, and Cornick Run. In addition to the biological sampling, Ohio EPA conducted one to three site visits to measure water temperature, DO, pH, and conductivity. This field meter data was used in the overall assessment of each stream’s antidegradation category and aquatic life use. The field meter data is presented in Appendix O.

Of the 44 streams evaluated in 2013 and 2015, only three streams had field measurements that exceeded water quality standards. Big Threemile Creek had temperature exceedances at two sampling sites; Ellis Run, also in the Big Threemile Creek basin, had a temperature exceedance; and Evans Run in the Straight Creek basin had a DO exceedance.

2017 Sampling

In 2017, water chemistry samples were collected at seven of the 2013 and 2015 supplemental study sampling locations. This subset of sampling locations was selected for chemistry sampling to provide additional information to help assess the sites for attainment of aquatic life use. Following evaluation of the biological and habitat data, these sites were listed as partial or non-attainment, however, causes for the reduced attainment status was unclear from the biological and habitat scores. Therefore, chemistry data was collected to help determine causes and sources of partial or non-attainment at these sites.

Surface water samples were analyzed for metals, nutrients, pH, temperature, conductivity, DO, percent DO saturation, and suspended and dissolved solids. Results from the water chemistry sampling are presented in Appendix H. None of the measured parameters exceeded Ohio WQS criteria.

Nutrient parameters measured included ammonia, nitrate+nitrite, TKN, and total phosphorus. Ammonia levels did not exceed water quality criteria. Geometric means for dissolved inorganic nitrogen (ammonia + nitrate+nitrite) and total phosphorus in the 2017 sampling sites are presented in Table 8. As above for the 2016 sampling, eutrophication risk categories were assigned using the geometric means. Red Oak Creek was the only location with a risk level greater than Low. Livestock was observed in and near the stream at this site which could account for the elevated nutrient levels.

Table 8 — Nutrient sampling results in the SORT, summer (June 15 – October 15) 2017.

The seasonal geometric mean for each site was used to assign a site to a risk category (Ohio EPA 2015b). The risk categories do not directly translate to cause/source determinations for Aquatic Life Use impairment. Rather, this data serves as one of many lines of evidence in the cause/source determination process. However, this information does give one a general sense of how individual site nutrient levels compare to statewide data.

| Stream (Stream Code) | | | | Total Phosphorus | | Ammonia + (Nitrate + Nitrite) | | Risk Category ^b |
|-----------------------------------|------------|--------------------------|-------------------------|------------------|--------|-------------------------------|--------|----------------------------|
| Station | River Mile | Drainage AU ^a | Area (mi ²) | Geometric Mean | | Geometric Mean | | |
| | | | | Samples (#) | (mg/L) | Samples (#) | (mg/L) | |
| Red Oak Creek (10-040-000) | | | | | | | | |
| 302933 | 7.2 | 08-01 | 4.0 | 3 | 0.14 | 3 | 0.62 | M |

| West Fork Redoak Creek (10-041-000) | | | | | | | | |
|--|-------|-------|-----|---|------|---|------|---|
| 302934 | 0.05 | 08-01 | 3.9 | 3 | 0.11 | 3 | 0.81 | L |
| Big Threemile Creek (10-043-000) | | | | | | | | |
| 302936 | 11.12 | 06-04 | 5.8 | 3 | 0.05 | 3 | 0.61 | L |
| Beetle Creek (10-102-000) | | | | | | | | |
| 302942 | 4.85 | 07-05 | 5.1 | 3 | 0.07 | 3 | 0.76 | L |
| Brushy Fork (10-105-000) | | | | | | | | |
| 302945 | 1.0 | 07-05 | 4.0 | 3 | 0.06 | 3 | 0.16 | L |
| Suck Run (10-106-000) | | | | | | | | |
| 302946 | 1.7 | 07-05 | 5.2 | 3 | 0.08 | 3 | 0.09 | L |
| Washburn Run (10-112-000) | | | | | | | | |
| 302948 | 1.4 | 07-03 | 1.4 | 3 | 0.03 | 3 | 0.50 | L |

a AU – HUC-12 Assessment Unit – HUC-8: 05090201.

b Risk categories from Ohio EPA (2015b).

| <u>Risk category</u> | <u>Total phosphorus</u> | <u>DIN</u> |
|----------------------|-------------------------|------------|
| L (Low) | <0.131 | <3.6 |
| M (Medium) | ≥0.131 and <0.4 | <3.6 |
| H (High) | ≥0.4 | ≥3.6 |

Sediment Chemistry Results

Ohio EPA collects surficial sediment samples in the watershed being surveyed. These samples are typically analyzed for percent solids, TOC, total phosphorus, metals, pesticides, PCBs, and s-VOCs (PAHs). Sampling locations are selected in the study plan to determine background sediment quality, assess the impact from point sources and urban nonpoint runoff, and evaluate downstream transport and recovery. Samples are collected following the *Sediment Sampling Guide and Methodologies*, 3rd Edition (Ohio EPA, 2012). The goal is to collect a representative sample that is composed of more than 30 percent silt and clay particles. These fine-grained particles are much more physically, chemically, and biologically reactive because they hold more interstitial water and have unbalanced electrical charges that can attract contaminants.

The streams of the SORT contain little in the way of fine-grained sediment in large enough volumes to have much of an ecological impact. Fine particles are predominantly washed downstream at higher flows. Many of the stream beds are shale, offering no place for sediments to deposit. Fine-grained sediments in large enough quantities for collection could not be found at the locations selected for sediment sampling. The locations that were attempted to be sampled are presented below. The sampling locations are pictured below in Figure 8 through Figure 12.



Figure 8 — Turkey Creek at Friendship at U.S. Rte. 52.



Figure 9 — Upper Twin Creek at McGaw at U.S. Rte. 52.



Figure 10 — Lower Twin Creek northwest of Buena Vista, adjacent to Lower Twin Creek.



Figure 11 — Eagle Creek downstream confluence with West Fork and East Fork Eagle Creek.



Figure 12 — Straight Creek at Centerpoint at Old U.S. Rte. 68.

Physical Habitat Results

Stream habitat was evaluated at 90 fish sampling locations throughout the SORT study area in 2013-2017. Stream modifications such as straightened channels or leveed banks were not a common theme in this forested study area. Clean rocky substrates and good to excellent stream habitats dominated the landscape. Due to the rocky geology throughout the study area, physical habitat impacts from instream livestock were localized and downstream siltation was not found to be a main cause of impairment.

The highest QHEI score in the study area (91) was from Mackletree Run (RM 0.43), located in Shawnee State Forest (Figure 14). Seventy four percent (n=67) of the sites were found to have excellent quality stream habitats (Table 9). Twenty sites (22.2 percent) scored good quality stream habitat and just three anomalous sites (3.3 percent) (Wolfden Run (RM 0.5), Mackenzie Run (RM 0.2), and Redoak Creek (RM 7.2)) were found to have only fair quality stream habitats. These small drainages were sampled during interstitial low flow conditions when riffles and other habitat features that otherwise might have been in the wetted channel were desiccated. This would have likely elevated the QHEI scores to within the narratively good range during more average flows.



Figure 13 — Illustrated above is a well-used path to Redoak Creek from instream livestock watering which contributes to erosion and siltation. Out of stream livestock watering is encouraged where possible.



Figure 14 — Mackletree Run (RM 0.43) along Mackletree Rd. in Shawnee State Park, Scioto County, scored the best available habitat for aquatic life out of all 90 sampling stations in the study area (QHEI=91).



Figure 15 — One of the multiple steep waterfalls within the sampling zone in Campbell Run at old U.S. Rte. 68, RM 0.20.

Table 9 – Summarized results of QHEI scores for the SORT study area, 2013-2017.

| Key QHEI Components | WWH Attributes | | | | | | | | | | MWH Attributes | | | | | | | | | | MWH M.I. / WWH Ratio | | | | | | | | | | | | | | | | | |
|------------------------------------|----------------|------|-----------------|------------------|------------------------------|----------------------------------|---------------------|----------------------------|-------------------------|--------------------------|---------------------|-------------------------|-------------------------|------------------|--------------------------------|-------------------------|----------------------|--------------|-----------------|------------------|----------------------|------------------------------------|--------------------|---------------------------|------------------------|--------------------------|-----------------------|---------------|-------------------------|-------------------------|-----------------|----------------------------|-------------------------------|------------------------------------|-----------|--------------------------|------|--|
| | Station | QHEI | Narrative Score | Gradient (ft/mi) | Not Channelized or Recovered | Boulder/Cobble/Gravel Substrates | Silt Free Substrate | Good/Excellent Development | Moderate/High Sinuosity | Extensive/Moderate Cover | Fast Current/Eddies | Low/Normal Embeddedness | Low/Normal Embeddedness | Max Depth > 40cm | Low/Normal Riffle Embeddedness | Channelized/No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40cm | | High-Influence Modified Attributes | Recovering Channel | Heavy/Moderate Substrates | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1 or 2 Cover Types | Intermittent/Poor Pools | No Fast Current | High/Moderate Embeddedness | High/Mod. Riffle Embeddedness | Mod. Influence Modified Attributes | No Riffle | MWH H.I.+1 / WWH+1 Ratio | | |
| Wolfden Run (10-530-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2014 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302768 | 0.5 | 53.0 | F | 44.20 | X | X | | | | | X | | | 3 | | | | X | X | X | 3 | | | | | X | | | | | | X | | | 3 | 1.00 | 1.00 | |
| Old Lade Run (10-527-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302190 | 0.1 | 77.3 | E | 48.78 | X | X | X | X | X | X | X | X | X | 9 | | | | | X | 1 | | | | | | | X | | | | | | | | 1 | 0.20 | 0.20 | |
| Lampblack Run (10-526-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302189 | 0.1 | 78.0 | E | 50.00 | X | X | X | X | X | X | X | X | X | 9 | | | | | X | 1 | | | | | | | | | | | | | | | 0 | 0.20 | 0.10 | |
| Mackletree Run (10-524-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302188 | 0.4 | 91.0 | E | 66.67 | X | X | X | X | X | X | X | X | X | 10 | | | | | | | 0 | | | | | | | | | | | | | | 0 | 0.09 | 0.09 | |
| Harber Fork (10-523-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302187 | 0.1 | 78.8 | E | 42.55 | X | X | X | X | X | X | X | X | X | 9 | | | | | X | 1 | | | | | | | | | | | | | | | 0 | 0.20 | 0.10 | |
| Wes Run (10-520-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302186 | 0.3 | 76.0 | E | 60.61 | X | X | X | X | X | X | X | X | X | 8 | | | | | X | 1 | | | | | | | | | X | | | X | 2 | 0.22 | 0.33 | | | |
| Brush Fork (10-519-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302185 | 0.1 | 80.8 | E | 117.6 | X | X | X | X | X | X | X | X | X | 9 | | | | | | | 0 | | | | | | | | X | X | | | X | 3 | 0.10 | 0.40 | | |
| Rock Lick (10-518-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302770 | 0.5 | 79.0 | E | 161.5 | X | X | X | X | X | X | X | X | X | 9 | | | | | X | 1 | | | | | | | | | | | | | | 0 | 0.20 | 0.10 | | |
| Pond Lick Run (10-517-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302184 | 0.2 | 79.0 | E | 64.52 | X | X | X | X | X | X | X | X | X | 9 | | | | | X | 1 | | | | | | | | | | | | | | 0 | 0.20 | 0.10 | | |
| Odell Creek (10-516-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2013 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302183 | 0.3 | 81.5 | E | 54.05 | X | X | X | X | X | X | X | X | X | 10 | | | | | | | 0 | | | | | | | | | | | | | 0 | 0.09 | 0.09 | | |

| Key QHEI Components | WWH Attributes | | | | | | | | | | MWH Attributes | | | | | | | | | | MWH M.I. / WWH Ratio | | | | | | | | | | | | | | | | | |
|--|----------------|------|-----------------|------------------|------------------------------|----------------------------------|---------------------|----------------------------|-------------------------|--------------------------|---------------------|-------------------------|------------------|--------------------------------|----------------|-------------------------|----------------------|--------------|-----------------|------------------|----------------------|------------------------------------|--------------------|---------------------------|------------------------|--------------------------|-----------------------|---------------|-------------------------|-------------------------|-----------------|----------------------------|-------------------------------|------------------------------------|-----------|--------------------------|------|--|
| | Station | QHEI | Narrative Score | Gradient (ft/mi) | Not Channelized or Recovered | Boulder/Cobble/Gravel Substrates | Silt Free Substrate | Good/Excellent Development | Moderate/High Sinuosity | Extensive/Moderate Cover | Fast Current/Eddies | Low/Normal Embeddedness | Max Depth > 40cm | Low/Normal Riffle Embeddedness | WWH Attributes | Channelized/No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40cm | | High-Influence Modified Attributes | Recovering Channel | Heavy/Moderate Substrates | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1 or 2 Cover Types | Intermittent/Poor Pools | No Fast Current | High/Moderate Embeddedness | High/Mod. Riffle Embeddedness | Mod. Influence Modified Attributes | No Riffle | MWH H.I.+1 / WWH+1 Ratio | | |
| Turkey Creek (10-508-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303610 | 12.9 | 82.5 | E | 155.0 | X | X | X | X | X | X | X | X | X | X | 10 | | | | | | 0 | | | | | | | | | | | | | | 1 | 0.09 | 0.18 | |
| 303609 | 10.7 | 74.0 | E | 88.20 | X | X | X | X | X | | X | X | X | | 9 | | | | X | | 1 | | | | | | | | | X | X | | | | 2 | 0.20 | 0.30 | |
| X04P03 | 9.6 | 80.5 | E | 73.20 | X | X | | X | X | X | | X | X | | 8 | | | | | | 0 | | X | | | | | | | | | X | | | 2 | 0.11 | 0.33 | |
| Turkey Creek (10-508-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 200744 | 6.7 | 78.0 | E | 52.00 | X | X | | X | X | X | X | X | X | | 9 | | | | | | 0 | | | | | | | X | | | | | | | 1 | 0.10 | 0.20 | |
| X04P02 | 4.1 | 81.5 | E | 40.90 | X | X | | X | X | X | X | X | X | | 9 | | | | | | 0 | | | | | | | | | | | | | | 0 | 0.10 | 0.10 | |
| Nace Run (10-507-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303601 | 0.4 | 70.0 | E | 147.0 | X | X | | X | X | X | X | X | | 8 | | | | | X | | 1 | | | | | | | | | | | | | | 0 | 0.22 | 0.11 | |
| Town Run (10-407-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X02S05 | 0.8 | 77.0 | E | 166.7 | X | X | X | X | X | X | X | X | X | X | 10 | | | | | | 0 | | | | | | | | X | | | | | | 1 | 0.09 | 0.18 | |
| X02W04 | 0.6 | 77.0 | E | 153.9 | X | | X | X | X | X | X | X | X | | 9 | | | | | | 0 | | | | | | | | X | | | | | | 1 | 0.10 | 0.20 | |
| Sycamore Run (10-316-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2017 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302968 | 0.1 | 79.5 | E | 20.00 | X | X | | X | X | X | | X | X | | 7 | | | | | | 0 | | X | | X | | | | X | X | X | X | | | 6 | 0.13 | 1.00 | |
| Buck Run (10-315-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302967 | 0.1 | 74.5 | E | 25.00 | X | X | | X | X | X | | X | X | X | 8 | | | | | | 0 | | | | | | | | X | X | | | X | | 3 | 0.11 | 0.44 | |
| West Fork Straight Creek (10-314-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302966 | 1.3 | 68.5 | G | 21.27 | X | X | | X | X | X | | X | | 7 | | | | | X | | 1 | | | | | | | | X | | | X | | | 2 | 0.25 | 0.38 | |
| Honey Run (10-313-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302965 | 0.1 | 67.8 | G | 26.47 | X | X | | X | X | | X | X | X | | 7 | | | | X | | 1 | | | | X | X | | X | X | | | X | | 5 | 0.25 | 0.75 | | |
| Myers Run (10-311-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302964 | 0.1 | 60.0 | G | 97.87 | X | | | X | X | X | X | X | X | | 8 | | | | X | | 1 | | | | X | X | | X | | | | | | 3 | 0.22 | 0.44 | | |

| Key QHEI Components | WWH Attributes | | | | | | | | | | MWH Attributes | | | | | | | | | | MWH M.I. / WWH Ratio | | | | | | | | | | | | | | | | | |
|------------------------------------|----------------|------|-----------------|-----------------|------------------------------|----------------------------------|---------------------|----------------------------|-------------------------|--------------------------|---------------------|-------------------------|------------------|--------------------------------|----------------|-------------------------|----------------------|--------------|-----------------|------------------|----------------------|------------------------------------|--------------------|---------------------------|------------------------|--------------------------|-----------------------|---------------|-------------------------|-------------------------|-----------------|----------------------------|-------------------------------|------------------------------------|-----------|--------------------------|------|--|
| | Station | QHEI | Narrative Score | Gradient (ft/m) | Not Channelized or Recovered | Boulder/Cobble/Gravel Substrates | Silt Free Substrate | Good/Excellent Development | Moderate/High Sinuosity | Extensive/Moderate Cover | Fast Current/Eddies | Low/Normal Embeddedness | Max Depth > 40cm | Low/Normal Riffle Embeddedness | WWH Attributes | Channelized/No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40cm | | High-Influence Modified Attributes | Recovering Channel | Heavy/Moderate Substrates | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1 or 2 Cover Types | Intermittent/Poor Pools | No Fast Current | High/Moderate Embeddedness | High/Mod. Riffle Embeddedness | Mod. Influence Modified Attributes | No Riffle | MWH H.I.+1 / WWH+1 Ratio | | |
| Camp Run (10-310-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302963 | 0.1 | 60.8 | G | 67.85 | X | | X | X | X | X | X | X | X | 6 | | | | | | 0 | | | | X | X | | | | X | | X | | | | 4 | 0.14 | 0.71 | |
| Scott Run (10-309-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302962 | 0.2 | 69.5 | G | 251.2 | X | | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | | | | X | | | | | | 1 | 0.11 | 0.22 | |
| Bull Run (10-308-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302961 | 0.1 | 73.5 | E | 95.23 | X | X | X | X | X | X | X | X | X | 8 | | | | | X | 1 | | | | | | | | | | | | | | | 0 | 0.22 | 0.11 | |
| Washburn Run (10-307-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302960 | 1.3 | 71.0 | E | 51.92 | X | | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | | | | X | | | | | | 1 | 0.11 | 0.22 | |
| Evans Run (10-305-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302959 | 0.1 | 77.3 | E | 128.0 | X | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | | | | | | | | X | | | | X | | 2 | 0.10 | 0.30 | |
| Campbell Run (10-304-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302958 | 0.2 | 74.5 | E | 183.3 | X | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | | | | | | | | X | | | | X | | 2 | 0.10 | 0.30 | |
| Sheep Run (10-303-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302957 | 0.1 | 69.3 | G | 103.8 | X | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | X | X | | | X | X | | | | | | 4 | 0.11 | 0.56 | |
| Rangle Run (10-302-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302956 | 0.3 | 73.8 | E | 192.0 | X | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | X | X | | | X | | | | | X | | 4 | 0.11 | 0.56 | |
| Sink Creek (10-301-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302955 | 0.2 | 58.8 | G | 12.50 | X | X | | | X | | X | | | 4 | | | | | | 0 | X | | X | X | | | X | X | X | | X | | | | 7 | 0.20 | 1.80 | |
| Straight Creek (10-300-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303475 | 17.7 | 70.5 | E | 31.25 | X | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | | | | X | X | | | X | | 3 | 0.11 | 0.44 | |

| Key QHEI Components | WWH Attributes | | | | | | | | | | MWH Attributes | | | | | | | | | | MWH M.I. / WWH Ratio | | | | | | | | | | | | | | | | | |
|--|----------------|-------------|-----------------|------------------|------------------------------|----------------------------------|---------------------|----------------------------|-------------------------|--------------------------|---------------------|-------------------------|------------------|--------------------------------|----------------|-------------------------|----------------------|--------------|-----------------|------------------|------------------------------------|--------------------|---------------------------|------------------------|--------------------------|-----------------------|---------------|-------------------------|-------------------------|-----------------|----------------------------|-------------------------------|------------------------------------|-----------|--------------------------|----------------------|------|--|
| | Station | QHEI | Narrative Score | Gradient (ft/mi) | Not Channelized or Recovered | Boulder/Cobble/Gravel Substrates | Silt Free Substrate | Good/Excellent Development | Moderate/High Sinuosity | Extensive/Moderate Cover | Fast Current/Eddies | Low/Normal Embeddedness | Max Depth > 40cm | Low/Normal Riffle Embeddedness | WWH Attributes | Channelized/No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40cm | High-Influence Modified Attributes | Recovering Channel | Heavy/Moderate Substrates | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1 or 2 Cover Types | Intermittent/Poor Pools | No Fast Current | High/Moderate Embeddedness | High/Mod. Riffle Embeddedness | Mod. Influence Modified Attributes | No Riffle | MWH H.I.+1 / WWH+1 Ratio | MWH M.I. / WWH Ratio | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X03W09 | 16.8 | 70.8 | E | 16.95 | X | X | X | X | X | X | X | X | X | 9 | | | | | X | 1 | | | | | | | | | | | | | | | 1 | 0.20 | 0.30 | |
| X03W11 | 9.5 | 72.3 | G | 27.40 | X | | X | X | X | X | X | X | X | 8 | | | | | X | 1 | | | | X | | | | | | | | | | | 2 | 0.22 | 0.33 | |
| X03W12 | 2.8 | 76.8 | E | 22.47 | X | X | X | X | X | X | X | X | X | 9 | | | | | X | 1 | | | | X | | | | | | | | | | | 1 | 0.20 | 0.20 | |
| Mackenzie Run (10-203-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2014 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302767 | 0.2 | 52.0 | F | 60.60 | X | X | | X | | | X | | | 4 | | | | | X | X | 2 | | | X | | | | | | | | | X | 3 | 0.60 | 1.00 | | |
| Honey Creek E of Russellville @ Mouth (10-120-002) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X99Q04 | 0.1 | 70.3 | E | 61.80 | X | | X | X | X | X | X | X | X | 7 | | | | | X | 1 | | | | | | | | | | | | | X | | 1 | 0.25 | 0.25 | |
| Trib To W Fk Eagle Creek (7.05) @ Russellville-Winchester Rd (10-120-001) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X03W07 | 1.8 | 64.3 | G | 14.93 | X | | X | | X | X | X | X | X | 5 | | | | | X | 1 | | | | X | X | | | | | | | X | | 3 | 0.33 | 0.67 | | |
| West Fork Eagle Creek (10-120-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X03W05 | 7.4 | 88.8 | E | 20.20 | X | X | | X | X | X | X | X | X | 9 | | | | | | | | | | | | | | | | | | | | | 0 | 0.10 | 0.10 | |
| 200693 | 3.3 | 87.5 | E | 20.90 | X | X | X | X | X | X | X | X | X | 10 | | | | | | | | | | | | | | | | | | | | | 0 | 0.09 | 0.09 | |
| Gordon Run (10-116-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302953 | 0.1 | 77.8 | E | 30.71 | X | X | | X | X | X | | X | | 6 | | | | | | 0 | | X | | | | | | | | | | X | X | X | 4 | 0.14 | 0.71 | |
| Lick Run (10-115-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302952 | 1.0 | 74.3 | E | 33.33 | X | X | | X | X | | X | | | 5 | | | | | X | 1 | | X | | X | | | | | | | X | X | X | X | 6 | 0.33 | 1.17 | |
| Hills Fork (10-114-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302951 | 3.1 | 81.5 | E | 22.72 | X | X | | X | X | X | | X | X | 8 | | | | | | 0 | | | | | | | | | | | X | | | | 1 | 0.11 | 0.22 | |
| 302950 | 1.3 | 78.5 | E | 13.04 | X | | X | X | X | | X | | | 5 | | | | | | 0 | | X | | | | | | | | | X | X | X | | 4 | 0.17 | 0.83 | |
| Ada Run (10-113-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302949 | 0.7 | 83.3 | E | 57.14 | X | X | | X | X | X | | X | X | 8 | | | | | | 0 | | | | | | | | | | | X | | | X | 2 | 0.11 | 0.33 | |

