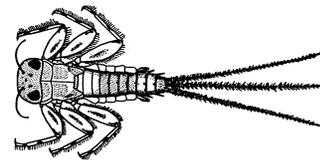
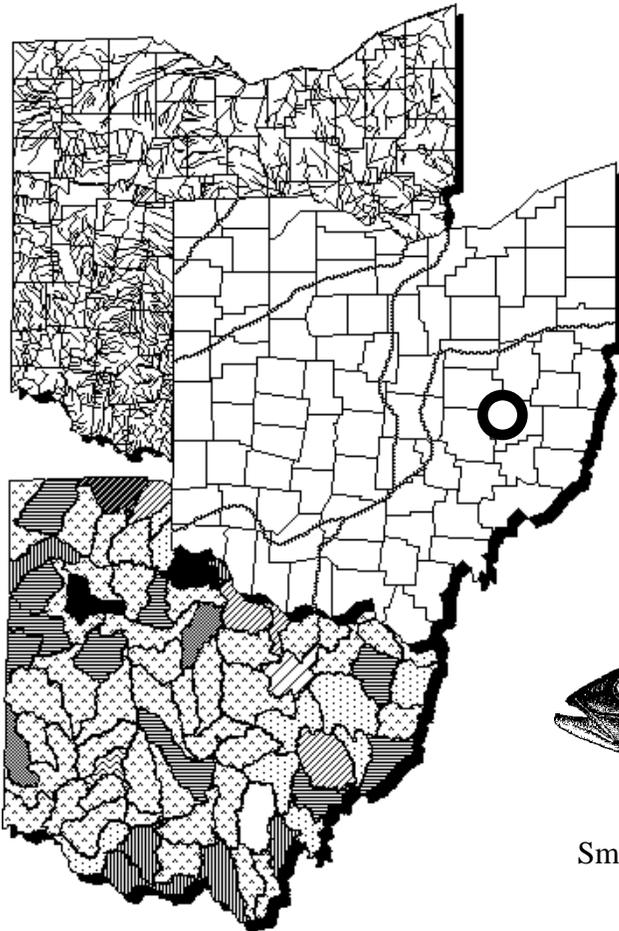
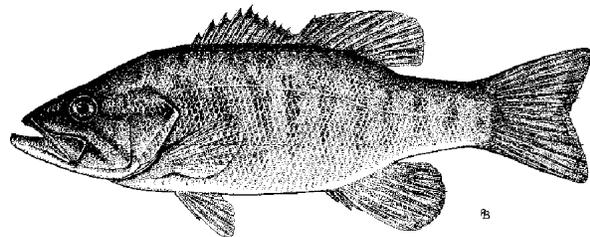


Biological and Water Quality Study of Wills Creek and Selected Tributaries

Guernsey, Coshocton, and Muskingum Counties, Ohio



Mayfly (*Stenacron sp.*)



Smallmouth Bass (*Micropterus dolomieu*)

October 31, 1995

**Biological and Water Quality Study of Wills Creek
and Selected Tributaries**

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October 31, 1995

OEPA Technical Report MAS/1995-6-5

prepared by

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Division of Surface Water
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NOTICE TO USERS

Ohio EPA incorporated biological criteria into the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) regulations in February 1990 (effective May 1990). These criteria consist of numeric values for the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), both of which are based on fish assemblage data, and the Invertebrate Community Index (ICI), which is based on macroinvertebrate assemblage data. Criteria for each index are specified for each of Ohio's five ecoregions (as described by Omernik 1987), and are further organized by organism group, index, site type, and aquatic life use designation. These criteria, along with the existing chemical and whole effluent toxicity evaluation methods and criteria, figure prominently in the monitoring and assessment of Ohio's surface water resources.

The following Ohio EPA documents support the use of biological criteria by outlining the rationale for using biological information, the methods by which the biocriteria were derived and calculated, the field methods by which sampling must be conducted, and the process for evaluating results:

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

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

Ohio Environmental Protection Agency. 1989b. Addendum to Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1989c. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

Ohio Environmental Protection Agency. 1990a. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Division of Water Quality Planning & Assessment, Ecological Assessment Section, Columbus, Ohio.

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

These documents and this report can be obtained by writing to or calling:

Ohio EPA, Division of Surface Water
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Biological and Water Quality Study of Wills Creek and Selected Tributaries

Guernsey, Muskingum, and Coshocton Counties (Ohio)

State of Ohio Environmental Protection Agency
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INTRODUCTION

Wills Creek is 81 miles long and begins at the confluence of Buffalo Creek and Buffalo Fork. The watershed occupies 853 square miles, with major tributaries including Salt Fork, Seneca Fork, Buffalo Fork, Buffalo Creek, and Leatherwood Creek. The Cambridge Wastewater Treatment Plant (WWTP) is the largest contributor of wastewater to the Wills Creek basin. The Wills Creek watershed lies entirely within the unglaciated region of Ohio and the Western Allegheny Plateau ecoregion. The Wills Creek watershed has been identified in Ohio as the highest contributor of eroded soil. High gradient land slopes, combined with overgrazing by livestock and surface mining, result in high total soil loss (USDA 1989).

As part of Ohio EPA's Five-year Basin Approach for Monitoring and National Pollutant Discharge Elimination System (NPDES) permitting, chemical, physical, and biological sampling was conducted in a 76 mile segment of Wills Creek. Selected tributaries in the Salt Fork drainage were assessed for nonpoint source influences. All sampling was conducted during the summer and fall of 1994. Twenty-five sites were selected for bi-weekly water chemistry analyses, 28 sites were assessed for biological quality, seven sites were sampled for sediment chemistry assessment and three fish tissue samples were collected for evaluating bioaccumulation concerns. In addition, an extensive study of Chapman Run and associated wetlands was conducted for the Ohio EPA Division of Emergency and Remedial Response. The Chapman Run study is detailed in a separate report (Ohio EPA 1995). The principal objectives of this study were to:

- 1) monitor and assess the chemical, physical and biological integrity of the Wills Creek study area,
- 2) evaluate impacts from municipal wastewater treatment plants (WWTPs), habitat alterations, several wastewater pumping stations in Cambridge, and nonpoint source pollution on Wills Creek,
- 3) determine the attainment status of the current designated Warmwater Habitat (WWH) aquatic life use for Wills Creek and other non-aquatic use designations and recommend changes in use where appropriate,
- 4) evaluate potential impacts associated with agricultural nonpoint source runoff from livestock in the Salt Fork Lake drainage, and
- 5) conduct a water resource trend assessment where historical data exists.

Similar to the previous survey of 1984, standardized methods were used throughout the study area to collect quantitative and qualitative biological, chemical, and physical data. Two point source discharges (Cambridge and Byesville) were directly evaluated and included analyses of pollutant loading trends based on monthly operating reports (MORs), NPDES permit violations, lift station overflows, and whole effluent toxicity tests. Other relevant information indicative of potential environmental impacts within the Wills Creek study area (*e.g.*, spills, overflows, bypasses, unauthorized releases of pollutants, and Ohio Department of Natural Resources fish kill reports) were also reviewed and summarized.

The findings of this report may factor into regulatory actions taken by the Ohio EPA [*e.g.*, NPDES permits, Director's Orders, the Ohio Water Quality Standards (OAC 3745-1)], and may be incorporated into the State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the biennial Water Resource Inventory (305[b] report).

SUMMARY

Wills Creek

A total of 76.0 miles of Wills Creek was assessed in 1994. Based on the performance of the biological communities in comparison to the ecoregional biocriteria, 9.9 miles of Wills Creek was in FULL attainment of the designated WWH aquatic life use (13.0% of the study area). **NON** attainment occurred in 15.7 miles of Wills Creek (20.6% of the study area) and this area of **NON** attainment occurred between RMs 70 and 50 (Byesville to ten miles downstream from Cambridge). **PARTIAL** attainment of the WWH use designation occurred in 50.4 miles of the stream (66.4 % of the study area) and was due primarily to the failure of the fish community to meet the WWH biocriteria. An improvement in aquatic life attainment status for Wills Creek occurred between 1984 and 1994 (RM 76 to RM 27). Although no river miles within this section achieved full attainment status during either 1984 or 1994, the miles of **NON** attainment declined from 47.5 (1984) to 15.8 (1994), and the miles in partial attainment increased from 2.0 (1984) to 33.2 (1994). Area of Degradation Values improved from 18 to 41 percent between 1984 and 1994. Biological index scores and the use attainment status for the individual sampling locations are provided in Table 1.

The Cambridge WWTP is the only significant permitted point source discharge contributing pollutant loads to the Wills Creek mainstem. The Cambridge WWTP effluent loading trends of ammonia-N, a toxicant to aquatic life, have shown a substantial decrease from 1988 to 1994, with the reduction associated with the implementation of advanced wastewater treatment. A corresponding reduction in ammonia-N levels occurred in Wills Creek during 1994 in comparison to 1984. An evaluation of the Cambridge WWTP was conducted using effluent bioassay acute and chronic toxicity tests between 1989 and 1994. Results of these tests revealed that three out of 12 acute tests and two of the four chronic tests exceeded allowable effluent toxicity.

Chemical parameters associated with mine drainage influences (aluminum, iron, total dissolved solids, manganese, sulfate, and conductivity) were elevated throughout the Wills Creek mainstem and frequently exceeded the upper range for relatively unimpacted reference sites in the Western Allegheny Plateau ecoregion. These elevated conditions were particularly evident in the upper half of Wills Creek, an area historically influenced by mine drainage. High fecal coliform levels were

recorded in Wills Creek in the Cambridge area upstream from the Cambridge WWTP. Suspected sewer line breaks or lift station overflows (strong sewage odors have been recorded in Wills Creek near Stubenville Road) are potential sources. Elevated fecal coliform concentrations were observed in Cambridge during the 1984 study and were associated with raw sewage from a sewer line break. Phosphorus and nitrogen concentrations within Wills Creek were at levels indicative of good water quality. Sediment testing results documented iron within the Severe Effects Level at seven of eight sampling locations. However, these elevated iron concentrations occurred both upstream and downstream from Byesville and Cambridge and appear to be associated with soil and parent material background levels of iron.

The Wills Creek channel has been modified in the past at several locations, and because of its inherent low gradient, has recovered little of its natural free flowing character in these modified areas. Exacerbating the slow recovery is the tremendous silt and clay load presently carried by the stream, which is attributable to unreclaimed strip mines and gob piles, upland erosion, and livestock which have free access to tributaries and the mainstem throughout the watershed. The mean Qualitative Habitat Evaluation Index (QHEI) score for all sites surveyed was 44, suggesting that fish communities are not likely to achieve the WWH biocriteria.

At free flowing sites in Wills Creek, the highest quality macroinvertebrate communities (*i.e.*, exceptional or very good) were found upstream from Cambridge at RMs 75.8 and 64.1 and in the lower 45 miles of the mainstem, well downstream from Cambridge. Invertebrate community health declined sharply within the city of Cambridge, with ICI values in the fair range over an approximate five mile stretch from RMs 62.7-57.4. The initial impacts were detected *upstream* from known point source discharges and the Cambridge WWTP. The strong similarity between benthic communities both upstream and downstream from the WWTP suggests a similar source of impact. Fugitive wastewater discharges from the Cambridge sewer system are a strong possibility (high fecal coliform levels and elevated ammonia-N values were documented in Wills Creek at Stubenville Road - RM 62.7). Potential impacts from the Byesville WWTP and Chapman Run were difficult to assess due to channel modified conditions in Wills Creek in the Byesville area. Sampling for macroinvertebrates in the tailwaters of the lowhead dam at RM 66.7, while negatively affected by slow current, suggested enriched conditions. Communities fully recovered by RM 64.1, a distance of 2.6 miles downstream.

Fish communities in Wills Creek did not meet the WWH ecoregional biocriteria for all stations sampled except RM 0.3, where the WWH biocriteria were marginally achieved. The impairment at virtually every site is attributed primarily to extensive sedimentation of the bottom substrates. A change of the water quality use designation from WWH to Modified Warmwater Habitat (MWH) is not warranted, however, because a large source of the sedimentation results from nonpoint source runoff, mine drainage and livestock pasturing practices. The Byesville and Cambridge WWTPs did not appear to impact the fish communities in Wills Creek, as index scores (Index of Biotic Integrity, IBI and Modified Index of Well-Being, MIwb) within the mixing zone or downstream sites did not differ from sites immediately upstream. IBI and MIwb scores at the site two miles downstream from the Cambridge WWTP was among the highest in the survey. However, given that the pollution and habitat sensitive components of the ambient fish community were lacking due to the pervasive nonpoint source impacts, the IBI and MIwb would not be expected to resolve any minor impacts associated with these entities.

A slight improvement in biological communities was observed in Wills Creek between the 1984 and 1994 surveys, and this occurred primarily downstream from the Cambridge WWTP. While full

attainment remains low, overall performance has improved as measured by the Area of Degradation Values (IBI, MIwb, and ICI performance improved by 18%, 41%, and 25%, respectively between 1984 and 1994).

Salt Fork Tributaries

Ten tributaries in the Salt Fork drainage of Wills Creek were surveyed to assess nonpoint source pollution impacts. Yellow Water Creek and Clear Fork were in FULL attainment of the WWH aquatic life use designation. Yellow Water Creek was represented by natural stream habitats, low levels of nutrient and mine drainage chemical parameters, and good to exceptional biological communities. Clear Fork physical stream habitats were fair, chemical water quality conditions were suggestive of slight nutrient enrichment and biological communities were indicative of good condition. Any potential nonpoint source influences were not sufficiently pervasive to result in impairment of the biological communities in Clear Fork and Yellow Water Creek.

Coon Run and Christian Run were in **NON** attainment of the WWH aquatic life use designation. Biological communities were in the fair to poor range and physical habitat quality was considered poor in both streams. Riffles were poorly developed and the channel of both streams was recovering from past channel modification activities. Christian Run showed evidence of unrestricted livestock access to the stream and chemical water quality results indicated moderate enrichment. Coon Run chemical water quality was generally good, except for high levels of manganese. Livestock were not present in Coon Run in the vicinity of the sampling site. However, grazed pastures were located along the stream upstream of the site. The sampling data from these two streams suggests that the fair to poor biological results are attributable to severe physical habitat damage due to unrestricted livestock access.

Turkey Run, Beeham Run, Salt Fork, Rocky Fork, Sugartree Fork, and Brushy Fork were all in PARTIAL attainment of the WWH aquatic life use designation. Biological communities were indicative of fair to exceptional conditions, depending on the organism group evaluated. Partial attainment was largely due to the failure of the fish communities to meet the WWH biocriteria. Two of the tributaries (Brushy Fork and Sugartree Fork) were impacted by unrestricted livestock access to the stream. Beeham Run had unrestricted livestock access at the fish sampling location, but further upstream at the macroinvertebrate site, the stream flowed through a small undisturbed woodlot. Aside from Turkey Run and Sugartree Fork, the streams in partial attainment were largely influenced by poor to fair physical habitat conditions. The tributaries which had exceptional macroinvertebrate communities appeared to have sustained base summer-fall stream flows. The unrestricted livestock access or recent channel modifications for a number of these tributaries demonstrated the widespread problem of nonpoint source impairment throughout the Salt Fork watershed.

Cambridge WWTP

The Cambridge WWTP discharges to Wills Creek at RM 61.52. The facility was upgraded to advanced wastewater treatment during November 1988. As a result of the 1988 upgrade, the loadings of ammonia-N to Wills Creek have declined substantially. The most significant industrial contributor to the WWTP is the Colgate-Palmolive Corp. Colgate has contributed to foaming problems at the Cambridge WWTP and at lift stations within the collection system due to the nature of the detergents in their waste stream. During an Ohio EPA site visit to Shieldalloy in early

December 1994, the lift station on the premises was observed discharging raw sewage into a small drainage ditch to Chapman Run. In Wills Creek in the area of Stubenville Road, sewage odors were noted each time sampling was conducted during the 1994 survey. No clear trends were evident in the effluent loadings of CBOD₅ (5-day carbonaceous biochemical oxygen demand) or total nonfilterable residue (TSS) from the Cambridge WWTP. Acute and chronic effluent bioassays have been conducted by both Ohio EPA and Cambridge. The biomonitoring data collected between 1989 and 1994 showed three out of 12 acute tests, and two of the four chronic tests exceeded the allowable effluent toxicity. The cause of this toxicity is currently being investigated.

Ambient nutrient water quality (phosphorus, nitrogen series) in Wills Creek downstream from the Cambridge WWTP appeared reflective of background conditions. Ammonia-N levels were less than the applicable WWH water quality criteria. The highest concentrations of ammonia-N were found in a two mile segment immediately upstream from the Cambridge WWTP. Three exceedances of the fecal coliform Primary Contact Recreation (PCR) criteria were recorded in Wills Creek; two upstream and one downstream from the Cambridge WWTP. The highest fecal coliform values were recorded at Stubenville Rd., upstream from the WWTP. Mine drainage also influenced water quality in Wills Creek within the area of the Cambridge WWTP. A comparison of mine drainage parameters with background reference levels revealed concentrations which exceeded the upper quartile range for relatively unimpacted reference stations in the Western Allegheny Plateau ecoregion. These elevated conditions were particularly evident in the upper half of Wills Creek.

Ambient biological performance (fish and benthic macroinvertebrate communities) upstream, within the mixing zone, and downstream from the Cambridge WWTP was characterized as fair. The impacts were considered primarily related to organic wastes from the sewer system reaching Wills Creek *upstream* from the Cambridge WWTP and pervasive habitat (sedimentation) limitations. No adverse effect associated with the Cambridge WWTP 001 effluent discharge was evident to aquatic life given the present set of limiting factors.

Byesville WWTP

The Byesville WWTP discharges to Wills Creek at RM 69.44. The facility provides secondary treatment to approximately 0.40 million gallons per day (MGD) of wastewater. Byesville has begun construction of significant upgrades to the facility which include a grit removal chamber, primary settling tanks, and an additional trickling filter. No clear trends in the loadings of ammonia-N, CBOD₅ or TSS from the Byesville WWTP were apparent. Effluent ammonia-N values were generally low, although some elevated values suggest variability in effluent quality.

Ambient nutrient water quality in Wills Creek downstream from the Byesville WWTP appeared reflective of background conditions. Ammonia-N levels were all less than applicable WWH water quality criteria, with instream values near or below lab detection limits. Mine drainage is influencing water quality in Wills Creek within the area of the Byesville WWTP. A comparison of mine drainage parameters with expected background levels revealed concentrations which exceeded the upper quartile range for relatively unimpacted reference stations in the Western Allegheny Plateau ecoregion. These elevated conditions were particularly evident in the Byesville area of Wills Creek.

Ambient biological performance in Wills Creek upstream and downstream from the Byesville WWTP was characterized as poor to fair. The influences of excessive sedimentation, impounded

habitat and nondetectable current appeared to be the major influence on the fish and macroinvertebrate communities. No adverse effect from the Byesville WWTP was evident to aquatic life given the present set of limiting factors.

CONCLUSIONS

Wills Creek

- Pervasive habitat limitations (primarily sedimentation of the substrates) continue to suppress the full biological potential of Wills Creek. The upper 50 miles are in NON or PARTIAL attainment of the WWH ecoregional biocriteria, and this is largely due to a combination of a heavy sediment bedload related to mine drainage and agricultural runoff, low stream gradient, and past channel modifications. FULL attainment of the biological criteria was observed in the lower five miles, where improved instream habitat conditions were available.
- Effluent discharges from the Byesville and Cambridge WWTPs had no detectable impact on the biological communities; however, effects were potentially masked by the background conditions instream. A discernable impact was detected in Wills Creek within a two mile section upstream from the Cambridge WWTP. This area had highly elevated fecal coliform concentrations, indicating that sewer system leaks or lift station overflows are discharging poorly treated human waste.
- An improvement in biological performance has occurred in Wills Creek since the 1984 survey. This improvement primarily occurred downstream from the Cambridge WWTP as a result of reduced ammonia-N loadings. In the sluggish pool habitats, which predominate in the upper section of Wills Creek, biological community performance continues to remain in the fair range and below WWH expectations.
- An evaluation of mine drainage chemical parameters revealed elevated levels, particularly in upper Wills Creek, compared with reference levels within the WAP ecoregion. The levels of these parameters during 1994 were generally consistent with 1984 concentrations, although iron and aluminum were considerably higher during the 1994 survey. Mine reclamation activities have occurred in some areas of the upper Wills Creek watershed; however, chemical concentrations associated with mine drainage continue to be elevated.

Salt Fork Tributaries

- The effects of unrestricted livestock access in five tributaries, evidence of past channel modifications in six streams, and the predominance of substrate embeddedness and heavy to moderate silt cover, resulted in the failure to attain the WWH use in eight tributaries.

RECOMMENDATIONS

Status of Aquatic Life Uses

Several of the streams evaluated during this study were originally designated for aquatic life uses in the 1978 Ohio WQS. The techniques used then did not include standardized approaches to the collection of instream biological data or numerical biological criteria. Therefore, this study represents a first use of this type of biological data to evaluate and establish aquatic life use designations. Ohio EPA is under obligation by a 1981 public notice to review and evaluate all aquatic life use designations outside of the WWH use prior to basing any permitting actions on the existing, unverified use designations. Thus some of the following aquatic life use recommendations constitute a fulfillment of that obligation.

- The existing Warmwater Habitat aquatic life use that applies to Wills Creek should be retained. The biological communities are impaired at a majority of locations due to poor physical conditions resulting from moderate to heavy sedimentation. The excessive sediment load is primarily the result of mine runoff and livestock pasture practices throughout the watershed. The Wills Creek watershed is rated as the highest total sediment contributor in Ohio. If and when these impacts are corrected, typical warmwater communities are expected to return.
- The Salt Fork tributaries sampled during the survey (Salt Fork, Sugartree Fork, Rocky Fork, Yellow Water Creek, Clear Fork, Turkey Run, Beeham Run, Brushy Fork, Christian Run and Coon Run) are recommended to retain the existing WWH aquatic life use designation. Although a number of these tributaries were impaired by poor habitat, recovery is possible with changes in near stream land use practices.

Status of Non-Aquatic Life Uses

- Currently, Wills Creek and the Salt Fork tributaries evaluated as part of this study are designated for Primary Contact Recreational (PCR), and Agricultural and Industrial Water Supplies. Based upon the findings of this investigation for Wills Creek, and the lack of extensive data for the Salt Fork tributaries, these use designations should be retained. The Cambridge drinking water treatment plant has an intake on Wills Creek at RM 66.7; this area of Wills Creek should be added under the Public Water Supply use designation in the Water Quality Standards.

Other Recommendations

- A study of the Cambridge sewer system should be initiated with particular emphasis placed on evaluating the operation, maintenance, and condition of the pump/lift stations and determining where sewer line breaks are located. A lift station located on Shieldalloy property was observed discharging raw sewage into Chapman Run during several days in December, 1994. This lift station is located 1.4 miles upstream from the Cambridge water treatment plant intake. A marked increase in fecal coliform levels in Wills Creek was documented upstream from the Cambridge WWTP effluent discharge and downstream from sewage pump/lift stations and sewer lines.
- Further acute and chronic effluent toxicity testing should be conducted at the Cambridge WWTP.

- Sections of Wills Creek in the Cambridge urban area were grossly littered with trash and junk, both in the stream and along the stream banks. At some of the sampling sites, trash was considered a major substrate component, causing degradation of stream habitats. Efforts should be made by state and local agencies to reduce illegal dumping, and clean-up the waterways.

Future Monitoring Needs

- A follow-up survey of Wills Creek should be conducted in 2004 in accordance with the Five-Year Basin Approach to document any changes in water resource quality and provide updated information for the reissuance of NPDES permits. Additional evaluations of mine drainage and livestock sedimentation influences should be conducted in tributaries to Wills Creek. This is particularly relevant in that the Wills Creek watershed is rated as the number one total sediment contributor in Ohio.
- An extensive fecal coliform/fecal strep/E. coli monitoring project should be conducted in Wills Creek in the Cambridge area to evaluate documented and undocumented sources of poorly treated human waste entering the waterway. This should include stream sampling during both wet and dry weather conditions, and geographically locating all sewer pipe outlets and crossings.

Table 1. Aquatic life use attainment status for the Warmwater Habitat (WWH) use designation in Wills Creek and tributaries based on data collected during June - September 1994.

RIVER MILE Fish/Invert.	Modified IBI	Iwb	ICI^a	QHEI^b	Attainment Status^c	Comment
Wills Creek						
<i>Western Allegheny Plateau - WWH Use Designation (Existing)</i>						
75.7 / 75.8	29*	6.7*	44	36.5	PARTIAL	Mod. reference site, NPS
70.4 / 70.2	22*	6.5*	18*	39.0	NON	Ust. Byesville WWTP
69.4 / 68.1	24*	6.8*	16*	45.0	NON	Dst. Byesville WWTP
67.2 / 67.2	24*	5.6*	14*	32.0	NON	Dst. Chapman Run, impd.
66.6 / 66.7	26*	7.0*	22*	35.0	NON	Ust. Cambridge, free-flow.
64.7 / 64.1	31*	7.9*	46	42.5	PARTIAL	Ust. sewer lift station
62.4 / 62.7	27*	6.6*	14*	42.0	NON	Dst. old sewer line break
61.8 / 62.2	26*	6.8*	14*	38.0	NON	Ust. Cambridge WWTP
61.5 / 61.5	28	7.5	14	53.5	N/A	Cambridge WWTP mix. zone
61.4 / 61.3	27*	7.4*	14*	53.5	NON	Dst. Cambridge WWTP
- / 60.1	-	-	22*	-	(NON)	Abandoned RR trestle
59.4 / 58.6	34*	8.0*	22*	58.5	NON	Dst. Crooked Cr., NPS
57.1 / 57.4	26*	6.9*	30*	61.0	NON	Ust. state hospital
53.4 / -	29*	8.0*	-	49.5	(NON)	Dst. state hospital
46.8 / 45.4	27*	7.1*	50	37.5	PARTIAL	Mod. reference site, NPS
38.0 / -	32*	7.2*	-	33.0	(NON)	Mod. reference site, NPS
27.4 / 27.6	29*	6.7*	48	35.5	PARTIAL	Mod. reference site, NPS
0.3 / 5.2	39 ^{ns}	8.1 ^{ns}	44	63.5	FULL	Dst. Wills Cr. Reservoir
<i>Western Allegheny Plateau - WWH Use Designation (Existing)</i>						
Salt Fork						
20.8 / -	34*	7.9 ^{ns}	-	41.0	(PARTIAL)	Wildlife area, wetlands
Sugartree Fork						
12.2 / 12.2	38*	NA	E	61.0	PARTIAL	NPS, livestock access
Rocky Fork						
5.6 / 5.6	34*	NA	G	44.0	PARTIAL	NPS
Yellow Water Creek						
0.8 / 0.8	50	NA	G	55.0	FULL	Forested
Clear Fork						
3.0 / 1.9	44	NA	G	47.0	FULL	Wildlife area, open field

Table 1. Continued.

RIVER MILE Fish/Invert.	Modified IBI	Iwb	ICI^a	QHEI^b	Attainment Status^c	Comment
<i>Western Allegheny Plateau - WWH Use Designation (Existing)</i>						
<i>Turkey Run</i> 0.6 / 0.9	42 ^{ns}	NA	F	59.0	PARTIAL	Forested
<i>Beeham Run</i> 1.7 / 2.8	38*	NA	E	46.0	PARTIAL	NPS, livestock access (dst. macroinvertebrate site)
<i>Brushy Fork</i> 3.1 / 3.4	30*	6.2*	G	36.0	PARTIAL	NPS, livestock access
<i>Christian Run</i> 0.1 / 0.1	36*	NA	P	25.0	NON	NPS, livestock access
<i>Coon Run</i> 0.8 / 0.8	32*	NA	P	39.0	NON	Wildlife area, wetlands
<i>Ecoregion Biocriteria: Western Allegheny Plateau (WAP)</i>						
<u>INDEX - Site Type</u>				<u>WWH</u>	<u>EWH</u>	<u>MWH^d</u>
IBI - Headwaters/Wading				44	50	24/24
IBI - Boat				40	48	24/24
Mod. Iwb - Wading				8.4	9.4	6.2/5.5
Mod. Iwb - Boat				8.6	9.6	5.8/5.4
ICI				36	46	22/30

* - Significant departure from ecoregion biocriteria; poor and very poor results are underlined.

ns - Nonsignificant departure from ecoregion biocriteria for WWH (4 IBI or ICI units; 0.5 MIwb units).

NA -Not applicable.

a - Narrative evaluation used in lieu of ICI (E=Exceptional; VG= Very good; G=good; MG=Marginally good; F=Fair; P=Poor; VP=Very Poor).

b - Qualitative Habitat Evaluation Index (QHEI) values based on Rankin (1989).

c - Attainment status based on one organism group is parenthetically expressed.

d - Modified Warmwater Habitat for channel modified areas/ mine affected areas.

STUDY AREA

The Wills Creek subbasin lies in the southeast corner of the Muskingum River basin. There are three impoundments in the subbasin: Wills Creek Reservoir, Senecaville Reservoir, and Salt Fork Reservoir. The first two are primarily flood control reservoirs, while the latter is intended to be a multiple-use impoundment; however, they all have recreational uses.

The Wills Creek watershed includes 853 square miles and is the third largest direct tributary to the Muskingum River. The mainstem of Wills Creek is 81 miles long and is formed by the confluence of Buffalo Creek and Buffalo Fork, in southern Guernsey County. From there, Wills Creek flows north, where it receives the discharges of the Byesville WWTP and the Cambridge WWTP. In Cambridge, Wills Creek is joined by Leatherwood Creek and Crooked Creek. Leatherwood Creek receives the discharge from the Quaker City WWTP. Wills Creek continues to flow north from Cambridge, where it receives the discharge from the Cambridge State Hospital WWTP, into northern Guernsey County, where it changes course to flow west to the Muskingum River. Chemical, physical and biological sampling locations are listed in Table 2 and presented graphically in Figures 1 and 2. Stream characteristics are listed in Table 3.

Wills Creek and its tributaries all lie in the unglaciated Appalachian Plateau region of eastern Ohio. This area is characterized by rugged terrain and steep slopes. Flat lands are confined for the most part to terraces and flood plains bordering larger streams.

Bedrock geology in the subbasin is mostly Pennsylvanian Age strata. These strata consist of many recurring beds of coal, clay, limestone, iron ore, shale and sandstone. Soils in the subbasin consist primarily of Gilpin-Dekalb and Gilpin-Guernsey-Keene soil associations. These soils are generally moderately deep, acid, and low in natural fertility.

The Wills Creek subbasin drains the Western Allegheny Plateau ecoregion in Ohio. This ecoregion represents the unglaciated portion of Ohio.

Land use in the study area is approximately 2% urban, 20% row crop agriculture, 13% pasture and 60% forest. Although a substantial area of the Wills Creek subbasin is composed of forest land, over 34,000 acres are grazed by domestic livestock. This is the highest level of any of the watersheds in Ohio. The primary effect of forest grazing is increased soil erosion. In addition to the soil losses and reduced productivity caused by erosion, grazing also compacts the soil and significantly changes soil characteristics.