| Key QHEI Components | WWH Attributes | | | | | | | | MWH Attributes | | | | | | | | MWH M.I. / WWH Ratio | | | | | | | | | | | | | | | | | | |
|---|----------------|------|-----------------|------------------|------------------------------|----------------------------------|---------------------|----------------------------|-------------------------|--------------------------|---------------------|-------------------------|------------------|--------------------------------|----------------|-------------------------|----------------------|----------------------|--------------|-----------------|------------------|------------------------------------|--------------------|---------------------------|------------------------|--------------------------|-----------------------|---------------|-------------------------|-------------------------|-----------------|----------------------------|-------------------------------|------------------------------------|-----------|
| | Station | QHEI | Narrative Score | Gradient (ft/mi) | Not Channelized or Recovered | Boulder/Cobble/Gravel Substrates | Silt Free Substrate | Good/Excellent Development | Moderate/High Sinuosity | Extensive/Moderate Cover | Fast Current/Eddies | Low/Normal Embeddedness | Max Depth > 40cm | Low/Normal Riffle Embeddedness | WWH Attributes | Channelized/No Recovery | | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40cm | High-Influence Modified Attributes | Recovering Channel | Heavy/Moderate Substrates | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1 or 2 Cover Types | Intermittent/Poor Pools | No Fast Current | High/Moderate Embeddedness | High/Mod. Riffle Embeddedness | Mod. Influence Modified Attributes | No Riffle |
| Washburn Run (10-112-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302948 | 1.4 | 66.3 | G | 45.00 | X | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | | | | X | X | | X | 3 | 0.11 | 0.44 |
| Town Branch (10-111-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302947 | 0.2 | 73.0 | E | 108.0 | X | | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | | | | X | | | | 1 | 0.11 | 0.22 |
| Trib. To East Fork Eagle Creek (6.92) (10-110-002) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303611 | 0.1 | 80.3 | E | 40.20 | X | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | X | | | | | | | | X | | 2 | 0.10 | 0.30 | |
| East Fork Eagle Creek (10-110-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303607 | 11.0 | 78.8 | E | 19.40 | X | X | X | X | X | | | X | X | 7 | | | | | | 0 | | X | | | | | | | X | X | X | | 4 | 0.13 | 0.63 |
| X03S03 | 7.9 | 83.5 | E | 14.70 | X | X | X | X | X | | | X | X | 8 | | | | | | 0 | | X | | | | | | | X | | | | 2 | 0.11 | 0.33 |
| 200691 | 4.3 | 89.8 | E | 12.90 | X | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | | | | | | | | | | | | 0 | 0.10 | 0.10 |
| X03W04 | 0.8 | 81.0 | E | 34.48 | X | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | | | | | | | | | | | | 0 | 0.10 | 0.10 |
| Suck Run (10-106-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302946 | 1.7 | 65.5 | G | 54.09 | X | | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | X | X | | X | | | X | 4 | 0.11 | 0.56 |
| Brushy Fork (10-105-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302945 | 1.0 | 57.3 | G | 40.32 | X | | | | X | | | | X | 3 | | | | | | X | X | 2 | | | | X | X | | X | X | | X | 5 | 0.75 | 1.50 |
| Lafferty Run (10-103-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302943 | 0.1 | 74.0 | E | 94.12 | X | X | X | X | X | X | X | X | X | 10 | | | | | | X | 1 | | | | | X | X | | | | | | 2 | 0.18 | 0.27 |
| Beetle Creek (10-102-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302942 | 4.9 | 75.0 | E | 26.32 | X | X | X | X | X | X | X | X | X | 9 | | | | | | X | 1 | | | | | X | | | X | | | | 2 | 0.20 | 0.30 |
| 302941 | 0.5 | 69.3 | G | 36.48 | X | X | X | X | X | X | X | X | X | 8 | | | | | | X | 1 | | | | | X | | | X | | | | 2 | 0.22 | 0.33 |
| Baylor Run (10-101-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302940 | 0.2 | 68.0 | G | 122.7 | X | X | X | X | X | X | X | X | X | 8 | | | | | | X | 2 | | | | | X | | | | | | | 1 | 0.33 | 0.22 |

| Key QHEI Components | WWH Attributes | | | | | | | | | | MWH Attributes | | | | | | | | | | MWH M.I. / WWH Ratio | | | | | | | | | | | | | | | | | |
|--|----------------|------|-----------------|------------------|------------------------------|----------------------------------|---------------------|----------------------------|-------------------------|--------------------------|---------------------|-------------------------|------------------|--------------------------------|----------------|-------------------------|----------------------|--------------|-----------------|------------------|----------------------|------------------------------------|--------------------|---------------------------|------------------------|--------------------------|-----------------------|---------------|-------------------------|-------------------------|-----------------|----------------------------|-------------------------------|------------------------------------|-----------|--------------------------|------|--|
| | Station | QHEI | Narrative Score | Gradient (ft/mi) | Not Channelized or Recovered | Boulder/Cobble/Gravel Substrates | Silt Free Substrate | Good/Excellent Development | Moderate/High Sinuosity | Extensive/Moderate Cover | Fast Current/Eddies | Low/Normal Embeddedness | Max Depth > 40cm | Low/Normal Riffle Embeddedness | WWH Attributes | Channelized/No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40cm | | High-Influence Modified Attributes | Recovering Channel | Heavy/Moderate Substrates | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1 or 2 Cover Types | Intermittent/Poor Pools | No Fast Current | High/Moderate Embeddedness | High/Mod. Riffle Embeddedness | Mod. Influence Modified Attributes | No Riffle | MWH H.I.+1 / WWH+1 Ratio | | |
| Eagle Creek (10-100-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303537 | 14.4 | 88.3 | E | 20.30 | X | X | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | | | | | | | | | | | | | 0 | 0.10 | 0.10 | |
| 200689 | 6.2 | 88.0 | E | 18.00 | X | X | X | X | X | X | X | X | X | X | 10 | | | | | | 0 | | | | | | | | | | | | | | 0 | 0.09 | 0.09 | |
| Pond Run (10-099-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303613 | 4.6 | 77.5 | E | 93.90 | X | X | X | X | X | X | X | X | X | X | 10 | | | | | | 0 | | | | | | | | X | | | | | 1 | 0.09 | 0.18 | | |
| 303602 | 0.4 | 77.5 | E | 63.70 | X | X | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | | | | | | | | | | | | | 0 | 0.10 | 0.10 | |
| Mcatee Run (10-096-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303603 | 0.7 | 66.5 | G | 192.0 | X | X | X | X | X | X | X | X | X | X | 9 | | | X | X | 2 | | | | X | | | | | | | | | | 1 | 0.30 | 0.20 | | |
| East Fork Upper Twin Creek (10-089-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303597 | 0.1 | 79.3 | E | 86.90 | X | X | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | X | | X | | | | | | 2 | 0.11 | 0.33 | | |
| Upper Twin Creek (10-085-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X04P01 | 2.6 | 80.0 | E | 64.70 | X | X | X | X | X | X | X | X | X | X | 10 | | | | | | 0 | | | | | | | | | | | | | 0 | 0.09 | 0.09 | | |
| Lower Twin Creek (10-082-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303600 | 5.2 | 74.3 | E | 105.0 | X | X | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | | | | | | X | X | | | | | 2 | 0.10 | 0.30 | | |
| X99Q02 | 1.7 | 73.0 | E | 28.57 | X | X | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | X | | X | X | | | | | | 3 | 0.11 | 0.44 | | |
| Rock Run (10-081-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303604 | 1.8 | 73.5 | E | 92.80 | X | X | X | X | X | X | X | X | X | X | 6 | | | | X | 1 | | X | | | | | X | X | X | X | X | | | 5 | 0.29 | 0.86 | | |
| Year: 2017 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303604 | 0.3 | 65.5 | G | 92.80 | X | X | X | X | X | X | X | X | X | X | 7 | | | | | | 0 | | | | | | X | X | | | | | | 2 | 0.13 | 0.38 | | |
| Sulphur Creek (10-077-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303608 | 0.4 | 64.5 | G | 180.0 | X | X | X | X | X | X | X | X | X | X | 7 | | | | X | 1 | | X | | X | | X | X | | | | X | X | X | 5 | 0.25 | 0.75 | | |
| Long Lick Run (10-075-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303599 | 1.2 | 80.0 | E | 143.0 | X | X | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | X | | | | | | | 1 | 0.11 | 0.22 | | |

| Key QHEI Components | WWH Attributes | | | | | | | | | | MWH Attributes | | | | | | | | | | WWH M.I. / WWH Ratio | | | | | | | | | | | | | | | | | |
|--|----------------|------|-----------------|------------------|------------------------------|----------------------------------|---------------------|----------------------------|-------------------------|--------------------------|---------------------|-------------------------|------------------|--------------------------------|----------------|-------------------------|----------------------|--------------|-----------------|------------------|------------------------------------|--------------------|---------------------------|------------------------|--------------------------|-----------------------|---------------|-------------------------|-------------------------|-----------------|----------------------------|-------------------------------|------------------------------------|-----------|--------------------------|--------------------------|--|--|
| | Station | QHEI | Narrative Score | Gradient (ft/mi) | Not Channelized or Recovered | Boulder/Cobble/Gravel Substrates | Silt Free Substrate | Good/Excellent Development | Moderate/High Sinuosity | Extensive/Moderate Cover | Fast Current/Eddies | Low/Normal Embeddedness | Max Depth > 40cm | Low/Normal Riffle Embeddedness | WWH Attributes | Channelized/No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40cm | High-Influence Modified Attributes | Recovering Channel | Heavy/Moderate Substrates | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1 or 2 Cover Types | Intermittent/Poor Pools | No Fast Current | High/Moderate Embeddedness | High/Mod. Riffle Embeddedness | Mod. Influence Modified Attributes | No Riffle | WWH H.I.+1 / WWH+1 Ratio | MWH H.I.+1 / WWH+1 Ratio | | |
| Puntenney Run (10-071-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302195 | 1.4 | 63.8 | G | 4.08 | X | X | X | X | X | X | X | X | 7 | | | | | X | X | 2 | | | | X | | | | | | X | X | X | X | 3 | 0.38 | 0.50 | | |
| Russell Fork (10-069-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303605 | 0.1 | 68.8 | G | 62.00 | X | X | X | X | X | X | X | X | 7 | | | | | | 0 | | X | | X | | | | | | X | X | X | X | 5 | 0.13 | 0.88 | | | |
| Stout Run (10-067-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 200741 | 3.0 | 67.3 | G | 127.0 | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | | | | X | X | | | | | 2 | 0.11 | 0.33 | | |
| Donaldson Run (10-060-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303595 | 0.5 | 72.3 | E | 175.0 | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | | | | | | | X | | | | X | 2 | 0.11 | 0.33 | | |
| Island Creek (10-057-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303598 | 1.1 | 71.0 | E | 96.60 | X | X | X | X | X | X | X | X | 9 | | | | | X | 1 | | | | | | | | | X | | | | | | 1 | 0.20 | 0.20 | | |
| Isaacs Creek (10-056-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2017 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 303612 | 1.4 | 74.0 | E | 95.50 | X | X | | X | X | X | X | X | 6 | | | | | | 0 | | | | X | X | | | X | | | | | | 3 | 0.14 | 0.57 | | | |
| Little Threemile Creek (10-050-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X99Q01 | 1.3 | 90.5 | E | 22.39 | X | X | X | X | X | X | X | X | 9 | | | | | | 0 | | | | | | | | | | | | | | | 0 | 0.10 | 0.10 | | |
| Fishing Gut Creek (10-049-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2016 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X03W13 | 1.7 | 74.3 | E | 44.44 | X | X | X | X | X | X | X | X | 8 | | | | | | 0 | | | | X | X | | | X | | | | | X | 4 | 0.11 | 0.56 | | | |
| Fishing Gut Creek (10-049-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2017 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| X03W13 | 1.0 | 72.8 | E | 44.44 | X | X | | X | X | X | X | X | 7 | | | | | | 0 | | | | X | | | | X | | | | | | 2 | 0.13 | 0.38 | | | |
| Morley Run (10-048-000) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2015 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 302939 | 0.1 | 80.0 | E | 144.4 | X | X | X | X | X | X | X | X | 10 | | | | | | 0 | | | | | | | | | | | | | | | 0 | 0.09 | 0.09 | | |

Fish Community Results

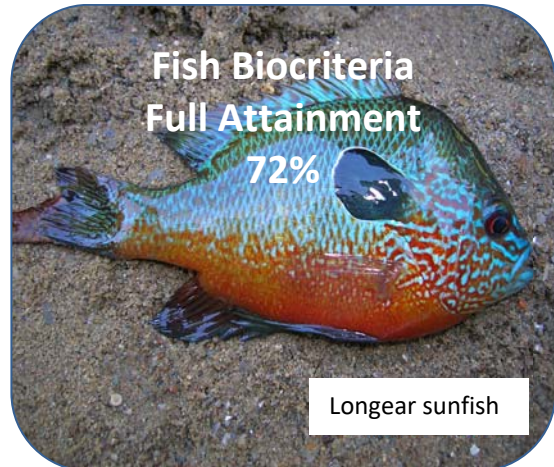
Fish sampling was conducted at 90 sites in the SORT study area. Relative numbers of fish species collected per location are presented in Appendix D, and IBI and MIwb scores are presented in Appendix E. Sampling locations were evaluated using WWH and EWH biocriteria. A summary of the fish data is presented in Table 10.

Twenty-two of the 90 fish sampling stations did not meet the applicable biocriteria. Of the 90 fish stations assessed, 68 sites (75.6 percent) were fully meeting the designated or recommended ALU.

Narrative fish community evaluations based on IBI and MIwb scores in Table 10 allow for the comparison of fish communities from site to site. Ten of the sites scored exceptional fish communities out of the 90 total sites¹. Fifty-two percent of fish sites scored within the narratively very good to marginally good range. Sites that were scored within the very good, good, and marginally good categories would meet WWH expectations for fish in the IP and WAP ecoregions. Thirty-one sites were found to have fair to very poor fish communities based upon IBI and MIwb scores alone.

The remaining four fish sites that scored in the narratively fair to very poor range were fully meeting their recommended or designated aquatic life uses. This is because there are no numerical criteria for CWH designated streams in Ohio. Ecological conditions at these locations were more oligotrophic and contained limited numbers of fish species establishing CWH assemblages (Appendix D). These streams were Brush Fork, Wes Run, Harber Fork, and Wolfden Run (Table 1). More than 20 percent of the sample sites in the SORT study area had fish species indicative of good ground water connectivity and were either already designated or recommended for CWH ALU (Table 1 and Table 13). Most of these sites were found within the WAP ecoregion or along the eastern side of the IP ecoregion where naturally good ground water connectivity was present.

Table 10 — Fish community status for stations sampled in the SORT study area based on data collected in 2013-2017. The IBI and MIwb are scores based on the performance of the fish community. The narrative fish evaluations (exceptional, very good, etc.) were based upon the corresponding IBI and MIwb scores relative to the drainage area, ecoregion and the assigned ALU. The QHEI is a measure of the ability of the physical habitat to support a biotic community.



| Station | WAU | River Mile | Drain. Area (mi ²) | Fish Species | Rel. Num. | Rel. Biomass (kg) | QHEI | IBI | MIwb | Narrative Evaluation (IBI : MIwb) |
|-----------------------------------|-------|------------|--------------------------------|--------------|-----------|-------------------|------|-----|------|-----------------------------------|
| | | | | | | | | | | |
| Dry Run (17-309-000) | | | | | | | | | | |
| 302620 | 05 01 | 0.14 | ^H 3.0 | 0 | 0 | - | 74.5 | 12 | - | Very Poor : - |
| Dinner Fork (17-081-000) | | | | | | | | | | |
| 302288 | 11 01 | 1.22 | ^H 2.5 | 16 | 540 | - | 65.5 | 52 | - | Exceptional : - |
| Limestone Run (17-079-000) | | | | | | | | | | |
| 302182 | 11 02 | 0.17 | ^H 1.2 | 12 | 373 | - | 53.0 | 52 | - | Exceptional : - |
| Reasoners Run (17-077-000) | | | | | | | | | | |
| 302181 | 11 04 | 0.06 | ^H 4.6 | 12 | 462 | - | 73.5 | 36 | - | Fair : - |

¹ All samples are displayed in Table 13; however, discussion is based on averaging samples at multiple pass sites.

| Station | WAU | River Mile | | Drain. Area (mi ²) | Fish Species | Rel. Num. | Rel. Biomass (kg) | QHEI | IBI | MIwb | Narrative Evaluation (IBI : MIwb) |
|---|-------|------------|---|--------------------------------|--------------|-----------|-------------------|------|-----|------|-----------------------------------|
| Stony Creek (17-076-000) | | | | | | | | | | | |
| 302180 | 11 04 | 0.47 | H | 1.0 | 7 | 730 | - | 72.0 | 38 | - | Fair : - |
| Allen Run (17-075-000) | | | | | | | | | | | |
| 302179 | 11 03 | 0.05 | H | 1.7 | 9 | 533 | - | 71.5 | 44 | - | Good : - |
| Scott Run (17-074-000) | | | | | | | | | | | |
| 302178 | 11 03 | 0.11 | H | 3.0 | 10 | 1886 | - | 61.0 | 46 | - | Very Good : - |
| Elk Run (17-072-000) | | | | | | | | | | | |
| 302364 | 11 04 | 0.18 | H | 0.9 | 9 | 945 | - | 67.0 | 42 | - | Marg. Good : - |
| Cow Run (17-071-000) | | | | | | | | | | | |
| 302177 | 11 04 | 0.01 | H | 1.4 | 17 | 1130 | - | 73.5 | 50 | - | Exceptional : - |
| Peeper Run (17-065-000) | | | | | | | | | | | |
| 302176 | 10 01 | 0.10 | H | 1.3 | 18 | 958 | - | 70.8 | 46 | - | Very Good : - |
| Kickapoo Creek (17-064-000) | | | | | | | | | | | |
| 302175 | 10 01 | 0.12 | H | 2.3 | 13 | 422 | - | 72.0 | 38 | - | Fair : - |
| Hedgehog Creek (17-063-000) | | | | | | | | | | | |
| 302174 | 10 01 | 0.09 | H | 2.5 | 14 | 950 | - | 62.8 | 34 | - | Fair : - |
| Pleasant Run (17-062-000) | | | | | | | | | | | |
| 302378 | 10 01 | 0.50 | H | 0.8 | 14 | 2588 | - | 54.5 | 44 | - | Good : - |
| Buck Run (17-061-000) | | | | | | | | | | | |
| 302173 | 10 01 | 0.08 | H | 5.5 | 20 | 2176 | - | 60.5 | 42 | - | Marg. Good : - |
| Chaneyville Run (17-060-000) | | | | | | | | | | | |
| 302386 | 10 01 | 1.48 | H | 0.4 | 7 | 715 | - | 74.0 | 42 | - | Marg. Good : - |
| Browns Run (17-058-000) | | | | | | | | | | | |
| 302387 | 10 02 | 0.20 | H | 0.5 | 8 | 780 | - | 64.5 | 40 | - | Marg. Good : - |
| Mcperson Run (17-056-000) | | | | | | | | | | | |
| 302400 | 10 02 | 0.10 | H | 0.9 | 17 | 1088 | - | 61.5 | 44 | - | Good : - |
| Lick Run (17-055-000) | | | | | | | | | | | |
| 302379 | 10 02 | 0.05 | H | 0.8 | 9 | 1093 | - | 63.8 | 46 | - | Very Good : - |
| Scott Run (17-054-000) | | | | | | | | | | | |
| 302170 | 10 02 | 0.01 | H | 3.0 | 12 | 1080 | - | 60.4 | 43 | - | Marg. Good : - |
| Mile Run (17-052-000) | | | | | | | | | | | |
| 302169 | 10 03 | 0.72 | H | 1.3 | 15 | 2640 | - | 62.5 | 42 | - | Marg. Good : - |
| Buckeye Run (17-051-000) | | | | | | | | | | | |
| 302263 | 10 03 | 0.05 | H | 3.2 | 19 | 1683 | - | 74.5 | 50 | - | Exceptional : - |
| North Branch Coal Run (17-050-000) | | | | | | | | | | | |
| 302168 | 10 03 | 1.80 | H | 4.3 | 21 | 1517 | - | 75.5 | 50 | - | Exceptional : - |
| Shrader Run (17-049-000) | | | | | | | | | | | |
| 201308 | 10 03 | 0.10 | H | 2.3 | 10 | 873 | - | 80.5 | 44 | - | Good : - |
| Laurel Run (17-047-000) | | | | | | | | | | | |
| 302165 | 10 04 | 0.65 | H | 6.8 | 22 | 1637 | - | 71.5 | 46 | - | Very Good : - |

| Station | WAU | River Mile | | Drain. Area (mi ²) | Fish Species | Rel. Num. | Rel. Biomass (kg) | QHEI | IBI | MIwb | Narrative Evaluation (IBI : MIwb) |
|--------------------------------------|-------|------------|---|--------------------------------|--------------|-----------|-------------------|------|-----|------|-----------------------------------|
| Whitewater Creek (17-046-000) | | | | | | | | | | | |
| 302164 | 10 04 | 0.01 | H | 3.6 | 22 | 640 | - | 82.0 | 46 | - | Very Good : - |
| Lucas Run (17-045-000) | | | | | | | | | | | |
| 302163 | 10 04 | 0.85 | H | 4.1 | 12 | 884 | - | 59.8 | 44 | - | Good : - |
| Chainey Run (17-043-000) | | | | | | | | | | | |
| 302385 | 09 02 | 0.52 | H | 0.4 | 5 | 413 | - | 65.0 | 38 | - | Fair : - |
| Turkeyhen Run (17-040-000) | | | | | | | | | | | |
| 302161 | 09 02 | 1.20 | H | 3.3 | 12 | 2078 | - | 50.8 | 36 | - | Fair : - |
| Painter Run (17-036-000) | | | | | | | | | | | |
| 302160 | 09 03 | 0.42 | H | 2.8 | 4 | 600 | - | 54.8 | 32 | - | Fair : - |
| Flint Run (17-034-000) | | | | | | | | | | | |
| 302159 | 10 04 | 0.14 | H | 2.8 | 7 | 565 | - | 56.5 | 30 | - | Fair : - |
| Bosman Run (17-033-000) | | | | | | | | | | | |
| 302390 | 10 04 | 0.22 | H | 0.7 | 11 | 1125 | - | 59.5 | 40 | - | Marg. Good : - |
| Duck Creek (17-032-000) | | | | | | | | | | | |
| 302158 | 10 04 | 0.04 | H | 2.8 | 9 | 620 | - | 65.5 | 42 | - | Marg. Good : - |
| Hayward Run (17-031-000) | | | | | | | | | | | |
| 302157 | 10 04 | 0.57 | H | 3.4 | 20 | 1764 | - | 65.0 | 42 | - | Marg. Good : - |
| Wolfden Run (10-530-000) | | | | | | | | | | | |
| 302768 | 02 01 | 0.50 | H | 0.4 | 4 | 199 | - | 53.0 | 30 | - | Fair : - |
| Old Lade Run (10-527-000) | | | | | | | | | | | |
| 302190 | 02 01 | 0.20 | H | 2.2 | 8 | 420 | - | 77.3 | 36 | - | Fair : - |
| Lampblack Run (10-526-000) | | | | | | | | | | | |
| 302189 | 02 01 | 0.10 | H | 2.7 | 10 | 916 | - | 78.0 | 42 | - | Marg. Good : - |
| Mackletree Run (10-524-000) | | | | | | | | | | | |
| 302188 | 02 01 | 0.43 | H | 5.8 | 14 | 1452 | - | 91.0 | 48 | - | Very Good : - |
| Harber Fork (10-523-000) | | | | | | | | | | | |
| 302187 | 02 02 | 0.07 | H | 4.7 | 4 | 330 | - | 78.8 | 26 | - | Poor : - |
| Wes Run (10-520-000) | | | | | | | | | | | |
| 302186 | 02 02 | 0.01 | H | 1.0 | 2 | 152 | - | 76.0 | 24 | - | Poor : - |
| Brush Fork (10-519-000) | | | | | | | | | | | |
| 302185 | 02 02 | 0.01 | H | 1.1 | 3 | 186 | - | 80.8 | 26 | - | Poor : - |
| Rock Lick (10-518-000) | | | | | | | | | | | |
| 302770 | 02 02 | 0.50 | H | 0.4 | 0 | 0 | - | 79.0 | 12 | - | Very Poor : - |
| Pond Lick Run (10-517-000) | | | | | | | | | | | |
| 302184 | 02 02 | 0.20 | H | 5.3 | 12 | 332 | - | 79.0 | 46 | - | Very Good : - |
| Odell Creek (10-516-000) | | | | | | | | | | | |
| 302183 | 02 02 | 0.30 | H | 5.3 | 7 | 1342 | - | 81.5 | 44 | - | Good : - |
| Turkey Creek (10-508-000) | | | | | | | | | | | |
| 303610 | 02 01 | 12.90 | H | 1.6 | 8 | 576 | - | 82.5 | 40 | - | Marg. Good : - |
| 303609 | 02 01 | 10.70 | H | 8.7 | 9 | 388 | - | 74.0 | 42 | - | Marg. Good : - |