Unreclaimed surface mines, underground mines and gob piles account for a small portion of the surface acreage in the study area, however, they are scattered throughout the headwater streams and along the mainstem of Wills Creek. The unreclaimed strip mines and gob piles have a significant influence on the Wills Creek drainage by adding large amounts of sediment into the stream beds, which in turn reduces habitat suitability for biological communities.

The Salt Fork watershed is dominated by forest, followed by pastureland and cropland. Sedimentation of the Salt Fork reservoir has been identified as a major nonpoint source pollution problem and is primarily caused by excessive erosion from pastured woodland.

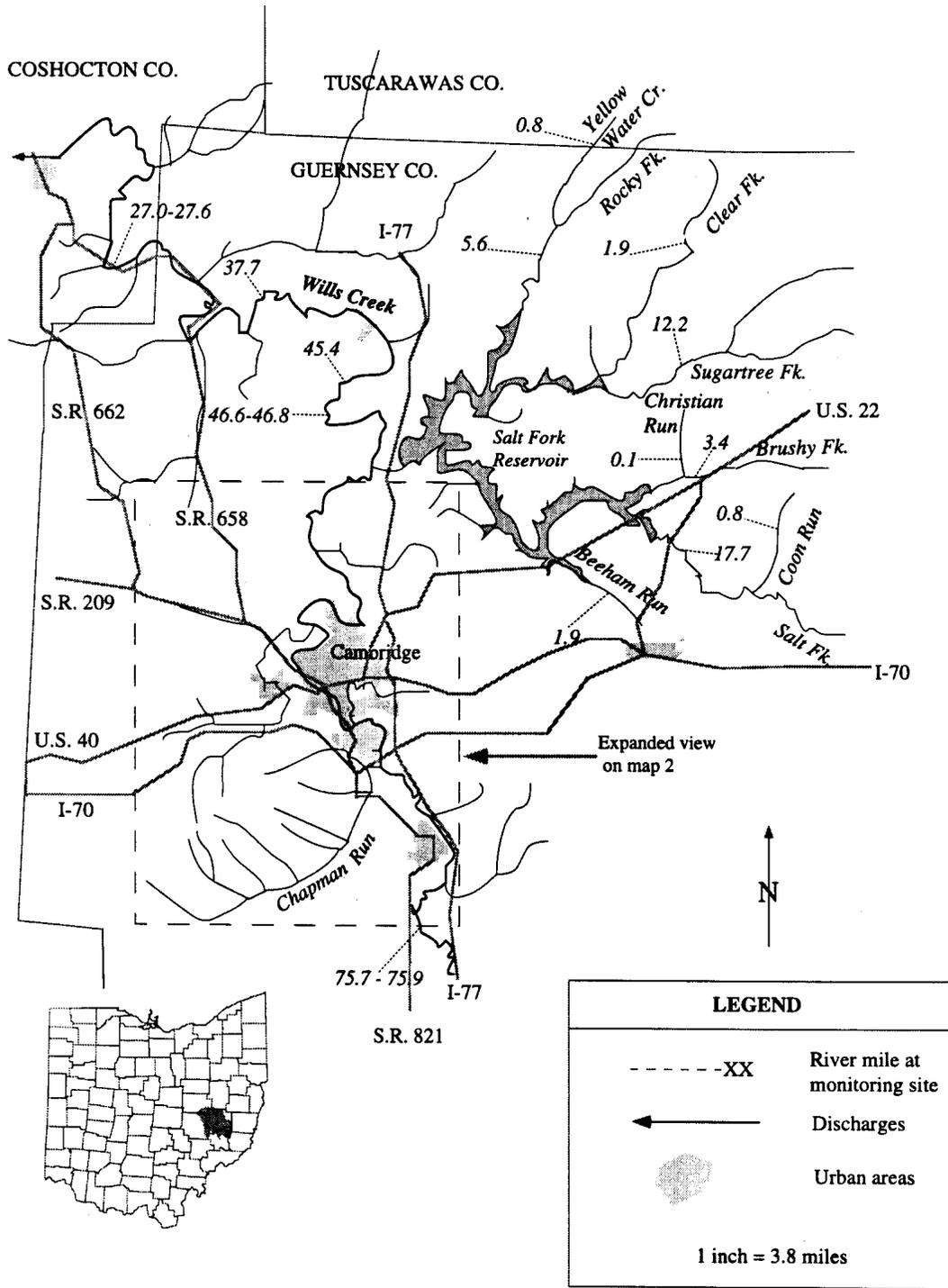


Figure 1. The Wills Creek study area showing principal streams and tributaries, population centers, and pollution sources.

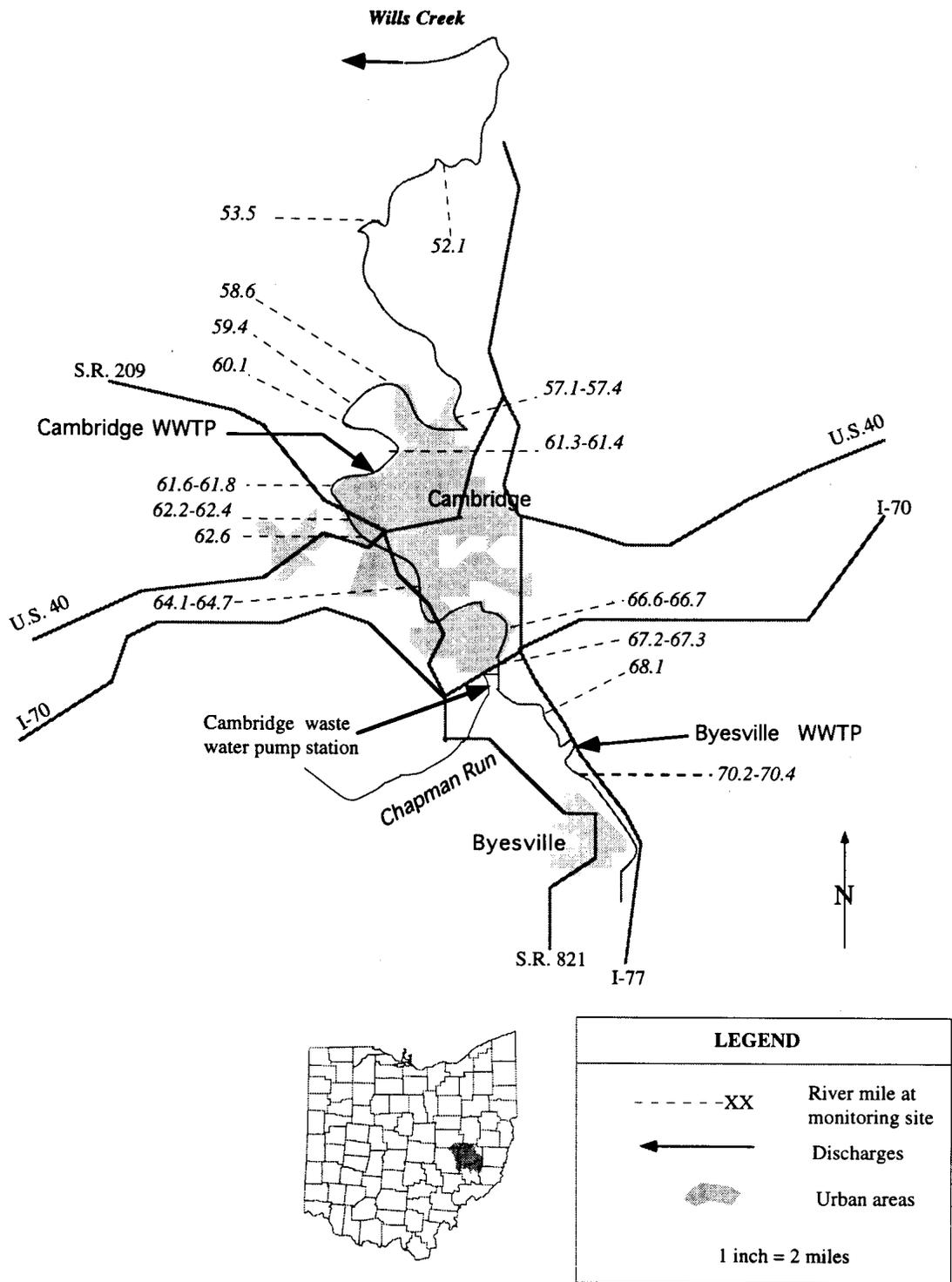


Figure 1. An enlargement of the Cambridge area of the Wills Creek study area showing principal streams and tributaries, landmarks, and pollution sources.

Table 2. Sampling locations in the Wills Creek study area, 1994 (E - effluent sample, C - water chemistry, D - datasonde continuous D.O. monitor, S - sediment chemistry, B - benthic macroinvertebrates, F - fish, T - fish tissue).

<i>Stream / River Mile</i>	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 minute Quadrangle Map
<i>Wills Creek</i>				
75.90	C,S	39 56 25 / 81 32 55	SR 821 (Seneca Lane)	Byesville
75.8	M	39 56 27 / 81 33 01	SR 821 Ust. Byesville	Byesville
75.7	F	39 56 28 / 81 33 02	SR 821 Ust. Byesville	Byesville
70.4	F,T	39 58 31 / 81 32 28	Byesville City Park	Byesville
70.2	M	39 58 38 / 81 32 36	CR 43 (Ideal Rd.)	Byesville
70.19	C	39 58 38 / 81 32 35	CR 43 (Ideal Rd.)	Byesville
69.44	E	39 59 02 / 81 32 42	Byesville WWTP	Byesville
69.4	F	39 59 05 / 81 32 46	Dst. Byesville WWTP	Byesville
68.13	C,S	39 59 30 / 81 33 29	Twp. Rd. 347	Byesville
68.1	M	39 59 30 / 81 33 30	Twp. Rd. 347	Byesville
67.5	T	39 59 35 / 81 33 49	Ust. Chapman Run	Byesville
67.33	C	39 59 50 / 81 33 54	I-70	Byesville
67.2	F, M,T	39 59 48 / 81 33 54	Dst. I 70 & Chapman Run	Byesville
66.70	M, C	40 00 15 / 81 33 44	@ low head dam	Cambridge
66.6	F	40 00 20 / 81 33 54	Dst. Dam @ Slay's Farm	Cambridge
64.7	F	40 00 30 / 81 34 48	Ust. Campbell Ave	Cambridge
64.10	M, C	40 00 53 / 81 35 13	@ Campbell Ave	Cambridge
62.7	M	40 01 31 / 81 36 11	SR 209 (Stubenville Rd.)	Cambridge
62.60	C, S	40 01 35 / 81 36 15	SR 209 (Stubenville Rd.)	Cambridge
62.4	F	40 01 35 / 81 36 15	Adj. Water Street	Cambridge
62.2	M	40 01 55 / 81 36 24	Ust. Cambridge WWTP	Cambridge
61.8	F	40 02 00 / 81 36 24	Ust. Cambridge WWTP	Cambridge
61.61	C	40 02 16 / 81 36 07	Ust. Cambridge WWTP	Cambridge
61.52	E	40 02 17 / 81 36 08	Cambridge WWTP	Cambridge
61.5	F, M	40 02 16 / 81 36 06	WWTP Mix Zone	Cambridge
61.40	F, S	40 02 12 / 81 36 00	Dst. Cambridge WWTP	Cambridge
61.3	M	40 02 11 / 81 35 53	Dst. Cambridge WWTP	Cambridge
60.06	C	40 02 40 / 81 35 56	2nd RR bridge	Cambridge
60.1	M	40 02 40 / 81 35 57	Ust. Crooked Creek	Cambridge
59.4	F	40 03 02 / 81 36 08	Dst. Crooked Creek	Cambridge
58.6	M	40 03 17 / 81 35 15	CR 33 (8th St.)	Cambridge
58.58	C, S	40 03 17 / 81 35 21	CR 33 (8th St.)	Cambridge
57.4	M	40 02 42 / 81 34 37	Jct. CRs 35 & 33	Cambridge
57.36	C	40 02 43 / 81 34 33	at GAGE	Cambridge
57.1	F	40 02 50 / 81 33 24	Adj. CR35, Cedar Hills	Cambridge
53.5	M	40 05 10 / 81 36 02	@ Jct. CRs 33 & 368	Cambridge
53.4	F	40 05 10 / 81 35 56	Dst. jct. CRs 33 & 368	Cambridge
52.12	C	40 05 43 / 81 35 22	Twp. Rd. 364	Cambridge

Table 2. Continued.

<i>Stream / River Mile</i>	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 minute Quadrangle Map
<i>Wills Creek</i>				
46.8	F	40 07 13 / 81 35 24	Twp. Rd. 365	Cambridge
46.57	C,S	40 07 18 / 81 35 34	Twp. Rd. 365	Cambridge
45.4	M	40 07 19 / 81 35 34	@ RR bridge	Cambridge
38.0	F	40 09 40 / 81 37 15	SR 541 east of Birds Run	Plainfield/ Kimbolton
37.74	C, S	40 09 41 / 81 37 32	Near Birds Run	Plainfield
37.7	M	40 09 42 / 81 37 32	SR 541 east of Birds Run	Plainfield
27.6	M	40 10 21 / 81 41 36	SR 541 near Linton Mills	Plainfield
27.4	F	40 10 30 / 81 41 29	SR 541 near Linton Mills	Plainfield
27.04	C	40 10 47 / 81 41 26	Near Linton Mills	Plainfield
5.25	C	40 10 39 / 81 51 03	@ Wills Cr. Dam Rd.	Wills Creek
5.2	M	40 10 43 / 81 51 05	@ Wills Cr. Dam Rd.	Wills Creek
1.75	D	40 09 31 / 81 53 29	Near the mouth	Conesville
0.3	F	40 09 23 / 81 54 12	Mouth of Wills Creek	Conesville
<i>Salt Fork</i>				
20.8	F	40 03 28 / 81 24 53	Fairgrounds Road	Old Washington
17.72	C	40 04 33 / 81 25 58	SR 285	Birmingham
<i>Sugartree Fork</i>				
12.2	F, M	40 08 31 / 81 25 26	Birmingham Road	Birmingham
12.15	C	40 08 31 / 81 25 26	Birmingham Road	Birmingham
<i>Rocky Fork</i>				
5.6	F, M	40 10 30 / 81 29 42	Rocky Fork Road	Birmingham
5.56	C	40 10 29 / 81 29 41	Rocky Fork Road	Birmingham
<i>Yellow Water Creek</i>				
0.8	F, M	40 11 25 / 81 29 13	Twp. Rd. 859	Birmingham
0.75	C	40 11 25 / 81 29 13	Twp. Rd. 859	Birmingham
<i>Clear Fork</i>				
3.0	F	40 09 24 / 81 26 57	Ust. Twp. Rd.5880	Birmingham
1.9	M	40 08 53 / 81 27 14	Twp. Rd. 5880	Birmingham
1.83	C	40 08 50 / 81 27 15	Twp. Rd. 5880	Birmingham
<i>Turkey Run</i>				
0.90	M, C	40 09 09 / 81 24 39	Ust. Red Hill Farms	Birmingham
0.6	F	40 09 34 / 81 24 44	Ust. Red Hill Farms	Birmingham

Table 2. Continued.

<i>Stream / River Mile</i>	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 minute Quadrangle Map
<i>Beeham Run</i>				
2.8	M	40 03 01 / 81 27 08	Adj. Beeham Road	Old Washington
1.9	C	40 03 34 / 81 26 52	Adj. Beeham Road	Old Washington
1.7	F	40 03 37 / 81 26 08	Adj. Beeham Road	Old Washington
<i>Brushy Fork</i>				
3.4	F	40 06 00 / 81 25 09	SR 285	Old Washington
3.35	C	40 06 03 / 81 25 03	SR 285	Old Washington
3.1	M	40 06 01 / 81 25 14	US 22	Old Washington
<i>Christian Creek</i>				
0.1	F, M	40 06 07 / 81 25 20	Twp. Rd. 6716	Old Washington
0.06	C	40 06 03 / 81 25 21	Twp. Rd. 6716	Old Washington
<i>Coon Run</i>				
0.85	F	40 04 10 / 81 24 55	Ust. Twp. Rd. 671	Old Washington
0.82	C	40 04 09 / 81 24 56	Twp. Rd. 671	Old Washington
0.8	M	40 04 09 / 81 24 56	Twp. Rd. 671	Old Washington

Table 3. Stream characteristics and significant identified pollution sources in the Wills Creek study area.

Stream Name	Length (Miles)	Average Fall (Feet/Mile)	Drainage Area (Square Miles)	Nonpoint Source Pollution Categories	Point Sources Evaluated
Wills Creek	81.0	0.9	853	Surface, Subsurface Coal Mining, On-site Wastewater Treatment	Cambridge WWTP Byesville WWTP
Salt Fork	32.0	11.2	161	Livestock, resource extraction, agriculture	
Sugartree Fork	13.4	14.5	63	Agriculture, pasture, oil & gas production	
Rocky Fork	9.2	21.1	21	Agriculture, pasture, oil & gas production	
Yellow Water Cr.	3.4	54.1	5.4	Agriculture, pasture, oil & gas production	
Clear Fork	7.2	25.0	15	Agriculture, pasture, oil & gas production	
Turkey Run	2.3	37.4	8.5	Agriculture, pasture, oil & gas production	
Beeham Run	3.0	38.0	6.0	Agriculture, pasture, oil & gas production	
Brushy Fork	7.5	18.8	38	Agriculture, pasture, oil & gas production	
Christian Creek	1.9	51.6	1.4	Agriculture, pasture, oil & gas production	
Coon Run	1.9	97.9	2.1	Agriculture, pasture, oil & gas production	

METHODS

All chemical, physical, and biological field, laboratory, data processing, and data analysis methodologies and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 1989a) and Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a, 1987b, 1989b, 1989c), and The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989) for aquatic habitat assessment.

Determining Use Attainment Status

The attainment status of aquatic life uses (*i.e.*, FULL, PARTIAL, and NON) is determined by using the biological criteria codified in the Ohio Water Quality Standards (WQS; Ohio Administrative Code [OAC] 3745-1-07, Table 7-17). The biological community performance measures which are used include the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), based on fish community characteristics, and the Invertebrate Community Index (ICI) which is based on macroinvertebrate community characteristics. The IBI and ICI are multimetric indices patterned after an original IBI described by Karr (1981) and Fausch *et al.* (1984). The ICI was developed by Ohio EPA (1987b) and further described by DeShon (1995). The MIwb is a measure of fish community abundance and diversity using numbers and weight information and is a modification of the original Index of Well-Being originally applied to fish community information from the Wabash River (Gammon 1976; Gammon *et al.* 1981).

Performance expectations for the principal aquatic life uses in the Ohio WQS (Warmwater Habitat [WWH], Exceptional Warmwater Habitat [EWH], and Modified Warmwater Habitat [MWH]) were developed using the regional reference site approach (Hughes *et al.* 1986; Omernik 1988). This fits the practical definition of biological integrity as the biological performance of the natural habitats within a region (Karr and Dudley 1981). Attainment of the aquatic life use is FULL if all three indices (or those available) meet the applicable biocriteria, PARTIAL if at least one of the indices does not attain and performance is at least fair, and NON-attainment if all indices fail to attain or any index indicates poor or very poor performance. Partial and non-attainment indicate that the receiving water is impaired and does not meet the designated use criteria specified by the Ohio WQS.

Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the metrics used to determine the QHEI score which generally ranges from 20 to 100. The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas. Scores greater than 75 frequently typify habitat conditions which have the ability to support exceptional warmwater faunas.

Macroinvertebrate Community Assessment

Macroinvertebrates were sampled quantitatively in Wills Creek using multiple-plate, artificial substrate samplers (modified Hester/Dendy) in conjunction with a qualitative assessment of the available natural substrates. Macroinvertebrate communities in tributaries were evaluated qualitatively based on sampling all available natural aquatic habitat types at a sampling site. During the present study, macroinvertebrate data collected from the natural substrates were also examined using a new assessment tool currently under evaluation. This method relies on tolerance values derived for each taxon, based upon the abundance data for that taxon from artificial substrate (quantitative) samples collected throughout Ohio. To determine the tolerance value of a given taxon, ICI scores at all locations where the taxon has been collected are weighted by its abundance on the artificial substrates. The mean of the weighted ICI scores for the taxon results in a value which represents its relative level of tolerance on the ICI's 0 to 60 scale. For the qualitative collections in the Wills Creek study area, the median tolerance value of all organisms from a site resulted in a score termed the Qualitative Community Tolerance Value (QCTV). The QCTV shows potential as a method to supplement existing assessment methods using the natural substrate collections. Use of the QCTV in evaluating sites in the Wills Creek study area was relegated to relative comparisons between sites and was not singly used to interpret quality of the sites or aquatic life use attainment status.

Fish Community Assessment

Fish were sampled using wading or boat method pulsed DC electrofishing gear. The wading method (used primarily in tributaries) was used at a frequency of one or two samples at each site. The boat method (used exclusively in the Wills Creek mainstem) was used at a frequency of two or three samples at each site. The specific electrofishing method and the number of samples for each sampling location is listed in Table 11. Whole body fish were collected in October, 1994 for tissue analysis. Fish tissue sampling procedures are detailed in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 1989a).

Area of Degradation Value (ADV)

An Area Of Degradation Value (ADV; Rankin and Yoder 1991; Yoder and Rankin 1995) was calculated for the study area based on the longitudinal performance of the biological community indices. The ADV portrays the length or "extent" of degradation to aquatic communities and is simply the distance that the biological index (IBI, MIwb, or ICI) departs from the applicable biocriterion or the upstream level of performance (Fig. 3). The "magnitude" of impact refers to the vertical departure of each index below the biocriterion or the upstream level of performance. The total ADV is represented by the area beneath the biocriterion (or upstream level) when the results for each index are plotted against river mile. The results are also expressed as ADV/mile to normalize comparisons between segments and other streams and rivers.

Causal Associations

Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine the use attainment status and assigning probable causes and sources of impairment. The identification of impairment in rivers and streams is straightforward - the numerical biological criteria are the principal arbiter of aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria in the role of principal arbiter within a weight of evidence framework has been extensively discussed elsewhere (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat

data, effluent data, biomonitoring results, land use data, and the biological response signatures (Yoder and Rankin 1995) within the biological data itself. Thus the assignment of principal causes and sources of impairment in this report do not represent a true “cause and effect” analysis, but rather represent the association of impairments (based on response indicators) with stressor and exposure indicators whose links with the biosurvey data are based on previous research or experience with analogous situations and impacts. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified. The process is similar to making a medical diagnosis in which a doctor relies on multiple lines of evidence concerning patient health. Such diagnoses are based on previous research which experimentally or statistically linked symptoms and test results to specific diseases or pathologies. Thus a doctor relies on previous experience in interpreting symptoms (*i.e.*, multiple lines from test results) to establish a diagnosis, potential causes and/or sources of the malady, a prognosis, and a strategy for alleviating the symptoms of the disease or condition. As in medical science, where the ultimate arbiter of success is the eventual recovery and the well-being of the patient, the ultimate measure of success in water resource management is restoration of lost or damaged ecosystem attributes including aquatic community structure and function. While there have been criticisms of misapplying the metaphor of ecosystem “health” compared to human patient “health” (Suter 1993), the process here involves identifying biological integrity and causes/sources associated with observed impairment, not whether human health and ecosystem health are analogous concepts.

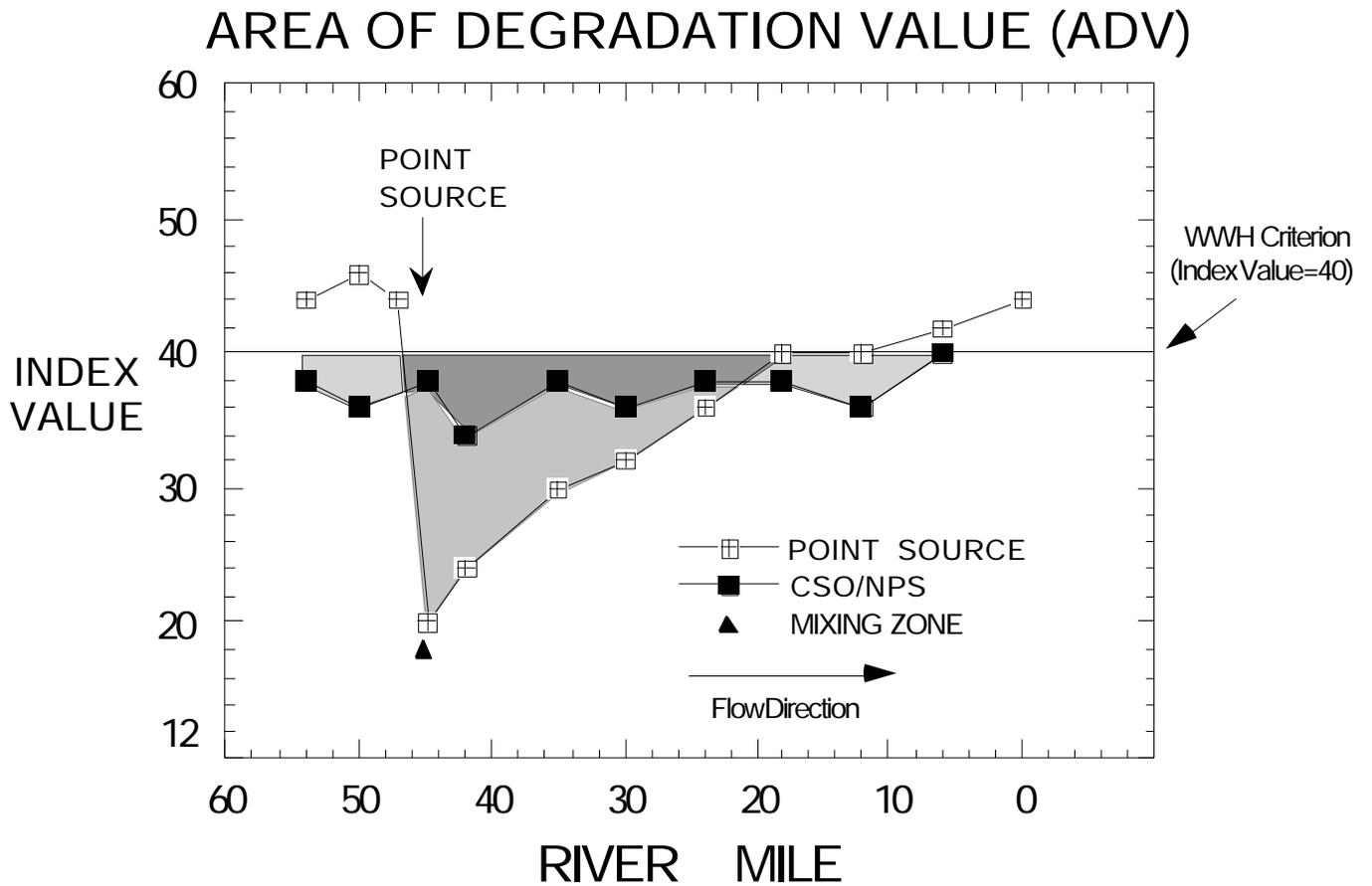


Figure 3. Graphic illustration of the Area of Degradation Value (ADV) based on the ecoregion biocriterion (WWH in this example). The index value trend line indicated by the unfilled boxes and solid shading (area of departure) represents a typical response to a point source impact (mixing zone appears as a solid triangle); the filled boxes and dashed shading (area of departure) represent a typical response to a nonpoint source or combined sewer overflow impact. The blended shading represents the overlapping impact of the point and nonpoint sources.

RESULTS AND DISCUSSION

Pollutant Loadings: 1980 - 1994

Cambridge WWTP

- The City of Cambridge operates a 3.0 million gallon per day (MGD) design flow, advanced activated sludge treatment plant that discharges to Wills Creek at RM 61.52. The Cambridge WWTP advanced treatment facility became operational in November 1988, when the existing secondary plant was upgraded. The average daily discharge for 1994 was 2.69 MGD. Current treatment processes consist of screening, grit removal, primary settling, aeration, secondary settling, chlorination and dechlorination. Sludge from the plant is anaerobically digested and/or dried on vacuum assisted drying beds and then land applied. The most significant industrial customer of the WWTP is Colgate-Palmolive Corp. Colgate has contributed to foaming problems at the Cambridge WWTP and at lift stations within the collection system due to the nature of the detergents in their waste stream. Colgate-Palmolive is responsible for the cost of repairs for damages caused by its discharge and also supplies the city with a defoaming agent for emergency situations.
- Cambridge has a significant sewer line inflow and infiltration (I/I) problem which causes sewage flows at the WWTP to reach and exceed 9.0 MGD during rain events. Upgrades to lift stations and older sewer lines are necessary to abate the problems. When flows exceed design capacity, a portion of the raw influent is directed to the primary clarifiers and discharged to the chlorination facilities without receiving secondary treatment. The Cambridge sewerage system is serviced by sanitary sewers only and has 19 lift stations. Bypasses or overflows from the lift stations were required to be eliminated by July 1988. During an Ohio EPA site visit to Shieldalloy in early December, 1994, the lift station on the premises was observed discharging raw sewage into a small drainage ditch to Chapman Run. The discharge occurred over at least a two day period. In Wills Creek in the area of Stubenville Road, strong sewage odors from adjacent sewer lines were noted each time sampling was conducted during the 1994 survey. During the 1984 survey, raw sewage from a sewer line break was entering Wills Creek via an unnamed tributary at RM 62.2.
- From April 1989 to October 1994 Cambridge experienced 37 ammonia-N effluent permit limit exceedances and was in violation of permit limits for CBOD₅ and TSS eight times each. Total residual chlorine was exceeded 104 times, fecal coliform bacteria 21 times and copper, cadmium, nickel and mercury a total of 16 times. In May 1994, more stringent total residual chlorine effluent limits went into effect at the Cambridge WWTP; this accounted for most of the chlorine violations recorded. During August, 1994 the plant brought dechlorination facilities on-line. This has resulted in meeting or nearly meeting the new chlorine limits. The ammonia violations were related to a build-up of foam due to excess sludge needing to be wasted to drying beds. Improving the balance between wasting digester sludge and the return activated sludge, and limiting MBAS from industrial customers will improve this problem. Heavy metals violations occurred from 1989 to 1992 and were related to a collapsed sewer (untreated sediment from the stream was slugging the treatment plant). This situation has been resolved and no recent metals exceedances have occurred.
- Loading trends for three pollutants discharged to Wills Creek from the Cambridge WWTP 001 effluent from 1980 through 1994 are shown in Figure 4. The ammonia-N annual loadings

graph shows a substantial decrease in loadings from 1988 onward, with 50th percentile values declining from 88.6 kg/day in 1987 to 3.5 kg/day in 1988. Ammonia-N 50th percentile annual loadings from the Cambridge WWTP since 1987 have been below 6 kg/day, except in 1994 (ammonia-N 50th percentile loading of 12.9 kg/day). No clear trends are evident in the loadings of cBOD₅ (5 day carbonaceous biochemical oxygen demand) or total nonfilterable residue (TSS) from the Cambridge WWTP.

- Acute and chronic bioassays have been conducted by Ohio EPA and Cambridge on the WWTP 001 effluent. Bioassay results for acute and chronic *Ceriodaphnia* and fathead minnow toxicity tests between 1989 and 1994 are presented in Table 4. Test results were compared to the Allowable Effluent Toxicity (AET) values of 0.5 TU_a (acute toxic units)(30% adverse effects) and 2.1 TU_c (chronic toxic units). A review of the biomonitoring data collected between 1989 and 1994 showed three out of 12 acute tests exceeded 0.5 TU_a and two of the four chronic tests exceeded the 2.1 TU_c.

Byesville WWTP

- The Village of Byesville operates a 0.4 MGD design flow wastewater treatment plant that discharges to Wills Creek at RM 69.44. The average daily discharge from January, 1993 through December, 1994 was 0.404 MGD with a maximum daily rate of 0.814 MGD in April, 1993. Current treatment includes screening, aeration, settling, trickling filtration, secondary settling and chlorination. The village has a permit to install and has begun construction of significant upgrades to the facility which include a grit removal chamber, primary settling tanks and an additional trickling filter. The upgrade will increase plant capacity to 0.5 MGD. The sludge is dried on drying beds and land applied. The most significant industrial user is Power Packaging, which packages various fruit juices into consumer sized containers and accounts for about 20 percent of the flow into the facility. Power Packaging is currently looking into expanding their production capacity which may result in increased flows to the plant or disconnection from village sewer lines and construction of their own wastewater treatment facility.
- Between 1989 and the end of 1994 the majority of NPDES permit violations at the Byesville WWTP were due to high fecal coliform bacteria and residual chlorine concentrations. Presently, the chlorine contact tank is thought to be undersized for the discharge volume and sufficient disinfection is not occurring even though residual chlorine in excess of the permit level of 0.5 mg/l (0.6-0.8) was measured on 13 occasions. Bacteria violations occurred 33 times. Total suspended solids were in violation on 12 occasions. The upgrade to this plant will improve contact time in the chlorine tank as well as throughout the plant and should eliminate these permit exceedances.
- Loading trends of three pollutants discharged to Wills Creek from the Byesville WWTP 001 effluent from 1980 through 1994 are shown in Figure 5. No clear trends are evident in the loadings of ammonia-N, cBOD₅ or TSS from the Byesville WWTP. Ammonia-N values were generally low, with 50th percentile annual loading values less than 3.5 kg/day (10 of 15 years had values less than 2.0 kg/day). Large differences between the 50th percentile and 95th percentile ammonia-N values were recorded during 1993 and 1994, suggesting high variability in effluent quality.

Spills/ Wild Animal Kills

- Lists of spills and wild animal kills are also indications of possible impacts due to pollutant loadings. Reviews were conducted for discharges and kills to the Wills Creek mainstem within the study area as reported by the Ohio EPA Division of Emergency and Remedial Response and the Ohio DNR Division of Wildlife Pollution Investigation Reports.
- The only reported fish kills in Wills Creek occurred once each summer, from 1990 through 1993, immediately downstream from the Wills Creek Reservoir. Similar circumstances surrounded each kill. The kills were reported following a period of high stream discharge caused by a heavy rainstorm. The suspected cause in each case was recently applied herbicide to the face of Wills Creek dam being washed into the creek. The kill report added that an abandoned mine shaft near the town of Wills Creek was also discharging mine wastes following the rain event, possibly exacerbating the problem.
- Lists of spills reported for Wills Creek and selected tributaries between 1989 and 1995 are reported in Table 5. A majority of the spills involved petroleum products (crude oil or diesel fuel) with 1,695 gallons released from eight spills.

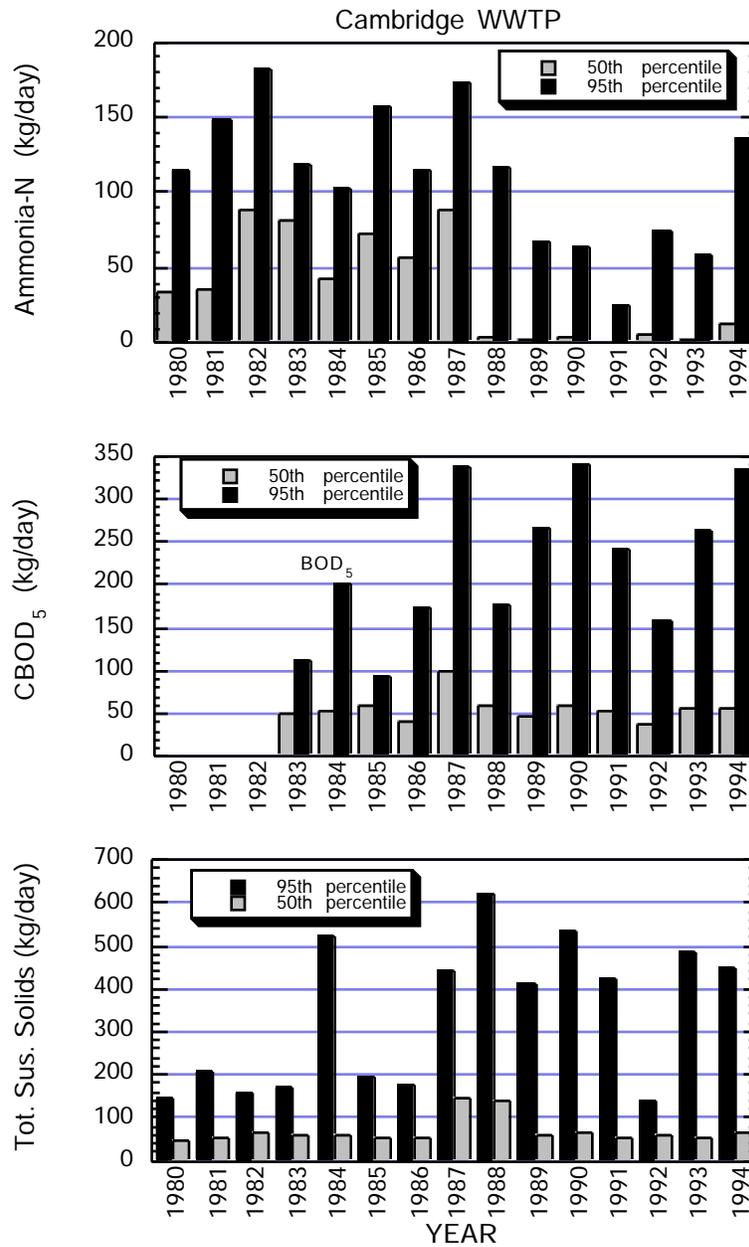


Figure 4. Annual effluent loadings (kg/day) of ammonia-N, CBOD₅ and TSS from the Cambridge WWTP 001 outfall into Wills Creek, 1980 - 1994.

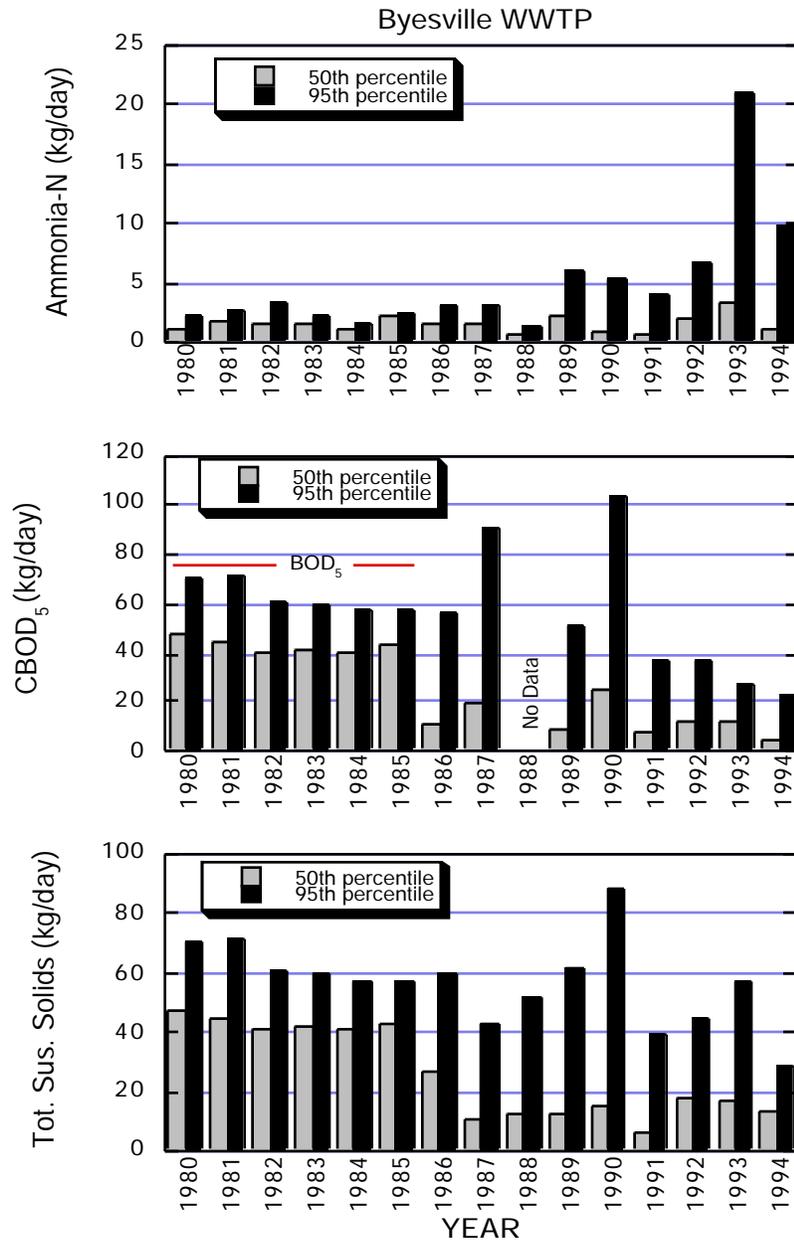


Figure 5. Annual effluent loadings (kg/day) of ammonia-N, CBOD₅ and TSS from the Byesville WWTP 001 outfall into Wills Creek, 1980 - 1994.

Table 4. Bioassay derived chronic (TU_c) and acute (TU_a) toxicity data from the Cambridge WWTP 001 effluent. Boldface values exceed the respective Allowable Effluent Toxicity of 0.5 TU_a and 2.1 TU_c.

Date	Tester	<i>Ceriodaphnia</i>			Fathead Minnow		
		Percent Affected In Effluent	TU _a	TU _c	Percent Affected In Effluent	TU _a	TU _c
June 1989	Ohio EPA	100	2.8	na	0	-	na
August 1989	Ohio EPA	0	-	na	0	-	na
November 1990	Cambridge		na	1.4		na	2.8
December 1990	Cambridge	10	-	na	10	-	na
January 1991	Cambridge	90	1.4	na	0	-	na
February 1991	Cambridge	0	na	-	100	na	1.4
March 1991	Cambridge	0	-	na	0	-	na
April 1991	Cambridge	0	-	na	0	-	na
May 1991	Cambridge	50	na	5.7	0	na	-
June 1991	Cambridge	0	-	na	10	-	na
July 1991	Cambridge	100	9.3	na	100	2.6	na
August 1991	Cambridge	0	na	-	37	na	-
September 1991	Cambridge	0	-	na	20	-	na
October 1991	Cambridge	0	-	na	0	-	na
February 1994	Ohio EPA	5	-	na	10	-	na
July 1994	Ohio EPA	15	-	na	10	-	na

Table 5. Summary of pollutant discharges to Wills Creek and selected tributaries reported to the Ohio EPA Division of Emergency and Remedial Response from 1989 - 1995.

Date	Stream	Entity	Material	Amount	Units
05/25/89	Buffalo Fork	Cavendish Oil	Crude Oil	550	Gal.
12/04/89	Clear Fork Trib.	Kelle Oil Gas	Diesel Fuel	15	Gal.
01/11/90	Wills Creek	Colgate Palmolive	Detergent/Dye	Unk.	-
06/05/90	Wills Creek	Cambridge WTP	Sludge	Unk.	-
06/08/90	Wills Cr. Trib.	AWP-Coal Prep.	Diesel Fuel	100	Gal.
07/23/90	Bushy Fork	Carlos Resources	Raw Sewage	Unk.	-
03/17/91	Wills Cr. Trib.	N.Am. Van Lines	Diesel Fuel	100	Gal.
08/20/91	Wills Cr. Trib.	Builders Transport	Diesel Fuel	130	Gal.
05/18/92	Salt Fork	Kelt Inc.	Crude Oil	250	Gal.
08/04/92	Rocky Fork	Kingston Petrol	Crude Oil	300	Gal.
08/28/92	Wills Creek	Colgate Palmolive	Foam	Unk.	-
12/09/92	Beeham Run	Jenkins	Oil	Unk.	-
01/21/93	Brush Run Trib.	OK Coal	Diesel Fuel	50	Gal.
03/30/93	Chapman Run	Mad R. Transport	Diesel Fuel	200	Gal.
07/25/94	Wills Creek	Miskimen	Automotive Fluid	Unk.	-
01/16/95	Wills Creek	Byesville WWTP	Wastewater	Unk.	-

Chemical Water Quality

Wills Creek

Surface water grab samples in Wills Creek were collected from 16 locations on six different sampling events between July and September, 1994. Byesville and Cambridge wastewater treatment plant effluents were sampled during each event. Sampling results are detailed in Appendix Table A-1.

- The daily average flows as reported by the United States Geological Survey for May through mid-October 1994 in Wills Creek at RM 64.12 are shown in Figure 6. The mean monthly discharge during these months was greatest during May (202 cfs) and lowest during September (37.1 cfs). The minimum daily flows during the end of September were less than Q_{7,10} (seven-day ten year low flow measured in cubic feet per second) conditions (2.6 cfs) and a majority of the daily flows during September were below the 80% duration value (20 cfs).
- Six parameters associated with mine drainage influences (manganese, sulfate, iron, aluminum, conductivity and total dissolved solids) are plotted longitudinally for Wills Creek from data collected during 1994 (Figure 7). Iron measurements exceeded the Warmwater Habitat water quality criterion in 91 of 92 surface water samples. Although elevated iron levels are not atypical for many streams in Ohio, the mean iron concentrations in Wills Creek were substantially above relatively unimpacted reference stations in the Western Allegheny Plateau (WAP) ecoregion. A comparison of the other five parameters with expected background levels (Ohio EPA 1992a) revealed concentrations which exceeded the upper quartile range for relatively unimpacted reference stations in the WAP ecoregion (Figure 7). These elevated conditions were particularly evident in the upper half of the Wills Creek study area. One total dissolved solids measurement (from RM 70.19) exceeded the Warmwater Habitat water quality criterion. Highly elevated concentrations of these six parameters were reported in Buffalo Fork during 1987 (Ohio EPA 1990b); Buffalo Fork is one of three tributaries which make up the headwater drainages of Wills Creek. Chemical water quality in the Buffalo Fork watershed is closely related to past and present mining activity.
- Nutrient levels in Wills Creek were generally reflective of good water quality. Ammonia-N values in Wills Creek were all less than the applicable WWH water quality criterion (Figure 8). The highest concentrations of ammonia-N were found in a one mile segment immediately upstream from the Cambridge WWTP. Nitrate-N levels in Wills Creek generally indicated a pattern similar to ammonia-N, and reflected the input of nitrogenous material from the Cambridge WWTP as well as an upstream source (e.g. lift station overflow at Campbell Ave./ potential sewer line break). Average five-day biochemical oxygen demand (BOD₅) measurements in Wills Creek were less than 3 mg/l at all stations sampled; however, one elevated maximum value (9.3 mg/l) occurred 0.1 mile downstream (RM 67.33) from Chapman Run.
- Fecal coliform samples were collected once from Wills Creek during October 1994. Three samples exceeded the Primary Contact Recreation (PCR) water quality criterion for fecal coliform (Table 6). The two highest coliform values (84,000 and 87,000) recorded during the study occurred at RM 62.60 (Stubenville Rd.) and RM 61.61, both sites immediately upstream from the Cambridge WWTP (RM 61.52). Downstream from the Cambridge WWTP, fecal coliform counts declined to 5200 at RM 60.06 and 520 at RM 58.58. The cause of elevated

levels of fecal coliform recorded in Wills Creek upstream from the Cambridge WWTP is unknown; however, suspected sewer line breaks or lift station overflows (strong sewage odors have been recorded in Wills Creek at Stubenville Road) are potential sources. Natural die-off of bacteria and dilution from Crooked Creek at RM 59.5 contribute to the gradual decrease in fecal coliform values downstream from the Cambridge WWTP. Fecal coliform contamination in Wills Creek upstream and downstream from the Byesville WWTP was not a problem, but one sample just downstream from Chapman Run was significantly higher (530 #/100ml) than the upstream sites and may reflect bacterial contamination from an intermittently discharging lift station into Chapman Run 0.9 miles from Wills Creek.

- Wills Creek surface water results for total chromium and total nickel were all reported as below lab detection limits. Total cadmium, arsenic, copper and lead sample results were generally reported near or below lab detection limits. None of these parameters exceeded applicable WWH water quality criteria.

Salt Fork Tributaries

- Salt Fork and nine small streams in the Salt Fork drainage were sampled during this survey in an effort to document nonpoint source water quality problems associated with livestock. Figures 9 and 10 provide a comparison of chemical water quality in each stream for mine drainage, parent soil, and nutrient parameters. Sulfate, total dissolved solids and conductivity, parameters associated with mine drainage impacts, were low in all ten tributaries. Aluminum, iron, and manganese, parameters associated with background soil conditions in the region (as well as potentially related to mine drainage) were highly elevated in four of the streams sampled; this condition suggested substantial input of soil into the streams. Exceedances of the WWH water quality criterion for iron was noted in 42 of the 59 tributary surface water samples. The highest iron levels were documented in Turkey Run, with a mean value of 6,400 ug/l. This exceeds the 5,000 ug/l Agricultural Water Supply iron criterion.
- Surface water sampling results indicated that Beeham Run, Yellow Water Creek, and Coon Run had good water quality. All of these streams were represented by low nutrient levels; mine drainage and parent soil parameters were also low in Beeham Run and Yellow Water Creek. The highest mean manganese value (2700 ug/l) within the study area was documented in Coon Run.
- Salt Fork, Turkey Run, Clear Fork, Sugartree Fork, Brushy Fork, and Christian Run surface water sampling results suggested some impact on water quality associated with nonpoint source influences. These streams had elevated levels of aluminum, iron and/or manganese and elevated nutrient concentrations. The combination of elevated parent soil parameters and elevated nutrients suggested potential influences from livestock in the area. Of these six streams, Sugartree Fork, Brushy Fork, Salt Fork, and Christian Run were frequently observed with livestock in or adjacent to the waterway.
- Rocky Fork surface water sampling results revealed low levels of mine drainage/parent soil parameters (excluding iron) and low nutrient levels. One copper sample (169 ug/l) exceeded the maximum Ohio water quality criterion. The source of the copper exceedance was unknown.

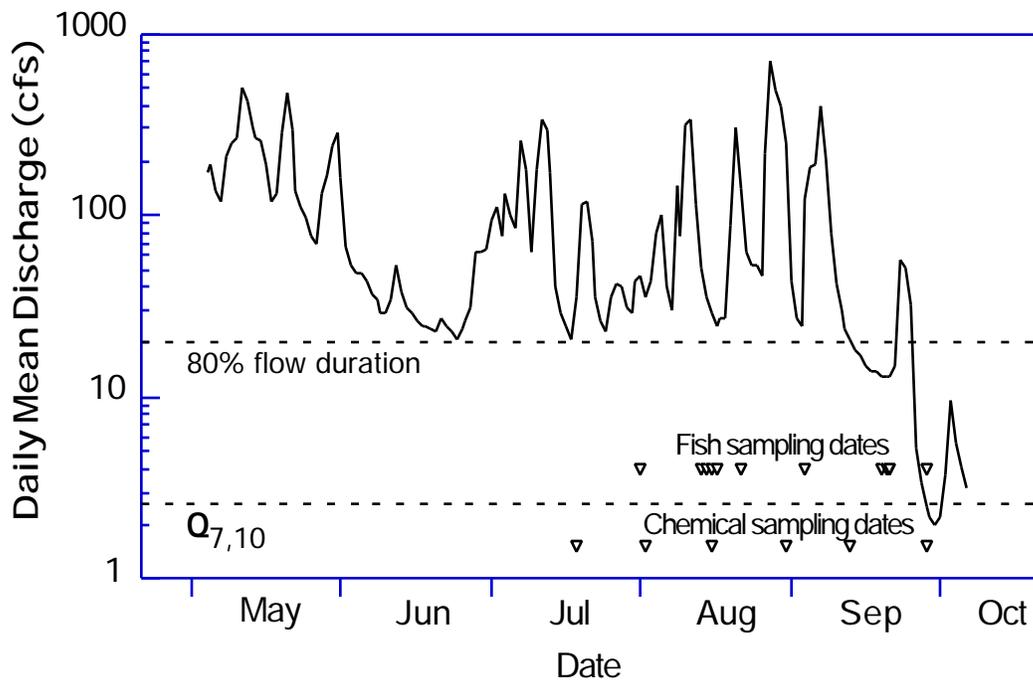


Figure 6. Flow hydrograph for Wills Creek at Cambridge, Ohio (RM 64.12) May through October, 1994. Sampling dates and May through November low-flow conditions ($Q_{7,10}$ [2.6 cfs] to 80% duration flow [20 cfs]; period of record: 1937 to present) are indicated on the flow hydrograph.

Table 6. Exceedances of Ohio EPA Warmwater Habitat criteria (OAC 3745-1) for chemical/physical parameters measured in the Wills Creek study area, 1994 (units are $\mu\text{g/l}$ for metals, $\#/\text{100 ml}$ for fecal coliform).

Stream Name	River Mile	Violation: Parameter (value)
Wills Creek	70.19	Total Dissolved Solids (3460 †)
	62.58	Fecal coliform (87,000)
	61.61	Fecal coliform (84,000)
	60.06	Fecal coliform (5,200)
	75.90-5.25	Iron (91 of 92 samples exceeded 1000 $\mu\text{g/l}$ †)
Rocky Fork	5.56	Copper (169***)
Salt Fork Tributaries		Iron (42 of 59 samples exceeded 1000 $\mu\text{g/l}$ †)

*** indicates an exceedance of numerical criteria for prevention of lethality (Final Acute Value).
 † indicates an exceedance of the Primary Contact Recreation criterion.

† indicates an exceedance of the WWH outside mixing zone 30 day average iron criterion.

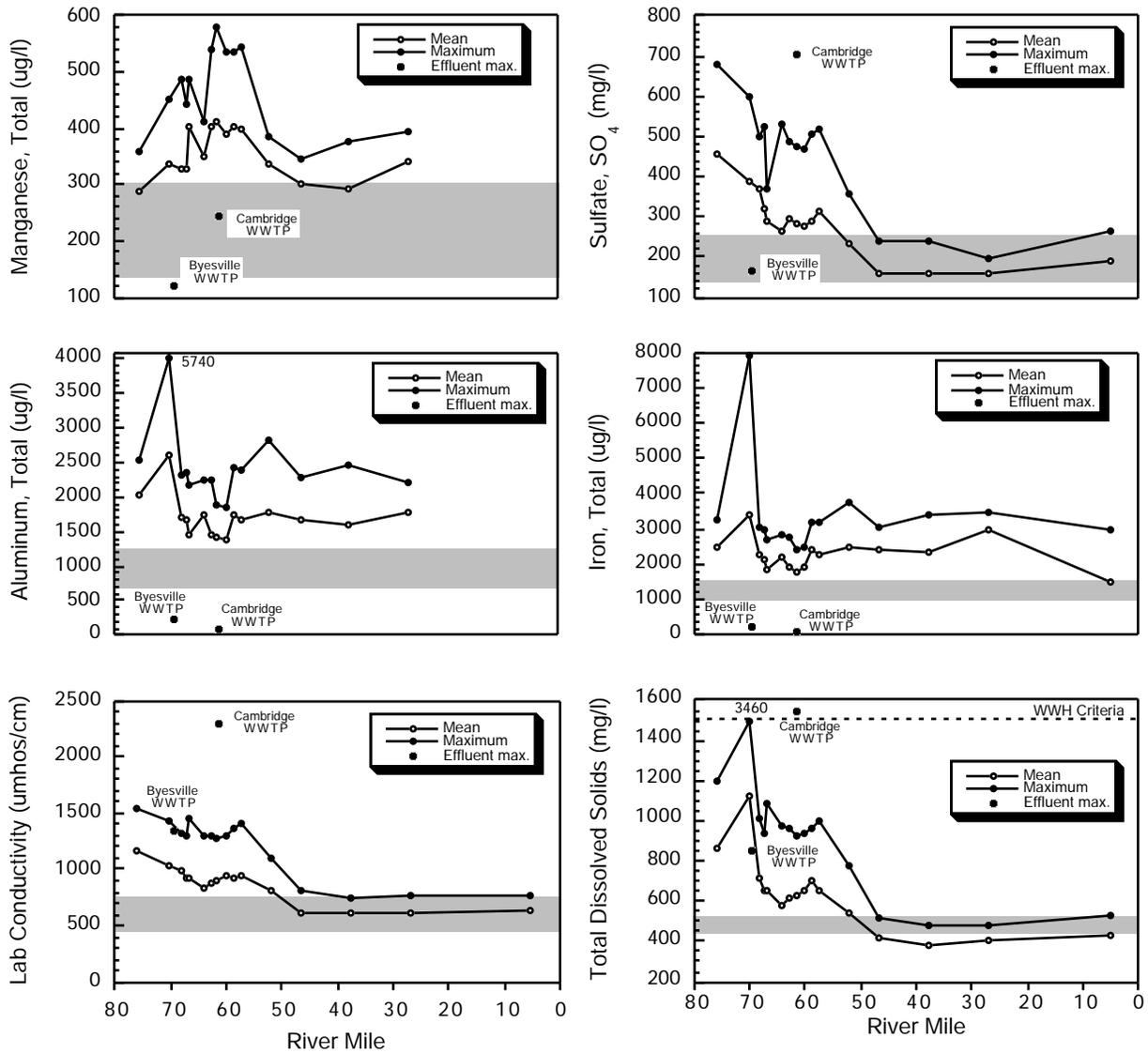


Figure 7. Longitudinal profile of mean and maximum stream values for total aluminum, total iron, total manganese, sulfate, lab conductivity, and total dissolved solids in Wills Creek during 1994. Maximum effluent concentrations are reported for the Cambridge and Byesville WWTPs. Shaded areas represent the range between the median and 75th percentile values for relatively unimpacted Western Allegheny Plateau ecoregion reference sites (Ohio EPA 1992a). Shading for aluminum was based on data from the Muskingum River basin as reported in Ohio EPA (1988).

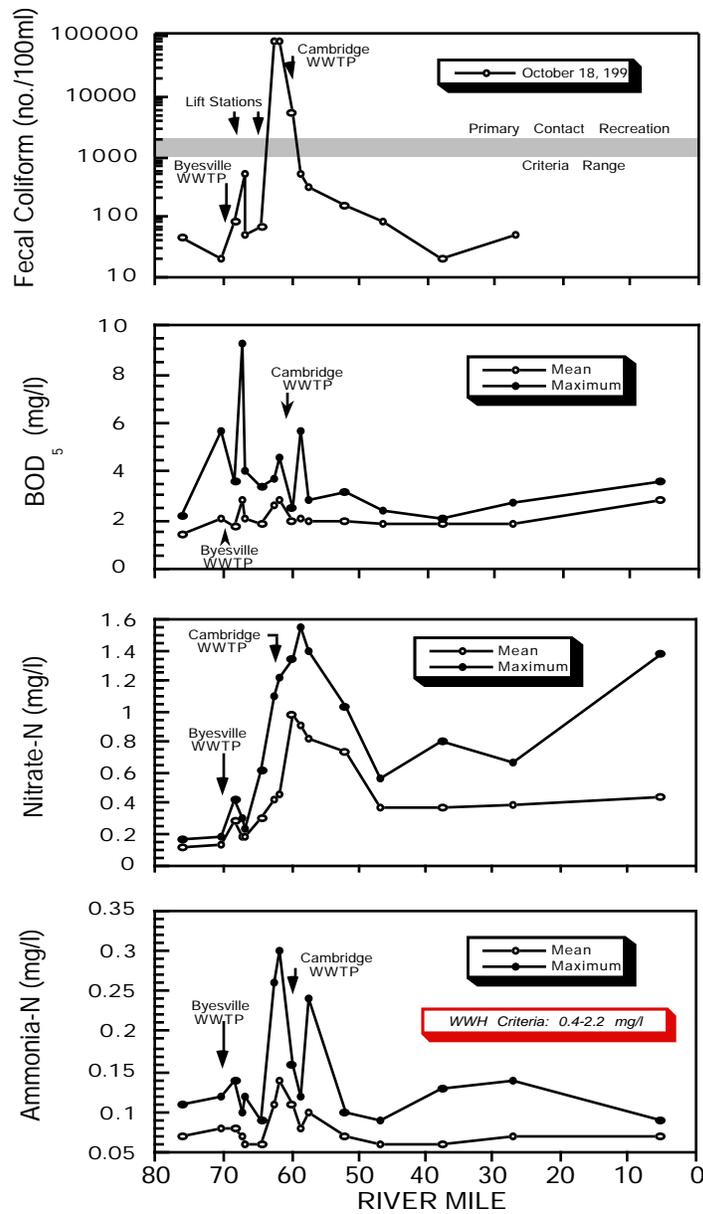


Figure 8. Longitudinal profile of mean and maximum concentrations of nitrate-N, ammonia-N and five-day biochemical oxygen demand (BOD₅), and one sample run of fecal coliform in Wills Creek during 1994.