| Station | WAU | River Mile | | Drain. Area (mi ²) | Fish Species | Rel. Num. | Rel. Biomass (kg) | QHEI | IBI | MIwb | Narrative Evaluation (IBI : MIwb) |
|--|-------|------------|--------------|--------------------------------|--------------|-----------|-------------------|------|-----|------|-----------------------------------|
| X04P03 | 02 02 | 9.58 | ^H | 16.5 | 23 | 598 | - | 80.5 | 54 | - | Exceptional : - |
| 200744 | 02 02 | 6.70 | ^H | 26.4 | 16 | 394 | 21.0 | 78.0 | 46 | 8.8 | Very Good : Good |
| X04P02 | 02 02 | 4.13 | ^H | 39.5 | 26 | 753 | 8.4 | 81.5 | 54 | 8.7 | Exceptional : Good |
| Nace Run (10-507-000) | | | | | | | | | | | |
| 303601 | 02 04 | 0.43 | ^H | 1.4 | 4 | 970 | - | 70.0 | 40 | - | Marg. Good : - |
| Town Run (10-407-000) | | | | | | | | | | | |
| X02S05 | 10 03 | 0.81 | ^H | 1.4 | 2 | 618 | - | 77.0 | 20 | - | Poor : - |
| X02W04 | 10 03 | 0.63 | ^H | 1.4 | 3 | 316 | - | 77.0 | 20 | - | Poor : - |
| Sycamore Run (10-316-000) | | | | | | | | | | | |
| 302968 | 08 02 | 0.05 | ^H | 1.6 | 11 | 394 | - | 79.5 | 30 | - | Fair : - |
| Buck Run (10-315-000) | | | | | | | | | | | |
| 302967 | 08 02 | 0.05 | ^H | 2.2 | 11 | 694 | - | 74.5 | 38 | - | Marg. Good : - |
| West Fork Straight Creek (10-314-000) | | | | | | | | | | | |
| 302966 | 08 02 | 1.25 | ^H | 4.3 | 7 | 1184 | - | 68.5 | 24 | - | Poor : - |
| Honey Run (10-313-000) | | | | | | | | | | | |
| 302965 | 08 02 | 0.10 | ^H | 3.0 | 8 | 306 | - | 67.8 | 30 | - | Fair : - |
| Myers Run (10-311-000) | | | | | | | | | | | |
| 302964 | 08 02 | 0.05 | ^H | 1.3 | 11 | 658 | - | 60.0 | 36 | - | Marg. Good : - |
| Camp Run (10-310-000) | | | | | | | | | | | |
| 302963 | 08 02 | 0.10 | ^H | 2.9 | 12 | 1416 | - | 60.8 | 36 | - | Marg. Good : - |
| Scott Run (10-309-000) | | | | | | | | | | | |
| 302962 | 08 02 | 0.20 | ^H | 1.2 | 0 | 0 | - | 69.5 | 12 | - | Very Poor : - |
| Bull Run (10-308-000) | | | | | | | | | | | |
| 302961 | 08 02 | 0.05 | ^H | 1.3 | 4 | 74 | - | 73.5 | 26 | - | Poor : - |
| Washburn Run (10-307-000) | | | | | | | | | | | |
| 302960 | 08 02 | 1.25 | ^H | 5.1 | 6 | 772 | - | 71.0 | 26 | - | Poor : - |
| Evans Run (10-305-000) | | | | | | | | | | | |
| 302959 | 08 03 | 0.05 | ^H | 5.3 | 5 | 450 | - | 77.3 | 22 | - | Poor : - |
| Campbell Run (10-304-000) | | | | | | | | | | | |
| 302958 | 08 03 | 0.20 | ^H | 2.0 | 9 | 394 | - | 74.5 | 32 | - | Fair : - |
| Sheep Run (10-303-000) | | | | | | | | | | | |
| 302957 | 08 03 | 0.10 | ^H | 3.7 | 15 | 1598 | - | 69.3 | 46 | - | Very Good : - |
| Rangle Run (10-302-000) | | | | | | | | | | | |
| 302956 | 08 03 | 0.30 | ^H | 1.0 | 19 | 1428 | - | 73.8 | 46 | - | Very Good : - |
| Sink Creek (10-301-000) | | | | | | | | | | | |
| 302955 | 08 03 | 0.15 | ^H | 1.7 | 10 | 142 | - | 58.8 | 24 | - | Poor : - |
| Straight Creek (10-300-000) | | | | | | | | | | | |
| 303475 | 08 02 | 17.70 | ^H | 8.9 | 16 | 1124 | - | 70.5 | 40 | - | Good : - |
| X03W09 | 08 02 | 16.75 | ^H | 12.5 | 18 | 1782 | - | 70.8 | 46 | - | Very Good : - |
| X03W11 | 08 02 | 9.45 | ^H | 34.0 | 12 | 1164 | 10.2 | 72.3 | 34 | 7.5 | Fair : Fair |
| X03W12 | 08 03 | 2.78 | ^W | 57.0 | 20 | 1560 | 30.8 | 76.8 | 42 | 8.4 | Good : Good |

| Station | WAU | River Mile | Drain. Area (mi ²) | Fish Species | Rel. Num. | Rel. Biomass (kg) | QHEI | IBI | MIwb | Narrative Evaluation (IBI : MIwb) |
|--|-------|------------|--------------------------------|--------------|-----------|-------------------|------|-----|------|-----------------------------------|
| Mackenzie Run (10-203-000) | | | | | | | | | | |
| 302767 | 05 06 | 0.20 | ^H 0.6 | 7 | 284 | - | 52.0 | 44 | - | Good : - |
| Honey Creek E Of Russellville @ Mouth (10-120-002) | | | | | | | | | | |
| X99Q04 | 07 01 | 0.10 | ^H 0.9 | 10 | 1318 | - | 70.3 | 52 | - | Exceptional : - |
| Trib To W Fk Eagle Creek (7.05) @ Russellville-Winchester Rd (10-120-001) | | | | | | | | | | |
| X03W07 | 07 01 | 1.80 | ^H 7.2 | 10 | 1638 | - | 64.3 | 38 | - | Marg. Good : - |
| West Fork Eagle Creek (10-120-000) | | | | | | | | | | |
| X03W05 | 07 01 | 7.38 | ^H 28.0 | 24 | 1280 | 12.8 | 88.8 | 48 | 9.5 | Very Good : Exceptional |
| 200693 | 07 04 | 3.30 | ^W 54.0 | 27 | 606 | 30.3 | 87.5 | 50 | 9.6 | Exceptional : Exceptional |
| Gordon Run (10-116-000) | | | | | | | | | | |
| 302953 | 07 03 | 0.05 | ^H 3.1 | 13 | 1278 | - | 77.8 | 40 | - | Good : - |
| Lick Run (10-115-000) | | | | | | | | | | |
| 302952 | 07 03 | 0.95 | ^H 0.7 | 6 | 782 | - | 74.3 | 32 | - | Fair : - |
| Hills Fork (10-114-000) | | | | | | | | | | |
| 302951 | 07 03 | 3.05 | ^H 5.3 | 13 | 1452 | - | 81.5 | 38 | - | Marg. Good : - |
| 302950 | 07 03 | 1.30 | ^H 10.1 | 17 | 582 | - | 78.5 | 46 | - | Very Good : - |
| Adas Run (10-113-000) | | | | | | | | | | |
| 302949 | 07 03 | 0.70 | ^H 3.3 | 8 | 2046 | - | 83.3 | 26 | - | Poor : - |
| Washburn Run (10-112-000) | | | | | | | | | | |
| 302948 | 07 03 | 1.40 | ^H 1.4 | 5 | 750 | - | 66.3 | 24 | - | Poor : - |
| Town Branch (10-111-000) | | | | | | | | | | |
| 302947 | 07 03 | 0.15 | ^H 1.8 | 11 | 3074 | - | 73.0 | 40 | - | Good : - |
| Trib. To East Fork Eagle Creek (6.92) (10-110-002) | | | | | | | | | | |
| 303611 | 07 02 | 0.10 | ^H 5.1 | 14 | 898 | - | 80.3 | 50 | - | Exceptional : - |
| East Fork Eagle Creek (10-110-000) | | | | | | | | | | |
| 303607 | 07 02 | 10.95 | ^H 9.9 | 14 | 808 | - | 78.8 | 44 | - | Good : - |
| X03S03 | 07 02 | 7.90 | ^H 15.1 | 16 | 824 | - | 83.5 | 46 | - | Very Good : - |
| 200691 | 07 03 | 4.30 | ^H 36.0 | 21 | 800 | 25.7 | 89.8 | 46 | 9.5 | Very Good : Exceptional |
| X03W04 | 07 03 | 0.82 | ^H 48.0 | 19 | 1713 | 19.7 | 81.0 | 44 | 8.8 | Good : Good |
| Suck Run (10-106-000) | | | | | | | | | | |
| 302946 | 07 05 | 1.70 | ^H 5.2 | 7 | 1266 | - | 65.5 | 32 | - | Fair : - |
| Brushy Fork (10-105-000) | | | | | | | | | | |
| 302945 | 07 05 | 1.00 | ^H 4.0 | 5 | 2074 | - | 57.3 | 28 | - | Fair : - |
| Lafferty Run (10-103-000) | | | | | | | | | | |
| 302943 | 07 05 | 0.05 | ^H 2.7 | 19 | 1010 | - | 74.0 | 52 | - | Exceptional : - |
| Beetle Creek (10-102-000) | | | | | | | | | | |
| 302942 | 07 05 | 4.85 | ^H 5.1 | 7 | 512 | - | 75.0 | 32 | - | Fair : - |
| 302941 | 07 05 | 0.45 | ^H 10.9 | 19 | 1110 | - | 69.3 | 42 | - | Good : - |
| Baylor Run (10-101-000) | | | | | | | | | | |
| 302940 | 07 05 | 0.15 | ^H 0.9 | 2 | 28 | - | 68.0 | 22 | - | Poor : - |

| Station | WAU | River Mile | | Drain. Area (mi ²) | Fish Species | Rel. Num. | Rel. Biomass (kg) | QHEI | IBI | MIwb | Narrative Evaluation (IBI : MIwb) | |
|--|-------|------------|---|--------------------------------|--------------|-----------|-------------------|------|-----|------|-----------------------------------|---------------|
| Eagle Creek (10-100-000) | | | | | | | | | | | | |
| 303537 | 07 05 | 14.43 | H | 107.0 | 22 | 584 | 41.3 | 88.3 | 44 | 9.6 | Good | : Exceptional |
| 200689 | 07 05 | 6.20 | W | 129.0 | 24 | 1034 | 30.8 | 88.0 | 48 | 10.1 | Very Good | : Exceptional |
| Pond Run (10-099-000) | | | | | | | | | | | | |
| 303613 | 02 03 | 4.64 | H | 3.2 | 6 | 802 | - | 77.5 | 48 | - | Very Good | : - |
| 303602 | 02 03 | 0.38 | H | 11.3 | 14 | 1274 | - | 77.5 | 44 | - | Good | : - |
| Mcatee Run (10-096-000) | | | | | | | | | | | | |
| 303603 | 02 07 | 0.66 | H | 1.6 | 5 | 610 | - | 66.5 | 36 | - | Fair | : - |
| East Fork Upper Twin Creek (10-089-000) | | | | | | | | | | | | |
| 303597 | 02 05 | 0.10 | H | 3.9 | 9 | 710 | - | 79.3 | 50 | - | Exceptional | : - |
| Upper Twin Creek (10-085-000) | | | | | | | | | | | | |
| X04P01 | 02 05 | 2.55 | H | 12.8 | 10 | 888 | - | 80.0 | 44 | - | Good | : - |
| Lower Twin Creek (10-082-000) | | | | | | | | | | | | |
| 303600 | 02 06 | 5.20 | H | 6.1 | 8 | 408 | - | 74.3 | 40 | - | Marg. Good | : - |
| X99Q02 | 02 06 | 2.10 | H | 14.1 | 12 | 678 | - | 73.0 | 46 | - | Very Good | : - |
| Rock Run (10-081-000) | | | | | | | | | | | | |
| 303604 | 02 07 | 1.80 | H | 0.8 | 9 | 358 | - | 69.5 | 46 | - | Very Good | : - |
| Sulphur Creek (10-077-000) | | | | | | | | | | | | |
| 303608 | 02 10 | 0.35 | H | 2.4 | 9 | 648 | - | 64.5 | 42 | - | Marg. Good | : - |
| Long Lick Run (10-075-000) | | | | | | | | | | | | |
| 303599 | 02 10 | 1.23 | H | 2.7 | 20 | 2098 | - | 80.0 | 58 | - | Exceptional | : - |
| Puntenney Run (10-071-000) | | | | | | | | | | | | |
| 302195 | 02 09 | 1.35 | H | 0.5 | 2 | 382 | - | 63.8 | 24 | - | Poor | : - |
| Russell Fork (10-069-000) | | | | | | | | | | | | |
| 303605 | 02 09 | 0.10 | H | 5.1 | 13 | 780 | - | 68.8 | 52 | - | Exceptional | : - |
| Stout Run (10-067-000) | | | | | | | | | | | | |
| 200741 | 02 09 | 3.00 | H | 5.4 | 16 | 2664 | - | 67.3 | 56 | - | Exceptional | : - |
| Donaldson Run (10-060-000) | | | | | | | | | | | | |
| 303595 | 06 01 | 0.45 | H | 2.8 | 13 | 594 | - | 72.3 | 48 | - | Very Good | : - |
| Island Creek (10-057-000) | | | | | | | | | | | | |
| 303598 | 06 01 | 1.10 | H | 6.8 | 12 | 1406 | - | 71.0 | 38 | - | Marg. Good | : - |
| Isaacs Creek (10-056-000) | | | | | | | | | | | | |
| 303612 | 06 01 | 1.43 | H | 4.9 | 13 | 520 | - | 74.0 | 38 | - | Marg. Good | : - |
| Little Threemile Creek (10-050-000) | | | | | | | | | | | | |
| X99Q01 | 06 05 | 1.30 | H | 4.7 | 10 | 830 | - | 90.5 | 36 | - | Marg. Good | : - |
| Fishing Gut Creek (10-049-000) | | | | | | | | | | | | |
| X03W13 | 06 05 | 1.70 | H | 1.9 | 7 | 1130 | - | 73.6 | 33 | - | Fair | : - |
| Morley Run (10-048-000) | | | | | | | | | | | | |
| 302939 | 06 04 | 0.05 | H | 1.1 | 7 | 242 | - | 80.0 | 32 | - | Fair | : - |
| Ellis Run (10-047-000) | | | | | | | | | | | | |
| 302938 | 06 04 | 0.05 | H | 2.1 | 13 | 754 | - | 76.5 | 48 | - | Very Good | : - |

| Station | WAU | River Mile | | Drain. Area (mi ²) | Fish Species | Rel. Num. | Rel. Biomass (kg) | QHEI | IBI | MIwb | Narrative Evaluation (IBI : MIwb) |
|--|-------|------------|--------------|--------------------------------|--------------|-----------|-------------------|------|-----|------|-----------------------------------|
| Slickaway Run (10-044-000) | | | | | | | | | | | |
| 302937 | 06 04 | 0.10 | ^H | 1.3 | 10 | 372 | - | 82.3 | 42 | - | Good : - |
| Threemile Creek (10-043-000) | | | | | | | | | | | |
| 302936 | 06 04 | 11.12 | ^H | 5.8 | 14 | 1486 | - | 74.8 | 34 | - | Fair : - |
| 302935 | 06 04 | 8.07 | ^H | 11.3 | 13 | 5428 | - | 56.0 | 36 | - | Marg. Good : - |
| X03W02 | 06 04 | 4.18 | ^H | 19.7 | 22 | 2164 | - | 75.5 | 54 | - | Exceptional : - |
| West Fork Redoak Creek (10-041-000) | | | | | | | | | | | |
| 302934 | 08 01 | 0.05 | ^H | 3.9 | 6 | 606 | - | 65.8 | 26 | - | Poor : - |
| Redoak Creek (10-040-000) | | | | | | | | | | | |
| 302933 | 08 01 | 7.20 | ^H | 4.0 | 9 | 684 | - | 47.5 | 30 | - | Fair : - |
| 302932 | 08 01 | 6.30 | ^H | 8.7 | 13 | 1836 | - | 66.5 | 36 | - | Marg. Good : - |
| X03W01 | 08 01 | 2.32 | ^H | 16.2 | 24 | 1258 | - | 84.0 | 48 | - | Very Good : - |
| Cornick Run (10-038-000) | | | | | | | | | | | |
| 302931 | 08 04 | 0.70 | ^H | 2.1 | 20 | 1016 | - | 70.8 | 44 | - | Good : - |
| Wolfpen Run (06-336-000) | | | | | | | | | | | |
| 302619 | 08 01 | 0.03 | ^H | 1.1 | 4 | 294 | - | 46.8 | 38 | - | Fair : - |
| Mcbride Run (06-333-000) | | | | | | | | | | | |
| 302618 | 08 01 | 0.05 | ^H | 1.8 | 10 | 1052 | - | 56.8 | 46 | - | Very Good : - |
| Rocky Run (06-326-000) | | | | | | | | | | | |
| 203995 | 08 03 | 0.20 | ^H | 3.1 | 16 | 1332 | - | 57.3 | 50 | - | Exceptional : - |
| Camp Run (06-325-000) | | | | | | | | | | | |
| 203993 | 08 02 | 0.40 | ^H | 1.6 | 7 | 406 | - | 67.5 | 42 | - | Marg. Good : - |
| Dry Bone Creek (02-816-000) | | | | | | | | | | | |
| 303699 | 12 01 | 1.60 | ^H | 4.4 | 7 | 1484 | - | 62.0 | 36 | - | Fair : - |
| Sparcy Run (02-813-000) | | | | | | | | | | | |
| 303698 | 12 04 | 0.15 | ^H | 2.2 | 8 | 304 | - | 77.8 | 34 | - | Fair : - |
| Lick Run (02-812-000) | | | | | | | | | | | |
| 303697 | 12 04 | 0.40 | ^H | 1.1 | 8 | 700 | - | 70.8 | 48 | - | Very Good : - |
| Long Run (02-807-000) | | | | | | | | | | | |
| 303696 | 12 05 | 0.10 | ^H | 2.0 | 8 | 428 | - | 65.8 | 38 | - | Fair : - |
| Georges Run (02-806-000) | | | | | | | | | | | |
| 303695 | 12 05 | 0.10 | ^H | 0.9 | 2 | 102 | - | 73.5 | 26 | - | Poor : - |
| Camp Run (02-805-000) | | | | | | | | | | | |
| 303694 | 12 05 | 0.15 | ^H | 1.2 | 8 | 246 | - | 75.3 | 44 | - | Good : - |
| Bull Run (02-803-000) | | | | | | | | | | | |
| 203364 | 12 05 | 0.10 | ^H | 1.6 | 9 | 1386 | - | 71.8 | 48 | - | Very Good : - |
| Loys Run (02-801-000) | | | | | | | | | | | |
| 303693 | 12 06 | 0.10 | ^H | 1.4 | 10 | 358 | - | 66.3 | 42 | - | Marg. Good : - |
| Smith Branch (02-539-000) | | | | | | | | | | | |
| 303692 | 05 04 | 1.20 | ^H | 2.6 | 16 | 1164 | - | 74.3 | 48 | - | Very Good : - |

| Station | WAU | River Mile | | Drain. Area (mi ²) | Fish Species | Rel. Num. | Rel. Biomass (kg) | QHEI | IBI | MIwb | Narrative Evaluation (IBI : MIwb) |
|-------------------------------------|-------|------------|--------------|--------------------------------|--------------|-----------|-------------------|------|-----|------|-----------------------------------|
| Churn Creek (02-538-000) | | | | | | | | | | | |
| 303691 | 05 04 | 1.10 | ^H | 1.9 | 17 | 1844 | - | 84.5 | 46 | - | Very Good : - |
| Blinco Branch (02-537-000) | | | | | | | | | | | |
| 303690 | 05 04 | 1.85 | ^H | 3.1 | 15 | 2808 | - | 71.5 | 50 | - | Exceptional : - |
| Plum Run (02-536-000) | | | | | | | | | | | |
| 303687 | 05 04 | 1.10 | ^H | 3.4 | 14 | 968 | - | 68.0 | 40 | - | Good : - |
| Franklin Branch (02-535-000) | | | | | | | | | | | |
| V10K35 | 05 05 | 1.90 | ^H | 5.6 | 11 | 497 | - | 82.5 | 32 | - | Fair : - |
| Puncheon Run (02-534-000) | | | | | | | | | | | |
| V10K33 | 05 05 | 0.50 | ^H | 3.6 | 17 | 2134 | - | 83.8 | 48 | - | Very Good : - |
| Heads Branch (02-533-000) | | | | | | | | | | | |
| 303686 | 05 05 | 1.60 | ^H | 3.3 | 10 | 422 | - | 68.8 | 40 | - | Good : - |
| Factory Branch (02-531-000) | | | | | | | | | | | |
| 303685 | 05 05 | 0.10 | ^H | 1.3 | 3 | 410 | - | 77.5 | 26 | - | Poor : - |
| Swift Creek (02-030-000) | | | | | | | | | | | |
| 303684 | 13 02 | 1.72 | ^H | 5.4 | 17 | 1752 | - | 54.5 | 52 | - | Exceptional : - |
| Dutch Run (02-029-000) | | | | | | | | | | | |
| 303683 | 13 02 | 0.30 | ^H | 2.7 | 13 | 1558 | - | 69.0 | 48 | - | Very Good : - |
| Millstone Run (02-028-000) | | | | | | | | | | | |
| 303679 | 13 02 | 0.15 | ^H | 0.9 | 8 | 1562 | - | 71.8 | 42 | - | Marg. Good : - |
| Fivemile Creek (02-026-000) | | | | | | | | | | | |
| 303678 | 13 03 | 0.25 | ^H | 1.6 | 12 | 1528 | - | 70.0 | 52 | - | Exceptional : - |
| Fourmile Creek (02-025-000) | | | | | | | | | | | |
| 303677 | 13 03 | 0.35 | ^H | 5.1 | 17 | 1024 | - | 71.0 | 42 | - | Marg. Good : - |
| Millers Run (02-024-000) | | | | | | | | | | | |
| 303674 | 13 03 | 0.10 | ^H | 1.2 | 7 | 1102 | - | 71.5 | 46 | - | Very Good : - |
| Herrold Run (01-120-000) | | | | | | | | | | | |
| J03G04 | 09 05 | 0.10 | ^H | 1.8 | 18 | 2094 | - | 73.5 | 54 | - | Exceptional : - |

H Headwater site (draining ≤20 miles²)

W Wading site (non-boat site draining >20 miles²)

- Headwater site, MIwb is not applicable, no weights taken

Macroinvertebrate Community Results

Macroinvertebrate communities were evaluated at 92 stations in the SORT study area from 2013 to 2016 (Table 11, Appendices B, C). The community performance was evaluated as exceptional at 27 stations, very good at 10, good at 44, marginally good at seven, fair at two, and low fair at two. The stations with the highest total mayfly (Ephemeroptera), stonefly (Plecoptera), and caddisfly (Trichoptera) taxa richness (EPT) was on Long Lick Run adjacent to Long Lick Road (RM 1.5) and Pond Run upstream US 52 (RM 0.38) with 27 taxa. The station with the highest number of total sensitive taxa (ST) was on Lower Twin Creek adjacent to Lower Twin Creek Road (RM 5.2) with 32 taxa.

Forty-three uncommonly collected sensitive taxa were collected during this study and their collection locations are listed in Table 12. This basin contained a very high number of uncommonly collected sensitive taxa which is an indication of the very high aquatic resource quality in the SORT basin, especially in the WAP streams east of Ohio Brush Creek. No state listed invertebrate species were collected during this study. However, two taxa collected during this study were new state records for Ohio. They were the mayfly *Ephemera guttulata* from Mackenzie Run (RM 0.2) and Waggoner Run (RM 1.04) and the caddisfly *Homoptera doringa* or *monticola* from Puntenney Run (RM 1.35) and Scott Run (RM 0.2). Two species of freshwater mussels were documented (as live or fresh-dead shells) during this study. Watters et al. (2009) documented recent records (extant after 1980) of 11 species in the Eagle Creek basin (including the two species found in this study). This list included one state listed species (Species of Concern), *Truncilla truncata* (Deertoe).



Table 11 — Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the SORT basin, June to October, 2013-2016 (except Puntteney Run and Waggoner Run which were sampled in April 2013).

| Station | RM | Drain. Area (mi ²) | Data Notes | Qual. Taxa | EPT QI/Total | Sens. Taxa QI/Total | Density QI/Qt. | CW Taxa | Predominant Organisms on the Natural Substrates with Tolerance Category(ies) | ICI/Narrative Evaluation |
|--|-------|--------------------------------|------------|------------|--------------|---------------------|----------------|---------|--|--------------------------|
| Interior Plateau Ecoregion | | | | | | | | | | |
| Town Run (10-407-000) | | | | | | | | | | |
| X02S05 | 0.81 | 1.4 | - | 35 | 9 | 4 | L | 1 | Hydropsychid caddisflies (F), midges (F), riffle beetles (F) | Good |
| X02W04 | 0.63 | 1.4 | - | 24 | 3 | 0 | H | 1 | Hydropsychid caddisflies (F), midges (F), flatworms (F) | Low Fair |
| Straight Creek (10-300-000) | | | | | | | | | | |
| X03W09 | 16.75 | 12.5 | - | 45 | 14 | 9 | L | 1 | Mayflies (F,MI), hydropsychid caddisflies (F), riffle beetles (F) | Good |
| X03W11 | 9.45 | 34.0 | - | 50 | 20 | 18 | M | 0 | Caddisflies (F,MI), midges (F), Baetid mayflies (F,MI,I) | Exceptional |
| X03W12 | 2.78 | 57 | - | 40 | 21/22 | 18/22 | L-M | 0 | Baetid mayflies (MI,F,I), caddisflies (MI,F) | 50 |
| Sink Creek (10-301-000) | | | | | | | | | | |
| 302955 | 0.65 | 1.4 | - | 48 | 15 | 7 | L-M | 2 | Hydropsychid caddisflies (F), baetid mayflies (F), blackflies (F) | Good |
| Rangle Run (10-302-000) | | | | | | | | | | |
| 302956 | 0.05 | 1.0 | - | 29 | 11 | 6 | L | 5 | Baetid mayflies (MI,F), midges (F), hydropsychid caddisflies (F) | Good |
| Sheep Run (10-303-000) | | | | | | | | | | |
| 302957 | 0.1 | 3.7 | 9 | 54 | 19 | 10 | L-M | 1 | Baetid mayflies (F,MI), midges (F,T), hydropsychid caddisflies (F) | Very Good |
| Campbell Run (10-304-000) | | | | | | | | | | |
| 302958 | 0.2 | 2.0 | - | 37 | 15 | 8 | L-M | 1 | Baetid mayflies (F,MI), hydropsychid caddisflies (F), blackflies (F) | Good |
| Evans Run (10-305-000) | | | | | | | | | | |
| 302959 | 0.05 | 5.3 | - | 35 | 14 | 7 | L | 2 | Baetid mayflies (F), hydropsychid caddisflies (F), midges (F,T) | Good |
| Washburn Run (10-307-000) | | | | | | | | | | |
| 302960 | 1.25 | 5.1 | - | 41 | 10 | 6 | L-M | 0 | Hydropsychid caddisflies (F), midges (F), baetid mayflies (F) | Marg. Good |
| Bull Run (10-308-000) | | | | | | | | | | |
| 302961 | 0.05 | 1.3 | - | 34 | 11 | 6 | L-M | 2 | Midges (F), hydropsychid caddisflies (F), baetid mayflies (F) | Good |
| Scott Run (10-309-000) | | | | | | | | | | |
| 302962 | 0.2 | 1.2 | - | 42 | 14 | 9 | L | 4 | Midges (F,T), caddisflies (F,MI) | Good |
| Camp Run (10-310-000) | | | | | | | | | | |
| 302963 | 0.1 | 2.9 | - | 46 | 17 | 11 | M | 0 | Caddisflies (F,MI), midges (F,T), baetid mayflies (F,I) | Good |
| Myers Run (10-311-000) | | | | | | | | | | |
| 302964 | 0.05 | 1.3 | - | 31 | 8 | 4 | L | 1 | Hydropsychid caddisflies (F), midges (F), flatworms (F) | Marg. Good |
| Honey Run (10-313-000) | | | | | | | | | | |
| 302965 | 0.1 | 3.0 | - | 34 | 8 | 5 | L-M | 1 | Hydropsychid caddisflies (F), baetid mayflies (F), midges (F) | Marg. Good |
| West Fork Straight Creek (10-314-000) | | | | | | | | | | |
| 302966 | 1.0 | 4.3 | - | 57 | 13 | 7 | M | 1 | Hydropsychid caddisflies (F), baetid mayflies (F), midges (F) | Good |

| Station | RM | Drain. Area (mi ²) | Data Notes | Qual. Taxa | EPT QI/Total | Sens. Taxa QI/Total | Density QI/Qt. | CW Taxa | Predominant Organisms on the Natural Substrates with Tolerance Category(ies) | ICI/Narrative Evaluation |
|--|-------|--------------------------------|------------|------------|--------------|---------------------|----------------|---------|--|--------------------------|
| Buck Run (10-315-000) | | | | | | | | | | |
| 302967 | 0.05 | 2.2 | - | 46 | 8 | 5 | L-M | 1 | Hydropsychid caddisflies (F), midges (F,MI), flatworms (F) | Marg. Good |
| Sycamore Run (10-316-000) | | | | | | | | | | |
| 302968 | 0.05 | 1.6 | - | 46 | 6 | 3 | L | 4 | Midges (F), Hydropsychid caddisflies (F) | Fair |
| Cornick Run (10-038-000) | | | | | | | | | | |
| 302931 | 2.1 | 2.1 | - | 43 | 17 | 9 | M | 1 | Baetid mayflies (F,MI), blackflies (F), hydropsychid caddisflies (F) | Good |
| Redoak Creek (10-040-000) | | | | | | | | | | |
| 302933 | 7.2 | 4.0 | - | 44 | 13 | 9 | M | 0 | Hydropsychid caddisflies (F), baetid mayflies (F), midges (F) | Good |
| 302932 | 6.3 | 8.7 | - | 49 | 12 | 8 | L-M | 1 | Baetid mayflies (F), midges (F), hydropsychid caddisflies (F) | Good |
| X03W01 | 2.32 | 16.2 | - | 53 | 20 | 16 | M | 1 | Hydropsychid caddisflies (F), baetid mayflies (F), midges (F) | Exceptional |
| West Fork Redoak Creek (10-041-000) | | | | | | | | | | |
| 302934 | 0.05 | 3.9 | - | 44 | 9 | 3 | L-M | 1 | Midges (F), baetid mayflies(F,MI), Hydropsychid caddisflies (F) | Marg. Good |
| Eagle Creek (10-100-000) | | | | | | | | | | |
| 303537 | 14.43 | 107 | 8 | 76 | 20/20 | 20/22 | M | 0 | Baetid mayflies (F,MI), caddisflies (MI,F), midges (F) | 42 |
| 200689 | 6.2 | 129 | - | 59 | 24 | 24 | L-M | 0 | Baetid mayflies (F,MI,I), caddisflies (MI), midges (F) | Exceptional |
| West Fork Eagle Creek (10-120-000) | | | | | | | | | | |
| X03W05 | 7.38 | 28.0 | 15 | 65 | 13/14 | 10/15 | L-M | 0 | Caddisflies (MI,F), baetid mayflies (F,MI), midges (F) | 46 |
| 200693 | 3.3 | 54 | 8,12 | 63 | 18/19 | 15/19 | M | 0 | Baetid mayflies (F,MI), caddisflies (F,MI), midges (F) | 50 |
| Northwest Fork of West Fork Eagle Creek (Trib. to W. Fk. Eagle Cr. at RM 7.05) (10-120-001) | | | | | | | | | | |
| X03W07 | 1.8 | 7.2 | - | 49 | 13 | 6 | M-H | 0 | Flatworms (F), hydropsychid caddisflies (F), riffle beetles (F) | Good |
| Honey Creek (10-120-002) | | | | | | | | | | |
| X99Q04 | 0.1 | 0.9 | 29 | 23 | 3 | 0 | L | 0 | Flatworms (F) | Low Fair |
| East Fork Eagle Creek (10-110-000) | | | | | | | | | | |
| 303607 | 10.95 | 9.9 | - | 46 | 13 | 11 | L-M | 0 | Baetid mayflies (F,MI), hydropsychid caddisflies (F), riffle beetles (F) | Good |
| X03S03 | 7.9 | 15.1 | - | 44 | 11 | 8 | L-M | 0 | Baetid mayflies (F,MI), hydropsychid caddisflies (F), riffle beetles (F) | Good |
| 200691 | 4.3 | 36.0 | - | 57 | 18/20 | 15/17 | M | 0 | Caddisflies (F,MI), baetid mayflies (MI,F), riffle beetles (F) | 52 |
| X03W04 | 0.82 | 48.0 | - | 70 | 22/24 | 18/21 | M | 0 | Mayflies (MI,F), caddisflies (MI,F), midges (F) | 56 |
| Tributary to East Fork Eagle Creek at RM 6.92 (10-110-002) | | | | | | | | | | |
| 303611 | 0.1 | 5.1 | - | 37 | 15 | 13 | L-M | 0 | Mayflies (F,MI), hydropsychid caddisflies (F), riffle beetles (F) | Good |
| Baylor Run (10-101-000) | | | | | | | | | | |
| 302940 | 0.15 | 0.9 | 9,29 | 40 | 12 | 7 | L | 3 | Hydropsychid caddisflies (F), baetid mayflies (MI,F) | Good |
| Beetle Creek (10-102-000) | | | | | | | | | | |
| 302942 | 4.85 | 5.1 | - | 42 | 12 | 8 | L-M | 0 | Hydropsychid caddisflies (F), midges (F), flatworms (F) | Good |
| 302941 | 0.45 | 10.9 | - | 44 | 17 | 11 | M | 1 | Hydropsychid caddisflies (F), baetid mayflies (F, MI), midges (F) | Good |

| Station | RM | Drain. Area (mi ²) | Data Notes | Qual. Taxa | EPT QI/Total | Sens. Taxa QI/Total | Density QI/Qt. | CW Taxa | Predominant Organisms on the Natural Substrates with Tolerance Category(ies) | ICI/Narrative Evaluation |
|---|-------|--------------------------------|------------|------------|--------------|---------------------|----------------|---------|--|--------------------------|
| Lafferty Run (10-103-000) | | | | | | | | | | |
| 302943 | 0.05 | 2.7 | - | 62 | 21 | 17 | L-M | 3 | Baetid mayflies (F,MI), caddisflies (F,MI), midges (F,MI) | Exceptional |
| Indian Lick (10-104-000) | | | | | | | | | | |
| 302944 | 0.25 | 2.7 | 9 | 50 | 15 | 12 | L-M | 3 | Baetid mayflies (F,MI), hydropsychid caddisflies (F), midges (F) | Good |
| Brushy Fork (10-105-000) | | | | | | | | | | |
| 302945 | 1.0 | 4.0 | 9 | 40 | 17 | 13 | L-M | 0 | Baetid mayflies (F,MI), midges (F), hydropsychid caddisflies (F) | Good |
| Suck Run (10-106-000) | | | | | | | | | | |
| 302946 | 1.7 | 5.2 | 9 | 61 | 21 | 15 | L-M | 0 | Baetid mayflies (MI, F), hydropsychid caddisflies (F), midges (F) | Exceptional |
| Town Branch (10-111-000) | | | | | | | | | | |
| 302947 | 0.15 | 1.8 | 9 | 41 | 14 | 7 | L-M | 2 | Hydropsychid caddisflies (F), baetid mayflies (F, MI) | Good |
| Washburn Run (10-112-000) | | | | | | | | | | |
| 302948 | 1.4 | 1.4 | - | 38 | 15 | 9 | L-M | 5 | Hydropsychid caddisflies (F), sowbugs (MT,T), baetid mayflies (F, MI) | Good |
| Adas Run (10-113-000) | | | | | | | | | | |
| 302949 | 0.5 | 3.4 | - | 48 | 16 | 12 | L-M | 1 | Hydropsychid caddisflies (F), sowbugs (MT,T), baetid mayflies (F, MI) | Good |
| Hills Fork (10-114-000) | | | | | | | | | | |
| 302951 | 3.05 | 5.3 | - | 44 | 14 | 10 | L-M | 1 | Midges (F), hydropsychid caddisflies (F), baetid mayflies (F,MI) | Good |
| 302950 | 1.3 | 10.1 | - | 51 | 17 | 13 | L-M | 0 | Hydropsychid caddisflies (F), midges (F), baetid mayflies (F,MI) | Good |
| Lick Run (10-115-000) | | | | | | | | | | |
| 302952 | 0.95 | 0.7 | 29 | 55 | 13 | 6 | M | 0 | Sowbugs (MT), mayflies (F,MI), midges (F,T) | Good |
| Gordon Run (10-116-000) | | | | | | | | | | |
| | 0.05 | 3.1 | - | 31 | 10 | 6 | - | 1 | Hydropsychid caddisflies (F), midges (F), riffle beetles (F) | Marg. Good |
| Hannah Run (10-117-000) | | | | | | | | | | |
| 302954 | 0.01 | 2.3 | - | 41 | 11 | 4 | M-H | 0 | Midges (T,F,MI) | Marg. Good |
| Big Threemile Creek (10-043-000) | | | | | | | | | | |
| 302936 | 11.12 | 5.8 | - | 50 | 16 | 12 | L-M | 0 | Hydropsychid caddisflies (F), baetid mayflies (F,MI), midges (F) | Good |
| 302935 | 8.07 | 11.3 | - | 49 | 17 | 11 | L-M | 0 | Mayflies (F,MI), hydropsychid caddisflies (F), midges (F) | Good |
| X03W02 | 4.18 | 19.7 | - | 52 | 20 | 16 | L-M | 0 | Mayflies (F,MI), caddisflies (F,MI), midges (F) | Exceptional |
| Slickaway Run (10-044-000) | | | | | | | | | | |
| 302937 | 0.1 | 1.3 | 9 | 42 | 14 | 9 | L-M | 3 | Caddisflies (F,MI), mayflies (F), midges (F) | Good |
| Ellis Run (10-047-000) | | | | | | | | | | |
| 302938 | 0.25 | 2.1 | 9 | 46 | 17 | 11 | L-M | 0 | Mayflies (F,MI), caddisflies (F,MI), midges (F) | Good |
| Meffords Run (Morley Run) (10-048-000) | | | | | | | | | | |
| 302939 | 0.2 | 1.1 | 2 | 37 | 13 | 7 | L-M | 2 | Hydropsychid caddisflies (F), baetid mayflies (F, MI), blackflies (F) | Good |

| Station | RM | Drain. Area (mi ²) | Data Notes | Qual. Taxa | EPT QI/Total | Sens. Taxa QI/Total | Density QI/Qt. | CW Taxa | Predominant Organisms on the Natural Substrates with Tolerance Category(ies) | ICI/Narrative Evaluation |
|--|------|--------------------------------|------------|------------|--------------|---------------------|----------------|---------|---|--------------------------|
| Fishing Gut Creek (10-049-000) | | | | | | | | | | |
| X03W13 | 1.5 | 2.2 | - | 52 | 14 | 12 | L | 3 | Baetid mayflies (F,MI), midges (F), blackflies (F) | Good |
| Little Threemile Creek (10-050-000) | | | | | | | | | | |
| X99Q01 | 1.3 | 4.7 | - | 48 | 13 | 9 | L | 0 | Mayflies (F,MI), hydropsychid caddisflies (F), midges (F) | Good |
| Isaacs Creek (10-056-000) | | | | | | | | | | |
| 303612 | 41 | 4.9 | - | 41 | 11 | 10 | L | 1 | Hydropsychid caddisflies (F), baetid mayflies (F,MI), midges (F) | Good |
| Island Creek (10-057-000) | | | | | | | | | | |
| 303598 | 1.1 | 6.8 | - | 43 | 18 | 14 | L-M | 1 | Caddisflies (F,MI), baetid mayflies (F,MI), midges (F) | Very Good |
| Donaldson Run (10-060-000) | | | | | | | | | | |
| 303595 | 0.45 | 2.8 | - | 44 | 15 | 15 | L-M | 3 | Hydropsychid caddisflies (F), baetid mayflies (MI,F), riffle beetles (F) | Good |
| Western Allegheny Plateau Ecoregion | | | | | | | | | | |
| Waggoner Run (10-202-000) | | | | | | | | | | |
| 302194 | 1.04 | 0.3 | 14,29 | 20 | 15 | 16 | L-M | 8 | <i>Ameletus</i> mayflies (MI), <i>Leuctra</i> stoneflies (MI) | Very Good |
| Mackenzie Run (10-203-000) | | | | | | | | | | |
| 303767 | 0.2 | 0.6 | 29 | 39 | 14 | 15 | L-M | 5 | <i>Leuctra</i> stoneflies (MI), scuds (F), hydropsychid caddisflies (F) | Very Good |
| Stout Run (10-067-000) | | | | | | | | | | |
| 200741 | 3.0 | 5.4 | - | 60 | 23 | 24 | M | 2 | Caddisflies (F,MI), mayflies (F,MI), <i>Leuctra</i> stoneflies (MI) | Exceptional |
| Puntenney Run (10-071-000) | | | | | | | | | | |
| 302195 | 1.35 | 0.5 | 14,29 | 16 | 11 | 8 | L-M | 5 | <i>Ameletus</i> mayflies (MI), <i>Leuctra</i> stoneflies (MI) | Good |
| Russell Fork (10-069-000) | | | | | | | | | | |
| 303605 | 0.1 | 5.1 | - | 32 | 14 | 10 | L | 1 | Mayflies (MI,F), hydropsychid caddisflies (F), midges (F) | Good |
| Long Lick Run (10-075-000) | | | | | | | | | | |
| 303599 | 1.5 | 2.0 | - | 65 | 27 | 29 | L-M | 9 | Mayflies (I,F,MI), stoneflies (MI), caddisflies (MI,F) | Exceptional |
| Sulphur Creek (10-077-000) | | | | | | | | | | |
| 303608 | 0.35 | 2.4 | - | 61 | 23 | 24 | L-M | 8 | <i>Leuctra</i> stoneflies (MI), mayflies (MI,F,I), hydropsychid caddisflies (F) | Exceptional |
| Rock Run (10-081-000) | | | | | | | | | | |
| 303604 | 1.8 | 0.8 | 29 | 43 | 20 | 24 | M | 8 | <i>Leuctra</i> stoneflies (MI), caddisflies (F,MI), midges (MI,F) | Exceptional |
| Lower Twin Creek (10-082-000) | | | | | | | | | | |
| 303600 | 5.2 | 6.1 | - | 57 | 26 | 32 | L-M | 10 | Stoneflies (MI), mayflies (MI,I), hydropsychid caddisflies (F) | Exceptional |
| X99Q02 | 1.52 | 15.1 | - | 47 | 23 | 31 | L-M | 4 | Mayflies (MI,F,I), caddisflies (F,MI), midges (F,MI) | Exceptional |
| Upper Twin Creek (10-085-000) | | | | | | | | | | |
| X04P01 | 3.3 | 12.1 | - | 52 | 25 | 26 | L | 3 | Mayflies (MI,F), caddisflies (F,MI), midges (MI,F) | Exceptional |
| East Fork Upper Twin Creek (10-089-000) | | | | | | | | | | |
| 303597 | 0.1 | 3.9 | - | 50 | 26 | 31 | L | 8 | Mayflies (F,MI), stoneflies (MI), caddisflies (F,MI) | Exceptional |

| Station | RM | Drain. Area (mi ²) | Data Notes | Qual. Taxa | EPT QI/Total | Sens. Taxa QI/Total | Density QI/Qt. | CW Taxa | Predominant Organisms on the Natural Substrates with Tolerance Category(ies) | ICI/Narrative Evaluation |
|------------------------------------|------|--------------------------------|------------|------------|--------------|---------------------|----------------|---------|--|--------------------------|
| McAtee Run (10-096-000) | | | | | | | | | | |
| 303603 | 0.66 | 1.6 | - | 39 | 19 | 20 | L | 5 | <i>Leuctra</i> stoneflies (MI), mayflies (MI,F), caddisflies (MI,F) | Exceptional |
| Pond Run (10-099-000) | | | | | | | | | | |
| 303613 | 4.64 | 3.2 | - | 50 | 21 | 25 | L-M | 8 | Stoneflies (MI), mayflies (MI,F), hydropsychid caddisflies (F) | Exceptional |
| 303602 | 0.38 | 11.3 | - | 49 | 27 | 28 | L-M | 4 | Mayflies (F,MI), caddisflies (MI,F), <i>Leuctra</i> stoneflies (MI) | Exceptional |
| Nace Run (10-507-000) | | | | | | | | | | |
| 303601 | 0.43 | 1.4 | - | 45 | 15 | 16 | L-M | 6 | Mayflies (F,MI), hydropsychid caddisflies (F), water pennies (MI) | Very Good |
| Turkey Creek (10-508-000) | | | | | | | | | | |
| 303610 | 12.9 | 1.6 | - | 43 | 18 | 21 | L | 8 | Water pennies (MI), <i>Leuctra</i> stoneflies (MI), hydropsychid caddisflies (F) | Exceptional |
| 303609 | 10.7 | 8.7 | - | 50 | 15 | 14 | L | 2 | Mayflies (F,MI), hydropsychid caddisflies (F), midges (F) | Good |
| X04P03 | 9.58 | 16.5 | - | 56 | 15 | 13 | L-M | 3 | Caddisflies (MI,F), midges (F,MT), heptageniid mayflies (MI,F) | Good |
| 200744 | 6.7 | 26.4 | 15 | 61 | 20/21 | 17/21 | L-F/202 | 0 | Baetid mayflies (MI,F), <i>Chimarra</i> caddisflies (MI), Midges (F) | Exceptional |
| X04P02 | 4.13 | 39.5 | - | 47 | 17 | 18 | L-M | 1 | Mayflies (MI,F), <i>Chimarra</i> caddisflies (MI), midges (F) | Very Good |
| Odell Creek (10-516-000) | | | | | | | | | | |
| 302183 | 0.1 | 5.3 | 9 | 41 | 15 | 15 | - | 2 | Midges, heptageniid mayflies | Very Good |
| Pond Lick Run (10-517-000) | | | | | | | | | | |
| 302184 | 0.2 | 5.3 | 9 | 36 | 18 | 17 | - | 2 | Midges | Exceptional |
| Rock Lick (10-518-000) | | | | | | | | | | |
| 302770 | 0.5 | 0.4 | 9,29 | 31 | 11 | 18 | L | 10 | Philopotamid caddisflies (MI), water pennies (MI), heptageniid mayflies (F) | Very Good |
| Brush Fork (10-519-000) | | | | | | | | | | |
| 302185 | 0.05 | 1.1 | 16 | 22 | 10 | 11 | - | 6 | Mayflies | Good |
| Wes Run (10-520-000) | | | | | | | | | | |
| 302186 | 0.3 | 1.0 | - | 12 | 2 | 5 | - | 2 | Scuds (MT), sowbugs (MT) | Fair |
| Harber Fork (10-523-000) | | | | | | | | | | |
| 302187 | 0.05 | 4.7 | 9 | 39 | 21 | 20 | - | 3 | Midges, heptageniid mayflies | Exceptional |
| Mackletree Run (10-524-000) | | | | | | | | | | |
| 302188 | 0.4 | 5.8 | - | 37 | 16 | 18 | - | 1 | <i>Leuctra</i> stoneflies (MI), water pennies (MI) | Very Good |
| Lampblack Run (10-526-000) | | | | | | | | | | |
| 302189 | 0.1 | 2.7 | - | 33 | 14 | 12 | - | 4 | <i>Leuctra</i> stoneflies (MI), midges | Good |
| Old Lade Run (10-527-000) | | | | | | | | | | |
| 302190 | 0.2 | 2.2 | 9 | 45 | 22 | 20 | - | 1 | <i>Leuctra</i> stoneflies (MI) | Exceptional |
| Wolfden Run (10-530-000) | | | | | | | | | | |
| 302768 | 0.5 | 0.4 | 9,29 | 30 | 10 | 10 | L | 6 | Midges (F) | Good |

RM river mile.