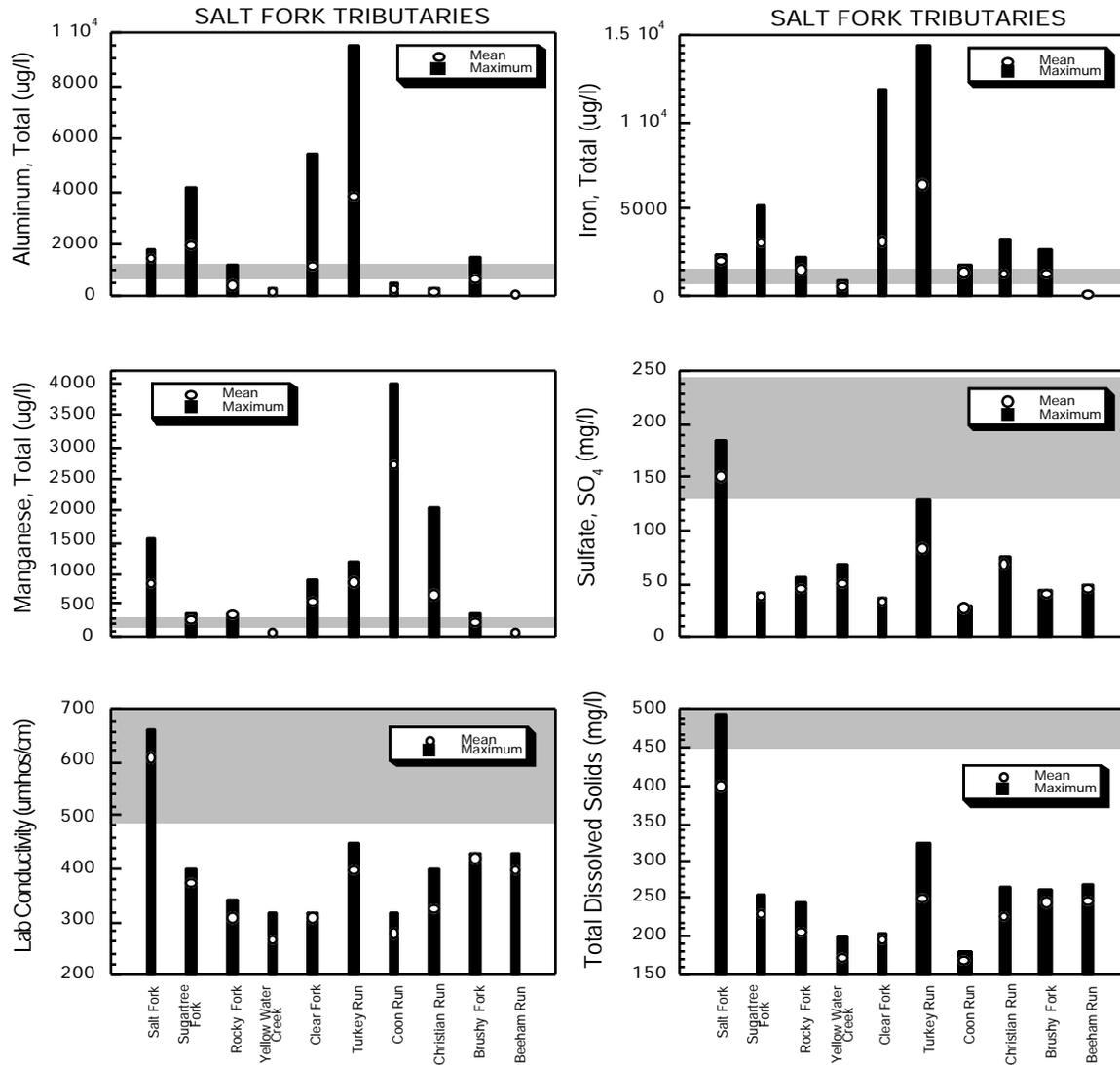


Figure 9. Mean and maximum values for total aluminum, total iron, total manganese, sulfate, total dissolved solids and lab conductivity for Salt Fork and nine tributaries. Each stream was sampled at one location during the 1994 survey. Shaded areas represent the range between the median and 75th percentile values for relatively unimpacted Western Allegheny Plateau ecoregion reference sites (Ohio EPA 1992a). Shading for aluminum was based on data from the Muskingum River basin as reported in Ohio EPA (1988).

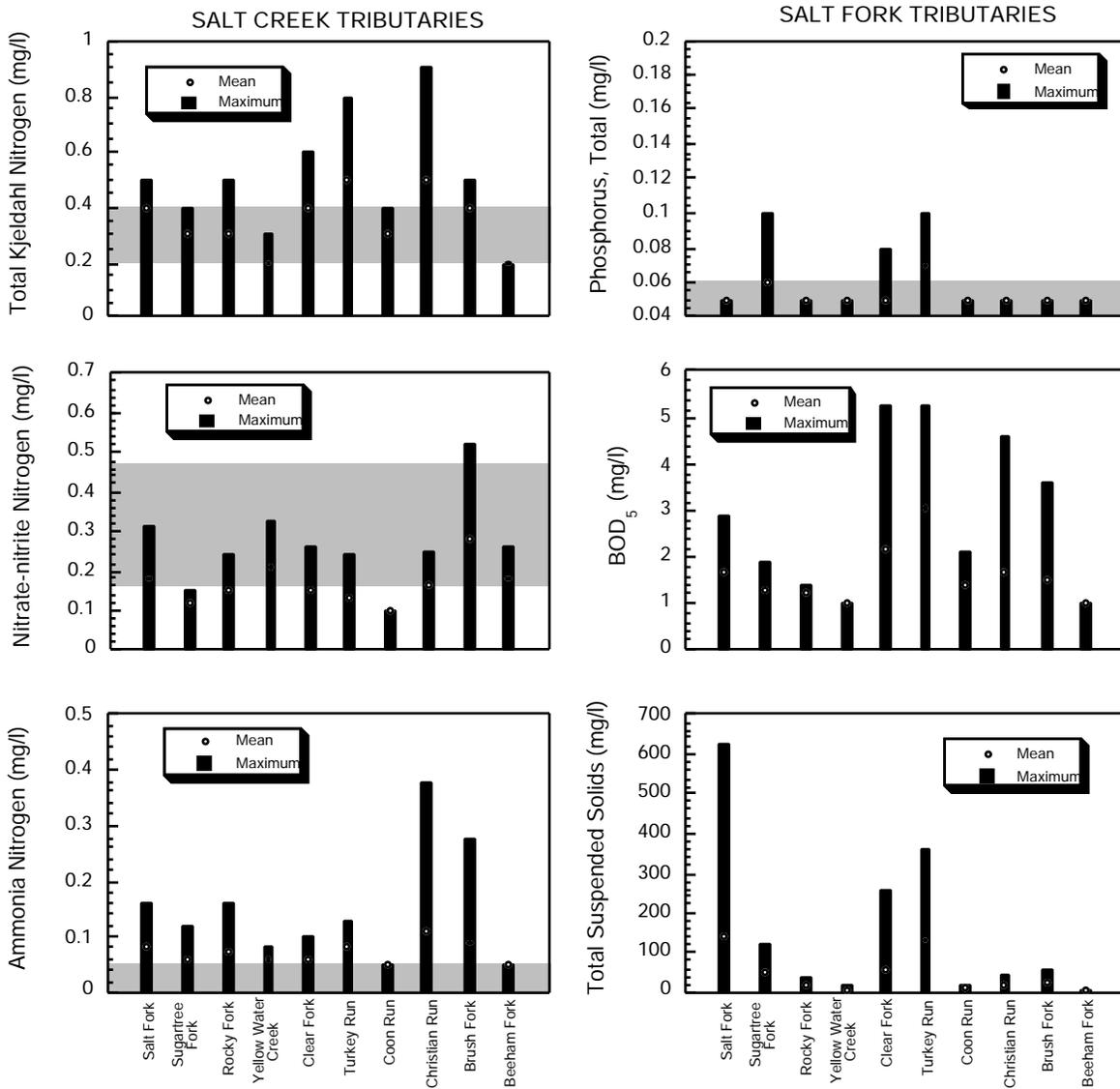


Figure 10. Mean and maximum values for ammonia-nitrogen, nitrate-nitrite nitrogen, total kjeldahl nitrogen, total suspended solids, five-day biochemical oxygen demand (BOD₅), and total phosphorus for Salt Fork and nine tributaries. Each stream was sampled at one location during the 1994 survey. Shaded areas represent the range between the median and 75th percentile values for relatively unimpacted Western Allegheny Plateau ecoregion reference sites.

Sediment Chemistry

Wills Creek

Sediment samples were collected at eight locations in Wills Creek from RM 68.1 (downstream from the Byesville WWTP) to RM 37.7 (SR 541 near Birds Run). Eight metal parameters were tested and the results are presented in Table 7.

- Sediment samples were evaluated using guidelines established by the Ontario Ministry of the Environment (Persaud *et al.* 1994). For metals analysis, these guidelines define two levels of ecotoxic effects and are based on the chronic, long term effects of contaminants on benthic organisms. A *Lowest Effect Level* is a level of sediment contamination that can be tolerated by the majority of benthic organisms, and a *Severe Effect Level* indicates a level at which pronounced disturbance of the sediment-dwelling community can be expected. The Severe Effect Level is the sediment concentration of a compound that would be detrimental to the majority of benthic species. When any parameters are at or above the Severe Effect Level Guideline, the material tested is considered highly contaminated and will likely have a significant effect on benthic biological resources.
- Iron exceeded the Severe Effect Level at seven of eight sediment sampling sites in Wills Creek. These exceedances occurred both upstream and downstream from Byesville and Cambridge and appear to be associated with soil and parent material background levels of iron. The sampling location at RM 62.6 (SR 209 - Stubenville Rd.), had the highest overall levels of metals within the study segment. In addition, arsenic, cadmium, copper, chromium, lead, nickel and zinc were above the Lowest Effect Level at a number of locations.

Table 7. Concentrations of heavy metals in sediments of Wills Creek, 1994. All parameter concentrations were evaluated based on Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (Persaud *et al.* 1994).

(LEL/SEL)^a River Mile	Sediment Concentration (mg/kg dry weight)							
	As (6/33)	Cu (16/110)	Cd (0.6/10)	Cr (26/110)	Fe (20,000/ 40,000)	Pb (31/250)	Ni (16/75)	Zn (120/820)
WILLS CREEK								
75.9	15.6 ^b	19.3 ^b	0.291	27.1 ^b	55100^c	33.4 ^b	48.0 ^b	71.8
68.1	15.9 ^b	25.5 ^b	0.273	26.7 ^b	58500^c	39.3 ^b	48.5 ^b	97.9
66.8	10.2 ^b	23.6 ^b	0.404	28.2 ^b	41600^c	63.2 ^b	49.6 ^b	154 ^b
62.6	13.2 ^b	48.2 ^b	0.908 ^b	38.3 ^b	56700^c	137 ^b	55.8 ^b	242 ^b
61.4	11.6 ^b	35.1 ^b	0.739 ^b	30.5 ^b	44500^c	70.4 ^b	47.5 ^b	182 ^b
58.6	11.5 ^b	32.9 ^b	0.795 ^b	33.5 ^b	51100^c	56.4 ^b	50.7 ^b	138 ^b
46.4	12.2 ^b	27.1 ^b	NA	30.2 ^b	55300^c	46.9 ^b	50.4 ^b	163 ^b
37.7	8.63 ^b	13.4	0.394	25.2	32400 ^b	25.6	30.2 ^b	96.1

^aLEL is the Lowest Effect Level. SEL is the Severe Effect Level (mg/kg).

^bExceeds Lowest Effect Level (LEL).

^cExceeds Severe Effect Level (SEL).

NA Not analyzed.

Fish Tissue

Fish tissue samples were collected from three sites in Wills Creek between RM 70.4 and RM 67.0. Sampling results are available for two sites in Wills Creek, RMs 67.5 and 67.0, located immediately upstream and downstream from Chapman Run (Table 8.). The two sites bracketing Chapman Run were established to assess potential contaminant migration from the Shieldalloy metallurgical waste slag piles located near Chapman Run between river miles 0.9 and 1.3. Whole body composites of common carp and skin-off fillet samples of channel catfish were analyzed for percent lipid, vanadium, mercury, chromium, cadmium, lead, and radiological parameters of gross alpha, gross beta, thorium isotopes 228, 230 and 232, and uranium isotopes 234, 235, and 238.

- All gross alpha, thorium 228, 230, and 232 isotopes, and uranium 234 and 235 isotopes were below laboratory detection limits. Five of six uranium 238 samples were less than lab detection limits; the one detected sample was very low (0.7 ± 0.7 pCi/g). All samples had detectable levels of gross beta, with values ranging from 19 to 35 pCi/g. The levels of gross beta - in the absence of detectable levels of gross alpha, thorium, and uranium - were probably due to potassium⁴⁰ or other naturally occurring beta emitters. No detectable difference in radiological parameters was observed between fish sampling results upstream and downstream from Chapman Run, a stream which receives runoff from two slag piles which have low levels of radioactive material.
- Vanadium, mercury, chromium, cadmium, and lead were measured in all fish tissue samples collected from RMs 67.5 and 67.0. A majority of the metals analyses were near or less than laboratory detection levels. An elevated cadmium level in common carp was noted at RM 67.5. Mercury, the only parameter of those listed above with a Food and Drug Administration (FDA) Consumption Action Level (1 mg/kg), was detected in four of six samples at low levels.

Table 8. Results of tissue analyses from fish collected by the Ohio EPA in Wills Creek during 1994.

FISH TISSUE - METALS								
<i>Stream</i>								
River Mile	Lipid	Vanadium	Mercury	Chromium	Cadmium	Lead		
Fish Species	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		
<i>Wills Creek</i>								
RM 67.5 (Upst. Chapman Run)								
Common carp - WBC	2.5	0.6	<0.08	0.05	0.73	<0.10		
Channel catfish - SFFC	0.62	<0.2	0.11	0.05	<0.04	<0.10		
Channel catfish - SFF	1.6	<0.2	0.16	<0.04	<0.04	<0.10		
RM 67.0 (Dst. Chapman Run)								
Common carp - WBC	4.2	0.6	<0.08	0.06	0.14	0.15		
Channel catfish - SFFC	1.4	<0.2	0.10	<0.04	<0.04	<0.10		
Channel catfish - SFF	1.0	<0.2	0.10	<0.04	<0.04	<0.10		
FISH TISSUE - RADIOLOGICALS (pCi/g)								
	Gross Alpha	Gross Beta	Thorium			Uranium		
			228	230	232	234	235	238
<i>Wills Creek</i>								
RM 67.5 (Upst. Chapman Run)								
Common carp - WBC	ND	21±6.9	ND	ND	ND	ND	ND	ND
Channel catfish - SFFC	ND	34±7.5	ND	ND	ND	ND	ND	ND
Channel catfish - SFF	ND	22±7.0	ND	ND	ND	ND	ND	0.07±0.07
RM 67.0 (Dst. Chapman Run)								
Common carp - WBC	ND	19±7.0	ND	ND	ND	ND	ND	ND
Channel catfish - SFFC	ND	35±7.8	ND	ND	ND	ND	ND	ND
Channel catfish - SFF	ND	23±7.1	ND	ND	ND	ND	ND	ND

WBC = whole body composite. SFFC = skin off fillet composite. SFF = skin off fillet. ND = not detected

Physical Habitat for Aquatic Life

Wills Creek

- Parts of the Wills Creek channel have been modified in the past, and because of its inherent low gradient, has recovered little of its natural free flowing character. Exacerbating the slow recovery is the tremendous silt and clay load carried by the stream, attributable to unreclaimed strip mines and gob piles and livestock which have free access to tributaries and the mainstem throughout the watershed. Riffles were absent or poorly developed from most sites surveyed (13 of 16 sites), the channel had little sinuosity, and riparian strips were generally narrow. Instream cover was limited to woody debris, and the vertical profile of the stream channel was generally trapezoidal at most sampling locations. The degraded habitat quality was reflected in QHEI scores (Table 9). Wills Creek demonstrated an overwhelming predominance of moderate and high influence modified habitat attributes at nearly all mainstem sampling locations. The mean QHEI score for all sites surveyed was 44.0. Typically, mean QHEI scores below 46 for a stream suggest that aquatic communities, especially fish, are not likely to achieve WWH biocriteria.

Salt Fork Tributaries

- Ten tributaries in the Salt Fork drainage of Wills Creek were surveyed to assess nonpoint source impacts (Table 9). QHEI scores for the tributaries were generally low (mean = 45.9). The most important sources of habitat impairment were heavy to moderate silt cover, and high to moderate riffle and substrate embeddedness due to the effects of intensive livestock practices throughout the drainage; five of the streams surveyed had livestock in them. In addition, six of the ten tributaries showed evidence of recent (< 15 year) modification. Where modification and livestock impacts were not evident (Yellow Water Creek and Rocky Fork), sand was the predominant substrate, owing to parent sandstone material within the drainage.

Table 9. Qualitative Habitat Evaluation Index (QHEI) matrix showing modified and warmwater habitat characteristics for the Wills Creek study area, 1994.

Key QHEI Components		WWH Attributes										MWH Attributes									
		River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered Boulder/Cobble/Gravel Substrates Silt Free Substrates	Good/Excellent Development Moderate/High Sinuosity Extensive/Moderate Cover	Fast Current/Eddies Low/Normal Embeddedness Max Depth > 40 cm Low/No Riffle Embeddedness	Total WWH Attributes	High Influence				Moderate Influence						Total M.I. MWH Attributes	MWH H.I./WWH Ratio	MWH M.I./WWH Ratio
									Channelized or No Recovery Silt/Muck Substrates Low Sinuosity	Sparse/No Cover Max Depth < 40 cm (WD, HW)	Total H.I. MWH Attributes	Recovering Channel Heavy/Moderate Silt Cover Sand Substrates (Boat)	Hardpan Substrate Origin Fair/Poor Development Low/No Sinuosity	Only 1-2 Cover Types Intermittent & Poor Pools No Fast Current High/Moderate Embeddedness Ext./Moderate Riffle Embed. No Riffle							
(17-800) - Wills Creek																					
Year: 94																					
	75.7	36.5	.3	■			2	●	1	▲▲	▲▲▲	▲▲	▲	8	.67	3.33					
	69.4	45.0	.3		■	■	3	●	1	▲▲	▲	▲▲	▲	6	.50	2.00					
	67.3	32.0	.3		■	■	2	●●	3	▲	▲▲	▲▲	▲	6	1.33	3.33					
	66.6	35.0	.3		■	■	2	●●	3	▲	▲▲	▲▲	▲	6	1.33	3.33					
	64.7	42.5	.3	■	■	■	3	●●	2	▲	▲▲	▲▲	▲	6	.75	2.25					
	62.4	42.0	.3	■	■	■	3	●	1	▲▲	▲▲	▲▲▲		7	.50	2.25					
	61.9	38.0	.3		■	■	2	●●	2	▲▲	▲▲	▲▲	▲	7	1.00	3.33					
	61.5	53.5	.3		■	■	2	●	1	▲▲	▲▲	▲▲▲		7	.67	3.00					
	59.4	58.5	.3	■	■	■	4		0	▲▲	▲▲	▲▲	▲▲	6	.20	1.40					
	57.1	61.0	.3	■	■	■	9	●	1	▲▲	▲	▲▲▲		6	.20	.80					
	53.4	49.5	.3	■	■	■	6	●	1	▲▲	▲	▲▲	▲▲	5	.29	1.00					
	46.8	37.5	.3		■	■	2	●●	2	▲	▲▲	▲▲	▲	6	1.00	3.00					
	38.0	33.0	.3		■	■	1	●●●	3	▲	▲▲	▲▲	▲	6	2.00	5.00					
	27.4	35.5	.3		■	■	1	●●●	3	▲	▲▲▲	▲▲	▲	7	2.00	5.50					
	.1	66.0	1.5	■	■	■	4		0	▲	▲▲	▲▲▲	▲	6	.20	1.40					
(17-817) - Chapman Run																					
Year: 94																					
	.1	16.5	.1			■	1	●●●●	4	▲	▲▲▲	▲▲	▲	7	2.50	6.00					
(17-820) - Salt Fork																					
Year: 94																					
	20.8	40.5	2.6		■	■	3	●	1	▲▲	▲	▲	▲▲▲	7	.50	2.25					
(17-821) - Sugartree Fork																					
Year: 94																					
	12.2	60.5	6.0	■	■	■	5		0	▲▲		▲▲▲		5	.17	1.00					
(17-822) - Rocky Fork																					
Year: 94																					
	5.6	44.0	5.4	■	■	■	3	●	1	▲▲	▲	▲▲▲		6	.50	2.00					
(17-823) - Yellow Water Creek																					
Year: 94																					
	.8	59.5	17.5	■	■	■	3	●	1	▲	▲▲	▲▲▲		6	.50	2.00					

Table 9. Continued.

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes						MWH Attributes						Total M.I. MWH Attributes	MWH H.I./WWH Ratio	MWH M.I./WWH Ratio										
			No Channelization or Recovered Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/ Eddies	Low/Normal Embeddedness	Max Depth > 40 cm	Low/No Riffle Embeddedness	Total WWH Attributes	Channelized or No Recovery	Silt/Muck Substrates				Low Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD,HW)	Total H.I. MWH Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low/No Sinuosity
(17-824) – Clear Fork																											
Year: 94																											
1.9	47.0	7.3	■	■				2	●				1	▲▲	▲		▲▲▲	6	.67	2.67							
(17-825) – Turkey Run																											
Year: 94																											
.8	58.5	32.7	■	■	■	■		5	●	●			2	▲			▲▲▲	4	.50	1.17							
(17-826) – Beeham Run																											
Year: 94																											
1.7	48.0	35.0	■	■	■	■		5		●	●		2	▲		▲	▲▲▲	5	.50	1.33							
(17-827) – Brushy Fork																											
Year: 94																											
3.2	36.0	6.7	■					1	●	●	●		3	▲▲	▲▲▲	▲▲▲	▲▲▲	9	2.00	6.50							
(17-828) – Christian Creek																											
Year: 94																											
.2	25.0	16.0						0	●	●	●	●	4	▲▲	▲▲▲	▲▲▲	▲▲▲	8	5.00	*. **							
(17-829) – Coon Run																											
Year: 94																											
.8	39.0	23.8	■					1	●	●	●		3	▲▲	▲▲▲	▲▲▲	▲▲▲	8	2.00	6.00							

Biological Assessment: Macroinvertebrate Community

Wills Creek

- Artificial substrate samples were collected at eighteen Wills Creek stations from RMs 75.8 to 5.2 (Table 10; Figure 11). Four sites in the Byesville area (RMs 70.2-66.7) were collected from nondetectable or very slow current (0.0-0.1 ft. per second), primarily due to a low head dam at RM 66.7. Because the current velocities fell below the required 0.3 feet per second needed for direct interpretation of the ICI and the applicable biocriterion, these sites were evaluated using an interim criterion for impounded habitats (ICI=22) or best professional judgement. The remaining fourteen sites were collected from free flowing (lotic) habitats with adequate current velocities. Lists of macroinvertebrate taxa and ICI metric scores from each site in the Wills Creek study area can be found in Appendix Tables A-2 and A-3.
- Station RM 75.8 was located upstream from Byesville and all known point source discharges. Significant surface mining and reclamation activity has occurred in the upper watershed, particularly in the Buffalo Fork basin. The ICI of 44 was in the very good range. The community was predominated by mayflies and caddisflies (43% and 35.3%, respectively); while tolerant and other dipteran/noninsect organisms were found in low numbers (1.1% and 12.1%, respectively). ICI metric scores for these parameters (metrics 9 and 8) each scored '6' on the 0 to 6 point scoring range. In contrast, the seven taxa of mayflies and caddisflies collected from the natural substrates (Qualitative EPT taxa richness metric 10) received a score of '2', indicating this aspect of the community was performing below ecoregional expectations. The results suggested the water column quality of Wills Creek was relatively good but natural substrate communities were more directly impacted by the extensive silt deposition observed throughout the stream channel.
- Station RM 70.2 was located upstream from the Byesville WWTP. Samplers were collected from a pooled habitat in nondetectable current in order to compare community performance to impounded sites downstream from both the WWTP at RM 68.1 and Chapman Run at RM 67.2. Natural substrates at each site were heavily silted and sampling at RM 67.2 was limited due to the sheer dropoff and deep water along the west bank downstream from Chapman Run. ICI scores were in the lower fair range with values from 14 to 18 at the three sites (Table 10). All scores fell below both the WWH criterion of 36 and the interim impoundment criterion of 22. Natural substrate communities were also of lower quality and scored '0' for Qual. EPT richness at each site. Excessive siltation, impounded habitat and nondetectable current were the major influences on the macroinvertebrates. Potential negative impacts from point sources and the Shieldalloy complex on Chapman Run could not be distinguished from the overriding background conditions.
- Immediately downstream from the low head dam impoundment at RM 66.7, the ICI increased to 22 (fair) but the artificial substrate community may have been influenced by slow current velocities (measured 0.1 ft. per second). Despite improved habitat in the dam tailwaters, the qualitative EPT (Qual. EPT) of 4 scored a '0' and remained well below ecoregional expectations. This suggested an impact from upstream sources, beyond simple habitat quality or lack of current.
- Macroinvertebrates improved substantially at Campbell Road (RM 64.1) where the ICI of 46 (exceptional) easily achieved the WWH criterion. This site was located immediately upstream from a large wastewater pump station. Community composition and ICI metric scores were very similar to the most upstream Wills Creek site at RM 75.8. Like RM 75.8, only 7 Qual. EPT taxa were collected from the natural substrates, a continued indication of the more direct impacts from siltation and pervasive nonpoint influences.

- Community health declined sharply into the low fair range (at RMs 62.7 and 62.2), upstream from the Cambridge WWTP (ICIs = 14 and 16, respectively). A sewer line ran adjacent to the creek at RM 62.7 (Stubenville Road) and a strong odor of sewage was detected. Station RM 62.2 was located immediately downstream from an unnamed tributary that had received discharges from a broken sewer line during the 1984 intensive survey. The sewer line was repaired and no obvious discharges were observed from the tributary during the 1994 sampling.
- The decline in the ICI beginning at RM 62.7 reflected a significant water quality impact *upstream* from the Cambridge WWTP. Declines were characterized by reductions in both the overall taxa richness and the percentages of pollution sensitive mayflies and caddisflies. Conversely, sharp increases were noted in percentages of tolerant and other dipteran/non-insect organisms. Figure 11 depicts the divergent trends in mayfly and tolerant organism percentages as the stream flows through the Cambridge urban area. Natural substrate communities were also impacted as evidenced by the drop in Qual. EPT taxa richness) between RMs 64.1 and 62.7 (Figure 11).
- Beginning downstream from the unnamed tributary at RM 62.2, increasingly larger amounts of trash were observed in Wills Creek and along the stream banks. Over twenty discarded automobile tires were counted at RM 62.2 within a 50 yard stretch of stream. At RM 61.3 large amounts of trash and junk had been illegally dumped over the banks and littered the stream channel. The greatest amount of trash was observed within a few miles of Cambridge.
- The Cambridge WWTP mixing zone revealed a fair quality community (ICI=14) predominated by more pollution tolerant midges and oligochaetes. Assemblages included both toxic and nutrient tolerant varieties and were similar to Wills Creek communities immediately upstream and downstream from the discharge (Figure 11). When the mixing zone site was compared to the nearest upstream site (RM 62.2), 52% of the quantitative taxa representing over 90% of total organisms were common to both stations. Oligochaetes and two midge taxa (*Glyptotendipes sp* and *Polypedilum (P.) illinoense*) were most numerous at both stations. The strong similarities between these communities suggested a common source of impact. Most likely, wastewater from the Cambridge sewer system was reaching Wills Creek between RMs 64.1 and 62.7. The impacts were considered primarily related to organic wastes and not indicative of acutely toxic conditions.
- Communities downstream from the Cambridge WWTP remained impacted but gradually improved with increased distance downstream. The ICI reached the WWH criterion of 36 at RM 53.5, approximately nine miles downstream from Cambridge. Improvements were characterized by gradual increases in mayfly and caddisfly abundance and corresponding decreases in the percentages of tolerant and other dipteran/non-insect organisms. Communities at RM 53.5 were not considered equal to high quality assemblages upstream from Byesville (RM 75.8) or the Cambridge urban area (RM 64.1). Full recovery of the macroinvertebrate community was considered incomplete.
- Exceptional and very good communities were found at four additional downstream stations between RMs 45.4 and 5.2. The recovery trend which began downstream from Cambridge continued as taxa richness and mayfly and caddisfly abundance increased. These increases coincided with further declines in tolerant taxa and other dipteran/non-insect abundance. At station RM 5.2, a sharp increase in community density (4,232 organism per square foot) and the abundance of net-spinning hydropsychid caddisflies (78.9% of total organisms) were observed downstream from Will Creek Reservoir. Increases in filter-feeders are often associated with dam releases due to increased algal and plankton growth within the impoundments.

- Natural substrate communities also improved in the lower sections of Wills Creek from upstream to downstream. The most downstream sites at RMs 37.7, 27.6, and 5.2 were the first to score either a '4' or '6' for the Qual EPT taxa richness metric. These scores indicated a lessening of impacts from siltation and point source discharges in the upper half of the basin.

Salt Fork Tributaries

- Macroinvertebrates were collected from nine Salt Fork tributaries to assess ambient conditions and possible nonpoint source impacts from livestock (Table 10). Christian Run, Coon Run and Turkey Run yielded communities in the poor and fair ranges while all other tributaries were in the good or exceptional ranges. Macroinvertebrates were not collected from Salt Fork.
- Besides the more traditional assessment protocols (*i.e.* total taxa richness, EPT taxa richness), macroinvertebrate communities at each station were also evaluated using the Qualitative Community Tolerance Value (QCTV). Box plots of the QCTV score (the median taxa tolerance value) along with the upper and lower quartile taxa tolerance values at each site are displayed in Figure 12. QCTV scores which fall above the 25th percentile QCTV scores of good and exceptional Western Allegheny Plateau (WAP) streams in the Ohio EPA database (QCTV = 37.7) are generally considered achieving WWH expectations (*i.e.*, good or exceptional quality). In contrast, median values below the 75th percentile QCTV scores of WAP poor and fair sites (QCTV = 36.0) are indications of lower quality communities which probably are not achieving WWH expectations. Macroinvertebrate community data from Christian Run, Coon Run and Turkey Run were the only results which fell in this fair to poor range.
- Poor quality communities in Christian Run and Coon Run appeared to result from severe physical habitat damage and unrestricted livestock access. Christian Run, in particular, flowed through a livestock pasture, had a ditch-like channel with severely denuded banks, and had bottom substrates composed of soft muck and silt. Coon Run had failing banks and the channel was split around numerous bars and hummocks, densely covered with weeds and shrubs. Livestock access (upstream from the site) appeared less extensive than in Christian Run but communities were still of poor quality.
- Fair quality in Turkey Run appeared to result from reduced habitat quality due to beaver dam impoundments (upstream) and a farm pond downstream. Compared to previous sampling in 1992, the QCTV experienced a 4.2 point drop (from 39.2 to 35.0) and Qual. EPT taxa declined from 13 to 6. The declines did not appear related to livestock.
- Livestock were observed in several other Salt Fork tributaries (e.g., Sugartree Fork, Brushy Fork) but this did not appear to significantly impact the macroinvertebrate communities. This may result from larger stream size, more adequate gradient or variations in agricultural land use between basins.

Table 10. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Wills Creek study area, August to September, 1994.

<i>Stream</i> River Mile	Relative Density	<i>Quantitative Evaluation</i>				ICI	Narrative Evaluation
		Quant. Taxa	Qual. Taxa	Qual. EPT ^a	QCTV ^b		
<i>Wills Creek</i>							
75.8	560	27	28	7	38.1	44	Very Good
70.2	47	33	21	3	31.4	18*	Fair
68.1	190	24	25	3	30.1	16*	Fair
67.2	61	19	9	0	30.3	14*	Fair
66.7	981	42	25	4	37.8	22*	Fair
64.1	379	38	29	7	37.7	46	Exceptional
62.7	101	20	23	2	29.6	14*	Fair
62.2	364	25	20	1	30.1	14*	Fair
61.5 <i>mix zone</i>	413	23	21	1	32.6	14*	Fair
61.3	505	23	20	1	32.6	14*	Fair
60.1	568	38	25	3	31.4	22*	Fair
58.6	284	33	15	1	30.3	22*	Fair
57.4	436	38	33	7	32.6	30*	Fair
53.5	866	33	30	10	40.1	36*	Good
45.4	458	40	27	8	38.9	50	Exceptional
37.7	421	31	33	13	38.2	50	Exceptional
27.6	758	34	26	12	41.3	48	Exceptional
5.2	4322	38	46	17	41.3	44	Very Good
<i>Qualitative Evaluation</i>							
<i>Stream</i> River Mile	No. Qual. Taxa	QCTV ^b	Qual. EPT ^a	Relative Density	Predominant Organisms	Narrative Evaluation ^c	
<i>Sugartree Fork</i>							
12.2	61	38.9	20 (6)	Low-Mod.	Caddisflies, mayflies	Exceptional	
<i>Rocky Fork</i>							
5.6	53	38.2	13 (6)	Low-Mod.	Midges	Good	
<i>Yellow Water Creek</i>							
0.8	50	38.2	12 (6)	Low-Mod.	Caddisflies, mayflies	Good	

Table 10. (continued).

<i>Stream</i> River Mile	No. Qual. Taxa	QCTV ^b	<i>Qualitative Evaluation</i>			Predominant Organisms	Narrative Evaluation ^c
			Qual. EPT ^a	Relative Density			
<i>Clear Fork</i> 1.9	62	38.2	17 (6)	Low-Mod.	Caddisflies, mayflies	Good	
<i>Turkey Run</i> 0.9	44	35.0	6 (2)	Low-Mod.	None	Fair	
<i>Beeham Run</i> 1.8	56	39.1	13 (6)	Moderate	Caddisflies, mayflies	Exceptional	
<i>Brushy Fork</i> 3.1	43	37.8	12 (6)	Low	Caddisflies, mayflies	Good	
<i>Christian Run</i> 0.1	27	30.3	3 (0)	Low	Beetles	Poor	
<i>Coon Run</i> 0.8	26	30.1	2 (0)	Low	Fingernail clams, midges	Poor	

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

<u>INDEX</u>	<u>WWH</u>	<u>EWH</u>	<u>MWH^d</u>
ICI	36	46	22

^d - Modified Warmwater Habitat for channel modified areas.

^a EPT= total Ephemeroptera (mayflies), Plecoptera (stoneflies) and Tricoptera (caddisflies) taxa richness; the number in parentheses is the ICI metric 10 score based on that particular number of EPT taxa and the size of the watershed at the sampling location.

^b Qualitative Community Tolerance Value (QCTV) derived as the median of the tolerance values calculated for each qualitative taxon present (see discussion in text).

^c The qualitative narrative evaluation is based on best professional judgement and is used when quantitative data are not available to calculate an Invertebrate Community Index (ICI) score.

* Significant departure from ecoregion biocriteria (>4 ICI units); poor and very poor results are underlined.

^{ns} Nonsignificant departure from biocriterion (< 4 ICI units).

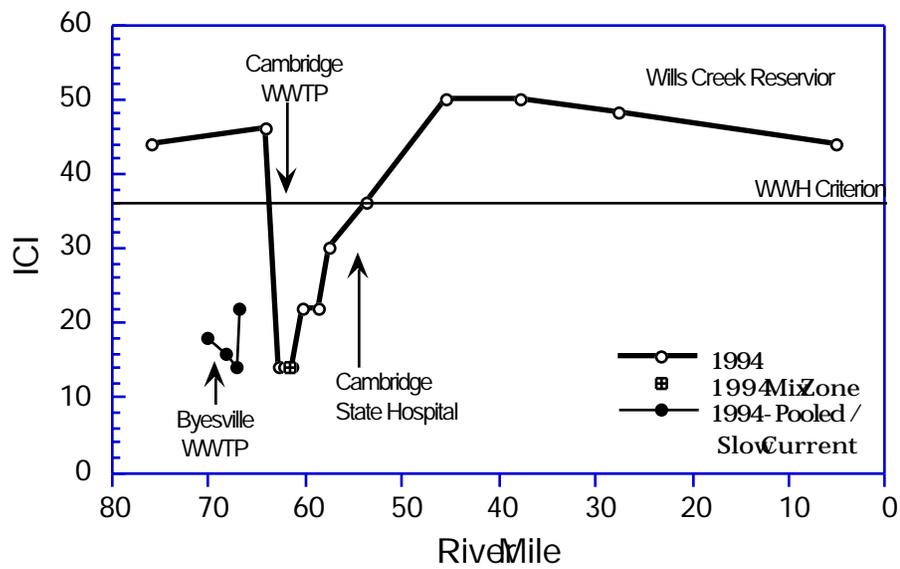


Figure 11. Longitudinal trend of the Invertebrate Community Index (ICI) in the Wills Creek study area, 1994.

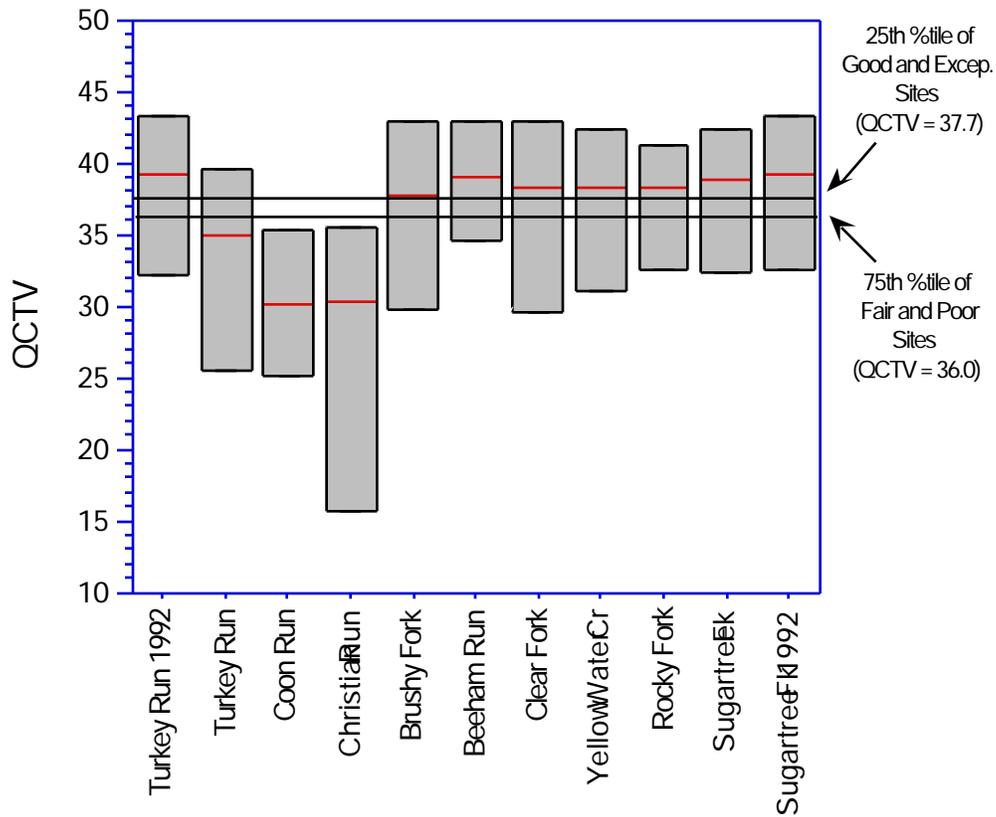


Figure 12. Box plots of the median, upper quartile and lower quartile values for the macroinvertebrate Qualitative Community Tolerance Value (QCTV) at Salt Fork tributary locations, 1994.

Biological Assessment: Fish Community

Wills Creek

- Fish communities in Wills Creek did not achieve the WWH ecoregional biocriteria, as judged by either the IBI or MIwb, for all stations sampled except RM 0.3, where the WWH biocriteria were marginally achieved (Table 11, Figure 13). The mean IBI and MIwb scores of all locations were 28.3 and 7.1, respectively. The impairment across virtually every station is attributed to habitat limitation as indicated by a mean QHEI score of 44.0 for the entire Wills Creek mainstem. The degree of habitat impairment was so severe that fish communities in the few sections of stream with good habitat were not capable of achieving the WWH biocriteria (Figure 14). The correlation between the IBI and QHEI was not significant for Wills Creek, when RM 0.3 was excluded, demonstrating the generalized effect of widespread habitat impairment on the fish community. The site at the mouth of Wills Creek was excluded because of its close proximity to the Muskingum River, and its isolation from the upstream sites by Wills Creek Reservoir (dam at RM 5.3). For the Salt Fork tributary sites, where the effects of habitat on the fish community are presumably localized, a significant correlation between the IBI and QHEI exists (Figure 14). A reduction in the water quality use designation of Wills Creek or its tributaries from WWH to MWH is not warranted, however, because a large source of habitat impairment results from mine drainage and livestock pasturing practices throughout the watershed.
- The composition of the fish fauna in Wills Creek reflected the pervasive degraded habitat conditions instream. Omnivorous and tolerant fishes composed the largest percentages (38.8% and 24.3%, respectively) of the fish fauna at most stations sampled, whereas intolerant species were virtually absent. Omnivores (*i.e.*, generalists) are favored in disturbed environments through loss of habitat heterogeneity, and tolerant fishes can withstand silt, and low dissolved oxygen levels or elevated ammonia-N concentrations. Most other functional components of the fish fauna, though present, were in low relative abundance. Common carp, silver redhorse, channel catfish, quillback carpsucker and golden redhorse comprised nearly 90% of the total weight of fishes sampled. Numerically, spotfin shiner, bluntnose minnow, common carp, gizzard shad and channel catfish were most abundant. Although the condition of the fauna is similar to what one would expect as a result of industrial or organic pollution, it differs in that fish faunas degraded by industrial pollutants or sewage, showing similar IBI and MIwb scores, have greater than 85% of their composition in tolerant individuals and are almost completely lacking other functional components (Ohio EPA 1992b). A list of species collected and their relative abundance at each location in Wills Creek during the 1994 study is compiled in Appendix Table A-4.
- Longitudinal trends in either the IBI or MIwb were not readily apparent. Both indices showed variability for the locations sampled near Byesville and Cambridge (Figure 13), likely due to nonpoint source impacts associated with proximity to urban and residential areas. The lowest IBI score was recorded at a site downstream of a large junkyard and adjacent to a small industrial park in Byesville (RM 70.4). At least seven empty 55 gallon drums were noted in Wills Creek at this sampling site. Community indices at several sites in Wills Creek adjacent to an industrialized area on the northwest side of Cambridge (RM 62.4 - 61.2) were marginally lower than those for sites immediately upstream and downstream. Much trash was observed in the stream and on the banks along this reach, as well as in the Byesville area. Index scores were also lower at RM 57.1 compared with adjacent sites; RM 57.1 is immediately

downstream from large residential complexes on the northeast side of Cambridge.

- The Byesville and Cambridge WWTPs did not appear to impact the fish communities in Wills Creek, as IBI and MIwb scores in the mixing zones and downstream sites did not differ from sites immediately upstream. IBI and MIwb scores for the site in Wills Creek two miles downstream from the Cambridge WWTP were among the highest in the survey. However, given that the pollution and habitat sensitive components of the ambient fish community were lacking, the IBI and MIwb would not have resolved minor impacts associated with those point sources. The mouth of Wills Creek was the only location to achieve the WWH ecoregional biocriteria, though marginally. The physical habitat was capable of fully supporting a WWH community, and the fish community had unrestricted access to the Muskingum River. Wills Creek Reservoir (RM 5.3 to RM 13.0) likely acts as a settling basin for silt, aiding recovery downstream.

Salt Fork Tributaries

- Ten tributaries in the Salt Fork drainage of the Wills Creek watershed were evaluated for impacts associated with nonpoint sources of pollution (Table 11). The fish communities at only three sites met IBI and/or MIwb WWH biocriteria, and one site partially met the WWH biocriteria. IBI scores were in the poor to fair range for the remaining six locations. Index scores closely reflected the severity of habitat and water quality degradation due to nonpoint source impacts (Table 11, Figure 14). The least impacted site, Yellow Water Creek, flowed through forested bottom land, and the IBI score of 50 met the EWH biocriterion. Sugartree Fork had good physical habitat (QHEI = 61.5), but only a fair fish community (IBI = 38). The impaired fish community was associated with cows allowed free access to the stream. In contrast, Clear Fork also had unfenced pasture bordering the stream, but the pasture appeared to be retired or only lightly utilized. The fish community of Clear Fork met the WWH biocriteria during the 1994 survey. Turkey Run was slightly impacted from upstream livestock, but the riparian and adjacent land was wooded, and the fish community marginally achieved WWH biocriteria (IBI = 42). The remaining sites, having a mean IBI score of 34.6, suffered from either unrestricted livestock access (Christian Run, Brushy Fork, Beeham Run) or recent channel modification (Salt Fork, Rocky Fork, Coon Run), demonstrating the widespread problem of nonpoint source impairment throughout the Salt Fork watershed.

Table 11. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in Wills Creek and selected Salt Fork tributaries during July - October, 1994. Additional historical data is presented for Wills Creek and tributaries between 1984 and 1994. The number of samples collected at each location is listed with the sampling method. Relative number and weight are per km for boat sites and per 0.3 km for wading sites. Mixing zone samples are denoted by italics.

<i>Stream</i>	Sampling	Mean #	Total #	Mean	Mean		Mean	Mean	
RM	Method	Species	Species	Relative	Relative	QHEI	Modified	Index of	Narrative
				Number	Weight(kg)		Index of	Biotic	Evaluation
							Well Being	Integrity	
<i>Wills Creek (1994)</i>									
75.7	Boat-2	9.0	12	76	33	36.5	6.7*	29*	Fair
70.4	Boat-3	11.3	18	56	45	39.0	6.5*	22*	Fair/Poor
69.4	Boat-3	10.3	16	72	44	45.0	6.8*	24*	Fair/Poor
67.2	Boat-3	9.7	12	93	49	32.0	5.6*	24*	Poor
66.6	Boat-3	10.3	16	91	58	35.0	7.0*	26*	Fair
64.7	Boat-3	15.3	20	106	44	42.5	7.9*	31*	Fair
62.4	Boat-3	14.0	21	160	47	42.0	6.6*	27*	Fair
61.8	Boat-3	11.7	16	126	67	38.0	6.8*	26*	Fair
61.5 ^{mz}	Boat-3	9.3	15	243	95	53.5	7.5	28	Fair
61.4	Boat-3	13.3	19	174	60	53.5	7.4*	27*	Fair
59.4	Boat-3	15.0	23	146	58	58.5	8.0*	34*	Fair
57.1	Wading-2	16.0	24	538	19	61.0	6.9*	26*	Fair/Poor
53.4	Boat-3	15.0	20	170	70	49.5	8.0*	29*	Fair
46.8	Boat-3	12.3	19	137	51	37.5	7.1*	27*	Fair
38.0	Boat-3	12.0	19	116	36	33.0	7.2*	32*	Fair
27.4	Boat-3	12.0	19	108	51	35.5	6.7*	29*	Fair
0.3	Boat-3	22.7	28	363	101	63.5	8.1 ^{ns}	39 ^{ns}	M.Good
<i>Wills Creek (1988)</i>									
0.3	Boat-2	26.0	32	958	108	72	8.9	44	Good/V.Good
<i>Wills Creek (1984)</i>									
75.9	Boat-3	18.0	26	158	49	50	7.7*	33*	Fair
74.0	Boat-3	11.0	20	88	35	35	5.8*	24*	Poor
68.1	Boat-3	10.3	18	88	57	41	5.3*	22*	Poor
66.5	Boat-3	14.0	20	315	48	33	7.0*	29*	Fair
65.3	Boat-3	15.3	21	206	56	39	6.4*	28*	Fair
62.4	Boat-3	16.0	26	151	49	49	6.9*	27*	Fair
61.8	Boat-3	10.3	18	158	137	51	5.7*	22*	Poor
60.7	Boat-3	14.7	22	246	108	49	7.7*	25*	Fair/Poor
58.4	Boat-3	10.7	18	92	27	37	6.3*	24*	Poor
56.4	Boat-3	16.3	25	212	96	42	6.6*	26*	Fair
53.5	Boat-3	16.7	23	302	77	52	7.8*	29*	Fair
46.6	Boat-3	11.3	19	260	30	42	6.2*	26*	Poor/Fair
37.7	Boat-2	13.0	18	184	38	39	6.5*	28*	Fair
27.0	Boat-2	11.5	14	129	60	37	5.8*	26*	Poor/Fair

Table 1. Continued.

<i>Stream</i> RM	Sampling Method	Mean # Species	Total # Species	Mean Relative Number	Mean Relative Weight(kg)	QHEI	Mean Modified Index of Well Being	Mean Index of Biotic Integrity	Narrative Evaluation
<i>Salt Fork (1994)</i>									
20.8	Wading-1	25	25	788	58	41	7.9 ^{ns}	34*	M.Good/Fair
<i>Sugartree Fork (1994)</i>									
12.2	Wading-1	22	22	3,452	14	61	NA	38*	Fair
<i>Sugartree Fork (1993)</i>									
12.2	Wading-1	22	22	1,186	22	-	NA	36*	Fair
<i>Sugartree Fork (1992)</i>									
12.2	Wading-2	19	21	629	22	79	NA	30*	Fair
<i>Rocky Fork (1994)</i>									
5.6	Wading-1	18	18	1,479	6	44	NA	34*	Fair
<i>Yellow Water Creek (1994)</i>									
0.8	Wading-1	21	21	2,320	10	55	NA	50	Exceptional
<i>Clear Fork (1994)</i>									
1.95	Wading-1	21	21	3,551	18	47	NA	44	Good
<i>Turkey Run (1994)</i>									
0.6	Wading-1	13	13	2,512	8	59	NA	42 ^{ns}	M.Good
<i>Turkey Run (1993)</i>									
0.6	Wading-1	13	13	2,788	7	-	NA	44	Good
<i>Turkey Run (1992)</i>									
0.6	Wading-2	15	17	1,123	5	71	NA	44	Good
<i>Beeham Run (1994)</i>									
1.7	Wading-1	11	11	2,076	3	46	NA	38*	Fair
<i>Brushy Fork (1994)</i>									
3.4	Wading-1	23	23	2,922	23	36	6.2*	30*	Fair

Table 11. Continued.

<i>Stream</i> RM	Sampling Method	Mean # Species	Total # Species	Mean Relative Number	Mean Relative Weight(kg)	QHEI	Mean Modified Index of Well Being	Mean Index of Biotic Integrity	Narrative Evaluation
<i>Christian Run (1994)</i>									
0.1	Wading-1	8	8	844	2	25	NA	36*	Fair
<i>Coon Run (1994)</i>									
0.85	Wading-1	11	11	818	2	39	NA	32*	Fair

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)

<u>INDEX - Site Type</u>	<u>WWH</u>	<u>EWB</u>	<u>MWH^a</u>
IBI - Headwaters/Wading	44	50	24/24
IBI - Boat .	40	48	24/24
Mod. Iwb - Wading	8.4	9.4	6.2/5.5
Mod. Iwb - Boat	8.6	9.6	5.8/5.4

* - significant departure from ecoregion biocriteria; poor and very poor results are underlined.

^{ns} - nonsignificant departure from ecoregion biocriteria for WWH (4 IBI or ICI units; 0.5 MIwb units).

NA -Not applicable.

^a - Modified Warmwater Habitat for channel modified areas/ mine affected areas.

mz-Mixing zone.

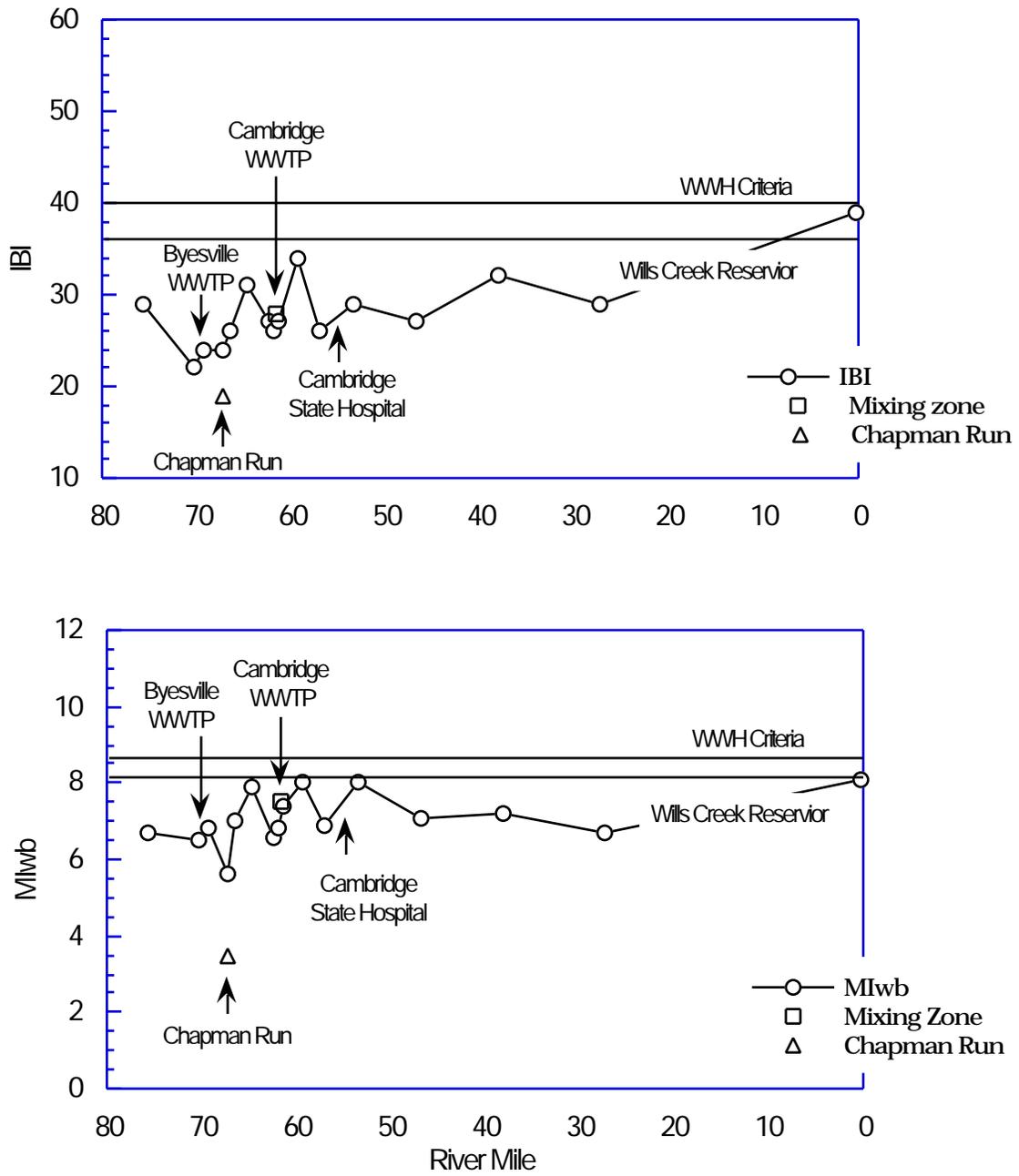


Figure 13. Longitudinal trends in fish community performance for Wills Creek based on the Index of Biotic Integrity (IBI, top) and the Modified Index of Well-being (MIwb, bottom).

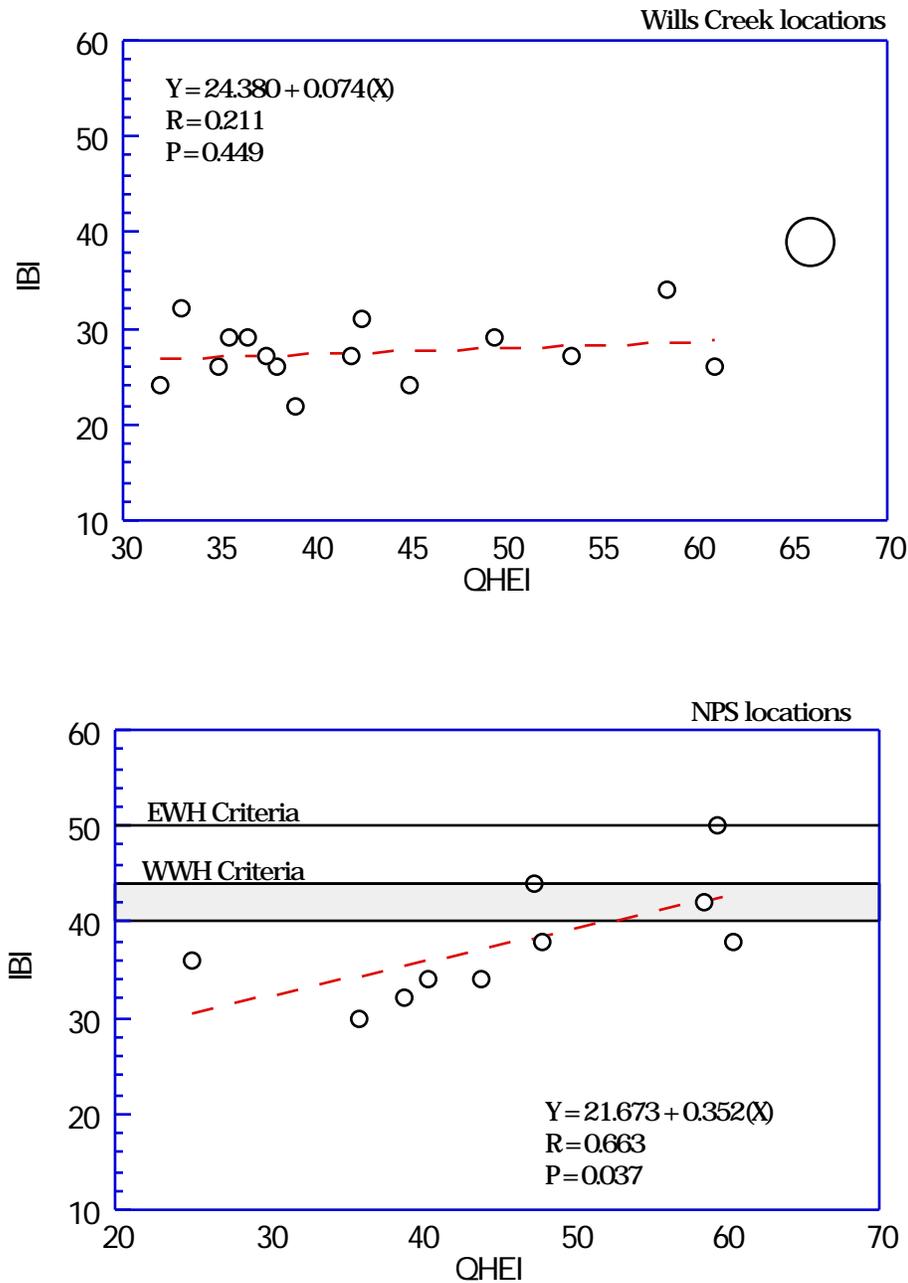


Figure 14. Plots of IBI scores against corresponding QHEI scores for Wills Creek (top) and the nonpoint source (NPS) locations in the Salt Fork drainage. The large circle in the Wills Creek plot is for the location at RM 0.3. It was not included in the regression given the magnitude of its leverage as indicated by the size of the circle.

TREND ASSESSMENT

Chemical Water Quality Changes: 1984 - 1994

- Surface water chemical results for Wills Creek were compared from surveys conducted during 1984 and 1994. Results for specific nutrient, bacterial and mine drainage/parent soil parameters are depicted in Figures 15 and 16.
- Due to upgrades at the Cambridge WWTP, a significant change in the concentrations of ammonia-N has occurred in Wills Creek. Influent entering the Cambridge WWTP is characteristically high in ammonia-N, which is known to be toxic to aquatic life at low concentrations. By increasing aeration and retention time, aerobic bacteria can more efficiently convert ammonia-N to nitrite-N and then nitrate-N. This increase in nitrification has reduced mean ammonia-N concentrations in Wills Creek between 1984 and 1994. The mean ammonia-N concentration at RM 60.06 (old abandoned railroad bridge), downstream from the Cambridge WWTP, has decreased from 0.85 mg/l in 1984 to 0.11 mg/l in 1994. A corresponding increase in nitrate+nitrite-N concentrations occurred in Wills Creek during 1994 downstream from the Cambridge WWTP. However, the 1994 base levels of nitrate+nitrite-N were lower than the 1984 levels. The higher base levels of nitrate+nitrite-N in Wills Creek during 1984 correspond with elevated levels in Buffalo Fork, an upstream tributary to Wills Creek. The higher nitrate+nitrite-N concentrations in Buffalo Fork during 1984 appeared associated with strip mine reclamation activity, which included application of fertilizer containing nitrogen. The lower base levels of nitrate+nitrite-N in Wills Creek during 1994 corresponded with the discontinued use of fertilizer at established reclamation projects in the Buffalo Fork drainage.
- A substantial decline in mean total phosphorus concentrations occurred in Wills Creek downstream from the Cambridge WWTP between 1984 and 1994 (Figure 16). This corresponded to a decline in total phosphorus levels in the Cambridge WWTP effluent recorded by Ohio EPA during the 1984 (mean = 3.87 mg/l) and 1994 (mean = 1.63 mg/l) surveys.
- Bacteriological sampling conducted during 1984 and 1994 indicated that fecal contamination continues to occur in Wills Creek within the Cambridge area. The highest levels of fecal coliform in Wills Creek during the 1994 survey were measured at RMs 61.6 and 62.6, upstream from the Cambridge WWTP, and suggested contamination from sewer line breaks or lift station overflows. During the 1984 survey, a sewer line break was discovered on a small urban stream which flows into Wills Creek at RM 62.2.
- Trends in four parameters associated with mine drainage impacts are depicted in Figure 15. No apparent trend was observed in total sulfate and total dissolved solids concentrations between data collected in 1984 and 1994. Results for both parameters during 1984 and 1994 revealed that the highest levels were documented in the upper section of Wills Creek, where the headwater tributaries (Buffalo Fork, Buffalo Creek and Seneca Fork) have had extensive strip mine and underground mine activity. Iron and aluminum concentrations were substantially higher in Wills Creek during the 1994 survey, compared with data collected during 1984. At least part of the cause of the elevated levels of iron and aluminum were associated with higher concentrations of total suspended solids in Wills Creek during 1994. During 1994, the highest mean total suspended solids concentration in Wills Creek was observed at RM 70.9. This particular location also had the highest mean levels of iron and aluminum (Figure 15).