Drain. Area drainage area.

Data Notes 8=non-detectable current speed over HDs (~0 fps); 9=intermittent/interstitial stream flow conditions; 14=spring sampling (prior to 15 June); 15=slow current speed over HDs (< 0.3 fps); 16=fall sampling (after 30 September); 29=primary headwater stream (drainage area ≤ 1 mi²).

Ql Qualitative sample collected from the natural substrates.

Sens. Taxa Taxa listed on Ohio EPA's Macroinvertebrate Taxa List as MI (moderately intolerant) or I (intolerant).

Qt Quantitative sample collected on Hester-Dendy artificial substrates, density is expressed in organisms per square foot.

Qualitative sample relative density: L=Low; M=Moderate; H=High.

CW cold water.

Tolerance Categories VT=Very Tolerant; T=Tolerant; MT=Moderately Tolerant; F=Facultative; MI=Moderately Intolerant; I=Intolerant

ICI values in parentheses are invalidated due to insufficient current speed over the artificial substrates or by disturbance. The station evaluation at these sites is based on the qualitative sample narrative evaluation.

Table 12 — Uncommonly collected sensitive macroinvertebrate taxa and all freshwater mussel species collection locations in the SORT basin, June to October 2013-2016 (except Puntteney Run and Waggoner Run which were sampled in April 2013). Taxa listed with CW are also CWH-indicator taxa. Freshwater mussels were considered extant at the station if they were observed live or as fresh-dead shells.

| Taxa | Collection Location by River Mile |
|---------------------------------------|--|
| Mayflies | |
| <i>Ameletus sp. CW</i> | Puntteney Run 1.35; Waggoner Run 1.04 |
| <i>Acentrella nadineae</i> | E. Fk. Upper Twin Cr. 0.1; Long Lick Run 1.5; Lower Twin Cr. 5.2; 1.65; Pond Run 4.64; 0.38; Russell Fork 0.1; Stout Run 3.0; Turkey Cr. 10.7; 6.7; 4.13 |
| <i>Acentrella turbida</i> | Camp Run 0.1; Eagle Cr. 6.2; Lafferty Run 0.05; Long Lick Run 1.5; Lower Twin Cr. 5.2, 1.65; McAtee Run 0.66; Straight Cr. 9.45, 2.78; Sulphur Cr. 0.35; Upper Twin Cr. 3.3 |
| <i>Plauditus dubius</i> | Lower Twin Cr. 5.2, 1.65; Pond Run 4.64, 0.38; Upper Twin Cr. 3.3 |
| <i>Epeorus sp. CW</i> | Puntteney Run 1.35; Waggoner Run 1.04 |
| <i>Choroterpes basalis</i> | Adas Run 0.5; Beetle Creek; Big Threemile Cr. 11.12, 8.07, 4.18; Camp Run 0.1; Eagle Cr. 14.43, 6.2; E. Fk. Eagle Cr. 10.95, 4.3, 0.82; E. Fk. Upper Twin Cr. 0.1; Ellis Run 0.25; Fishing Gut Cr. 1.5; Hills Fork 3.05, 1.3; Indian Lick 0.25; Island Cr. 1.1; Lafferty Run 0.05; L. Threemile Cr. 1.3; Lower Twin Cr. 5.2; McAtee Run 0.66; Meffords Run 0.2; Nace Run 0.43; Pond Run 4.64, 0.38; Rock Run 1.8; Straight Cr. 16.75, 2.78; Suck Run 1.7; Sulphur Cr. 0.35; Turkey Cr. 12.9, 6.7; W. Fk. Eagle Cr. 7.38; W. Fk. Straight Cr. 1.0 |
| <i>Habrophlebiodes sp. CW</i> | Long Lick Run 1.5 |
| <i>Ephemera guttulata</i> | Mackenzie Run 0.2; Waggoner Run 1.04 |
| Dragonflies | |
| <i>Boyeria grafiana CW</i> | Long Lick Run 1.5; Lower Twin Cr. 5.2, 1.65; Mackenzie Run 0.2; Pond Run 4.64; Rock Run 1.8; Rock Lick 0.5; Turkey Cr. 12.9, 9.58; Waggoner Run 1.04 |
| Stoneflies | |
| <i>Amphinemura sp. CW</i> | Waggoner Run 1.04 |
| <i>Acroneuria carolinensis</i> | E. Fk. Upper Twin Cr. 0.1; Donaldson Cr. 0.45; Long Lick Run 1.5; Lower Twin Cr. 5.2, 1.65; Mackenzie Run 0.2; McAtee Run 0.66; Pond Run 4.64, 0.38; Rock Run 1.8; Sulphur Cr. 0.35; Turkey Cr. 12.9, 9.58, 6.7; Upper Twin Cr. 3.3; Waggoner Run 1.04 |
| <i>Neoperla sp.</i> | Long Lick Run 1.5; Lower Twin Cr. 1.65; Trib. to E. Fk. Eagle Cr. (6.92) 0.1 |
| <i>Clioperla clio CW</i> | Waggoner Run 1.04 |
| <i>Diploperla robusta CW</i> | Puntteney Run 1.35 |
| <i>Isoperla montana</i> | Puntteney Run 1.35 |
| <i>Sweltsa sp. CW</i> | Lower Twin Cr. 5.2; Nace Run 0.43; Waggoner Run 1.04 |
| Fishflies | |
| <i>Nigronia fasciata CW</i> | Baylor Run 0.25; E. Fk. Upper Twin Cr. 0.1; Mackenzie Run 0.2; McAtee Run 0.66; Nace Run 0.43; Rangle Run 0.05; Rock Lick 0.5; Rock Run 1.8; Sulphur Cr. 0.35; Turkey Cr. 12.9, 10.7; Wes Run 0.3; Wolfden Run 0.5 |
| Caddisflies | |
| <i>Dolophilodes distinctus CW</i> | E. Fk. Upper Twin Cr. 0.1; Long Lick Run 1.5; Lower Twin Cr. 5.2, 1.65; McAtee Run 0.66; Pond Run 4.64, 0.38; Rock Lick 0.5; Rock Run 1.8; Sulphur Cr. 0.35; Turkey Cr. 12.9; Upper Twin Cr. 3.3 |
| <i>Wormaldia moesta CW</i> | Rock Lick 0.5 |
| <i>Homoplectra doringa CW</i> | Puntteney Run 1.35; Scott Run 0.2 |
| <i>Rhyacophila invaria complex CW</i> | Pond Run 4.64, 0.38; Turkey Cr. 12.9 |
| <i>Ochrotrichia sp.</i> | Big Threemile Cr. 4.18; Indian Lick 0.25; Redoak Cr. 2.32 |
| <i>Goera sp. CW</i> | Waggoner Run 1.04 |
| <i>Lepidostoma sp. CW</i> | E. Fk. Upper Twin Cr. 0.1; Lower Twin Cr. 5.2; Rock Lick 0.5; Wolfden Run 0.5 |
| <i>Molanna sp. CW</i> | Rock Run 1.8 |

| Taxa | Collection Location by River Mile |
|--|--|
| Beetles | |
| <i>Lutrochus laticeps</i> | Big Threemile Cr. 8.07; Eagle Cr. 6.2; W. Fk. Eagle Cr. 3.3 |
| True Flies | |
| <i>Dicranota sp. CW</i> | McBride Run 0.05; Pond Run 4.64 |
| <i>Dixa sp. CW</i> | Long Lick Run 1.5 |
| <i>Trissopelopia ogemawi CW</i> | E. Fk. Upper Twin Cr. 0.1; Long Lick Run 1.5; Lower Twin Cr. 5.2; Pond Run 4.64; Rock Lick 0.5; Rock Run 1.8; Stout Run 3.0; Turkey Cr. 12.9 |
| <i>Corynoneura sp. 12</i> | W. Fk. Eagle Cr. 7.38 |
| <i>Cricotopus absurdus</i> | Straight Cr. 2.78; W. Fk. Eagle Cr. 3.3 |
| <i>Nanocladius downesi</i> | Eagle Cr. 14.43, 6.2; E. Fk. Eagle Cr. 0.82; Turkey Cr. 6.7, 4.13 |
| <i>Parachaetocladius sp. CW</i> | Long Lick Run 1.5; McBride Run 0.05 |
| <i>Demicryptochironomus sp.</i> | Lafferty Run 0.05; Lower Twin Cr. 1.65 |
| <i>Microtendipes rydalensis</i> | E. Fk. Upper Twin Cr. 0.1; Lower Twin Cr. 5.2, 1.65; Pond Run 0.38; Rock Lick 0.5 |
| <i>Polypedilum ontario</i> | W. Fk. Eagle Cr. 7.38, 3.3; E. Fk. Eagle Cr. 4.3 |
| <i>Cladotanytarsus vanderwulpi gr. # 5</i> | W. Fk. Eagle Cr. 7.38 |
| <i>Neozavrelia sp. 1 CW</i> | Lower Twin Cr. 5.2; Sulphur Cr. 0.35 |
| <i>Paratanytarsus longistilus CW</i> | Fishing Gut Cr. 1.5; Pond Run 4.64 |
| <i>Stempellina sp. 2</i> | Camp Run 0.4 |
| <i>Stempellina Johannsenii</i> | E. Fk. Upper Twin Cr. 0.1; Lower Twin Cr. 1.65 |
| <i>Stempellinella leptocelloides</i> | Camp Run 0.4 |
| <i>Neoplasta sp. CW</i> | Lower Twin Cr. 5.2 |
| Freshwater Mussels | |
| <i>Lampsilis siliquoidea (Fatmucket)</i> | Hills Fork 1.3; Trib. to E. Fk. Eagle Cr. (6.92) 0.1; W. Fk. Eagle Cr. 7.38 |
| <i>Pyganodon grandis (Giant Floater)</i> | W. Fk. Eagle Cr. 7.38 |

Aquatic Life Use Discussion

Table 13 — Aquatic life use attainment status for sampling locations in the SORT study area, 2013-2017. The IBI, MIwb, and ICI and macroinvertebrate narrative scores are based on the performance of the biological community. The QHEI is based on the ability of the stream habitat to support a biological community. The SORT study area is in the IP and WAP ecoregions. If biological impairment has occurred, the causes and sources of the impairment are noted.

| Station | Location | (Year Sampled) RM | Eco-Region | Aquatic Life Use | IBI | MIwb | ICI ^a | QHEI | Attain. Status | Causes | Sources |
|---|--|----------------------------------|------------|------------------|------------------|------|------------------|------|----------------|---------------------------|-----------------|
| Cornick Run (10-038-000) | | | | | | | | | | | |
| 302931 | Cornick Run adj. old U.S. Rte. 68 (Rd. 30) | (2015/2017) 0.70 ^H | IP | WWH | 44 | - | G | 70.8 | Full | | |
| Redoak Creek (10-040-000) | | | | | | | | | | | |
| 302933 | Redoak Creek at Rd. 231a | (2015) 7.20 ^H | IP | WWH | 30* | - | G | 47.5 | Partial | Unknown | Unknown |
| 302932 | Redoak Creek dst. W. Fk. Redoak Creek | (2015) 6.30 ^H | IP | WWH | 36 ^{NS} | - | G | 66.5 | Full | | |
| X03W01 | Redoak Creek at Stringtown at Ripley Rd. | (2015) 2.32 ^H | IP | WWH | 48 | - | E | 84.0 | Full | | |
| W Fk Redoak Creek (10-041-000) | | | | | | | | | | | |
| 302934 | W. Fk. Redoak Creek at end of Bealer Rd. (Rd. 231) | (2015) 0.05 ^H | IP | WWH | 26* | - | MG ^{NS} | 65.8 | Non | Unknown | Unknown |
| Big Threemile Creek (10-043-000) | | | | | | | | | | | |
| 302936 | Big Threemile Creek at Roush Hill Rd. (Rd. 20) | (2015) 11.12 ^H | IP | WWH | 34* | - | G | 74.8 | Partial | Unknown | Unknown |
| 302935 | Big Threemile Creek at St. Rte. 41 | (2015) 8.07 ^H | IP | WWH | 36 ^{NS} | - | G | 56.0 | Full | | |
| X03W02 | Big Threemile Creek NE of Aberdeen at St. Rte. 763 | (2015) 4.18 ^H | IP | WWH | 54 | - | E | 75.5 | Full | | |
| Slickaway Run (10-044-000) | | | | | | | | | | | |
| 302937 | Slickaway Run at Stringtown Rd. (Rd. 251) | (2015) 0.10 ^H | IP | WWH | 42 | - | G | 82.3 | Full | | |
| Ellis Run (10-047-000) | | | | | | | | | | | |
| 302938 | Ellis Run at Ellis Run Rd. (Rd. 44) near Ellsberry | (2015) 0.05 ^H | IP | WWH | 48 | - | G | 76.5 | Full | | |
| Meffords Run (10-048-000) | | | | | | | | | | | |
| 302939 | Meffords Run adj. Meffords Run Rd. (Rd. 248) | (2015) 0.05 ^H | IP | WWH | 32* | - | G | 80.0 | Partial | Natural (flow or habitat) | Natural sources |

| Station | Location | (Year Sampled) RM | Eco-Region | Aquatic Life Use | IBI | MIwb | ICI ^a | QHEI | Attain. Status | Causes | Sources |
|--|--|---|------------|------------------|------------------|------|------------------|------|----------------|--------|---------|
| Fishing Gut Creek (10-049-000) | | | | | | | | | | | |
| X03W13 | Fishing Gut Creek E of Aberdeen, near Old St. Rte. 249 | (2016/2017) 1.00 ^H /1.70 ^H | IP | WWH | 46 | - | G | 72.8 | Full | | |
| Little Threemile Creek (10-050-000) | | | | | | | | | | | |
| X99Q01 | L. Threemile Creek E of Maysville at U.S. Rte. 52 | (2016) 1.30 ^H | IP | WWH | 36 ^{ns} | - | G | 90.5 | Full | | |
| Isaacs Creek (10-056-000) | | | | | | | | | | | |
| 303612 | Isaacs Creek in Manchester at Broadway St. | (2016/2017) 1.43 ^H | IP | WWH | 38 ^{ns} | - | G | 74.0 | Full | | |
| Island Creek (10-057-000) | | | | | | | | | | | |
| 303598 | Island Creek at Island Creek Rd. | (2016) 1.10 ^H | IP | WWH | 38 ^{ns} | - | VG | 71.0 | Full | | |
| Donaldson Creek (10-060-000) | | | | | | | | | | | |
| 303595 | Donaldson Creek at U.S. Rte. 52 | (2016) 0.45 ^H | IP | WWH | 48 | - | G | 72.3 | Full | | |
| Stout Run (10-067-000) | | | | | | | | | | | |
| 200741 | Stout Run N. of Rome, adj. Blue Creek Rd., upst. Puntenney Run | (2016) 3.00 ^H | WAP | EWB/ CWH (R) | 56 | - | E | 67.3 | Full | | |
| Russell Fork (10-069-000) | | | | | | | | | | | |
| 303605 | Russell Fork at Point Cemetery Rd. | (2016) 0.10 ^H | WAP | WWH | 52 | - | G | 68.8 | Full | | |
| Puntenney Run (10-071-000) | | | | | | | | | | | |
| 302195 | Puntenney Run | (2016) 1.35 ^H | WAP | CWH (R) | 24 | - | G | 63.8 | Full | | |
| Long Lick Run (10-075-000) | | | | | | | | | | | |
| 303599 | Long Lick Run at Ford dst. Owl Hollow | (2016) 1.23 ^H | WAP | EWB/ CWH (R) | 58 | - | E | 80.0 | Full | | |
| Sulphur Creek (10-077-000) | | | | | | | | | | | |
| 303608 | Sulphur Creek at Sulphur Creek Rd. | (2016) 0.35 ^H | WAP | CWH (R) | 42 | - | E | 64.5 | Full | | |
| Rock Run (10-081-000) | | | | | | | | | | | |
| 303604 | Rock Run | (2016/2017) 0.30 ^H /1.80 ^H | WAP | CWH (R) | 46 | - | E | 65.5 | Full | | |
| Lower Twin Creek (10-082-000) | | | | | | | | | | | |
| 303600 | Lower Twin Creek (RM 5.2) adj. Lower Twin Creek Rd. | (2016) 5.20 ^H | WAP | CWH (R) | 40 | - | E | 74.3 | Full | | |
| X99Q02 | Lower Twin Creek NW of Buena Vista, adj. Lower Twin Creek Rd. | (2016) 1.65 ^H | WAP | EWB/ CWH (R) | 46 ^{ns} | - | E | 73.0 | Full | | |

| Station | Location | (Year Sampled) RM | Eco-Region | Aquatic Life Use | IBI | MIwb | ICI ^a | QHEI | Attain. Status | Causes | Sources |
|--|--|---------------------------|------------|------------------|------------------|-------|------------------|------|----------------|---------------------------|-----------------|
| Upper Twin Creek (10-085-000) | | | | | | | | | | | |
| X04P01 | Upper Twin Creek at McGaw at U.S. Rte. 52 | (2016) 2.55 ^H | WAP | CWH (R) | 44 | - | E | 80.0 | Full | | |
| East Fork Upper Twin Creek (10-089-000) | | | | | | | | | | | |
| 303597 | E. Fork Upper Twin Creek at Upper Twin Creek Rd. | (2016) 0.10 ^H | WAP | EWB/ CWH (R) | 50 | - | E | 79.3 | Full | | |
| Mcatee Run (10-096-000) | | | | | | | | | | | |
| 303603 | Mcatee Run at U.S. Rte. 52 | (2016) 0.66 ^H | WAP | CWH (R) | 36 | - | E | 66.5 | Full | | |
| Pond Run (10-099-000) | | | | | | | | | | | |
| 303613 | Pond Run off state forest Rd. 1 (Pond Run Rd.) at Backpack Trail | (2016) 4.64 ^H | WAP | CWH (R) | 48 | - | E | 77.5 | Full | | |
| 303602 | Pond Run at U.S. Rte. 52 SW of Friendship | (2016) 0.38 ^H | WAP | CWH (R) | 44 | - | E | 77.5 | Full | | |
| Eagle Creek (10-100-000) | | | | | | | | | | | |
| 303537 | Eagle Creek dst. confluence with W. Fk. and E. Fk. Eagle Creek | (2016) 14.43 ^W | IP | WWH | 44 | 9.58 | 42 | 88.3 | Full | | |
| 200689 | Eagle Creek E of Ripley at North Pole Rd. | (2016) 6.20 ^W | IP | EWB (R) | 48 ^{ns} | 10.05 | E | 88.0 | Full | | |
| Baylor Run (10-101-000) | | | | | | | | | | | |
| 302940 | Baylor Run at Scoffield Rd. | (2015) 0.15 ^H | IP | WWH | 22 [*] | - | G | 68.0 | Non | Natural (flow or habitat) | Natural sources |
| Beetle Creek (10-102-000) | | | | | | | | | | | |
| 302942 | Beetle Creek adj. E. Fk. Rd. | (2015) 4.85 ^H | IP | WWH | 32 [*] | - | G | 75.0 | Partial | Unknown | Unknown |
| 302941 | Beetle Creek at Griffith Rd. | (2015) 0.45 ^H | IP | WWH | 42 | - | G | 69.3 | Full | | |
| Lafferty Run (10-103-000) | | | | | | | | | | | |
| 302943 | Lafferty Run at North Pole Rd. (Rd. 13b) | (2015) 0.05 ^H | IP | EWB | 52 | - | E | 74.0 | Full | | |
| Indian Lick (10-104-000) | | | | | | | | | | | |
| 302944 | Indian Lick at Upper Eagle Creek Rd. | (2015) 0.05 ^H | IP | WWH | - | - | G | - | - | | |
| Brushy Fork (10-105-000) | | | | | | | | | | | |
| 302945 | Brushy Fork at Brushy Fork Rd. (Rd. 241) | (2015) 1.00 ^H | IP | WWH | 28 [*] | - | G | 57.3 | Partial | Natural (flow or habitat) | Natural sources |
| Suck Run (10-106-000) | | | | | | | | | | | |
| 302946 | Suck Run at Ebenezer Rd. (Rd. 33) | (2015) 1.70 ^H | IP | WWH | 32 [*] | - | E | 65.5 | Partial | Unknown | Unknown |
| East Fork Eagle Creek (10-110-000) | | | | | | | | | | | |