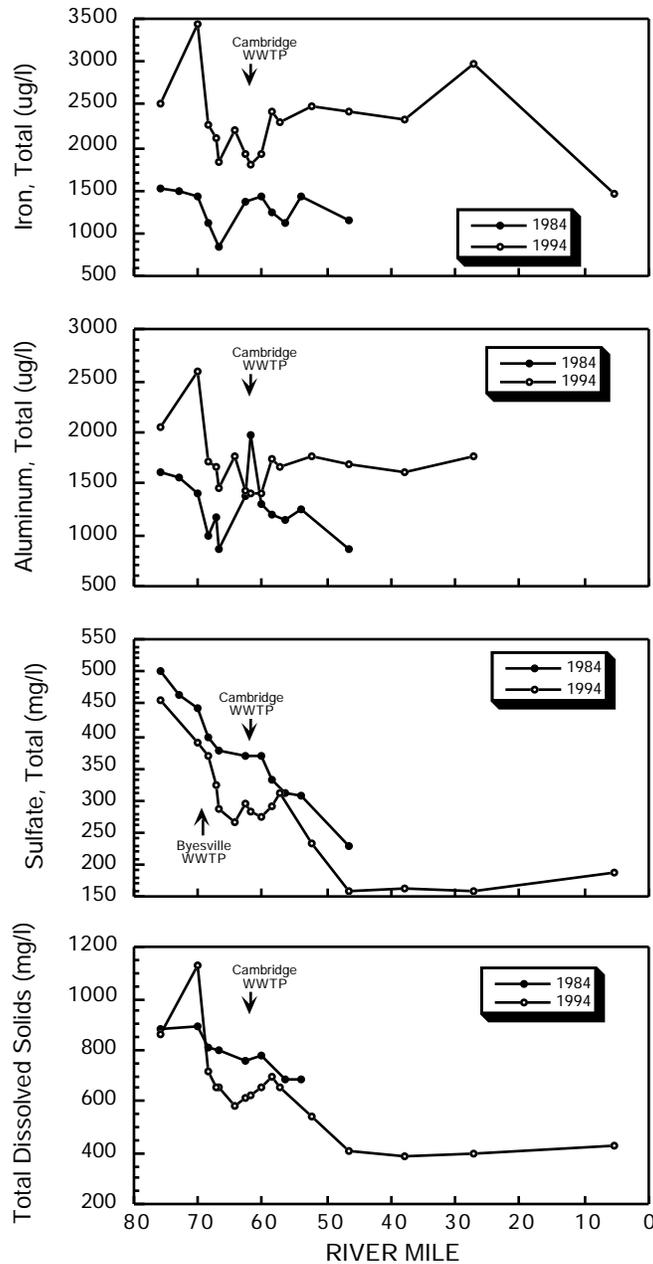


Figure 15. Longitudinal trend of manganese, sulfate, iron and total dissolved solids in Wills Creek, 1984 and 1994. Plotted values are mean concentrations by sampling location.

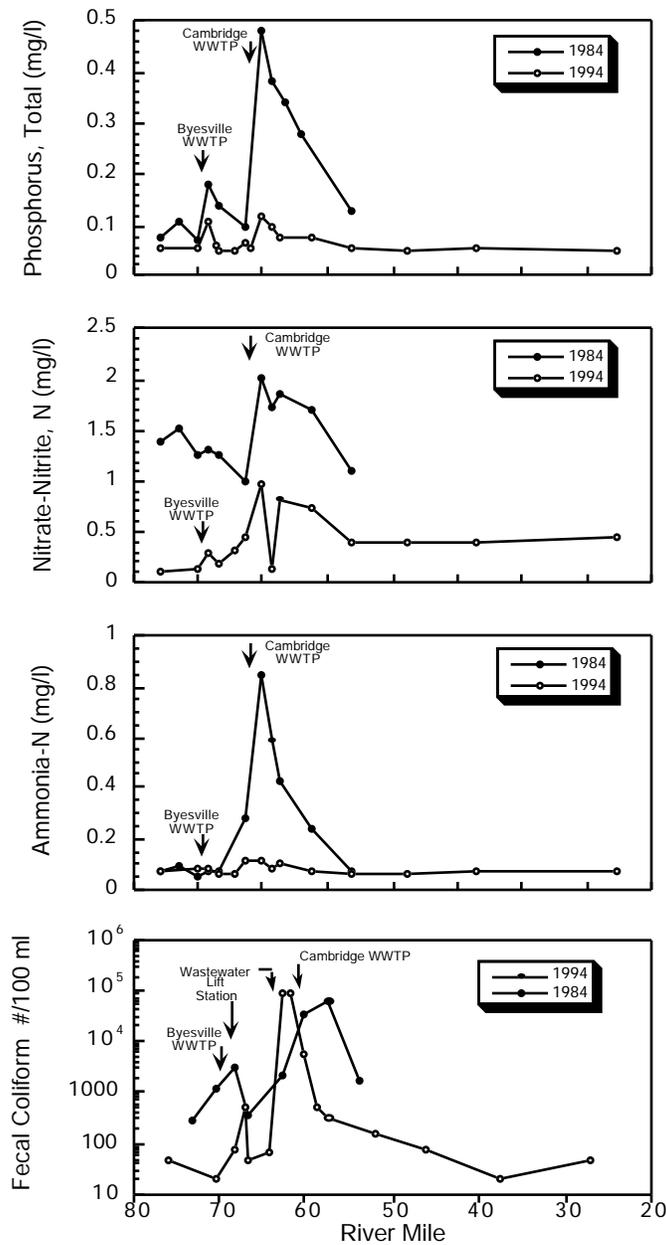


Figure 16. Longitudinal trend of ammonia-nitrogen, nitrate-nitrite nitrogen, total phosphorus, and fecal coliform in Wills Creek, 1984 and 1994. Plotted values are mean concentrations by sampling location (only one fecal coliform sample was collected per sampling location during the 1994 survey).

Changes in Biological Community Performance: 1984 - 1994

Macroinvertebrate Community Trends

- Macroinvertebrates from the upper half of the Wills Creek mainstem were sampled in 1984 and 1994 between RMs 74.8 and 45. However, defining clear trends in community health was difficult due to differences in sampling locations, habitat types, or current velocities from site to site or between surveys. For these reasons, trends plotted in Figure 17 are limited to selected stations between RMs 75.8 and 53.5 which were either comparable in habitat type or sampling location.
- Between 1984 and 1994, ICI scores improved from fair to very good at RM 75.8, upstream from all point source dischargers. However, communities collected from the natural substrates were very similar between surveys based on the relatively low numbers of EPT taxa and nearly identical QCTV scores (Figure 17). Results suggested improved water quality but more persistent problems with sedimentation from nonpoint sources in the upper watershed.
- Communities downstream from Byesville at RM 68.1 and Chapman Run at RM 66.7 indicated little change in communities since 1984. Impounded habitat and lack of current appeared to be the overriding influences on samples from RM 68.1. Slow current velocities may have also factored into the low ICI scores from the tailwaters of the lowhead dam at RM 66.7 during both surveys. However, the overall results reflected enriched conditions and continued fair water quality. A sharp increase in the QCTV in 1994 was considered an anomaly in the data and not indicative of significant change. The number of Qual. EPT taxa (3 and 4) were nearly identical between surveys and both totals were well below ecoregional expectations.
- A 1994 station at Campbell Ave. (RM 64.1) showed significant improvement immediately upstream from Cambridge (ICI = 46) but the site was not sampled in 1984. In 1994, community health declined sharply upstream from the Cambridge WWTP at Stubenville Road (RM 62.7). A similar trend was not well represented by the 1984 results which were fair throughout the Byesville to Cambridge area. This was possibly due to variation in sampling locations between surveys and the sluggish current velocities at some of the 1984 sites. The most recent survey indicated more severe impacts in the Cambridge area than were observed in 1984 and pinpointed the initial source of impact between RMs 64.1 and 62.7. The Cambridge sewer system is a suspected source based on similarities in community responses upstream and downstream from the Cambridge WWTP and a history of problems with broken sewer lines and pump station overflows in the Cambridge area. During both surveys, the potential influence of the Cambridge WWTP 001 discharge was largely masked by the already degraded condition of Wills Creek.
- Both 1984 and 1994 surveys showed improvement in macroinvertebrate community health with increased distance downstream from Cambridge. ICI scores during both years reached marginally good levels by RM 53.5, downstream from the Cambridge State Hospital. Further downstream, portions of the lower mainstem which were not sampled in 1984 reached exceptional levels in 1994.

Fish Community Trends

- Wills Creek was surveyed from RMs 75.9 to 27.0 in 1984 and at RM 0.3 in 1988. No significant changes in the performance of the fish community in Wills Creek were observed between the 1984 and 1994 surveys. The entire area of the common reach surveyed in 1984 and 1994 did not meet established fish biocriteria (Table 12). IBI and MIwb scores at the same locations were nearly identical between surveys, showing the same pattern of fluctuations (Figure 18). One possible exception was in the area downstream from the Cambridge WWTP. IBI scores in 1994 were slightly improved near the plant, and considerably improved at the next downstream site (RM 59.4), suggesting some improvement in WWTP effluent discharge. Area of Degradation Values (ADV) in the poor to very poor range decreased between 1984 and 1994, evidence of improved plant performance.
- Underregulated or unidentified industrial point sources, CSOs, nonpoint source pollution, and habitat modification are the major causes for continuing impairment of Ohio streams (OEPA 1992). The fair to poor performance of the fish community in Wills Creek illustrated the persistent nature of nonpoint source pollution from abandoned mines and livestock, and the chronic effect of instream habitat modification.

Table 12. Area of Degradation (ADV) statistics for the Wills Creek study area, 1984 and 1994 (calculated using ecoregion biocriteria as the background community performance).

<i>Stream Index</i>	<u>Biological Index Scores</u>				<u>ADV Statistics</u>			<u>Attainment Status (miles)</u>			
	Upper RM	Lower RM	Mini-mum	Maxi-mum	ADV	ADV/ Mile	Poor/VP ADV	FULL	PARTIAL	NON	Poor/VP
<i>Wills Creek (1984)</i>											
IBI			22	33	4756	96.1	167				
MIwb	75.9	27.0	5.3	7.8	4150	83.8	76	0.0	2.0	47.5	12.3
ICI			14	34	2078	42.0	0				
<i>Wills Creek (1994)</i>											
IBI			22	34	3854	78.6	83				
MIwb	75.9	27.4	5.5	8.1	2390	48.8	7	0.0	33.2	15.8	8.2
ICI			14	50	1530	31.2	0				

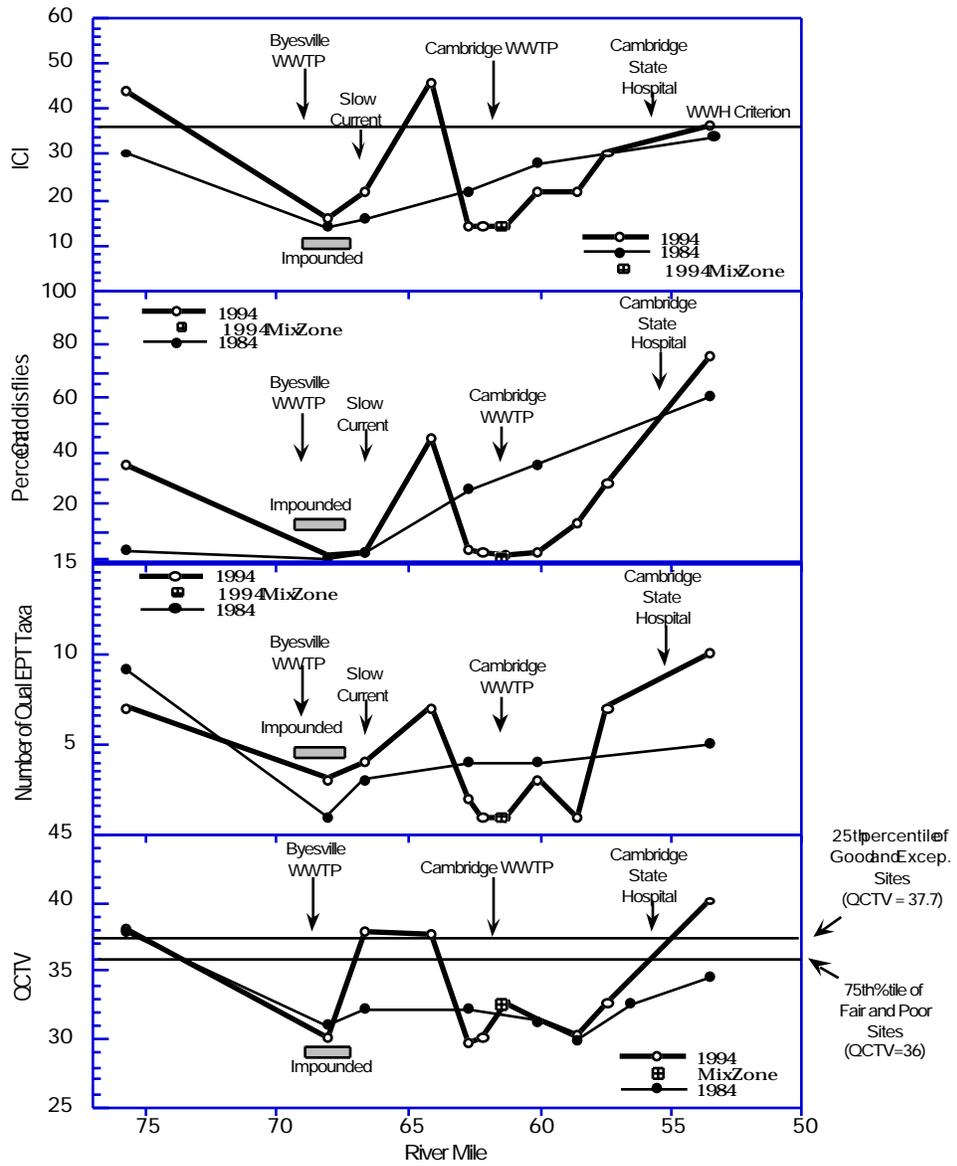


Figure 17. Longitudinal trends in the ICI, percent caddisfly abundance, Qualitative EPT taxa richness and QCTV in the upper reaches of Wills Creek, 1984 - 1994.

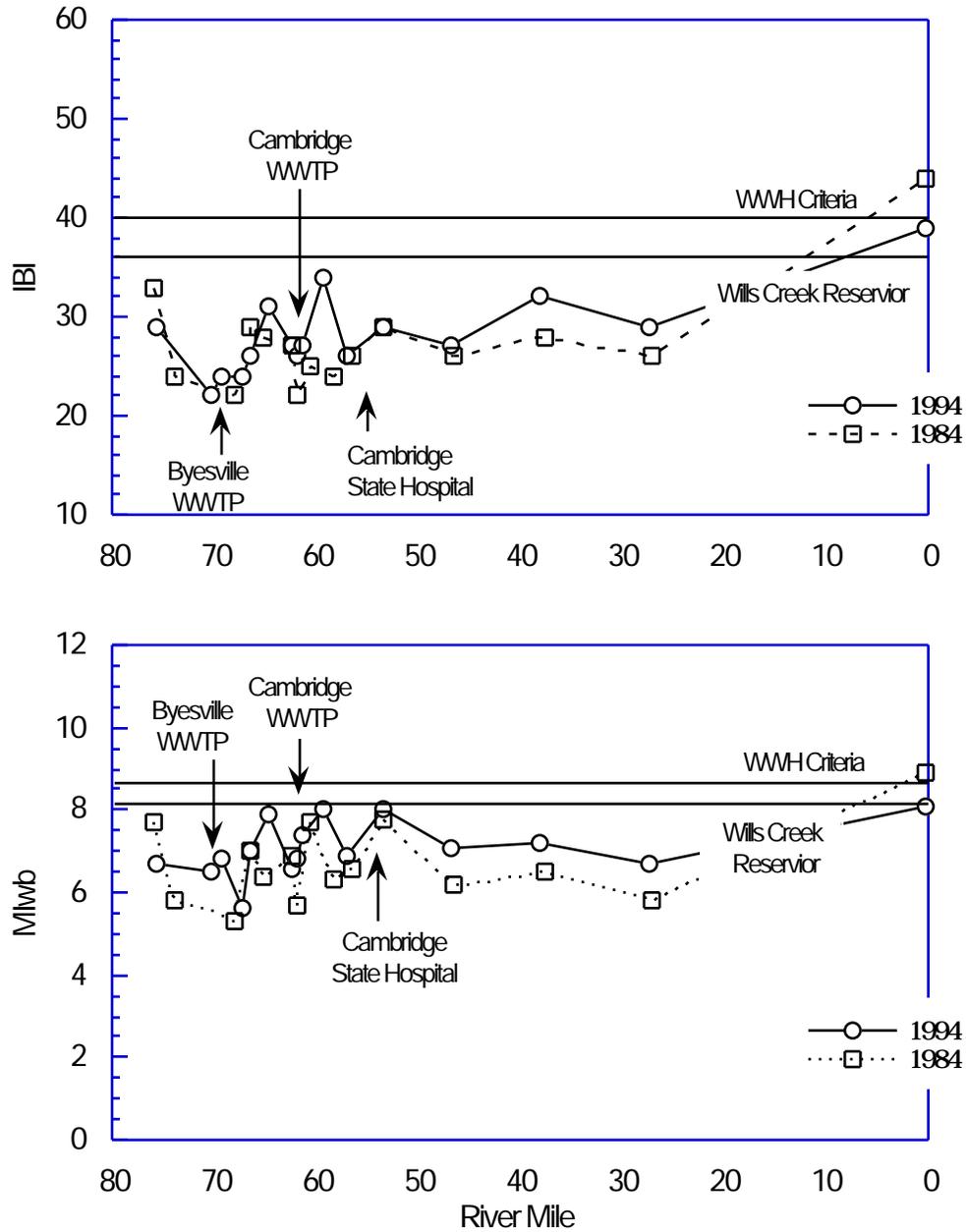


Figure 18. Longitudinal comparison of community indices (IBI top, MIwb bottom) for Wills Creek measured in 1984, 1988 and 1994 surveys. The mouth of Wills Creek (RM 0.3) was previously sampled only in 1988 but is included with the 1984 data points for visual continuity.

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APPENDIX TABLES

APPENDIX TABLE A-1
Chemical/physical water quality results
Data available upon request

APPENDIX TABLE A-2

Macroinvertebrate collection summary by river mile (RM) from the Wills Creek study area, 1994

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 75.80 **5**

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	8			
03360	<i>Plumatella sp</i>	0 +	No. Quantitative Taxa:	27	Total Taxa: 40
03600	<i>Oligochaeta</i>	2	No. Qualitative Taxa:	28	ICI: 44
06201	<i>Hyalella azteca</i>	0 +	Number of Organisms:	2800	Qual EPT: 7
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +			
11130	<i>Baetis intercalaris</i>	1123 +			
16700	<i>Tricorythodes sp</i>	20 +			
17200	<i>Caenis sp</i>	0 +			
18700	<i>Hexagenia sp</i>	0 +			
13400	<i>Stenacron sp</i>	58			
13570	<i>Stenonema terminatum</i>	2			
22300	<i>Argia sp</i>	14 +			
45100	<i>Palmacorixa sp</i>	0 +			
45400	<i>Trichocorixa sp</i>	0 +			
48410	<i>Corydalis cornutus</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	672 +			
52570	<i>Hydropsyche (H.) simulans</i>	304 +			
51206	<i>Cyrnellus fraternus</i>	3 +			
51300	<i>Neureclipsis sp</i>	5			
52560	<i>Hydropsyche (H.) orris</i>	3			
69400	<i>Stenelmis sp</i>	33 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
68901	<i>Macronychus glabratus</i>	3			
72700	<i>Anopheles sp</i>	0 +			
74100	<i>Simulium sp</i>	1			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	45 +			
78450	<i>Nilotanytus fimbriatus</i>	33			
80410	<i>Cricotopus (C.) sp</i>	4 +			
80420	<i>Cricotopus (C.) bicinctus</i>	9 +			
81231	<i>Nanocladius (N.) crassicornus or N. (N.)</i>	4 +			
80430	<i>Cricotopus (C.) tremulus group</i>	4 +			
82141	<i>Thienemanniella xena</i>	4 +			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	45			
80370	<i>Corynoneura lobata</i>	150			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	9 +			
85625	<i>Rheotanytarsus exiguus group</i>	222 +			
96900	<i>Ferrissia sp</i>	20			
98600	<i>Sphaerium sp</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 70.20 0

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	17	97601	<i>Corbicula fluminea</i>	0 +
03360	<i>Plumatella sp</i>	0 +	96900	<i>Ferrissia sp</i>	19
03451	<i>Urnatella gracilis</i>	0 +	95100	<i>Physella sp</i>	5
03600	<i>Oligochaeta</i>	70 +	98200	<i>Pisidium sp</i>	1
06201	<i>Hyalella azteca</i>	1 +			
08260	<i>Orconectes (Crokerinus) sanbornii</i>	0 +	No. Quantitative Taxa: 33		Total Taxa: 45
13400	<i>Stenacron sp</i>	0 +	No. Qualitative Taxa: 21		ICI: 18
18700	<i>Hexagenia sp</i>	0 +	Number of Organisms: 236		Qual EPT: 3
11670	<i>Procloeon irrubrum</i>	0 +			
17200	<i>Caenis sp</i>	2			
11200	<i>Callibaetis sp</i>	1			
22300	<i>Argia sp</i>	13 +			
22001	<i>Coenagrionidae</i>	0 +			
45100	<i>Palmacorixa sp</i>	0 +			
45300	<i>Sigara sp</i>	0 +			
57900	<i>Pycnopsyche sp</i>	1			
68708	<i>Dubiraphia vittata group</i>	6 +			
74501	<i>Ceratopogonidae</i>	5 +			
77120	<i>Ablabesmyia mallochi</i>	1 +			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	0 +			
78650	<i>Procladius sp</i>	6 +			
78401	<i>Natarsia species A (sensu Roback, 1978)</i>	1			
77115	<i>Ablabesmyia janta</i>	1			
80370	<i>Corynoneura lobata</i>	1			
81631	<i>Parakiefferiella n.sp 1</i>	0 +			
82820	<i>Cryptochironomus sp</i>	1			
82880	<i>Cryptotendipes sp</i>	1			
82730	<i>Chironomus (C.) decorus group</i>	2			
83051	<i>Dicrotendipes simpsoni</i>	1 +			
83003	<i>Dicrotendipes fumidus</i>	1			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	14 +			
84800	<i>Tribelos jucundum</i>	33			
83002	<i>Dicrotendipes modestus</i>	2			
84470	<i>Polypedilum (P.) illinoense</i>	1			
84460	<i>Polypedilum (P.) fallax group</i>	2			
84520	<i>Polypedilum (Tripodura) halterale group</i>	7			
84790	<i>Tribelos fuscicorne</i>	15			
84201	<i>Paratendipes subaequalis</i>	1			
85500	<i>Paratanytarsus sp</i>	2			
85840	<i>Tanytarsus guerlus group</i>	1			
85800	<i>Tanytarsus sp</i>	1			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 68.10 **8**

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	20			
01801	<i>Turbellaria</i>	2	No. Quantitative Taxa:	24	Total Taxa: 40
03600	<i>Oligochaeta</i>	103	No. Qualitative Taxa:	25	ICI: 16
06201	<i>Hyalella azteca</i>	1 +	Number of Organisms:	950	Qual EPT: 3
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +			
17200	<i>Caenis sp</i>	9 +			
18704	<i>Hexagenia atrocaudata</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	23 +			
42700	<i>Belostoma sp</i>	0 +			
45100	<i>Palmacorixa sp</i>	0 +			
43570	<i>Neoplea sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
51206	<i>Cynellus fraternus</i>	7			
59500	<i>Oecetis sp</i>	0 +			
68601	<i>Ancyronyx variegata</i>	1 +			
68708	<i>Dubiraphia vittata group</i>	2 +			
69400	<i>Stenelmis sp</i>	0 +			
77115	<i>Ablabesmyia janta</i>	7			
77120	<i>Ablabesmyia mallochi</i>	7			
77130	<i>Ablabesmyia rhamphe group</i>	7			
77140	<i>Ablabesmyia peleensis</i>	0 +			
78650	<i>Procladius sp</i>	14 +			
80370	<i>Corynoneura lobata</i>	2			
82600	<i>Axarus sp</i>	0 +			
82730	<i>Chironomus (C.) decorus group</i>	7			
83050	<i>Dicrotendipes lucifer</i>	14			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	259 +			
83410	<i>Harnischia curtilamellata</i>	0 +			
84020	<i>Parachironomus carinatus</i>	14			
84315	<i>Phaenopsectra flavipes</i>	7			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	14			
84790	<i>Tribelos fuscicorne</i>	357 +			
84800	<i>Tribelos jucundum</i>	56			
85500	<i>Paratanytarsus sp</i>	14			
85800	<i>Tanytarsus sp</i>	0 +			
95100	<i>Physella sp</i>	0 +			
96900	<i>Ferrissia sp</i>	3 +			
96120	<i>Menetus (Micromenetus) dilatatus</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/21/94 River Code: 17-800 River: Wills Creek

RM: 67.20 7

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	74 +			
06201	<i>Hyalella azteca</i>	1 +			
08260	<i>Orconectes (Crockerinus) sanbornii</i>	1 +			
17200	<i>Caenis sp</i>	13			
22001	<i>Coenagrionidae</i>	1 +			
22300	<i>Argia sp</i>	11 +			
45100	<i>Palmacorixa sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
51206	<i>Cyrnellus fraternus</i>	1			
68708	<i>Dubiraphia vittata group</i>	0 +			
78130	<i>Labrundinia neopilosella</i>	2			
78650	<i>Procladius sp</i>	12			
80370	<i>Corynoneura lobata</i>	3			
80420	<i>Cricotopus (C.) bicinctus</i>	2			
82730	<i>Chironomus (C.) decorus group</i>	2			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	76			
84460	<i>Polypedilum (P.) fallax group</i>	2			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	2			
84790	<i>Tribelos fuscicorne</i>	68			
84800	<i>Tribelos jucundum</i>	26			
85814	<i>Tanytarsus glabrescens group</i>	2			
96900	<i>Ferrissia sp</i>	5			
98600	<i>Sphaerium sp</i>	0 +			

No. Quantitative Taxa: 19 Total Taxa: 23
 No. Qualitative Taxa: 9 ICI: 14
 Number of Organisms: 304 Qual EPT: 0

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 66.70 **6**

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	8	84020	<i>Parachironomus carinatus</i>	26
01801	<i>Turbellaria</i>	2708 +	84700	<i>Stenochironomus sp</i>	13
03451	<i>Urnatella gracilis</i>	8	84790	<i>Tribelos fuscicorne</i>	145
03360	<i>Plumatella sp</i>	1 +	85500	<i>Paratanytarsus sp</i>	13
03040	<i>Fredericella sp</i>	0 +	85625	<i>Rheotanytarsus exiguus group</i>	26 +
03600	<i>Oligochaeta</i>	530 +	85814	<i>Tanytarsus glabrescens group</i>	66
06201	<i>Hyalella azteca</i>	2	87540	<i>Hemerodromia sp</i>	64
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	98600	<i>Sphaerium sp</i>	69 +
07860	<i>Cambarus (Puncticambarus) robustus</i>	0 +	97601	<i>Corbicula fluminea</i>	8 +
17200	<i>Caenis sp</i>	104 +	95100	<i>Physella sp</i>	17
22300	<i>Argia sp</i>	23 +			
44501	<i>Corixidae</i>	0 +	No. Quantitative Taxa: 42		Total Taxa: 51
47600	<i>Sialis sp</i>	1	No. Qualitative Taxa: 25		ICI: 22
52200	<i>Cheumatopsyche sp</i>	62 +	Number of Organisms: 4906		Qual EPT: 4
52530	<i>Hydropsyche (H.) depravata group</i>	0 +			
52570	<i>Hydropsyche (H.) simulans</i>	0 +			
51206	<i>Cyrnellus fraternus</i>	24			
53501	<i>Hydroptilidae</i>	8			
69400	<i>Stenelmis sp</i>	16 +			
68901	<i>Macronychus glabratus</i>	24 +			
68708	<i>Dubiraphia vittata group</i>	2			
71900	<i>Tipula sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
77130	<i>Ablabesmyia rhamphe group</i>	26			
77120	<i>Ablabesmyia mallochi</i>	26			
77001	<i>Tanypodinae</i>	26			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	105			
80370	<i>Corynoneura lobata</i>	16			
80430	<i>Cricotopus (C.) tremulus group</i>	40			
80410	<i>Cricotopus (C.) sp</i>	119 +			
80420	<i>Cricotopus (C.) bicinctus</i>	66 +			
81632	<i>Parakiefferiella n.sp 2</i>	13 +			
81231	<i>Nanocladius (N.) crassicornus or N. (N.)</i>	40			
81240	<i>Nanocladius (N.) distinctus</i>	13			
81631	<i>Parakiefferiella n.sp 1</i>	26			
83040	<i>Dicrotendipes neomodestus</i>	66 +			
83050	<i>Dicrotendipes lucifer</i>	40			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	264			
84450	<i>Polypedilum (P.) convictum</i>	26 +			
84800	<i>Tribelos jucundum</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	26			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 64.10 4

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01200	<i>Cordylophora lacustris</i>	1	83050	<i>Dicrotendipes lucifer</i>	3
03360	<i>Plumatella sp</i>	1 +	81240	<i>Nanocladius (N.) distinctus</i>	5
03600	<i>Oligochaeta</i>	0 +	81231	<i>Nanocladius (N.) crassicornus or N. (N.)</i>	11
06201	<i>Hyalella azteca</i>	1 +	85800	<i>Tanytarsus sp</i>	11
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	85625	<i>Rheotanytarsus exiguus group</i>	70
05800	<i>Caecidotea sp</i>	1	85814	<i>Tanytarsus glabrescens group</i>	3
08601	<i>Hydracarina</i>	3	95100	<i>Physella sp</i>	0 +
17200	<i>Caenis sp</i>	26 +	96120	<i>Menetus (Micromenetus) dilatatus</i>	0 +
11130	<i>Baetis intercalaris</i>	332 +	96900	<i>Ferrissia sp</i>	11
15000	<i>Paraleptophlebia sp</i>	3 +	01320	<i>Hydra sp</i>	15
13400	<i>Stenacron sp</i>	297 +			
13561	<i>Stenonema pulchellum</i>	0 +	No. Quantitative Taxa: 38		Total Taxa: 51
16700	<i>Tricorythodes sp</i>	2	No. Qualitative Taxa: 29		ICI: 46
22300	<i>Argia sp</i>	9 +	Number of Organisms: 1897		Qual EPT: 7
22001	<i>Coenagrionidae</i>	0 +			
45100	<i>Palmarcorixa sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
48410	<i>Corydalus cornutus</i>	0 +			
52560	<i>Hydropsyche (H.) orris</i>	80 +			
52200	<i>Cheumatopsyche sp</i>	675 +			
51300	<i>Neureclipsis sp</i>	6			
51206	<i>Cynellus fraternus</i>	23			
52570	<i>Hydropsyche (H.) simulans</i>	66			
68901	<i>Macronychus glabratus</i>	9 +			
69400	<i>Stenelmis sp</i>	2 +			
68708	<i>Dubiraphia vittata group</i>	1 +			
60350	<i>Gyretes sp</i>	0 +			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	21 +			
77500	<i>Conchapelopia sp</i>	35 +			
77120	<i>Ablabesmyia mallochi</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	32 +			
84040	<i>Parachironomus frequens</i>	0 +			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	5 +			
81201	<i>Nanocladius (N.) sp</i>	0 +			
80370	<i>Corynoneura lobata</i>	83			
84790	<i>Tribelos fuscicorne</i>	16			
84460	<i>Polypedilum (P.) fallax group</i>	19			
84800	<i>Tribelos jucundum</i>	5			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	3			
80490	<i>Cricotopus (Isocladius) intersectus group</i>	3			
80420	<i>Cricotopus (C.) bicinctus</i>	8			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 62.70 2

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	11 +			
03360	<i>Plumatella sp</i>	1 +			
03600	<i>Oligochaeta</i>	45 +			
08260	<i>Orconectes (Crokerinus) sanbornii</i>	0 +			
17200	<i>Caenis sp</i>	0 +			
11130	<i>Baetis intercalaris</i>	1			
22300	<i>Argia sp</i>	1 +			
47600	<i>Sialis sp</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	16 +			
69400	<i>Stenelmis sp</i>	4 +			
63900	<i>Laccophilus sp</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	191 +			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	128 +			
82730	<i>Chironomus (C.) decorus group</i>	0 +			
77120	<i>Ablabesmyia mallochi</i>	0 +			
84800	<i>Tribelos jucundum</i>	0 +			
83040	<i>Dicrotendipes neomodestus</i>	8 +			
77130	<i>Ablabesmyia rhamphe group</i>	0 +			
84790	<i>Tribelos fuscicorne</i>	4 +			
84315	<i>Phaenopsectra flavipes</i>	0 +			
84520	<i>Polypedilum (Tripodura) halterale group</i>	0 +			
84155	<i>Paralauterborniella nigrohalteralis</i>	0 +			
84460	<i>Polypedilum (P.) fallax group</i>	13			
83050	<i>Dicrotendipes lucifer</i>	21			
84450	<i>Polypedilum (P.) convictum</i>	8			
80410	<i>Cricotopus (C.) sp</i>	8			
77500	<i>Conchapelopia sp</i>	8			
80420	<i>Cricotopus (C.) bicinctus</i>	17			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	4			
82141	<i>Thienemanniella xena</i>	3			
85814	<i>Tanytarsus glabrescens group</i>	13			
96900	<i>Ferrissia sp</i>	0 +			
98600	<i>Sphaerium sp</i>	0 +			

No. Quantitative Taxa: 20 Total Taxa: 33
 No. Qualitative Taxa: 23 ICI: 14
 Number of Organisms: 505 Qual EPT: 2

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/21/94 River Code: 17-800 River: Wills Creek

RM: 62.20 2

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	42 +			
03360	<i>Plumatella sp</i>	1 +			
03600	<i>Oligochaeta</i>	582 +			
04901	<i>Erpobdellidae</i>	0 +			
04975	<i>Mooreobdella poss. tetragon</i>	2			
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +			
22300	<i>Argia sp</i>	13 +			
47600	<i>Sialis sp</i>	1			
52200	<i>Cheumatopsyche sp</i>	38 +			
69400	<i>Stenelmis sp</i>	4 +			
68901	<i>Macronychus glabratus</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	266 +			
84470	<i>Polypedilum (P.) illinoense</i>	448 +			
82770	<i>Chironomus (C.) riparius group</i>	73 +			
84800	<i>Tribelos jucundum</i>	0 +			
84520	<i>Polypedilum (Tripodura) halterale group</i>	0 +			
77500	<i>Conchapelopia sp</i>	48 +			
83050	<i>Dicrotendipes lucifer</i>	85 +			
80370	<i>Corynoneura lobata</i>	4			
84460	<i>Polypedilum (P.) fallax group</i>	24			
84790	<i>Tribelos fuscicorne</i>	48			
77130	<i>Ablabesmyia rhamphe group</i>	24			
84450	<i>Polypedilum (P.) convictum</i>	12			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	48			
81631	<i>Parakiefferiella n.sp 1</i>	12			
85800	<i>Tanytarsus sp</i>	12			
85814	<i>Tanytarsus glabrescens group</i>	12			
95100	<i>Physella sp</i>	5 +			
96900	<i>Ferrissia sp</i>	17 +			
97601	<i>Corbicula fluminea</i>	0 +			
98001	<i>Sphaeriidae</i>	1			

No. Quantitative Taxa: 25 Total Taxa: 32
 No. Qualitative Taxa: 20 ICI: 14
 Number of Organisms: 1822 Qual EPT: 1

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/21/94 River Code: 17-800 River: Wills Creek

RM: 61.50 1

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	8			
03360	<i>Plumatella sp</i>	1			
03600	<i>Oligochaeta</i>	601			+
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0			+
11130	<i>Baetis intercalaris</i>	1			
22300	<i>Argia sp</i>	11			+
47600	<i>Sialis sp</i>	0			+
48410	<i>Corydalus cornutus</i>	0			+
52200	<i>Cheumatopsyche sp</i>	19			+
69400	<i>Stenelmis sp</i>	7			+
74100	<i>Simulium sp</i>	0			+
84790	<i>Tribelos fuscicorne</i>	75			+
82770	<i>Chironomus (C.) riparius group</i>	201			+
77500	<i>Conchapelopia sp</i>	125			+
78750	<i>Rheopelopia paramaculipennis</i>	0			+
84470	<i>Polypedilum (P.) illinoense</i>	238			+
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	414			+
80430	<i>Cricotopus (C.) tremulus group</i>	100			+
84450	<i>Polypedilum (P.) convictum</i>	63			+
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	13			+
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	12			+
83050	<i>Dicrotendipes lucifer</i>	63			
80410	<i>Cricotopus (C.) sp</i>	38			
81631	<i>Parakiefferiella n.sp 1</i>	25			
83040	<i>Dicrotendipes neomodestus</i>	13			
85814	<i>Tanytarsus glabrescens group</i>	12			
98600	<i>Sphaerium sp</i>	0			+
98200	<i>Pisidium sp</i>	4			+
97601	<i>Corbicula fluminea</i>	0			+
96900	<i>Ferrissia sp</i>	23			

No. Quantitative Taxa: 23 Total Taxa: 30
 No. Qualitative Taxa: 21 ICI: 14
 Number of Organisms: 2067 Qual EPT: 1

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/21/94 River Code: 17-800 River: Wills Creek

RM: 61.30 1

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	12			
01801	<i>Turbellaria</i>	28			+
03360	<i>Plumatella sp</i>	1			+
03600	<i>Oligochaeta</i>	325			+
04975	<i>Mooreobdella poss. tetragon</i>	0			+
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0			+
17200	<i>Caenis sp</i>	2			
22300	<i>Argia sp</i>	7			+
45400	<i>Trichocorixa sp</i>	0			+
47600	<i>Sialis sp</i>	0			+
52200	<i>Cheumatopsyche sp</i>	38			+
52560	<i>Hydropsyche (H.) orris</i>	2			
69400	<i>Stenelmis sp</i>	12			+
74100	<i>Simulium sp</i>	14			+
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	469			+
78650	<i>Procladius sp</i>	0			+
84470	<i>Polypedilum (P.) illinoense</i>	886			+
77500	<i>Conchapelopia sp</i>	78			+
84450	<i>Polypedilum (P.) convictum</i>	52			+
80430	<i>Cricotopus (C.) tremulus group</i>	339			+
83410	<i>Harnischia curtilamellata</i>	0			+
82770	<i>Chironomus (C.) riparius group</i>	0			+
84790	<i>Tribelos fuscicorne</i>	26			
80420	<i>Cricotopus (C.) bicinctus</i>	52			
84020	<i>Parachironomus carinatus</i>	26			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	26			
85625	<i>Rheotanytarsus exiguus group</i>	26			
98600	<i>Sphaerium sp</i>	5			+
96900	<i>Ferrissia sp</i>	94			
98200	<i>Pisidium sp</i>	5			

No. Quantitative Taxa: 23 Total Taxa: 30
 No. Qualitative Taxa: 20 ICI: 14
 Number of Organisms: 2525 Qual EPT: 1

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/21/94 River Code: 17-800 River: Wills Creek

RM: 60.10 0

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01200	<i>Cordylophora lacustris</i>	1	96120	<i>Menetus (Micromenetus) dilatatus</i>	0 +
01801	<i>Turbellaria</i>	8 +	96900	<i>Ferrissia sp</i>	13 +
03360	<i>Plumatella sp</i>	1 +			
03600	<i>Oligochaeta</i>	776 +	No. Quantitative Taxa: 38		Total Taxa: 43
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	No. Qualitative Taxa: 25		ICI: 22
08601	<i>Hydracarina</i>	4	Number of Organisms: 2839		Qual EPT: 3
16700	<i>Tricorythodes sp</i>	0 +			
17200	<i>Caenis sp</i>	1			
22300	<i>Argia sp</i>	32 +			
45100	<i>Palmacorixa sp</i>	0 +			
48410	<i>Corydalis cornutus</i>	1 +			
47600	<i>Sialis sp</i>	1 +			
51206	<i>Cyrnellus fraternus</i>	2			
52200	<i>Cheumatopsyche sp</i>	47 +			
52560	<i>Hydropsyche (H.) orris</i>	8 +			
69400	<i>Stenelmis sp</i>	3 +			
68708	<i>Dubiraphia vittata group</i>	1 +			
68901	<i>Macronychus glabratus</i>	1			
77120	<i>Ablabesmyia mallochi</i>	23 +			
77130	<i>Ablabesmyia rhamphe group</i>	23			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	302 +			
80430	<i>Cricotopus (C.) tremulus group</i>	93			
81231	<i>Nanocladius (N.) crassicornus or N. (N.)</i>	23			
81240	<i>Nanocladius (N.) distinctus</i>	23			
81631	<i>Parakiefferiella n.sp 1</i>	46			
82710	<i>Chironomus (C.) sp</i>	23			
83050	<i>Dicrotendipes lucifer</i>	23			
83051	<i>Dicrotendipes simpsoni</i>	23			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	581 +			
84300	<i>Phaenopsectra obediens group</i>	23			
84450	<i>Polypedilum (P.) convictum</i>	70 +			
84460	<i>Polypedilum (P.) fallax group</i>	23			
84470	<i>Polypedilum (P.) illinoense</i>	70 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	116 +			
84700	<i>Stenochironomus sp</i>	46			
84790	<i>Tribelos fuscicorne</i>	186 +			
85625	<i>Rheotanytarsus exiguus group</i>	23			
85814	<i>Tanytarsus glabrescens group</i>	186 +			
87540	<i>Hemerodromia sp</i>	1			
98600	<i>Sphaerium sp</i>	12 +			
95100	<i>Physella sp</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/22/94 River Code: 17-800 River: Wills Creek

RM: 58.60 **8**

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	17			
03360	<i>Plumatella sp</i>	1 +	No. Quantitative Taxa:	33	Total Taxa: 38
03600	<i>Oligochaeta</i>	196 +	No. Qualitative Taxa:	15	ICI: 22
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	Number of Organisms:	1421	Qual EPT: 1
13400	<i>Stenacron sp</i>	11			
16700	<i>Tricorythodes sp</i>	8			
17200	<i>Caenis sp</i>	11			
22300	<i>Argia sp</i>	21 +			
45100	<i>Palmarixia sp</i>	0 +			
47600	<i>Sialis sp</i>	2 +			
52200	<i>Cheumatopsyche sp</i>	154 +			
52520	<i>Hydropsyche (H.) bidens</i>	7			
52560	<i>Hydropsyche (H.) orris</i>	14			
52570	<i>Hydropsyche (H.) simulans</i>	2			
51206	<i>Cyrnellus fraternus</i>	9			
68700	<i>Dubiraphia sp</i>	1			
68901	<i>Macronychus glabratus</i>	1			
69400	<i>Stenelmis sp</i>	4			
77115	<i>Ablabesmyia janta</i>	12			
77740	<i>Hayesomyia senata</i>	136			
80370	<i>Corynoneura lobata</i>	4			
81631	<i>Parakiefferiella n.sp 1</i>	12			
81231	<i>Nanocladius (N.) crassicornus or N. (N.)</i>	0 +			
83050	<i>Dicrotendipes lucifer</i>	12			
83051	<i>Dicrotendipes simpsoni</i>	12			
83040	<i>Dicrotendipes neomodestus</i>	0 +			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	346 +			
84450	<i>Polypedilum (P.) convictum</i>	37			
84470	<i>Polypedilum (P.) illinoense</i>	12 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	62 +			
84460	<i>Polypedilum (P.) fallax group</i>	37			
84790	<i>Tribelos fuscicorne</i>	148			
84800	<i>Tribelos jucundum</i>	0 +			
85625	<i>Rheotanytarsus exiguus group</i>	49 +			
85814	<i>Tanytarsus glabrescens group</i>	62			
87540	<i>Hemerodromia sp</i>	8			
96900	<i>Ferrissia sp</i>	12 +			
98600	<i>Sphaerium sp</i>	1			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/22/94 River Code: 17-800 River: Wills Creek

RM: 57.40 7

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	61	84450	<i>Polypedilum (P.) convictum</i>	76 +
01801	<i>Turbellaria</i>	0 +	84470	<i>Polypedilum (P.) illinoense</i>	15 +
03360	<i>Plumatella sp</i>	0 +	84540	<i>Polypedilum (Tripodura) scalaenum group</i>	30 +
03600	<i>Oligochaeta</i>	144 +	84800	<i>Tribelos jucundum</i>	0 +
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	84790	<i>Tribelos fuscicorne</i>	30
06700	<i>Crangonyx sp</i>	0 +	84300	<i>Phaenopsectra obediens group</i>	15
05800	<i>Caecidotea sp</i>	0 +	83050	<i>Dicrotendipes lucifer</i>	30
06201	<i>Hyalella azteca</i>	0 +	83040	<i>Dicrotendipes neomodestus</i>	15
08601	<i>Hydracarina</i>	12	85625	<i>Rheotanytarsus exiguus group</i>	137
11130	<i>Baetis intercalaris</i>	2	85814	<i>Tanytarsus glabrescens group</i>	76
13400	<i>Stenacron sp</i>	29 +	98600	<i>Sphaerium sp</i>	0 +
16700	<i>Tricorythodes sp</i>	12	96900	<i>Ferrissia sp</i>	5 +
17200	<i>Caenis sp</i>	3 +			
22300	<i>Argia sp</i>	12 +	No. Quantitative Taxa: 38		Total Taxa: 53
45400	<i>Trichocorixa sp</i>	0 +	No. Qualitative Taxa: 33		ICI: 30
45100	<i>Palmarcorixa sp</i>	0 +	Number of Organisms: 2182		Qual EPT: 7
47600	<i>Sialis sp</i>	2 +			
48410	<i>Corydalus cornutus</i>	3 +			
52315	<i>Diplectrona modesta</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	480 +			
52520	<i>Hydropsyche (H.) bidens</i>	56 +			
52560	<i>Hydropsyche (H.) orris</i>	56 +			
52570	<i>Hydropsyche (H.) simulans</i>	8 +			
51206	<i>Cynellus fraternus</i>	9			
68708	<i>Dubiraphia vittata group</i>	0 +			
69400	<i>Stenelmis sp</i>	68 +			
68901	<i>Macronychus glabratus</i>	6			
74100	<i>Simulium sp</i>	0 +			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	365			
80370	<i>Corynoneura lobata</i>	12			
80410	<i>Cricotopus (C.) sp</i>	30			
80420	<i>Cricotopus (C.) bicinctus</i>	0 +			
80430	<i>Cricotopus (C.) tremulus group</i>	30 +			
81231	<i>Nanocladius (N.) crassicornus or N. (N.)</i>	15			
81240	<i>Nanocladius (N.) distinctus</i>	46			
81650	<i>Parametrioctenemus sp</i>	0 +			
81631	<i>Parakiefferiella n.sp 1</i>	30 +			
82141	<i>Thienemanniella xena</i>	4			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	15			
84460	<i>Polypedilum (P.) fallax group</i>	61			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	182 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/22/94 River Code: 17-800 River: Wills Creek

RM: 53.50 **3**

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	8	96900	<i>Ferrissia sp</i>	8
01801	<i>Turbellaria</i>	16 +			
03360	<i>Plumatella sp</i>	1 +	No. Quantitative Taxa: 33 Total Taxa: 42		
03600	<i>Oligochaeta</i>	172 +	No. Qualitative Taxa: 30 ICI: 36		
08260	<i>Orconectes (Crockerinus) sanbornii</i>	1 +	Number of Organisms: 4328 Qual EPT: 10		
12200	<i>Isonychia sp</i>	8			
11130	<i>Baetis intercalaris</i>	8 +			
13400	<i>Stenacron sp</i>	152 +			
16700	<i>Tricorythodes sp</i>	9 +			
17200	<i>Caenis sp</i>	1 +			
18750	<i>Hexagenia limbata</i>	0 +			
22300	<i>Argia sp</i>	0 +			
45100	<i>Palmacorixa sp</i>	0 +			
47600	<i>Sialis sp</i>	1 +			
48410	<i>Corydalis cornutus</i>	3 +			
52200	<i>Cheumatopsyche sp</i>	3156 +			
52570	<i>Hydropsyche (H.) simulans</i>	14 +			
52520	<i>Hydropsyche (H.) bidens</i>	28 +			
52560	<i>Hydropsyche (H.) orris</i>	57 +			
59145	<i>Ceraclea neffi</i>	0 +			
68130	<i>Helichus sp</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	1 +			
69400	<i>Stenelmis sp</i>	172 +			
68601	<i>Ancyronyx variegata</i>	4			
68901	<i>Macronychus glabratus</i>	10			
77120	<i>Ablabesmyia mallochi</i>	0 +			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	143 +			
80370	<i>Corynoneura lobata</i>	4			
80410	<i>Cricotopus (C.) sp</i>	0 +			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	33			
82141	<i>Thienemanniella xena</i>	6			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	66 +			
84450	<i>Polypedilum (P.) convictum</i>	50 +			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	22			
84520	<i>Polypedilum (Tripodura) halterale group</i>	6			
85814	<i>Tanytarsus glabrescens group</i>	6			
85625	<i>Rheotanytarsus exiguus group</i>	149 +			
87540	<i>Hemerodromia sp</i>	12			
98600	<i>Sphaerium sp</i>	0 +			
97601	<i>Corbicula fluminea</i>	1 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 45.40 **5**

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	1 +	85814	<i>Tanytarsus glabrescens group</i>	3
03360	<i>Plumatella sp</i>	5 +	87540	<i>Hemerodromia sp</i>	12
03600	<i>Oligochaeta</i>	12 +	95100	<i>Physella sp</i>	0 +
08601	<i>Hydracarina</i>	8	98600	<i>Sphaerium sp</i>	0 +
11130	<i>Baetis intercalaris</i>	418 +	97601	<i>Corbicula fluminea</i>	0 +
14950	<i>Leptophlebia sp or Paraleptophebia sp</i>	2			
13000	<i>Leucrocuta sp</i>	12 +	No. Quantitative Taxa: 40		Total Taxa: 46
13400	<i>Stenacron sp</i>	185 +	No. Qualitative Taxa: 27		ICI: 50
13550	<i>Stenonema mexicanum integrum</i>	12 +	Number of Organisms: 2290		Qual EPT: 8
16700	<i>Tricorythodes sp</i>	58			
17200	<i>Caenis sp</i>	4			
22300	<i>Argia sp</i>	1 +			
45100	<i>Palmacorixa sp</i>	0 +			
48410	<i>Corydalus cornutus</i>	7 +			
47600	<i>Sialis sp</i>	0 +			
51206	<i>Cyrnellus fraternus</i>	1 +			
51300	<i>Neureclipsis sp</i>	20			
52200	<i>Cheumatopsyche sp</i>	529 +			
52520	<i>Hydropsyche (H.) bidens</i>	49 +			
52560	<i>Hydropsyche (H.) orris</i>	487 +			
52570	<i>Hydropsyche (H.) simulans</i>	79			
68901	<i>Macronychus glabratus</i>	4 +			
69400	<i>Stenelmis sp</i>	16 +			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	90 +			
80370	<i>Corynoneura lobata</i>	63			
81229	<i>Nanocladius (N.) crassicornus</i>	7 +			
81240	<i>Nanocladius (N.) distinctus</i>	3			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	7			
82121	<i>Thienemanniella n.sp 3</i>	3			
82141	<i>Thienemanniella xena</i>	3			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	7 +			
83840	<i>Microtendipes pedellus group</i>	3			
84040	<i>Parachironomus frequens</i>	3			
84060	<i>Parachironomus pectinatellae</i>	3			
84450	<i>Polypedilum (P.) convictum</i>	14 +			
84460	<i>Polypedilum (P.) fallax group</i>	14			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	7			
84790	<i>Tribelos fuscicorne</i>	14 +			
85625	<i>Rheotanytarsus exiguus group</i>	121 +			
85802	<i>Tanytarsus curticornis group</i>	3			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 37.70 7

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	0 +	85814	<i>Tanytarsus glabrescens group</i>	9
03360	<i>Plumatella sp</i>	2 +	85625	<i>Rheotanytarsus exiguus group</i>	263 +
03600	<i>Oligochaeta</i>	0 +	87540	<i>Hemerodromia sp</i>	2
06700	<i>Crangonyx sp</i>	0 +	98600	<i>Sphaerium sp</i>	0 +
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	95100	<i>Physella sp</i>	0 +
11130	<i>Baetis intercalaris</i>	445 +			
11670	<i>Procloeon irrubrum</i>	0 +	No. Quantitative Taxa: 31		Total Taxa: 46
13400	<i>Stenacron sp</i>	207 +	No. Qualitative Taxa: 33		ICI: 50
13550	<i>Stenonema mexicanum integrum</i>	13 +	Number of Organisms: 2103		Qual EPT: 13
16700	<i>Tricorythodes sp</i>	14 +			
18700	<i>Hexagenia sp</i>	0 +			
12200	<i>Isonychia sp</i>	6			
13570	<i>Stenonema terminatum</i>	15			
22300	<i>Argia sp</i>	0 +			
45100	<i>Palmarcorixa sp</i>	0 +			
48410	<i>Corydalus cornutus</i>	15 +			
59145	<i>Ceraclea neffi</i>	0 +			
51206	<i>Cynellus fraternus</i>	41 +			
52200	<i>Cheumatopsyche sp</i>	455 +			
52520	<i>Hydropsyche (H.) bidens</i>	99 +			
52560	<i>Hydropsyche (H.) orris</i>	209 +			
52570	<i>Hydropsyche (H.) simulans</i>	83 +			
51300	<i>Neureclipsis sp</i>	9 +			
59500	<i>Oecetis sp</i>	2			
68901	<i>Macronychus glabratus</i>	3			
69400	<i>Stenelmis sp</i>	17 +			
68130	<i>Helichus sp</i>	0 +			
66500	<i>Enochrus sp</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
77740	<i>Hayesomyia senata</i>	58 +			
80410	<i>Cricotopus (C.) sp</i>	0 +			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	9			
81231	<i>Nanocladius (N.) crassicornus or N. (N.)</i>	23			
80370	<i>Corynoneura lobata</i>	13			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	40 +			
84040	<i>Parachironomus frequens</i>	4 +			
84450	<i>Polypedilum (P.) convictum</i>	13 +			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	13			
84460	<i>Polypedilum (P.) fallax group</i>	13			
84790	<i>Tribelos fuscicorne</i>	4			
84700	<i>Stenochironomus sp</i>	4			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 27.60 7

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	8	85625	<i>Rheotanytarsus exiguus group</i>	344 +
03360	<i>Plumatella sp</i>	1 +	87540	<i>Hemerodromia sp</i>	16
03600	<i>Oligochaeta</i>	8	98600	<i>Sphaerium sp</i>	1 +
08260	<i>Orconectes (Crokerinus) sanbornii</i>	0 +	81630	<i>Parakiefferiella sp</i>	0 +
08601	<i>Hydracarina</i>	16			
11130	<i>Baetis intercalaris</i>	969 +	No. Quantitative Taxa:	34	Total Taxa: 45
11651	<i>Procloeon sp (w/o hindwing pads)</i>	0 +	No. Qualitative Taxa:	26	ICI: 48
13400	<i>Stenacron sp</i>	313 +	Number of Organisms:	3789	Qual EPT: 12
13000	<i>Leucrocuta sp</i>	0 +			
12200	<i>Isonychia sp</i>	41 +			
16700	<i>Tricorythodes sp</i>	0 +			
13550	<i>Stenonema mexicanum integrum</i>	37			
13561	<i>Stenonema pulchellum</i>	69			
13570	<i>Stenonema terminatum</i>	42			
22300	<i>Argia sp</i>	4 +			
21200	<i>Calopteryx sp</i>	1			
45100	<i>Palmacorixa sp</i>	0 +			
45400	<i>Trichocorixa sp</i>	0 +			
48410	<i>Corydalis cornutus</i>	13 +			
52200	<i>Cheumatopsyche sp</i>	946 +			
52801	<i>Potamyia flava</i>	34 +			
52520	<i>Hydropsyche (H.) bidens</i>	101 +			
52560	<i>Hydropsyche (H.) orris</i>	373 +			
51206	<i>Cyrnellus fraternus</i>	13 +			
59145	<i>Ceraclea neffi</i>	0 +			
52530	<i>Hydropsyche (H.) depravata group</i>	8			
52570	<i>Hydropsyche (H.) simulans</i>	101			
69400	<i>Stenelmis sp</i>	0 +			
68901	<i>Macronychus glabratus</i>	3			
68130	<i>Helichus sp</i>	1			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	73 +			
79085	<i>Telopelopia okoboji</i>	8			
80360	<i>Corynoneura "celeripes" (sensu Simpson &</i>	5			
80370	<i>Corynoneura lobata</i>	13			
81231	<i>Nanocladius (N.) crassicornus or N. (N.)</i>	16			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	32			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	49			
84460	<i>Polypedilum (P.) fallax group</i>	57			
84040	<i>Parachironomus frequens</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	73 +			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/20/94 River Code: 17-800 River: Wills Creek

RM: 5.20 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
00401	<i>Spongillidae</i>	0 +	68201	<i>Scirtidae</i>	0 +
01200	<i>Cordylophora lacustris</i>	1	68901	<i>Macronychus glabratus</i>	9
01801	<i>Turbellaria</i>	50 +	71300	<i>Limonia sp</i>	0 +
03360	<i>Plumatella sp</i>	2	77130	<i>Ablabesmyia rhamphe group</i>	0 +
03221	<i>Pectinatella magnifica</i>	4	77750	<i>Hayesomyia senata or Thienemannimyia</i>	709
03600	<i>Oligochaeta</i>	16 +	81240	<i>Nanocladius (N.) distinctus</i>	79
06201	<i>Hyalella azteca</i>	0 +	83300	<i>Glyptotendipes (Phytotendipes) sp</i>	276 +
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	84040	<i>Parachironomus frequens</i>	236
08601	<i>Hydracarina</i>	16	84480	<i>Polypedilum (P.) laetum group</i>	0 +
12200	<i>Isonychia sp</i>	1 +	84450	<i>Polypedilum (P.) convictum</i>	355 +
11130	<i>Baetis intercalaris</i>	629 +	84470	<i>Polypedilum (P.) illinoense</i>	0 +
11670	<i>Procloeon irrubrum</i>	0 +	85625	<i>Rheotanytarsus exiguus group</i>	1497 +
13400	<i>Stenacron sp</i>	95 +	87540	<i>Hemerodromia sp</i>	4
17200	<i>Caenis sp</i>	0 +	89700	<i>Limnophora sp</i>	0 +
16700	<i>Tricorythodes sp</i>	107 +	93900	<i>Elimia sp</i>	5 +
13570	<i>Stenonema terminatum</i>	347 +	95100	<i>Physella sp</i>	0 +
11620	<i>Paracloeodes sp 2</i>	0 +	98600	<i>Sphaerium sp</i>	1 +
13561	<i>Stenonema pulchellum</i>	0 +	99900	<i>Epioblasma triquetra</i>	0 +
22300	<i>Argia sp</i>	0 +	97601	<i>Corbicula fluminea</i>	2
23909	<i>Boyeria vinosa</i>	0 +	03121	<i>Paludicella articulata</i>	1
22001	<i>Coenagrionidae</i>	0 +			
24900	<i>Gomphus sp</i>	0 +	No. Quantitative Taxa: 38		Total Taxa: 61
26700	<i>Macromia sp</i>	0 +	No. Qualitative Taxa: 46		ICI: 44
27404	<i>Neurocordulia molesta</i>	1	Number of Organisms: 21161		Qual EPT: 17
45100	<i>Palmacorixa sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
48410	<i>Corydalis cornutus</i>	10 +			
52200	<i>Cheumatopsyche sp</i>	6247 +			
52620	<i>Macrostemum zebratum</i>	7 +			
52801	<i>Potamyia flava</i>	13 +			
52560	<i>Hydropsyche (H.) orris</i>	5842 +			
52570	<i>Hydropsyche (H.) simulans</i>	2604 +			
52520	<i>Hydropsyche (H.) bidens</i>	1509 +			
51300	<i>Neureclipsis sp</i>	272 +			
51600	<i>Polycentropus sp</i>	68 +			
51206	<i>Cyrnellus fraternus</i>	135			
52430	<i>Hydropsyche (Ceratopsyche) morosa group</i>	2			
53501	<i>Hydroptilidae</i>	4			
60300	<i>Dineutus sp</i>	1 +			
68130	<i>Helichus sp</i>	0 +			
69400	<i>Stenelmis sp</i>	4 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/21/94 River Code: 17-817 River: Chapman Run