| Station | Location | (Year Sampled) RM | Eco-Region | Aquatic Life Use | IBI | MIwb | ICI ^a | QHEI | Attain. Status | Causes | Sources |
|--|--|------------------------------|------------|------------------|------------------|------|------------------|------|----------------|---------------------------|-----------------|
| 303607 | E. Fk. Eagle Creek SW of West Union off St. Rte. 41 at farm ford | (2016) 10.95 ^H | IP | WWH | 44 | - | G | 78.8 | Full | | |
| X03S03 | E. Fk. Eagle Creek W of West Union at Twp. Rd. 231 | (2016) 7.90 ^H | IP | WWH | 46 | - | G | 83.5 | Full | | |
| 200691 | E. Fk. Eagle Creek S of Fairview at Brier Ridge Rd. | (2016) 4.30 ^W | IP | WWH | 46 | 9.47 | 52 | 89.8 | Full | | |
| X03W04 | E. Fk. Eagle Creek at end of East Fork Rd. | (2016) 0.82 ^W | IP | WWH | 44 | 8.77 | 56 | 81.0 | Full | | |
| Tributary to East Fork Eagle Creek (RM 6.92) (10-110-002) | | | | | | | | | | | |
| 303611 | Trib. to E. Fk. Eagle Creek (Rm 6.92) adj. Eagle Creek Rd. | (2016) 0.10 ^H | IP | WWH (R) | 50 | - | G | 80.3 | Full | | |
| Town Branch (10-111-000) | | | | | | | | | | | |
| 302947 | Town Branch adj. East Fork Rd. (Rd. 221) | (2015) 0.15 ^H | IP | WWH | 40 | - | G | 73.0 | Full | | |
| Washburn Run (10-112-000) | | | | | | | | | | | |
| 302948 | Washburn Run dst. St. Rte. 125 | (2015) 1.40 ^H | IP | WWH | 24 [*] | - | G | 66.3 | Non | Unknown | Unknown |
| Adas Run (10-113-000) | | | | | | | | | | | |
| 302949 | Adas Run dst. St. Rte. 125 | (2015) 0.70 ^H | IP | WWH | 26 [*] | - | G | 83.3 | Non | Unknown | Unknown |
| Hills Fork (10-114-000) | | | | | | | | | | | |
| 302951 | Hills Fork at Eckmansville Rd. (Rd. 2) | (2015) 3.05 ^H | IP | WWH | 38 ^{ns} | - | G | 81.5 | Full | | |
| 302950 | Hills Fork at St. Rte. 125 | (2015) 1.30 ^H | IP | WWH | 46 | - | G | 78.5 | Full | | |
| Lick Run (10-115-000) | | | | | | | | | | | |
| 302952 | Lick Run at Old Cincinnati Pike (Rd. 21) | (2015) 0.95 ^H | IP | WWH | 32 [*] | - | G | 74.3 | Partial | Natural (flow or habitat) | Natural sources |
| Gordon Run (10-116-000) | | | | | | | | | | | |
| 302953 | Gordon Run at Deatley Rd. | (2015) 0.05 ^H | IP | WWH | 40 | - | MG ^{ns} | 77.8 | Full | | |
| Hannah Run (10-117-000) | | | | | | | | | | | |
| 302954 | Hannah Run | (2015) 0.01 ^H | IP | WWH | - | - | MG ^{ns} | - | - | | |
| West Fork Eagle Creek (10-120-000) | | | | | | | | | | | |
| X03W05 | West Fork Eagle Creek SE of Russellville at St. Rte. 125 | (2016) 7.38 ^W | IP | EWH (R) | 48 ^{ns} | 9.54 | 46 | 88.8 | Full | | |
| 200693 | West Fork Eagle Creek W of Decatur, upst. St. Rte. 353 | (2016) 3.30 ^W | IP | EWH (R) | 50 | 9.56 | 50 | 87.5 | Full | | |
| Tributary to West Fork Eagle Creek (RM 7.05) (10-120-001) | | | | | | | | | | | |

| Station | Location | (Year Sampled) RM | Eco-Region | Aquatic Life Use | IBI | MIwb | ICI ^a | QHEI | Attain. Status | Causes | Sources |
|--|--|---------------------------|------------|------------------|------------------|-------|------------------|------|----------------|---------------------------|---------------------------|
| X03W07 | Trib. To West Fork Eagle Creek (7.05) at Russellville-Winchester Rd. | (2016) 1.80 ^H | IP | WWH | 38 ^{NS} | - | G | 64.3 | Full | | |
| Honey Creek (Northwest Fork RM 2.34) (10-120-002) | | | | | | | | | | | |
| X99Q04 | Honey Creek E of Russellville at mouth | (2016) 0.10 ^H | IP | WWH | 52 | - | LF* | 70.3 | Partial | Ammonia | Russellville WWTP lagoons |
| Waggoner Run (10-202-000) | | | | | | | | | | | |
| 302194 | Waggoner Run | (2014) 1.04 ^H | IP | EW/CWH (R) | - | - | VG | - | - | | |
| Mackenzie Run (10-203-000) | | | | | | | | | | | |
| 302767 | Mackenzie Run upst. Waggoner Riffle Rd. | (2015) 0.20 ^H | IP | CWH | 44 | - | VG | 52.0 | Full | | |
| Straight Creek (10-300-000) | | | | | | | | | | | |
| 303475 | Straight Creek Ash Ridge Arnheim Rd. | (2016) 17.70 ^H | IP | WWH | 40 | - | - | 70.5 | Full | | |
| X03W09 | Straight Creek at Arnheim at Brownstown-Arnheim Rd. | (2016) 16.75 ^H | IP | WWH | 46 | - | G | 70.8 | Full | | |
| X03W11 | Straight Creek WSW of Russellville at St. Rte. 125 | (2016) 9.45 ^W | IP | WWH | 34* | 7.54* | E | 72.3 | Partial | Unknown | Unknown |
| X03W12 | Straight Creek at Centerpoint at Old U.S. Rte. 68 | (2015) 2.78 ^W | IP | WWH | 42 | 8.37 | 50 | 76.8 | Full | | |
| Sink Creek (10-301-000) | | | | | | | | | | | |
| 302955 | Sink Creek adj. Old A and P Rd. (Rd. 67a) | (2015) 0.15 ^H | IP | WWH | 24* | - | G | 58.8 | Non | Natural (flow or habitat) | Natural sources |
| Rangle Run (10-302-000) | | | | | | | | | | | |
| 302956 | Rangle Run adj. Rangle Run Rd. (Rd. 541) | (2015) 0.30 ^H | IP | CWH (R) | 46 | - | G | 73.8 | Full | | |
| Sheep Run (10-303-000) | | | | | | | | | | | |
| 302957 | Sheep Run upst. Centerpoint Rd. (Rd. 67b) | (2015) 0.10 ^H | IP | WWH | 46 | - | VG | 69.3 | Full | | |
| Campbell Run (10-304-000) | | | | | | | | | | | |
| 302958 | Campbell Run at Old U.S. Rte. 68 (Rd. 30) | (2015) 0.20 ^H | IP | WWH | 32* | - | G | 74.5 | Partial | Natural (flow or habitat) | Natural sources |
| Evans Run (10-305-000) | | | | | | | | | | | |
| 302959 | Evans Run adj. Straight Creek Rd. (Rd. 255) at confluence | (2015) 0.05 ^H | IP | WWH | 22* | - | G | 77.3 | Non | Natural (flow or habitat) | Natural sources |
| Washburn Run (10-307-000) | | | | | | | | | | | |

| Station | Location | (Year Sampled) RM | Eco-Region | Aquatic Life Use | IBI | MIwb | ICI ^a | QHEI | Attain. Status | Causes | Sources |
|--|--|----------------------------------|------------|------------------|------------------|------|------------------|------|----------------|---|--|
| 302960 | Washburn Run about 100 yds. dst. Hockman Rd. (Rd. 68) | (2015) 1.25 ^H | IP | WWH | <u>26</u> * | - | MG ^{ns} | 71.0 | Non | Natural (flow or habitat) | Natural sources |
| Bull Run (10-308-000) | | | | | | | | | | | |
| 302961 | Bull Run near mouth | (2015) 0.05 ^H | IP | WWH | <u>26</u> * | - | G | 73.5 | Non | Natural (flow or habitat) | Natural sources |
| Scott Run (10-309-000) | | | | | | | | | | | |
| 302962 | Scott Run at U.S. Rte. 68 | (2015) 0.20 ^H | IP | WWH | <u>12</u> * | - | G | 69.5 | Non | Natural (flow or habitat) | Natural sources |
| Camp Run (10-310-000) | | | | | | | | | | | |
| 302963 | Camp Run at Day Hill-Arnheim Rd. | (2015) 0.10 ^H | IP | WWH | 36 ^{ns} | - | G | 60.8 | Full | | |
| Myers Run (10-311-000) | | | | | | | | | | | |
| 302964 | Myers Run at Martin-Hollow Rd. (Rd. 68) | (2015) 0.05 ^H | IP | WWH | 36 ^{ns} | - | MG ^{ns} | 60.0 | Full | | |
| Honey Run (10-313-000) | | | | | | | | | | | |
| 302965 | Honey Run adj. Day Hill-Arnheim Rd. | (2015) 0.10 ^H | IP | WWH | 30* | - | MG ^{ns} | 67.8 | Partial | Natural (flow or habitat) | Natural sources |
| West Fork Straight Creek (10-314-000) | | | | | | | | | | | |
| 302966 | West Fork Straight Creek at Westfork Rd. (Rd. 66a) | (2015) 1.25 ^H | IP | WWH | <u>24</u> * | - | G | 68.5 | Non | Unknown | Unknown |
| Buck Run (10-315-000) | | | | | | | | | | | |
| 302967 | Buck Run at Ash Ridge Arnheim Rd. (Rd. 17b) | (2015) 0.05 ^H | IP | WWH | 38 ^{ns} | - | MG ^{ns} | 74.5 | Full | | |
| Sycamore Run (10-316-000) | | | | | | | | | | | |
| 302968 | Sycamore Run near Fite-Hauck Rd. and Ash Ridge Arnheim Rd. | (2015/2017) 0.05 ^H | IP | WWH | 30* | - | F* | 71.5 | Non | Sedimentation/ siltation Organic enrichment DO Copper sulfate | Upstream impoundment - Lake Waynoka drinking water reservoir |
| Town Run (10-407-000) | | | | | | | | | | | |
| X02S05 | Town Run just upst. Georgetown WWTP | (2016) 0.81 ^H | IP | CWH | 20 | - | G | 77.0 | Full | | |
| X02W04 | Town Run dst. Georgetown WWTP | (2016) 0.63 ^H | IP | CWH | 20 | - | LF* | 77.0 | Partial | Natural (flow or habitat) Flow regime alternations | Natural sources Municipal point source |
| Nace Run (10-507-000) | | | | | | | | | | | |

| Station | Location | (Year Sampled) RM | Eco-Region | Aquatic Life Use | IBI | MIwb | ICI ^a | QHEI | Attain. Status | Causes | Sources |
|------------------------------------|--|---------------------------|------------|------------------|------------------|------|------------------|------|----------------|--------|---------|
| 303601 | Nace Run at Shawnee State Park Marina upst. dam | (2016) 0.43 ^H | WAP | CWH (R) | 40 | - | VG | 70.0 | Full | | |
| Turkey Creek (10-508-000) | | | | | | | | | | | |
| 303610 | Turkey Creek dst. Wolfden Run adj. St. Rte. 125 | (2016) 12.90 ^H | WAP | CWH (R) | 40 | - | E | 82.5 | Full | | |
| 303609 | Turkey Creek dst. Turkey Creek Lake | (2016) 10.70 ^H | WAP | WWH (R) | 42 ^{ns} | - | G | 74.0 | Full | | |
| X04P03 | Turkey Creek dst. Roosevelt Lake at St. Rte. 125 | (2016) 9.58 ^H | WAP | WWH (R) | 54 | - | G | 80.5 | Full | | |
| 200744 | Turkey Creek upst. Pond Lick Run at St. Rte. 125 | (2016) 6.70 ^W | WAP | WWH (R) | 46 | 8.79 | E | 78.0 | Full | | |
| X04P02 | Turkey Creek at Friendship at U.S. Rte. 52 | (2016) 4.13 ^W | WAP | WWH (R) | 54 | 8.67 | VG | 81.5 | Full | | |
| Odell Creek (10-516-000) | | | | | | | | | | | |
| 302183 | Odell Creek W of Friendship at driveway off Odell Creek Rd. | (2013) 0.30 ^H | WAP | WWH | 44 | - | VG | 81.5 | Full | | |
| Pond Lick Run (10-517-000) | | | | | | | | | | | |
| 302184 | Pond Lick Run NW of Friendship, near mouth adj. Shawnee Rd. | (2013) 0.20 ^H | WAP | EWH | 46 ^{ns} | - | E | 79.0 | Full | | |
| Rock Lick (10-518-000) | | | | | | | | | | | |
| 302770 | Rock Lick | (2013) 0.50 ^H | WAP | CWH | 12 | - | VG | 79.0 | Full | | |
| Brush Fork (10-519-000) | | | | | | | | | | | |
| 302185 | Brush Fork just W of Pond Lick Lake at mouth | (2013) 0.01 ^H | WAP | CWH | 26 | - | G | 80.8 | Full | | |
| Wes Run (10-520-000) | | | | | | | | | | | |
| 302186 | Wes Run N.W. of Friendship, near mouth Adj. Odell Cemetery Rd. | (2013) 0.01 ^H | WAP | CWH | 24 | - | F | 76.0 | Full | | |
| Harber Fork (10-523-000) | | | | | | | | | | | |
| 302187 | Harber Fork near Camp Oyo and mouth at Shawnee Rd. | (2013) 0.07 ^H | WAP | CWH | 26 | - | E | 78.8 | Full | | |
| Mackletree Run (10-524-000) | | | | | | | | | | | |
| 302188 | Mackletree Run just upst. Roosevelt Lake at Mackletree Rd. | (2013) 0.43 ^H | WAP | EWH | 48 ^{ns} | - | VG ^{ns} | 91.0 | Full | | |
| Lampblack Run (10-526-000) | | | | | | | | | | | |

| Station | Location | (Year Sampled) RM | Eco-Region | Aquatic Life Use | IBI | MIwb | ICI ^a | QHEI | Attain. Status | Causes | Sources |
|----------------------------------|---|--------------------------|------------|------------------|-----|------|------------------|------|----------------|---------------------------|-----------------|
| 302189 | Lampblack Run just upst. Turkey Creek Lake at parking lot | (2013) 0.10 ^H | WAP | CWH | 42 | - | G | 78.0 | Full | | |
| Old Lade Run (10-527-000) | | | | | | | | | | | |
| 302190 | Old Lade Run near mouth, adj. Big Run Rd. | (2013) 0.20 ^H | WAP | WWH | 36* | - | E | 77.3 | Partial | Natural (flow or habitat) | Natural sources |
| Wolfden Run (10-530-000) | | | | | | | | | | | |
| 302768 | Wolfden Run upst. Wolfden Lake | (2014) 0.50 ^H | WAP | CWH | 30 | - | G | 53.0 | Full | | |

a A narrative evaluation of the qualitative sample based on attributes such as EPT taxa richness, number of sensitive taxa and community composition was used when quantitative data was not available (or considered unreliable due to sampling constraints.) VP=Very Poor; P=Poor; F=Fair; MG=Marginally Good; G=Good; VG=Very Good; E=Exceptional.

NA MIwb is not applicable to headwater streams with drainage areas < 20 mi².

ns Nonsignificant departure from biocriteria (<4 IBI or ICI units, or <0.5 MIwb units).

* Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

- No sample taken.

H Headwater site, less than 20 mi² in drainage.

W Wading site, greater than 20 mi² in drainage.

| Index – Site Type | Biological Criteria ³ - IP | | Biological Criteria ³ - WAP | |
|-------------------|---------------------------------------|-----|--|-----|
| | WWH | EWH | WWH | EWH |
| IBI — Wading | 40 | 50 | 44 | 50 |
| IBI — Headwater | 40 | 50 | 44 | 50 |
| MIwb — Wading | 8.1 | 9.4 | 8.4 | 9.4 |
| ICI | 30 | 46 | 36 | 46 |

Biological attainment assessments were made at 90 sampling stations across Scioto, Adams and Brown counties between 2013 – 2017. Both fish and macroinvertebrate communities were fully meeting the designated or recommended ALU at 66 of the 90 assessed stations (Table 13). Partial attainment was achieved at 13 sampling stations and 11 sites were not attaining. Twelve sites were impaired due to natural conditions relating to physical habitat limitations. These small drainages had natural limitations which decreased fish species richness and abundance within the sampling zones. Creek chubs (*Semotilus atromaculatus*), a pioneering species, were found to be the dominant fish species in these streams. Some headwaters had very steep bedrock waterfalls while others became completely desiccated during the summer which made fish passage and establishment very difficult (Figure 15). Downstream sampling collections were completed on these streams where practical. Many of the sites were close to the downstream confluence or did not differ in drainage or habitat, these streams were not resampled. Where downstream sampling occurred, the streams were fully attaining their ALU. One site on Sycamore run (302968) was impaired by sedimentation and siltation, organic enrichment, low DO, and copper exceedances from the Lake Waynoka drinking water reservoir. One site on Honey Creek was impaired due to ammonia exceedances from the Russellville WWTP lagoons. Impairment to the macroinvertebrate community in Town Run downstream from the Georgetown WWTP (X02W04) was caused by flow regime alterations from the WWTP and the fish community was impaired by natural causes. The cause for impairment at the remaining nine sites not meeting their designated ALU was unknown.

White Oak Basin

Town Run was the only stream sampled in the White Oak Creek basin during this study in 2016. Ohio EPA conducted an intensive biological and water quality study of the White Oak Creek watershed in 2006 and part of the sampling efforts included Town Run. An excerpt from the report states: “High concentrations of ammonia-N (median of 3.24 mg/L), phosphorus-T (median of 3.04 mg/L), and nitrate+nitrite (median of 6.39 mg/L) were recorded downstream from the WWTP discharge in 2006.” As a result of observed stream impacts, Ohio EPA included Town Run on the 303(d) list, which is the state’s prioritized list of impaired waters. Since the impairment in Town Run could be directly attributed to high ammonia concentrations from a point source discharge (village of Georgetown WWTP), Ohio EPA prepared a Category 4B alternative in lieu of a TMDL.

The village completed improvements to the WWTP in 2014. As a result, ammonia levels in the treated effluent have dramatically improved. This was verified by the sampling conducted during the 2016 survey. During this survey, the median ammonia concentration in the effluent was 0.19 mg/L. In Town Run downstream from the outfall, the median concentration was 0.14 mg/L. The effluent samples had ammonia concentrations ranging from 0.14 to 0.33 mg/L, all below the water quality standard and below the plant’s monthly average permit limit of 0.6 mg/L. While nutrient values were elevated downstream of the plant, good quality habitat and shading prevented the manifestation of enrichment in the stream.

Biological samples were collected upstream and downstream from the Georgetown WWTP discharge (RM 0.80). Upstream of the discharge the macroinvertebrate community was evaluated as good (EPT=8, ST=4) and downstream (X02W04) they were low fair (EPT=3, ST=0). Torrential flows surged from the effluent pipe hourly as part of the WWTP’s operation, therefore rapidly raising and dropping downstream water levels. Temporary pools that formed between bedrock waterfalls began to shallow in a matter of minutes between effluent surges. These flow regime alterations made it difficult for macroinvertebrate colonization downstream of the plant’s effluent.

A new introduced species of leech (*Barbronia weberi*) was collected downstream from the discharge. This is the first time in the United States that it has been found in a natural stream. Rutter and Klemm (2001)

reported finding *B. weberi* in a home aquarium in south Florida and Genoni and Fazzino (2008) provided illustrations and characters to identify the species and summarized its anthropomorphic range extension from southeastern Asia to Australia, New Zealand, Europe, South America and North America, probably through the aquarium trade.

Macroinvertebrate communities showed a better comparison of water quality upstream and downstream of the Georgetown WWTP in this instance. The fish community at both sites in Town Run was comprised mostly of creek chubs, and as a result IBI scores were narratively poor (IBI=20). The similarity in fish community was more indicative of the small drainage area (1.4 mi²) and steep gradient (1,66.7 ft./mi.) along a bedrock waterfall laden channel than impacts from the WWTP.

Straight Creek Basin

Straight Creek (three stations) and all its tributaries (13 stations) sampled during this study were meeting or marginally meeting the macroinvertebrate expectations for the IP ecoregion, except for Sycamore Run (RM 0.05) (302968). Qualitative samples' EPT ranged from eight (marginally good) in Myers Run, Honey Run, and Buck Run to 20 and 21 (exceptional) in Straight Creek. Washburn Run, Bull Run, Scott Run, and Honey Run were found to have natural habitat features that physically limited the numbers and species of fish present.

Sycamore Run was not meeting macroinvertebrate expectations with EPT=6 and ST=3. Causes of impairment were low DO, high copper, organic enrichment, and siltation due to the Lake Waynoka drinking water reservoir, also known as Sycamore Run Reservoir. Field meter instantaneous DO reading levels were below the minimum water quality criteria on Sycamore Run measured at 1.4 mg/L (Table 4). Despite good channel morphology, riparian, riffles and good pool depth, substrates were covered in moderate amounts of silt. This was likely due to erosion from flashy flows by reservoir releases on this 1.6 mi² stream and silt coming from the upstream reservoir. The fish community was a mixture of pioneering headwater species and species from the reservoir which prefer more lentic habitats such as: largemouth bass (*Micropterus salmoides*); black crappie (*Pomoxis nigromaculatus*); bluegill sunfish (*Lepomis macrochirus*); green sunfish (*Lepomis cyanellus*); and yellow bullhead catfish (*Ameiurus natalis*). No sensitive or pollution intolerant fish species were collected. More than 70 percent of the fish community was tolerant of pollution and just one headwater species was present.

Copper exceeded water quality standards at two sites, in Sycamore Run and in Straight Creek at Arnheim (RM 16.75). The Straight Creek site is just one mile downstream of the Sycamore Run site. Both sites are downstream of the Lake Waynoka Water Supply Reservoir, which is an impoundment on Sycamore Run. Copper sulfate is periodically added to the water supply reservoirs to prevent harmful algal blooms, which negatively impact the quality of the community's drinking water supply. The elevated copper concentrations in Sycamore Run and Straight Creek occurred during high flow conditions when the reservoir was most likely overflowing into Sycamore Run. The stream copper concentrations are close to concentrations in lake samples collected several days before (Table 14, Figure 16).

Table 14 — Copper concentrations in Lake Waynoka community water supply reservoir and in downstream locations in 2016. Water quality standards exceedances are designated with ** for OMZM and * for OMZA.

| Station | River | | Sample Date | Copper µg/L |
|---------|-------|---|-------------|-------------|
| | Mile | Station Name | | |
| 204216 | 1.00 | Lake Waynoka Water Supply Reservoir, L-1 | 5/18/2016 | 273** |
| 204216 | 1.00 | Lake Waynoka Water Supply Reservoir, L-1 | 6/07/2016 | 101** |
| X03W11 | 9.45 | Straight Creek WSW of Russellville at St. Rte. 125 | 7/05/2016 | 9.4 |
| X03W09 | 16.75 | Straight Creek at Arnheim at Brownstown-Arnheim Rd. | 7/05/2016 | 15* |

| Station | River Mile | Station Name | Sample Date | Copper µg/L |
|---------|------------|--|-------------|-------------|
| 302968 | 0.05 | Sycamore Run near Fite-Hauck Rd. and Ash Ridge Arnheim Rd. | 7/05/2016 | 83.4** |
| 204216 | 1.00 | Lake Waynoka Water Supply Reservoir, L-1 | 7/06/2016 | 87.2** |
| X03W11 | 9.45 | Straight Creek WSW of Russellville at St. Rt. 125 | 7/26/2016 | 2.2 |
| X03W09 | 16.75 | Straight Creek at Arnheim at Brownstown-Arnheim Rd. | 7/26/2016 | < 2 |
| 302968 | 0.05 | Sycamore Run near Fite-Hauck Rd. and Ash Ridge Arnheim Rd. | 7/26/2016 | 13 |
| 204216 | 1.00 | Lake Waynoka Water Supply Reservoir, L-1 | 8/02/2016 | 16.7** |
| X03W11 | 9.45 | Straight Creek WSW of Russellville at St. Rte. 125 | 9/01/2016 | < 2 |
| X03W09 | 16.75 | Straight Creek at Arnheim at Brownstown-Arnheim Rd. | 9/01/2016 | < 2 |
| 204216 | 1.00 | Lake Waynoka Water Supply Reservoir, L-1 | 9/07/2016 | 55.3** |
| X03W11 | 9.45 | Straight Creek WSW of Russellville at St. Rte. 125 | 9/15/2016 | < 2 |
| X03W09 | 16.75 | Straight Creek at Arnheim at Brownstown-Arnheim Rd. | 9/15/2016 | < 2 |
| 302968 | 0.05 | Sycamore Run near Fite-Hauck Rd. and Ash Ridge Arnheim Rd. | 9/15/2016 | 4.2 |

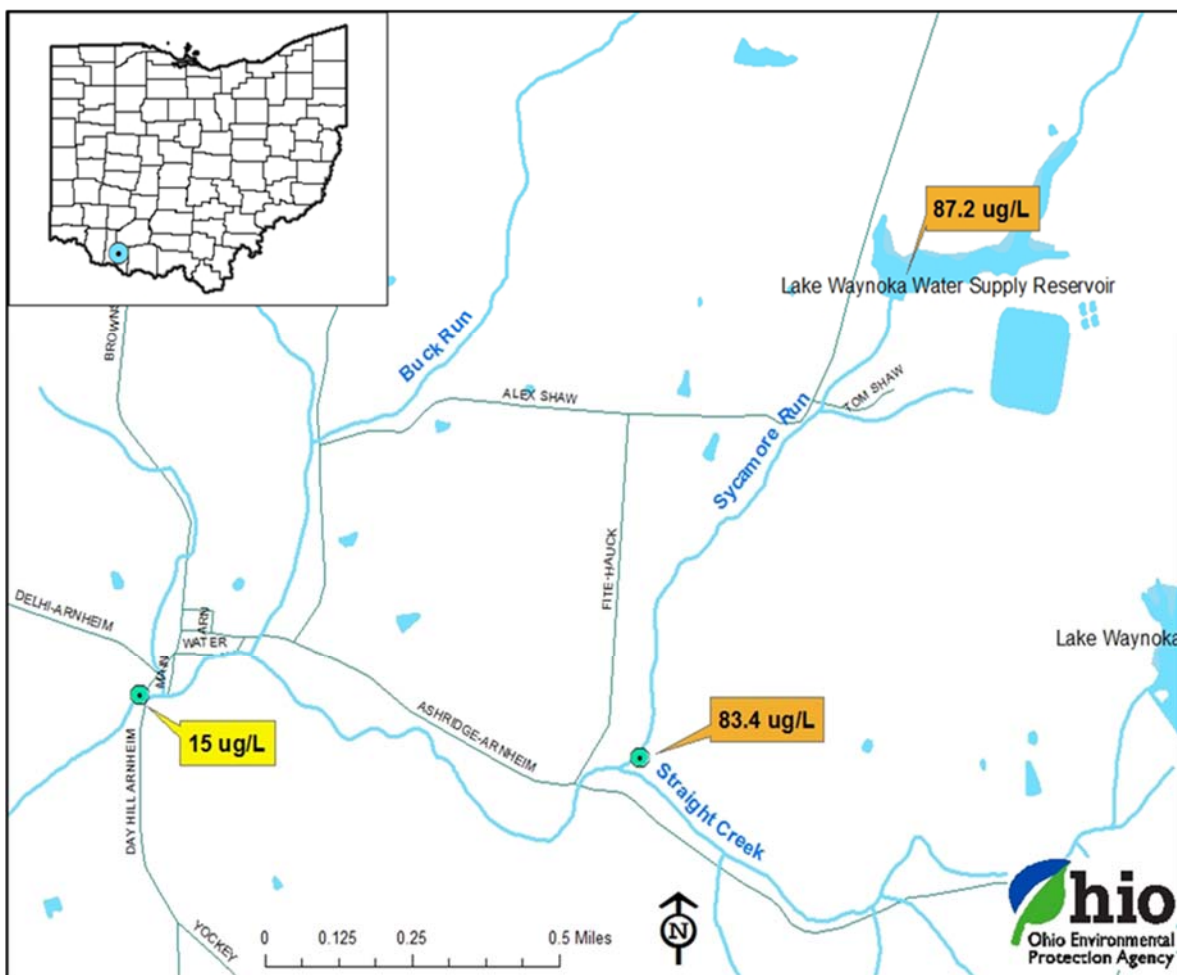


Figure 16 — Copper concentrations in Lake Waynoka community water supply reservoir and in downstream locations on July 5 and 6, 2016. Water quality standards exceedances are highlighted in orange (OMZM) and yellow (OMZA).

The more intensively pastured IP ecoregion had livestock in streams in many places; however, water chemistry results did not support a direct linkage to livestock impairment. Both Straight Creek at St. Rte. 125 (X03W11) and West Fork of Straight Creek at West Fork Rd. (302966) had pollution tolerant fish communities and algae eating central stoneroller minnows (*Campostoma anomalum*) were among the dominant species in both fish communities. While two sensitive fish species were collected in Straight

Creek in low abundance, none were collected in the West Fork. Neither fish community had a single species collected which was intolerant of pollution. The cause for impairment in these streams is unknown.

Eagle Creek Basin

Eagle Creek (two stations) and all tributaries (23 stations) sampled during this study were meeting or marginally meeting the macroinvertebrate expectations for the IP ecoregion except for Honey Creek (RM 0.1) (X99Q04). Eagle Creek was the largest stream in the study area and had the highest EPT (24 at RM 6.2) and ST (24 at RM 6.2) diversity of the streams in the IP ecoregion part of this study. Eagle Creek and its East and West forks also had the highest freshwater mussel diversity in this study area with 10 extant species as recorded in Watters et al. (2009).

The macroinvertebrate community sampled in Honey Creek was evaluated as low fair with very low (EPT=3, ST=0) diversity. This station is located about 0.6 miles downstream from the Russellville WWTP which has a lagoon system with controlled batch discharges. When irrigation is not possible, treated effluent can be control discharged to Honey Creek, with a ratio of 5:1 (stream flow to plant final effluent flow), and no discharge is allowed when the upstream flow is less than 0.5 MGD. However, due to maintenance issues, irrigation has been rarely used as the method for effluent disposal. Periodic discharges of ammonia from the WWTP were likely impacting the macroinvertebrate community. Effluent ammonia results reported by Russellville WWTP during the survey season ranged from 20.3 mg/L to 26.2 mg/L. For comparison, conventional treatment technologies utilized in WWTPs throughout the state routinely discharge treated water with nitrogen-ammonia concentrations less than 1 mg/L. One of the stream sampling events, which coincided with a time when the Russellville WWTP was discharging to Honey Creek, recorded an instream nitrogen-ammonia concentration of 2.53 mg/L, which exceeds the WQS of 1.7 mg/L. Despite a stream-flow to discharge-flow ratio of 6:1 on July 28, 2016, the Ohio EPA ammonia sample collected downstream of the WWTP discharge exceeded WQS. Four other samples taken during the survey were either non-detects or well below the WQS for ammonia. It is worth mentioning that these samples were taken five or more days after the WWTP ceased discharging to Honey Creek. This information strongly suggests that ammonia concentrations in Honey Creek elevate during the time the plant discharges and return to background at some point after the discharge ends.

Four Eagle Creek tributaries scored below IBI ALU attainment values. Fish communities in Beetle Creek (RM 4.85) (302942), Suck Run (302946), Washburn Run (302948), and Adas Run (302949) were not attaining their designated or recommended WWH aquatic life uses. No fish species intolerant of pollution were collected among the combined 2,168 fish captured at the four sites. Suck Run was the only one to have any sensitive fish species. Just six scarlet shiners (*Lythrurus fasciolaris*), less than one percent of the total catch, were collected in Suck Run. Pollution tolerant central stoneroller and fathead minnows (*Pimephales promelas*) were collected within these fish communities. Good to excellent QHEIs were scored at all four locations. The cause for impairment is unknown as water chemistry results did not support a direct linkage.

Three tributaries in the Eagle Creek basin were partially attaining their recommended or designated ALU due to natural habitat conditions. Baylor Run (302940) and Lick Run (302952) were primary headwater streams (<1 mi²) that supported good quality macro invertebrate communities but lacked the habitat to support a diverse fish community. Brushy Fork (302945) downstream of Brushy Fork Road was 3.5 mi² where the fish sample was collected. A series of shallow bedrock waterfalls having little noticeable flow comprised the zone. No pools or other significant habitat features were present that would support a diverse fish community.

Miscellaneous Ohio River Tributaries in the Interior Plateau Ecoregion

The Redoak Creek basin (four stations), Big Threemile Creek basin (six stations), and six other direct Ohio River tributaries in the IP ecoregion were meeting the macroinvertebrate expectations. EPT diversity ranged from 20 taxa (exceptional) in Redoak Creek (RM 2.32) and Big Threemile Creek (RM 4.18) to nine (marginally good to good) in West Fork Redoak Creek (RM 0.05). Fish communities in Redoak Creek (RM 7.2) (302933) and West Fork Redoak Creek (RM 0.05) (302934) scored below their respective ALU targets. No sensitive or pollution intolerant fish species were collected. Pollution tolerant central stoneroller minnows and fathead minnows were common components of both fish communities. The cause for impairment is unknown as water chemistry results did not support a direct linkage.

Big Threemile Creek at Roush Hill Rd. (RM 11.12) (302936) had noticeably more silt covering the coarse substrates than other sites in the basin. In-stream livestock upstream from this site likely led to more erosion, and siltation. No pollution intolerant fish species were collected at this site and just one sensitive species, scarlet shiner, was found. Central stoneroller minnows, creek chubs, and white suckers (*Catostomus commersonii*) were the main components of the fish community. The cause for impairment is unknown as water chemistry results did not support a direct linkage.

Miscellaneous Ohio River Tributaries in the Western Allegheny Plateau Ecoregion

Ninety percent of the WAP ecoregion sites were fully meeting their respective designated or recommended aquatic life use. Good quality streams in this area can be attributed to the mostly forested landscape and strong ground water connection in many of the streams. Just one anomalous site did not meet fish community biocriteria expectations for natural habitat reasons.

Draining 2.2 mi², Old Lade Run (302190) near Shawnee State Park was a very rocky and clear stream but was just too small and shallow to hold a robust fish community capable of meeting WWH criteria. Eight species of fish were collected, including one sensitive and two headwater species. A species indicative of good ground water connectivity, southern redbelly dace (*Chrosomus erythrogaster*), was also collected at this site.

The Ohio Brush Creek basin (two stations), Stout Run basin (three stations), Upper Twin Creek basin (two stations), Turkey Creek basin (15 stations), and seven other direct Ohio River tributaries in the WAP ecoregion were all meeting the macroinvertebrate expectations. EPT diversity ranged from 27 taxa (exceptional) in Long Lick Run (RM 1.5) and Pond Run (RM 0.38) to 10 (good) in Brush Fork (RM 0.05), excluding Wes Run. The collection of macroinvertebrates in Wes Run (EPT=2, ST=5, CW=2) was limited by interstitial flow. The presence of five sensitive taxa and two coldwater taxa including *Nigronia fasciata*, which has a two-year life cycle, along with the coldwater fish southern redbelly dace, indicates that this stream was functioning as CWH. The high number of CWH indicator macroinvertebrate taxa found in these streams indicate that streams in the WAP ecoregion had a high connectivity with ground water. All the stations (except one station in Turkey Creek) in this ecoregion had at least one CWH indicator taxon and 18 stations had four or more taxa.

Aquatic Life Trends

Historical data in this study area is limited to 1997 data from 12 sites on nine select streams. An overall trend toward improved water quality from east to west in the study area is illustrated by IBI score in Figure 17. No improvements in fish community performance were seen in Town Run upstream or downstream of the Georgetown WWTP. Negligible changes in the fish community in Town Run could be attributed to a series of steep bedrock waterfalls which make up the stream bed throughout the two sample reaches. In

general, these reaches are difficult for many fish species to inhabit. More discernable trends in Town Run can be seen in the macroinvertebrate community.

The great majority of comparable stations had similar or improved macroinvertebrate community metrics during this study compared to 1997. One exception was Honey Creek (RM 0.1) which looked a little worse in 2016 with EPT=3 and ST=0 compared to EPT=8 and ST=1 in 1997. Town Run was also sampled in 2008, 2006 and 1997. The communities looked similar in 2016, 2008, and 2006 with a good primary headwater community upstream from the Georgetown WWTP discharge. CWH indicator macroinvertebrates were usually uncommon with a high of three taxa collected in 2008. However, larval two-lined salamanders were commonly found upstream from the WWTP. The community downstream from the WWTP discharge has remained impacted by the WWTP discharge. However, the degree of impact has decreased since 1997 when the community was evaluated as very poor compared to 2016 when it was evaluated as low fair. This was probably the result of improvements to the WWTP treatment process.

One fish species intolerant of siltation and turbidity, the bigeye chub (*Hybopsis amblops*), was collected for the first time in the study area. Five individual bigeye chubs were collected in Turkey Creek near the U.S. Rte. 52 bridge in Friendship, Ohio on July 13, 2016. The presence of this species in Turkey Creek is indicative of well-established vegetated riparian buffers in the watershed. Further establishment of this species throughout the watershed is dependent upon continued good erosion and sediment control practices implemented in the state forest and private lands.

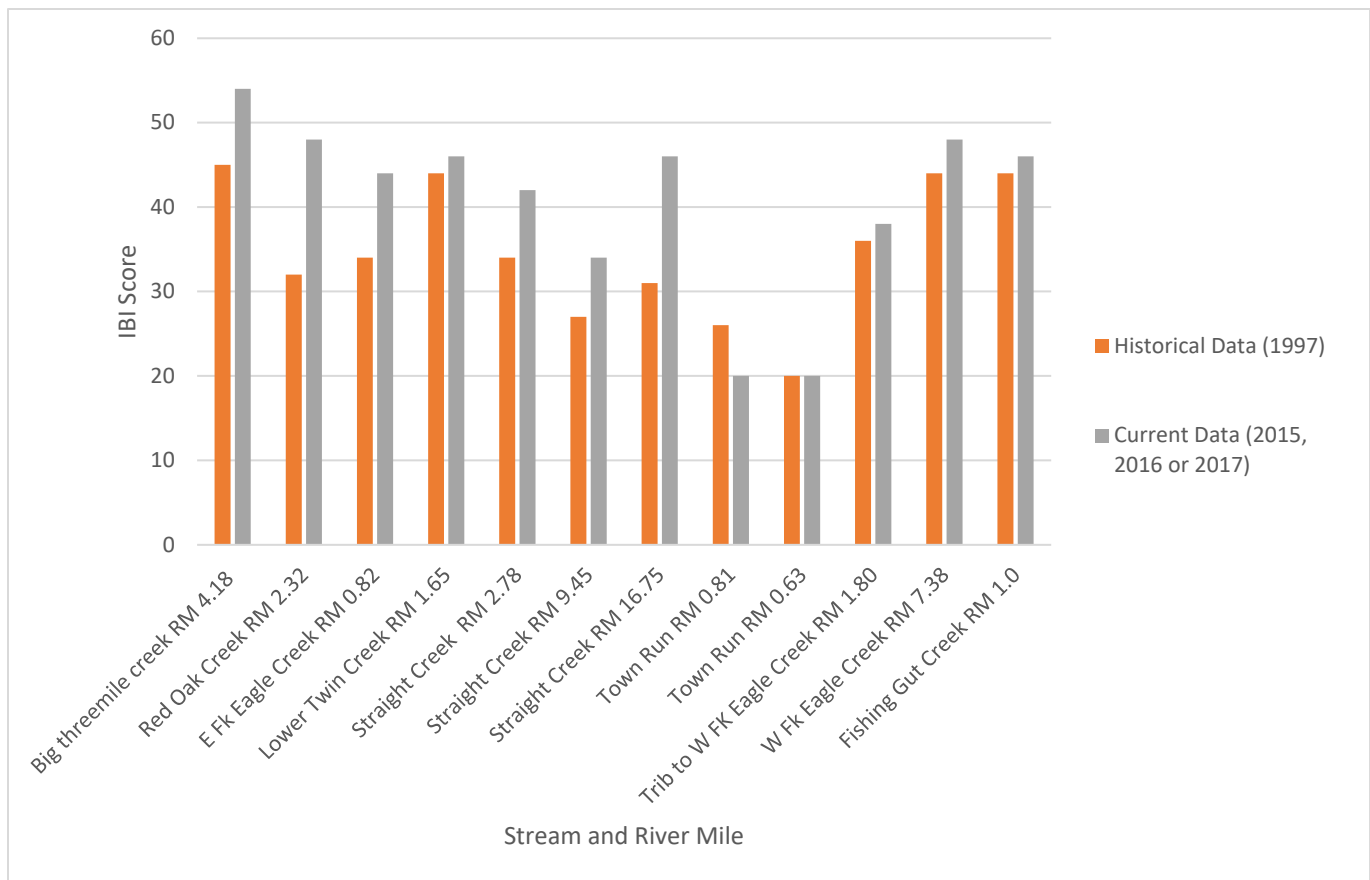


Figure 17 — Trends of fish community IBI for nine SORT streams, 1997-2017.

Recreation Use Results and Discussion

Water quality criteria for determining attainment of recreation use are established in the Ohio Water Quality Standards (Table 37-2 in OAC 3745-1-37) based upon the concentration of bacteria indicators (*Escherichia coli*) in the water column.

Escherichia coli (*E. coli*) bacteria are microscopic organisms that are present in large numbers in the feces and intestinal tracts of humans and other warm-blooded animals. *E. coli* typically comprises approximately 97 percent of the organisms found in the fecal coliform bacteria of human feces². There is currently no simple way to differentiate between human and animal sources of coliform bacteria in surface waters, although methodologies for this type of analysis are becoming more practicable. These microorganisms can enter water bodies where there is a direct discharge of human and animal wastes or may enter water bodies along with runoff from soils where these wastes have been deposited.

Pathogenic (disease-causing) organisms are typically present in the environment in such small amounts that it is impractical to monitor them directly. Fecal indicator bacteria by themselves, including *E. coli*, are usually not pathogenic. However, some strains of *E. coli* can be pathogenic, capable of causing serious illness. Although not necessarily agents of disease, fecal indicator bacteria such as *E. coli* may indicate the potential presence of pathogenic organisms that enter the environment through the same pathways. When *E. coli* are present in high numbers in a water sample, it invariably means that the water has received fecal matter from one source or another. Swimming or other recreational-based contact with water having a high fecal coliform or *E. coli* count may result in ear, nose and throat infections, as well as stomach upsets, skin rashes and diarrhea. Young children, the elderly and those with depressed immune systems are most susceptible to infection.

The streams of the SORT evaluated in this survey are designated as a Primary Contact Recreation (PCR) use in OAC Rule 3745-1-17. Water bodies with a designated recreational use of PCR "...are waters that, during the recreation season, are suitable for one or more full body contact recreation activities such as, but not limited to, wading, swimming, boating, water skiing, canoeing, kayaking and scuba diving. All surface waters of the state are designated as primary contact recreation unless otherwise designated as bathing waters or secondary contact recreation (SCR)" [OAC 3745-1-07 (B)(3)(b)]. Water bodies with a designated recreational use of SCR "...are waters that result in minimal exposure potential to water-borne pathogens because the waters are: rarely used for water-based recreation such as, but not limited to, wading; situated in remote, sparsely populated areas; have restricted access points; and have insufficient depth to provide full body immersion, thereby greatly limiting the potential for water-based recreation activities" [OAC 3745-1-07 (B)(3)(c)].

The *E. coli* criteria that apply to PCR streams include a geometric mean 126 cfu/100 mL, and a statistical threshold value (STV) of 410 cfu/100 mL. The *E. coli* criteria that apply to SCR streams include a geometric mean of 1,030 cfu/100 mL, and statistical threshold values of 1,030 cfu/100 mL. The geometric mean is based on two or more samples and is used as the basis for determining attainment status when more than one sample is collected. The statistical threshold value shall not be exceeded in more than 10 percent of samples taken in a 90-day period.

Summarized bacteria results are listed in Table 15, and the complete dataset is reported in Appendix J. Nineteen locations in the SORT study area were sampled for *E. coli* five times, from June 22 – August 18, 2016. Evaluation of *E. coli* results revealed that four of the 19 locations attained the applicable geometric mean criterion and thus were in full attainment of the recreation use.

² Dufour, A.P. (1977). *Escherichia coli*: The fecal coliform. Am. Soc. Test. Mater. Spec. Publ. 635: 45-58.

Sampling locations both upstream and downstream of the Georgetown WWTP presented with geometric means of 514.6 cfu/100 mL and 553.6 cfu/100 mL, which show these areas to be in non-attainment. Sampling performed on the Georgetown WWTP effluent demonstrated the facility was able to pass the geometric mean standard, but the STV of 410 cfu/100 mL in 10 percent of the samples was exceeded. The non-attainment in Town Run is mostly attributed to urban runoff from Georgetown, but also may be influenced occasionally by the WWTP. Isaacs Creek near Manchester, which had a geometric mean of 335.5 cfu/100 mL, may also be affected by urban runoff.

Nace Run had the highest geometric mean of all sample locations at 1,767.6 cfu/100 mL. During sampling, this site had very low to intermittent stream flow. It is likely that the non-attainment at this site was influenced by poorly performing or failing home sewage treatment systems (HSTS) located in the area adjacent to the stream. The sampling location at East Fork Eagle Creek west of West Union was in non-attainment with a geometric mean of 1,320.8 cfu/100 mL. This site is located adjacent to the unsewered Hale Drive subdivision, which could be a potential source of *E. coli*. All other areas sampled that are in non-attainment are located in mostly wooded areas with some intermittent agriculture and homes. Runoff from livestock areas or areas where manure is applied as a fertilizer may contribute to the non-attainment. Poorly performing or failing HSTS may also be a contributor.

Table 15 — A summary of *E. coli* data for the 19 locations in the SORT sampled June through August, 2016. Recreation Use Attainment Status is determined by comparing samples collected within a 90-day period during the recreation season to the geometric mean criterion of 126 cfu/100 mL and to the statistical threshold value (STV) of 410 cfu/100 mL, which should not be exceeded by more than 10 percent of individual samples.

| Station | Location | RM | # Samples | Geo. Mean | % > STV | Max. Value | Attain. Status | Possible Sources ¹ of Bacteria |
|--|---|-------|-----------|-----------|---------|------------|----------------|---|
| 05090201 02 01 – Headwaters Turkey Creek | | | | | | | | |
| 303609 | Turkey Creek dst. Turkey Creek Lake | 10.70 | 5 | 36.4 | 20% | 4,200 | NON | AG, HSTS |
| 05090201 02 02 – Odell Creek – Turkey Creek | | | | | | | | |
| X04P02 | Turkey Creek at Friendship dst. U.S. Rte. 52 | 4.1 | 5 | 103.2 | 0% | 365 | FULL | |
| 05090201 02 03 – Pond Run | | | | | | | | |
| 303602 | Pond Run at U.S. Rte. 52 | 0.38 | 5 | 28.6 | 0% | 185 | FULL | |
| 05090201 02 04 – Briery Branch – Ohio River | | | | | | | | |
| 303601 | Nace Run at Shawnee SP Marina dst. Dam | 0.43 | 5 | 1,767.6 | 80% | 7,310 | NON | AG, HSTS |
| 05090201 02 05 – Upper Twin Creek | | | | | | | | |
| X04P01 | Upper Twin Creek at McGaw at U.S. Rte. 52 | 2.6 | 5 | 54.9 | 0% | 86 | FULL | |
| 05090201 02 06 – Lower Twin Creek | | | | | | | | |
| X99Q02 | Lower Twin Creek adj. Upper Twin Creek – Rocky Fork Rd. | 1.65 | 5 | 53.1 | 0% | 228 | FULL | |
| 05090201 02 07 – Rock Run – Ohio River | | | | | | | | |
| 303603 | McAtee Run at U.S. Rte. 52 | 0.66 | 5 | 400.7 | 60% | 1,200 | NON | AG, HSTS |
| 05090201 02 09 – Stout Run | | | | | | | | |
| 200741 | Stout Run N of Rome, adj. Blue Creek Rd., dst. Russell Fork | 1.4 | 5 | 268.3 | 20% | 1,730 | NON | AG, HSTS |
| 05090201 02 10 – Quicks Run – Ohio River | | | | | | | | |
| 303608 | Sulphur Creek at Sulphur Creek Rd. | 0.35 | 5 | 445.6 | 40% | 20,900 | NON | AG, HSTS |

| Station | Location | RM | # Samples | Geo. Mean | % > STV | Max. Value | Attain. Status | Possible Sources ¹ of Bacteria |
|---|---|-------|-----------|-----------|---------|------------|----------------|---|
| 05090201 06 01 – Crooked Creek – Ohio River | | | | | | | | |
| 303612 | Isaacs Creek at Broadway St., Manchester | 1.43 | 5 | 335.5 | 20% | 1,200 | NON | AG, HSTS |
| 05090201 06 05 – Lawrence Creek – Ohio River | | | | | | | | |
| X99Q01 | L. Threemile Creek E of Maysville at U.S. Rte. 52 | 1.3 | 5 | 246.2 | 60% | 816 | NON | AG, HSTS |
| 05090201 07 02 – Headwaters East Fork Eagle Creek | | | | | | | | |
| 303607 | E. Fk. Eagle Creek W of West Union at Twp. Rd. 231 | 7.9 | 5 | 1,320.8 | 80% | 4,030 | NON | AG, HSTS |
| 05090201 07 04 – Rattlesnake Creek – West Fork Eagle Creek | | | | | | | | |
| 200693 | W. Fk. Eagle Creek W of Decatur, upst. St. Rte. 353 | 3.3 | 5 | 1,245.8 | 60% | 19,600 | NON | AG, HSTS |
| 05090201 07 05 – Eagle Creek | | | | | | | | |
| 303537 | Eagle Creek dst. confl. W. Fk and E. Fk Eagle Creek | 14.43 | 5 | 917.5 | 60% | 16,300 | NON | AG, HSTS |
| 05090201 08 02 – Headwaters Straight Creek | | | | | | | | |
| X03W11 | Straight Creek WSW of Russellville at St. Rte. 125 | 9.45 | 5 | 875.6 | 60% | 7,750 | NON | AG, HSTS |
| 05090201 08 03 – Evans Run – Straight Creek | | | | | | | | |
| X03W12 | Straight Creek at Centerpoint at Old U.S. Rte. 68 | 2.78 | 5 | 745.9 | 60% | 8,210 | NON | AG, HSTS |
| 05090201 10 03 – Big Run – Whiteoak Creek | | | | | | | | |
| X02S03 | Georgetown WWTP outfall 001 to Town Run | 0.8 | 5 | 33.5 | 20% | 461 | N/A | |
| X02W04 | Town Run dst. Georgetown WWTP | 0.63 | 5 | 533.6 | 60% | 1,990 | NON | Urban |
| X02S05 | Town Run just upst. Georgetown WWTP | 0.81 | 5 | 514.6 | 60% | 2,420 | NON | Urban |

¹ Possible sources: AG - agriculture; CAFO - concentrated animal feeding operation; HSTS - home sewage treatment systems; WWTP - wastewater treatment plant; CSOs - combined sewer overflows; SSOs - sanitary sewer overflows; Urban - urban runoff.

Public Water Supply Results and Discussion

The public water supply beneficial use in the WQS (OAC 3745 1 33) currently applies within 500 yards of drinking water intakes and for all publicly-owned lakes. Ohio EPA has developed an assessment methodology for this beneficial use which focuses on source water contaminants not effectively removed through conventional treatment methods. Section H of the 2016 Integrated Water Quality Report describes this methodology and is available at epa.ohio.gov/Portals/35/tmdl/2016intreport/SectionH.pdf.

Impaired source waters may contribute to increased human health risk or treatment costs. For the case when stream water is pumped to a reservoir, the stream and reservoir will be evaluated separately. These assessments are designed to determine if the quality of source water meets the standards and criteria of the Clean Water Act. Monitoring of the safety and quality of treated finished drinking water is regulated under the Safe Drinking Water Act and evaluated separately from this assessment. For those cases when the treatment plant processes do not specifically remove a source water contaminant, the finished water quality data may be considered representative of the raw source water directly feeding into the treatment plant.

Waynoka Regional Water and Sewer District is the one public water system directly served by a surface water source within the study area. Table 16 provides a summary of exceedances for the PWS use while Appendix M contains public water supply analytical results.

Table 16 — Summary of available water quality data for parameters of interest near/at PWS intake.

| Location | PDWS Parameters of Interest | | | | | |
|--|---|--------------------------|---|------------------------------------|------------------------------------|----------|
| | Nitrate-Nitrite WQC = 10 mg/L ¹ | | Atrazine WQC = 3.0 ug/L ² | | | |
| | Avg. ³ (sample count) | Max. (# samples >WQC) | Avg. (sample count) | Annual Avg. (2015) ⁴ | Annual Avg. (2016) ⁴ | Max. |
| Sycamore Run Reservoir L-1 (204216) | 0.1 mg/L (n=14) | 0.48 mg/L (0) | 1.1 ug/L (n=10) | BDL (<0.2 ug/L) | 1.0 ug/L | 4.5 ug/L |
| Waynoka Upground Water Supply Reservoir L-1 (204246) | <0.1 mg/L (n= 15) | 0.22 mg/L (0) | 0.3 ug/L (n=10) | BDL (<0.2 ug/L) | BDL (<0.2 ug/L) | 0.5 ug/L |

1 Nitrate Water Quality Criteria (WQC) evaluated as maximum value not to be exceeded, impaired waters defined as having two or more excursions about the criteria.

2 Atrazine WQC evaluated as annual average based on quarterly averages. Watch List conditions include maximum instantaneous value > 12.0 ug/L.

3 Four surface samples in 2015 (no bottom samples) and 10 samples in 2016 (five surface, five bottom).

4 Atrazine data was only collected for two quarters each year. Quarterly average assumes fall and winter quarters are zero.

Waynoka Regional Water and Sewer District

The Waynoka Regional Water and Sewer District operates a community public water system that serves a population of approximately 1,860 people through 740 service connections. The water treatment system obtains its water from the Lake Waynoka Water Supply Reservoir, also known as Sycamore Run Reservoir, an approximately 11-acre impoundment of Sycamore Run. Water is pumped from the Sycamore Run Reservoir into a 35-million gallon upground reservoir (Waynoka Upground Water Supply Reservoir) that supplies the water treatment plant. The system's treatment capacity is 432,000 gallons per day, with average production in 2015 listed at 73,000 gallons per day. The water treatment process includes coagulation/upflow clarification, sand filtration, and chemical adsorption (granular activated carbon). Treated water is chlorinated and fluoridated prior to distribution. To prevent, and in reaction to, problems associated with algal blooms, the system has periodically applied algaecides to the source waters.

Ohio EPA collected water quality samples from Sycamore Run Reservoir (L-1, station ID 204216) and Waynoka Upground Water Supply Reservoir (L-1, station ID 204246) during 2015 and 2016. The PWS assessment unit is HUC 05090201 08 02 (Headwaters Straight Creek) for both Sycamore Run Reservoir and Waynoka Upground Water Supply Reservoir. To assess the PWS beneficial use, samples were analyzed for nitrate, atrazine and cyanotoxins (microcystins, saxitoxins and cylindrospermopsin). Nitrate ranged from below detection limit (BDL, 0.2 mg/L) to 0.48 mg/L in Sycamore Run Reservoir and from BDL to 0.22 mg/L in Waynoka Upground Water Supply Reservoir. All results were below the water quality criterion for nitrate (10.0 mg/L). Atrazine ranged from BDL to 4.5 ug/L in Sycamore Run Reservoir and from BDL to 0.5 ug/L in Waynoka Upground Water Supply Reservoir. There were no exceedances of the maximum instantaneous value >12 ug/L, and annual averages of atrazine were below the water quality criteria (3.0 ug/L). Saxitoxins ranged from BDL to >0.44 ug/L in Sycamore Run Reservoir. All results for other cyanotoxins (microcystin and cylindrospermopsin) in were BDL in Sycamore Run Reservoir. In Waynoka Upground Water Supply Reservoir, all results for cyanotoxins were BDL. There was one exceedance of the water quality criterion for saxitoxins (0.2 ug/L). All results were below the water quality criterion for microcystins (1.0 ug/L) and cylindrospermopsin (1.0 ug/L).

Routine compliance raw water monitoring for microcystins and cyanobacteria screening began in June 2016. All results for microcystins were BDL. All results for cyanotoxin-producing genes were BDL. Prior to routine monitoring, saxitoxins were detected at the intake structure in Sycamore Run Reservoir with a maximum concentration of >0.88 ug/L. Concentrations exceeded the drinking water threshold for saxitoxins (0.2 ug/L) six times from October 20 through December 7, 2015. All historical and current data for cyanotoxins (microcystins, saxitoxins and cylindrospermopsin) are available at wwwapp.epa.ohio.gov/dsw/hab/HAB_Sampling_Results.xlsx.

Based on these exceedances for saxitoxins Headwaters Straight Creek (05090201 08 02) was listed as impaired for algae in the Ohio 2016 Integrated Report.

Beneficial Use Designations and Recommendations

Beneficial Use Designations

The aquatic life use designations of many of the larger streams in the SORT study area have previously been verified through, and in light of, biocriteria. However, there remain selected water bodies where designations for ALUs are still based on the original 1978 and 1985 state water quality standards. The techniques in use at that time did not include standardized approaches to the collection of in-stream biological data or numeric biocriteria. While some of the recommendations may appear to constitute downgrades (for example, EWH to WWH) or upgrades (for example, WWH to EWH), any change should not be construed as such because these, in most instances, constitute the first application of an objective and robust data-driven process to ascertain the appropriate aquatic life use designation. Any recommended changes to beneficial use designations will go through the Ohio rulemaking process before finalizing.

Current and recommended ALUs resulting from the 2013 through 2017 intensive survey are summarized in Table 17. Verification of current uses, re-designation of current, yet unverified uses, or designation of previously unlisted waters and other pertinent information, where needed, are presented below. Attainment status based on existing and recommended uses and associated causes and sources of waters identified as being impaired are presented in Table 1. Stream habitat quality being an important factor in use attainability, a matrix of riparian, channel and substrate features and resulting QHEI scores, by station and water body, are presented in Appendix F.

Streams in the SORT study area were evaluated for beneficial use potential in 2013 through 2017. Significant findings include the following.

- Forty-one streams in the study area have been previously verified as WWH from field assessments prior to 2013. These include: Straight Creek, Sink Creek, Rangle Run, Sheep Run, Campbell Run (Straight Creek RM 3.1), Evans Run, Washburn Run, Bull Run, Scott Run, Camp Run, Myers Run, Honey Run, West Fork Straight Creek, Buck Run, Sycamore Run, Cornick Run, Redoak Creek, West Fork Redoak Creek, Eagle Creek (headwaters to Indian Lick (RM 7.2)), Baylor Run, Beetle Creek, Indian Lick, Brushy Fork, Suck Run, East Fork Eagle Creek, Town Branch, Washburn Run Ada Run, Hills Fork, Lick Run, Gordon Run, Hannah Run, Unnamed tributary to West Fork Eagle Creek (7.05), Honey Creek (Northwest Fork Eagle Creek (RM 2.34)), Big Threemile Creek, Slickaway Run, Ellis Run, Morley Run (Meffords Run), Fishing Gut Creek, Odell Creek, and Old Lade Run. Biological sampling results from this study have shown that this ALU is still appropriate for these streams.
- Six streams have unverified WWH ALU in the WQS that were verified during this survey. Biological sampling conducted on Little Threemile Creek, Isaacs Creek, Island Creek, Donaldson Run, Russell Fork, and Turkey Creek (RM 4.0 to the mouth) demonstrated that this ALU is appropriate because WWH biological communities were fully or partially present.
- Two streams are recommended WWH ALU. Biological sampling from this study conducted on Tributary to East Fork Eagle Creek (RM 6.92) and Turkey Creek (Turkey Creek Lake to Friendship (RM 4.0)) showed that this ALU is appropriate because WWH biological communities were fully or partially present.
- Seven streams in the study area have been previously verified as CWH from field assessments prior to 2013. These include: Town Run, Mackenzie Run, Brush Fork, Wes Run, Harber Fork, Lampblack Run, and Wolfden Run. Biological sampling results from this study have shown that this ALU is still appropriate for these streams.

- One stream has an unverified CWH ALU in the WQS. Biological sampling conducted on Rock Lick verified that this ALU is appropriate because of the presence of a coldwater biological signature.
- Ten streams are recommended CWH ALU. These include: Rangle Run, Putteney Run, Sulphur Creek, Rock Run, Lower Twin Creek (headwaters to Sugar Camp Run (RM 2.3)), Upper Twin Creek, McAtee Run, Pond Run, Nace Run, and Turkey Creek (headwaters to Turkey Creek Lake (RM 11.8)). Biological sampling results from this study have shown that this ALU is appropriate because of the presence of a coldwater biological signature.
- Three streams in the study area have been previously verified as EWH from field assessments prior to 2013. These include: Lafferty Run, Pond Lick Run, and Mackletree Run. Biological sampling results from this study have shown that this ALU is still appropriate for these streams.
- Myers Run has an unverified EWH ALU in the WQS. Biological sampling from this study verified that this ALU is appropriate because EWH biological communities were fully or partially present.
- The unverified EWH ALU in the WQS was verified for Waggoner Run and it is also recommended CWH. Biological sampling from this study verified that the EWH/CWH ALU is appropriate because EWH and CWH biological communities were present.
- Two streams are recommended EWH ALU. These include Eagle Creek (from Indian Lick (RM 7.2) to the mouth) and West Fork Eagle Creek. Biological sampling results from this study have shown that this ALU is appropriate because of the presence of exceptional biological communities.
- Four streams are recommended EWH/CWH ALU. These include: Stout Run, Long Lick Run, Lower Twin Creek (Sugar Camp Run (RM 2.3) to the mouth), and East Fork Upper Twin Creek.
- All streams in this study area should maintain their AWS, IWS, and PCR uses, except for Honey Creek.

Recommendations

Once a watershed's condition has been studied and any impairment identified, it is useful to examine ways to correct the problems. In this section, some general recommendations for the SORT are discussed. More specifically, quantified recommendations may result from the Total Maximum Daily Load (TMDL) project. Recommendations are not limited to this section. Recommendations for changes at specific locations that would benefit stream resource quality (for example, riparian and streamside buffer practices and land use changes) are interspersed throughout this document. The greatest concerns to water quality identified by this study were organic enrichment and bacteria.

Organic Enrichment and Bacteria

Organic enrichment was a cause of impairment in this watershed study (please read the Recreation Use section for more details). Some of the streams in the study were found to have high levels of organic enrichment in all or parts of their reaches. Fourteen out of 19 sampling locations were also in non-attainment of the designated recreation use established in the Ohio WQS (Table 37-2 in OAC 3745-1-37) based on the quantities of fecal indicators (*Escherichia coli* bacteria) present in the water column. Potential sources of *E. coli* contamination at locations not attaining the recreation use criteria are failing HSTS, livestock pasture, land runoff, agricultural runoff, and wildlife accumulations. Land applications of livestock manure should always be completed with caution and follow proper BMPs when used as fertilizer. Buffering streams from storm runoff by allowing vegetated buffers to grow and fencing livestock out of

streams will not only reduce sedimentation from storm events, but will also help filter organics before they wash in.

Eagle Creek Basin - Honey Creek

Macroinvertebrate sampling in Honey Creek indicates the macroinvertebrate community was impacted by the Russellville WWTP discharge. In response to conditions observed during the 2016 survey, when the Russellville WWTP NPDES permit was renewed in 2018, 4.5 mg/L weekly and 3.0 mg/L monthly summer nitrogen-ammonia limits were added to the permit. In addition, Ohio EPA is working with the facility to renovate their land application system to be operational to avoid controlled discharge events during the summer months to lessen the impact to aquatic biology.

Effluent ammonia results reported by Russellville during the survey timeframe ranged from 20.3 mg/L to 26.2 mg/L. For comparison, conventional treatment technologies utilized in WWTPs throughout the state routinely discharge treated water with nitrogen-ammonia concentrations less than 1 mg/L. Since modern, mechanical treatment technology produces treated wastewater with ammonia concentrations less than 1 mg/L, consideration should be given as to whether an upgrade of the current Russellville WWTP to a mechanical system is warranted.

Straight Creek Basin - Sycamore Run

Sycamore Run did not meet macroinvertebrate expectations. One cause of impairment was high copper due to the Lake Waynoka drinking water supply reservoir. Copper sulfate is periodically added to the water supply reservoir to prevent harmful algal blooms, which negatively impact the quality of the community's drinking water supply. In December 2017, staff from Ohio EPA's Division of Surface Water met with the utility superintendent for the Waynoka Regional Water and Sewer District to discuss obtaining authorization to apply pesticides (copper sulfate) to the water supply through the Pesticides Discharge general permit (OHG870002). In addition to obtaining this important authorization, staff discussed the need for the development and implementation of a pesticide application management plan. The plan will address timing, methods and rates of copper sulfate application to protect the water supply from experiencing harmful algal blooms while ensuring aquatic life water quality criteria in the reservoir and Sycamore Run and Straight Creek downstream will be protected. Permit authorization is required 45 days prior to proposed pesticide application, which Waynoka has historically begun in May.

Table 17 — Water body use designation recommendations for streams sampled in the SORT study area, 2013-2017. Designations based on the 1978 and 1985 water quality standards appear as asterisks (*). A plus sign (+) indicates these designations have been field verified prior to this study, a triangle (▲) denotes a new recommended use based on the findings of this report, and current field verification of the 1978 and 1985 water quality standards based on biological sampling in this study are symbolized as (*/+).

| Water Body Segment | Use Designations | | | | | | | | | | | | Comments |
|--|----------------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|--------|-------------|-------------------------------|
| | Aquatic Life Habitat | | | | | | Water Supply | | | Recreation | | | |
| | S R W | W W H | E W H | M W H | S S H | C W H | L R W | P W S | A W S | I W S | B W | P C R | |
| Town Run | | | | | | + | | + | + | | | + | |
| Straight Creek | * | + | | | | | | + | + | | | + | |
| Sink Creek | * | + | | | | | | + | + | | | + | |
| Rangle Run | * | | | | | ▲ | | + | + | | | + | |
| Sheep Run | * | + | | | | | | + | + | | | + | |
| Campbell Run (Straight Creek RM 3.1) | * | + | | | | | | + | + | | | + | |
| Evans Run | * | + | | | | | | + | + | | | + | |
| Washburn Run | * | + | | | | | | + | + | | | + | |
| Bull Run | * | + | | | | | | + | + | | | + | |
| Scott Run | * | + | | | | | | + | + | | | + | |
| Camp Run | * | + | | | | | | + | + | | | + | |
| Myers Run | * | + | | | | | | + | + | | | + | |
| Honey Run | * | + | | | | | | + | + | | | + | |
| West Fork | * | + | | | | | | + | + | | | + | |
| Buck Run | * | + | | | | | | + | + | | | + | |
| Sycamore Run - at RM 0.97 | | + | | | | | + | + | + | | | + | PWS intake - Waynoka regional |
| - all other segments | | + | | | | | | + | + | | | + | |
| Cornick Run | * | + | | | | | | + | + | | | + | |
| Myers Run | * | | */+ | | | | | */+ | */+ | | | */+ | |
| Redoak Creek | * | + | | | | | | + | + | | | + | |
| West Fork | * | + | | | | | | + | + | | | + | |
| Eagle Creek - headwaters to Indian Lick (RM 7.2) | * | + | | | | | | + | + | | | + | |
| - all other segments | | | ▲ | | | | | + | + | | | + | |
| Baylor Run | * | + | | | | | | + | + | | | + | |
| Beetle Creek | * | + | | | | | | + | + | | | + | |
| Lafferty Run | * | | + | | | | | + | + | | | + | |
| Indian Lick | * | + | | | | | | + | + | | | + | |
| Brushy Fork | * | + | | | | | | + | + | | | + | |
| Suck Run | * | + | | | | | | + | + | | | + | |
| East Fork | * | + | | | | | | + | + | | | + | |
| Tributary to East Fork (RM 6.92) | | ▲ | | | | | | ▲ | ▲ | | | ▲ | |
| Town branch | * | + | | | | | | + | + | | | + | |
| Washburn Run | * | + | | | | | | + | + | | | + | |
| Ada Run | * | + | | | | | | + | + | | | + | |
| Hills Fork | * | + | | | | | | + | + | | | + | |
| Lick Run | * | + | | | | | | + | + | | | + | |
| Gordon Run | * | + | | | | | | + | + | | | + | |

| Water Body Segment | Use Designations | | | | | | | | | | | | Comments |
|--|----------------------|-------------|-------------|-------------|-------------|-------------|--------------|-------------|-------------|-------------|--------|-------------|----------|
| | Aquatic Life Habitat | | | | | | Water Supply | | | Recreation | | | |
| | S R W | W W H | E W H | M W H | S S H | C W H | L R W | P W S | A W S | I W S | B W | P C R | |
| Hannah Run | * | + | | | | | | | + | + | | + | |
| West Fork | * | | ▲ | | | | | | + | + | | + | |
| Unnamed tributary (West Fork RM 7.05) | | + | | | | | | | + | + | | + | |
| Honey Creek (Northwest Fork RM 2.34) | | + | | | | | | | + | + | | | + |
| Big Threemile Creek | * | + | | | | | | | + | + | | + | |
| Slickaway Run | * | + | | | | | | | + | + | | + | |
| Ellis Run | * | + | | | | | | | + | + | | + | |
| Morley Run (Meffords Run) | * | + | | | | | | | + | + | | + | |
| Fishing Gut Creek | | + | | | | | | | + | + | | + | |
| Little Threemile Creek | | */+ | | | | | | | */+ | */+ | | */+ | |
| Isaacs Creek | | */+ | | | | | | | */+ | */+ | | */+ | |
| Island Creek | | */+ | | | | | | | */+ | */+ | | */+ | |
| Donaldson Run | | */+ | | | | | | | */+ | */+ | | */+ | |
| Waggoner Run | * | | */+ | | | | ▲ | | */+ | */+ | | */+ | |
| Mackenzie Run | * | | | | | | + | | + | + | | + | |
| Stout Run | | | ▲ | | | | ▲ | | */+ | */+ | | */+ | |
| Russell Fork | | */+ | | | | | | | */+ | */+ | | */+ | |
| Puntenney Run | | | | | | | ▲ | | */+ | */+ | | */+ | |
| Long Lick Run | | | ▲ | | | | ▲ | | */+ | */+ | | */+ | |
| Sulphur Creek | | | | | | | ▲ | | */+ | */+ | | */+ | |
| Rock Run | | | | | | | ▲ | | */+ | */+ | | */+ | |
| Lower Twin Creek – headwaters to Sugar Camp Run (RM 2.3) | | | | | | | ▲ | | + | + | | + | |
| Lower Twin Creek – Sugar Camp Run (RM 2.3) to mouth | | | ▲ | | | | ▲ | | + | + | | + | |
| Upper Twin Creek | | | | | | | ▲ | | */+ | */+ | | */+ | |
| East Fork | | | ▲ | | | | ▲ | | */+ | */+ | | */+ | |
| McAtee Run | | | | | | | ▲ | | */+ | */+ | | */+ | |
| Pond Run | | | | | | | ▲ | | */+ | */+ | | */+ | |
| Nace Run | | | | | | | ▲ | | */+ | */+ | | */+ | |
| Turkey Creek - headwaters to Turkey Creek lake (RM 11.8) | * | | + | | | | ▲ | | + | + | | + | |
| Turkey Creek - Turkey Creek lake to Friendship (RM 4.0) | * | ▲ | + | | | | | | + | + | | + | |
| - all other segments | | */+ | | | | | | | + | + | | + | |
| Odell Creek | * | + | | | | | | | + | + | | + | |
| Pond Lick Run | * | | + | | | | | | + | + | | + | |
| Rock Lick | * | | | | | | */+ | | */+ | */+ | | */+ | |
| Brush Fork | * | | | | | | + | | + | + | | + | |
| Wes Run | * | | | | | | + | | + | + | | + | |
| Harber Fork | * | | | | | | + | | + | + | | + | |
| Mackletree Run | * | | + | | | | | | + | + | | + | |
| Lampblack Run | * | | | | | | + | | + | + | | + | |
| Old Lade Run | * | + | | | | | | | + | + | | + | |
| Wolfden Run | * | | | | | | + | | + | + | | + | |

SRW - state resource water; WWH - warmwater habitat; EWH - exceptional warmwater habitat; MWH - modified warmwater habitat; SSH - seasonal salmonid habitat; CWH - coldwater habitat; LRW - limited resource water; PWS - public water supply; AWS - agricultural water supply; IWS - industrial water supply; BW - bathing water;

PCR-primary contact recreation; SCR - secondary contact recreation.

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