RM: 0.40 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01320	<i>Hydra sp</i>	3			
03600	<i>Oligochaeta</i>	112			+
06800	<i>Gammarus sp</i>	0			+
08260	<i>Orconectes (Crokerinus) sanbornii</i>	0			+
11200	<i>Callibaetis sp</i>	0			+
14950	<i>Leptophlebia sp or Paraleptophebia sp</i>	2			
17200	<i>Caenis sp</i>	17			+
22001	<i>Coenagrionidae</i>	3			+
22300	<i>Argia sp</i>	1			
45100	<i>Palmacorixa sp</i>	0			+
63300	<i>Hydroporus sp</i>	3			+
65800	<i>Berosus sp</i>	1			
74501	<i>Ceratopogonidae</i>	3			
77120	<i>Ablabesmyia mallochi</i>	25			
77140	<i>Ablabesmyia peleensis</i>	0			+
77355	<i>Clinotanytus pinguis</i>	10			+
77750	<i>Hayesomyia senata or Thienemannimyia</i>	15			
79020	<i>Tanytus neopunctipennis</i>	30			+
78650	<i>Procladius sp</i>	20			+
81250	<i>Nanocladius (N.) minimus</i>	40			+
82730	<i>Chironomus (C.) decorus group</i>	50			+
82820	<i>Cryptochironomus sp</i>	0			+
83040	<i>Dicrotendipes neomodestus</i>	15			
83051	<i>Dicrotendipes simpsoni</i>	15			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	20			
84460	<i>Polypedilum (P.) fallax group</i>	10			
84470	<i>Polypedilum (P.) illinoense</i>	25			
84790	<i>Tribelos fuscicorne</i>	25			+
85500	<i>Paratanytarsus sp</i>	15			
85800	<i>Tanytarsus sp</i>	50			+
85814	<i>Tanytarsus glabrescens group</i>	30			
94400	<i>Fossaria sp</i>	1			
95100	<i>Physella sp</i>	11			
96002	<i>Helisoma anceps anceps</i>	1			

No. Quantitative Taxa: 28 Total Taxa: 34
 No. Qualitative Taxa: 17 ICI: 14
 Number of Organisms: 553 Qual EPT: 2

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/27/94 River Code: 17-821 River: Sugartree Fork

RM: 12.20 2

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03360	<i>Plumatella sp</i>	0 +	72700	<i>Anopheles sp</i>	0 +
03600	<i>Oligochaeta</i>	0 +	71100	<i>Hexatoma sp</i>	0 +
06201	<i>Hyalella azteca</i>	0 +	74501	<i>Ceratopogonidae</i>	0 +
07860	<i>Cambarus (Puncticambarus) robustus</i>	0 +	72340	<i>Dixella sp</i>	0 +
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	77800	<i>Helopelopia sp</i>	0 +
11130	<i>Baetis intercalaris</i>	0 +	81632	<i>Parakiefferiella n.sp 2</i>	0 +
11120	<i>Baetis flavistriga</i>	0 +	81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	0 +
11670	<i>Procloeon irrubrum</i>	0 +	84450	<i>Polypedilum (P.) convictum</i>	0 +
11200	<i>Callibaetis sp</i>	0 +	84475	<i>Polypedilum (P.) ophioides</i>	0 +
12200	<i>Isonychia sp</i>	0 +	84470	<i>Polypedilum (P.) illinoense</i>	0 +
13400	<i>Stenacron sp</i>	0 +	83840	<i>Microtendipes pedellus group</i>	0 +
13590	<i>Stenonema vicarium</i>	0 +	84800	<i>Tribelos jucundum</i>	0 +
13521	<i>Stenonema femoratum</i>	0 +	85625	<i>Rheotanytarsus exiguus group</i>	0 +
11101	<i>Baetis sp (w/o hindwing pads)</i>	0 +	85500	<i>Paratanytarsus sp</i>	0 +
14950	<i>Leptophlebia sp or Paraleptophebia sp</i>	0 +	86100	<i>Chrysops sp</i>	0 +
17200	<i>Caenis sp</i>	0 +	95100	<i>Physella sp</i>	0 +
18700	<i>Hexagenia sp</i>	0 +	96900	<i>Ferrissia sp</i>	0 +
23804	<i>Basiaeschna janata</i>	0 +	98200	<i>Pisidium sp</i>	0 +
22001	<i>Coenagrionidae</i>	0 +	98600	<i>Sphaerium sp</i>	0 +
28955	<i>Libellula lydia</i>	0 +	97601	<i>Corbicula fluminea</i>	0 +
21200	<i>Calopteryx sp</i>	0 +			
23909	<i>Boyeria vinosa</i>	0 +	No. Quantitative Taxa: 0		Total Taxa: 61
34130	<i>Acroneuria evoluta</i>	0 +	No. Qualitative Taxa: 61		ICI:
43300	<i>Ranatra sp</i>	0 +	Number of Organisms: 0		Qual EPT:
45300	<i>Sigara sp</i>	0 +			
45400	<i>Trichocorixa sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
51400	<i>Nyctiophylax sp</i>	0 +			
50315	<i>Chimarra obscura</i>	0 +			
51600	<i>Polycentropus sp</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
52430	<i>Hydropsyche (Ceratopsyche) morosa group</i>	0 +			
52530	<i>Hydropsyche (H.) depravata group</i>	0 +			
58505	<i>Helicopsyche borealis</i>	0 +			
60300	<i>Dineutus sp</i>	0 +			
67500	<i>Laccobius sp</i>	0 +			
68025	<i>Ectopria nervosa</i>	0 +			
68901	<i>Macronychus glabratus</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
69210	<i>Optioservus ampliatus</i>	0 +			
69400	<i>Stenelmis sp</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/27/94 River Code: 17-822 River: Rocky Fork Salt Fork

RM: 5.60 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03360	<i>Plumatella sp</i>	0 +	84470	<i>Polypedilum (P.) illinoense</i>	0 +
03600	<i>Oligochaeta</i>	0 +	84520	<i>Polypedilum (Tripodura) halterale group</i>	0 +
06201	<i>Hyalella azteca</i>	0 +	84460	<i>Polypedilum (P.) fallax group</i>	0 +
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	84116	<i>Paracladopelma nereis</i>	0 +
14950	<i>Leptophlebia sp or Paraleptophebica sp</i>	0 +	83040	<i>Dicrotendipes neomodestus</i>	0 +
13400	<i>Stenacron sp</i>	0 +	85840	<i>Tanytarsus guerlus group</i>	0 +
11018	<i>Acerpenna macdunnoughi</i>	0 +	85800	<i>Tanytarsus sp</i>	0 +
11249	<i>Centroptilum sp (w/ hindwing pads)</i>	0 +	85814	<i>Tanytarsus glabrescens group</i>	0 +
11130	<i>Baetis intercalaris</i>	0 +	85500	<i>Paratanytarsus sp</i>	0 +
11670	<i>Procloeon irrubrum</i>	0 +	85625	<i>Rheotanytarsus exiguus group</i>	0 +
11650	<i>Procloeon sp (w/ hindwing pads)</i>	0 +	96900	<i>Ferrissia sp</i>	0 +
17200	<i>Caenis sp</i>	0 +	97601	<i>Corbicula fluminea</i>	0 +
17600	<i>Baetisca sp</i>	0 +			
18600	<i>Ephemera sp</i>	0 +	No. Quantitative Taxa: 0		Total Taxa: 53
22300	<i>Argia sp</i>	0 +	No. Qualitative Taxa: 53		ICI:
21200	<i>Calopteryx sp</i>	0 +	Number of Organisms: 0		Qual EPT:
42700	<i>Belostoma sp</i>	0 +			
44501	<i>Corixidae</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
51600	<i>Polycentropus sp</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
52530	<i>Hydropsyche (H.) depravata group</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
68130	<i>Helichus sp</i>	0 +			
67000	<i>Helophorus sp</i>	0 +			
68901	<i>Macronychus glabratus</i>	0 +			
64050	<i>Liodessus sp</i>	0 +			
74501	<i>Ceratopogonidae</i>	0 +			
72700	<i>Anopheles sp</i>	0 +			
86100	<i>Chrysops sp</i>	0 +			
71910	<i>Tipula abdominalis</i>	0 +			
70000	<i>Diptera</i>	0 +			
77750	<i>Hayesomyia senata or Thienemannimyia</i>	0 +			
77120	<i>Ablabesmyia mallochi</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
82141	<i>Thienemanniella xena</i>	0 +			
82200	<i>Tvetenia bavarica group</i>	0 +			
80420	<i>Cricotopus (C.) bicinctus</i>	0 +			
81632	<i>Parakiefferiella n.sp 2</i>	0 +			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	0 +			
80430	<i>Cricotopus (C.) tremulus group</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/27/94 River Code: 17-823 River: Yellow Water Creek

RM: 0.80 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03360	<i>Plumatella sp</i>	0 +	84460	<i>Polypedilum (P.) fallax group</i>	0 +
03600	<i>Oligochaeta</i>	0 +	81650	<i>Parametriocnemus sp</i>	0 +
06201	<i>Hyalella azteca</i>	0 +	78500	<i>Paramerina fragilis</i>	0 +
13400	<i>Stenacron sp</i>	0 +	84800	<i>Tribelos jucundum</i>	0 +
15000	<i>Paraleptophlebia sp</i>	0 +	81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	0 +
11650	<i>Procloeon sp (w/ hindwing pads)</i>	0 +	85500	<i>Paratanytarsus sp</i>	0 +
17600	<i>Baetisca sp</i>	0 +	85800	<i>Tanytarsus sp</i>	0 +
11018	<i>Acerpenna macdunnoughi</i>	0 +	95100	<i>Physella sp</i>	0 +
13590	<i>Stenonema vicarium</i>	0 +	98200	<i>Pisidium sp</i>	0 +
18750	<i>Hexagenia limbata</i>	0 +			
18600	<i>Ephemera sp</i>	0 +	No. Quantitative Taxa: 0		Total Taxa: 50
21200	<i>Calopteryx sp</i>	0 +	No. Qualitative Taxa: 50		ICI:
22001	<i>Coenagrionidae</i>	0 +	Number of Organisms: 0		Qual EPT:
23909	<i>Boyeria vinosa</i>	0 +			
24501	<i>Gomphidae</i>	0 +			
42700	<i>Belostoma sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
48210	<i>Chauliodes pectinicornis</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
53800	<i>Hydroptila sp</i>	0 +			
57400	<i>Neophylax sp</i>	0 +			
51600	<i>Polycentropus sp</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
68130	<i>Helichus sp</i>	0 +			
60400	<i>Gyrinus sp</i>	0 +			
69400	<i>Stenelmis sp</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
67500	<i>Laccobius sp</i>	0 +			
74501	<i>Ceratopogonidae</i>	0 +			
72700	<i>Anopheles sp</i>	0 +			
72340	<i>Dixella sp</i>	0 +			
86100	<i>Chrysops sp</i>	0 +			
71900	<i>Tipula sp</i>	0 +			
71100	<i>Hexatoma sp</i>	0 +			
71910	<i>Tipula abdominalis</i>	0 +			
83300	<i>Glyptotendipes (Phytotendipes) sp</i>	0 +			
83840	<i>Microtendipes pedellus group</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
84700	<i>Stenochironomus sp</i>	0 +			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/27/94 River Code: 17-824 River: Clear Fork

RM: 1.90 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	0 +	77750	<i>Hayesomyia senata</i> or <i>Thienemannimyia</i>	0 +
03360	<i>Plumatella</i> sp	0 +	77115	<i>Ablabesmyia janta</i>	0 +
03600	<i>Oligochaeta</i>	0 +	81631	<i>Parakiefferiella n.sp I</i>	0 +
06201	<i>Hyalella azteca</i>	0 +	82300	<i>Xylotopus par</i>	0 +
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +	80420	<i>Cricotopus (C.) bicinctus</i>	0 +
07860	<i>Cambarus (Puncticambarus) robustus</i>	0 +	81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	0 +
11120	<i>Baetis flavistriga</i>	0 +	81259	<i>Nanocladius (N.) rectinervis</i>	0 +
11650	<i>Procloeon</i> sp (w/ hindwing pads)	0 +	83300	<i>Glyptotendipes (Phytotendipes) sp</i>	0 +
11250	<i>Centroptilum</i> sp (w/o hindwing pads)	0 +	83158	<i>Endochironomus nigricans</i>	0 +
11130	<i>Baetis intercalaris</i>	0 +	84470	<i>Polypedilum (P.) illinoense</i>	0 +
13400	<i>Stenacron</i> sp	0 +	83840	<i>Microtendipes pedellus</i> group	0 +
13590	<i>Stenonema vicarium</i>	0 +	83040	<i>Dicrotendipes neomodestus</i>	0 +
13521	<i>Stenonema femoratum</i>	0 +	84800	<i>Tribelos jucundum</i>	0 +
11150	<i>Labiobaetis propinquus</i>	0 +	85625	<i>Rheotanytarsus exiguus</i> group	0 +
11018	<i>Acerpenna macdunnoughi</i>	0 +	85615	<i>Rheotanytarsus distinctissimus</i> group	0 +
14900	<i>Leptophlebia</i> sp	0 +	85500	<i>Paratanytarsus</i> sp	0 +
18750	<i>Hexagenia limbata</i>	0 +	86100	<i>Chrysops</i> sp	0 +
22001	<i>Coenagrionidae</i>	0 +	95100	<i>Physella</i> sp	0 +
21200	<i>Calopteryx</i> sp	0 +	96900	<i>Ferrissia</i> sp	0 +
23909	<i>Boyeria vinosa</i>	0 +	98600	<i>Sphaerium</i> sp	0 +
35001	<i>Perlodidae</i>	0 +	97601	<i>Corbicula fluminea</i>	0 +
45400	<i>Trichocorixa</i> sp	0 +			
45300	<i>Sigara</i> sp	0 +	No. Quantitative Taxa: 0 Total Taxa: 62		
42700	<i>Belostoma</i> sp	0 +	No. Qualitative Taxa: 62 ICI:		
47600	<i>Sialis</i> sp	0 +	Number of Organisms: 0 Qual EPT:		
51500	<i>Phylocentropus</i> sp	0 +			
51400	<i>Nyctiophylax</i> sp	0 +			
51600	<i>Polycentropus</i> sp	0 +			
52200	<i>Cheumatopsyche</i> sp	0 +			
55300	<i>Ptilostomis</i> sp	0 +			
68708	<i>Dubiraphia vittata</i> group	0 +			
68901	<i>Macronychus glabratus</i>	0 +			
69200	<i>Optioservus</i> sp	0 +			
69400	<i>Stenelmis</i> sp	0 +			
74100	<i>Simulium</i> sp	0 +			
74501	<i>Ceratopogonidae</i>	0 +			
71910	<i>Tipula abdominalis</i>	0 +			
72700	<i>Anopheles</i> sp	0 +			
71100	<i>Hexatoma</i> sp	0 +			
77120	<i>Ablabesmyia mallochi</i>	0 +			
77500	<i>Conchapelopia</i> sp	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/27/94 River Code: 17-825 River: Turkey Run

RM: 0.90 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03360	<i>Plumatella sp</i>	0 +	74501	<i>Ceratopogonidae</i>	0 +
03600	<i>Oligochaeta</i>	0 +	23710	<i>Anax longipes</i>	0 +
04686	<i>Placobdella papillifera</i>	0 +	27307	<i>Epitheca (Epicordulia) princeps</i>	0 +
11250	<i>Centroptilum sp (w/o hindwing pads)</i>	0 +			
13400	<i>Stenacron sp</i>	0 +	No. Quantitative Taxa: 0		Total Taxa: 44
14900	<i>Leptophlebia sp</i>	0 +	No. Qualitative Taxa: 44		ICI:
17200	<i>Caenis sp</i>	0 +	Number of Organisms: 0		Qual EPT:
21200	<i>Calopteryx sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
24900	<i>Gomphus sp</i>	0 +			
28955	<i>Libellula lydia</i>	0 +			
23804	<i>Basiaeschna janata</i>	0 +			
45400	<i>Trichocorixa sp</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
52530	<i>Hydropsyche (H.) depravata group</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
60400	<i>Gyrinus sp</i>	0 +			
67800	<i>Tropisternus sp</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
69400	<i>Stenelmis sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
72700	<i>Anopheles sp</i>	0 +			
71910	<i>Tipula abdominalis</i>	0 +			
71900	<i>Tipula sp</i>	0 +			
77120	<i>Ablabesmyia mallochi</i>	0 +			
77355	<i>Clinotanypus pinguis</i>	0 +			
81650	<i>Parametriocnemus sp</i>	0 +			
82710	<i>Chironomus (C.) sp</i>	0 +			
82820	<i>Cryptochironomus sp</i>	0 +			
83840	<i>Microtendipes pedellus group</i>	0 +			
83158	<i>Endochironomus nigricans</i>	0 +			
84050	<i>Parachironomus hirtalatus</i>	0 +			
84450	<i>Polypedilum (P.) convictum</i>	0 +			
85500	<i>Paratanytarsus sp</i>	0 +			
85800	<i>Tanytarsus sp</i>	0 +			
86100	<i>Chrysops sp</i>	0 +			
71100	<i>Hexatoma sp</i>	0 +			
95100	<i>Physella sp</i>	0 +			
96002	<i>Helisoma anceps anceps</i>	0 +			
98200	<i>Pisidium sp</i>	0 +			
95907	<i>Gyraulus (Torquis) parvus</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/29/94 River Code: 17-826 River: Beeham Run

RM: 1.80 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	0 +	82200	<i>Tvetenia bavarica group</i>	0 +
03600	<i>Oligochaeta</i>	0 +	80410	<i>Cricotopus (C.) sp</i>	0 +
05800	<i>Caecidotea sp</i>	0 +	81631	<i>Parakiefferiella n.sp I</i>	0 +
11120	<i>Baetis flavistriga</i>	0 +	81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	0 +
13400	<i>Stenacron sp</i>	0 +	82141	<i>Thienemanniella xena</i>	0 +
13590	<i>Stenonema vicarium</i>	0 +	83840	<i>Microtendipes pedellus group</i>	0 +
16200	<i>Eurylophella sp</i>	0 +	84750	<i>Stictochironomus sp</i>	0 +
14900	<i>Leptophlebia sp</i>	0 +	84440	<i>Polypedilum (P.) aviceps</i>	0 +
17200	<i>Caenis sp</i>	0 +	85615	<i>Rheotanytarsus distinctissimus group</i>	0 +
18600	<i>Ephemera sp</i>	0 +	85814	<i>Tanytarsus glabrescens group</i>	0 +
21200	<i>Calopteryx sp</i>	0 +	85800	<i>Tanytarsus sp</i>	0 +
23909	<i>Boyeria vinosa</i>	0 +	87540	<i>Hemerodromia sp</i>	0 +
36500	<i>Sweltsa sp</i>	0 +	87601	<i>Dolichopodidae</i>	0 +
35560	<i>Isoperla similis</i>	0 +	86100	<i>Chrysops sp</i>	0 +
35250	<i>Diploperla robusta</i>	0 +	95100	<i>Physella sp</i>	0 +
45300	<i>Sigara sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +	No. Quantitative Taxa: 0		Total Taxa: 56
48610	<i>Nigronia fasciatus</i>	0 +	No. Qualitative Taxa: 56		ICI:
50301	<i>Chimarra aterrima</i>	0 +	Number of Organisms: 0		Qual EPT:
52315	<i>Diplectrona modesta</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
67100	<i>Hydrobius sp</i>	0 +			
67500	<i>Laccobius sp</i>	0 +			
63300	<i>Hydroporus sp</i>	0 +			
68025	<i>Ectopria nervosa</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
69400	<i>Stenelmis sp</i>	0 +			
71900	<i>Tipula sp</i>	0 +			
71100	<i>Hexatoma sp</i>	0 +			
74501	<i>Ceratopogonidae</i>	0 +			
71910	<i>Tipula abdominalis</i>	0 +			
71800	<i>Pseudolimnophila sp</i>	0 +			
79300	<i>Trissopelopia ogemawi</i>	0 +			
77800	<i>Helopelopia sp</i>	0 +			
78350	<i>Meropelopia sp</i>	0 +			
79400	<i>Zavrelimyia sp</i>	0 +			
80370	<i>Corynoneura lobata</i>	0 +			
80351	<i>Corynoneura n.sp I</i>	0 +			
81650	<i>Parametriocnemus sp</i>	0 +			
80420	<i>Cricotopus (C.) bicinctus</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/29/94 River Code: 17-827 River: Brushy Fork

RM: 3.10 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
01801	<i>Turbellaria</i>	0 +	95100	<i>Physella sp</i>	0 +
03360	<i>Plumatella sp</i>	0 +	97601	<i>Corbicula fluminea</i>	0 +
03600	<i>Oligochaeta</i>	0 +			
08260	<i>Orconectes (Crokerinus) sanbornii</i>	0 +	No. Quantitative Taxa: 0		Total Taxa: 43
06201	<i>Hyalella azteca</i>	0 +	No. Qualitative Taxa: 43		ICI:
11130	<i>Baetis intercalaris</i>	0 +	Number of Organisms: 0		Qual EPT:
11120	<i>Baetis flavistriga</i>	0 +			
13400	<i>Stenacron sp</i>	0 +			
15000	<i>Paraleptophlebia sp</i>	0 +			
11250	<i>Centroptilum sp (w/o hindwing pads)</i>	0 +			
13590	<i>Stenonema vicarium</i>	0 +			
11125	<i>Labiobaetis frondalis</i>	0 +			
17200	<i>Caenis sp</i>	0 +			
21200	<i>Calopteryx sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	0 +			
23909	<i>Boyeria vinosa</i>	0 +			
44300	<i>Pelocoris sp</i>	0 +			
45400	<i>Trichocorixa sp</i>	0 +			
45100	<i>Palmacorixa sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
52430	<i>Hydropsyche (Ceratopsyche) morosa group</i>	0 +			
50301	<i>Chimarra aterrima</i>	0 +			
52530	<i>Hydropsyche (H.) depravata group</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
68130	<i>Helichus sp</i>	0 +			
68901	<i>Macronychus glabratus</i>	0 +			
61400	<i>Agabus sp</i>	0 +			
87540	<i>Hemerodromia sp</i>	0 +			
71900	<i>Tipula sp</i>	0 +			
77500	<i>Conchapelopia sp</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
84700	<i>Stenochironomus sp</i>	0 +			
82141	<i>Thienemanniella xena</i>	0 +			
80420	<i>Cricotopus (C.) bicinctus</i>	0 +			
80430	<i>Cricotopus (C.) tremulus group</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
85500	<i>Paratanyarsus sp</i>	0 +			
85625	<i>Rheotanyarsus exiguus group</i>	0 +			
96900	<i>Ferrissia sp</i>	0 +			

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/29/93 River Code: 17-828 River: Christian Creek

RM: 0.10 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
03600	<i>Oligochaeta</i>	0 +			
08260	<i>Orconectes (Crokerinus) sanbornii</i>	0 +			
21200	<i>Calopteryx sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	0 +			
28955	<i>Libellula lydia</i>	0 +			
45300	<i>Sigara sp</i>	0 +			
47600	<i>Sialis sp</i>	0 +			
52200	<i>Cheumatopsyche sp</i>	0 +			
52530	<i>Hydropsyche (H.) depravata group</i>	0 +			
55300	<i>Ptilostomis sp</i>	0 +			
60900	<i>Peltodytes sp</i>	0 +			
67500	<i>Laccobius sp</i>	0 +			
67800	<i>Tropisternus sp</i>	0 +			
63900	<i>Laccophilus sp</i>	0 +			
68700	<i>Dubiraphia sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
71900	<i>Tipula sp</i>	0 +			
72700	<i>Anopheles sp</i>	0 +			
77355	<i>Clinotanytus pinguis</i>	0 +			
82730	<i>Chironomus (C.) decorus group</i>	0 +			
82820	<i>Cryptochironomus sp</i>	0 +			
84750	<i>Stictochironomus sp</i>	0 +			
85800	<i>Tanytarsus sp</i>	0 +			
74501	<i>Ceratopogonidae</i>	0 +			
87400	<i>Stratiomys sp</i>	0 +			
95100	<i>Physella sp</i>	0 +			

No. Quantitative Taxa: 0 Total Taxa: 27
 No. Qualitative Taxa: 27 ICI:
 Number of Organisms: 0 Qual EPT:

**Ohio EPA Water Quality Monitoring and Assessment Section
Macroinvertebrate Collection**

Collection Date: 09/27/94 River Code: 17-829 River: Coon Run

RM: 0.80 .

Taxa Code	Taxa	Quan/Qual	Taxa Code	Taxa	Quan/Qual
06201	<i>Hyalella azteca</i>	0 +			
08260	<i>Orconectes (Crockerinus) sanbornii</i>	0 +			
07800	<i>Cambarus sp</i>	0 +			
17200	<i>Caenis sp</i>	0 +			
18750	<i>Hexagenia limbata</i>	0 +			
21200	<i>Calopteryx sp</i>	0 +			
22001	<i>Coenagrionidae</i>	0 +			
22300	<i>Argia sp</i>	0 +			
28955	<i>Libellula lydia</i>	0 +			
45300	<i>Sigara sp</i>	0 +			
63300	<i>Hydroporus sp</i>	0 +			
68708	<i>Dubiraphia vittata group</i>	0 +			
71700	<i>Pilaria sp</i>	0 +			
71900	<i>Tipula sp</i>	0 +			
74100	<i>Simulium sp</i>	0 +			
77120	<i>Ablabesmyia mallochi</i>	0 +			
77355	<i>Clinotanypus pinguis</i>	0 +			
80410	<i>Cricotopus (C.) sp</i>	0 +			
83003	<i>Dicrotendipes fumidus</i>	0 +			
84315	<i>Phaenopsectra flavipes</i>	0 +			
84470	<i>Polypedilum (P.) illinoense</i>	0 +			
74501	<i>Ceratopogonidae</i>	0 +			
98600	<i>Sphaerium sp</i>	0 +			
96002	<i>Helisoma anceps anceps</i>	0 +			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	0 +			
86100	<i>Chrysops sp</i>	0 +			

No. Quantitative Taxa: 0 Total Taxa: 26
 No. Qualitative Taxa: 26 ICI:
 Number of Organisms: 0 Qual EPT:

APPENDIX TABLE A-3

Invertebrate Community Index (ICI) metrics and scores by river mile for locations sampled in the Wills Creek study area, 1994

Invertebrate Community Index (ICI) metrics and scores by river mile for locations sampled in the Wills Creek study area, 1994.

River Mile	Drainage Area (sq mi)	Number of				Percent:					Qual. EPT	Eco-region	ICI
		Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddisflies	Tany-tarsini	Other Dipt/NI	Tolerant Taxa			
WILLS CREEK — 17-800													
Year: 94													
75.80	281.0	27(4)	4(2)	5(6)	12(4)	43.0(6)	35.3(6)	7.9(2)	12.1(6)	1.1(6)	7(2)	4	44
70.20	287.0	33(4)	2(0)	1(2)	22(6)	1.3(2)	0.4(2)	1.7(2)	88.5(0)	42.4(0)	3(0)	4	18
68.10	292.0	24(4)	1(0)	1(2)	14(4)	0.9(2)	0.7(2)	1.5(2)	94.1(0)	11.9(0)	3(0)	4	16
67.20	313.0	19(2)	1(0)	1(2)	11(4)	4.3(2)	0.3(2)	0.7(2)	90.8(0)	28.0(0)	0(0)	4	14
66.70	313.0	42(6)	1(0)	3(4)	24(6)	2.1(2)	1.9(2)	2.1(2)	92.5(0)	13.3(0)	4(0)	4	22
64.10	407.0	38(6)	5(2)	5(4)	17(6)	34.8(6)	44.8(6)	4.4(2)	14.9(6)	2.3(6)	7(2)	4	46
62.70	408.0	20(2)	1(0)	1(2)	13(4)	0.2(2)	3.2(2)	2.6(2)	93.1(0)	52.7(0)	2(0)	4	14
62.20	407.0	25(4)	0(0)	1(2)	14(4)	0.0(0)	2.1(2)	1.3(2)	95.6(0)	63.1(0)	1(0)	4	14
61.50	408.0	23(2)	1(0)	1(2)	14(4)	0.1(2)	0.9(2)	0.6(2)	97.6(0)	51.4(0)	1(0)	4	14
61.30	408.0	23(2)	1(0)	2(2)	11(4)	0.1(2)	1.6(2)	1.0(2)	96.5(0)	53.7(0)	1(0)	4	14
60.10	409.0	38(6)	1(0)	3(4)	21(6)	0.1(2)	2.0(2)	7.4(2)	89.2(0)	33.5(0)	3(0)	4	22
58.60	472.0	33(4)	3(2)	5(4)	15(6)	2.1(2)	13.1(2)	7.8(2)	74.9(0)	18.9(0)	1(0)	4	22
57.40	472.0	38(6)	4(2)	5(4)	20(6)	2.1(2)	27.9(6)	9.8(2)	56.0(0)	12.4(0)	7(2)	4	30
53.50	486.0	33(4)	5(2)	4(4)	11(4)	4.1(2)	75.2(6)	3.6(2)	12.7(6)	4.1(4)	10(2)	4	36
45.40	557.0	40(6)	7(4)	6(6)	19(6)	30.2(6)	50.9(6)	5.5(2)	12.2(6)	1.3(6)	8(2)	4	50
37.70	671.0	31(4)	6(4)	7(6)	14(6)	33.3(6)	42.7(6)	12.9(2)	9.4(6)	0.6(6)	13(4)	4	50
27.60	738.0	34(4)	6(4)	7(6)	11(4)	38.8(6)	41.6(6)	9.1(2)	9.9(6)	1.7(6)	12(4)	4	48
5.20	842.0	38(6)	5(2)	11(6)	7(2)	5.6(2)	78.9(6)	7.1(2)	8.3(6)	0.4(6)	17(6)	4	44
CHAPMAN RUN — 17-817													
Year: 94													
0.40	19.3	28(4)	2(0)	0(0)	17(4)	3.4(2)	0.0(0)	17.2(4)	77.9(0)	40.3(0)	2(0)	4	14

APPENDIX TABLE A-4

Fish catch summary by river mile (RM) from the Wills Creek study area, 1994

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 75.70	Basin: Muskingum River	Date Range: 08/08/94
Data Source: 01	Time Fished: 3410 sec Drain Area: 281.0 sq mi	Thru: 09/13/94
Purpose:	Dist Fished: 1.00 km No of Passes: 2	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		5	5.00	6.58	0.26	0.79	52.40
QUILLBACK CARPSUCKER	C	O	M		1	1.00	1.32	1.20	3.63	1,200.00
SILVER REDHORSE	R	I	S	M	5	5.00	6.58	4.37	13.21	873.00
GOLDEN REDHORSE	R	I	S	M	21	21.00	27.63	6.22	18.82	296.24
NORTHERN HOG SUCKER	R	I	S	M	3	3.00	3.95	0.27	0.82	90.67
COMMON CARP	G	O	M	T	11	11.00	14.47	13.44	40.67	1,222.00
SPOTFIN SHINER	N	I	M		11	11.00	14.47	0.03	0.10	3.09
CHANNEL CATFISH	F		C		8	8.00	10.53	6.82	20.63	852.50
TROUT-PERCH		I	M		1	1.00	1.32	0.01	0.03	10.00
SMALLMOUTH BASS	F	C	C	M	1	1.00	1.32	0.09	0.28	92.00
BLUEGILL SUNFISH	S	I	C	P	1	1.00	1.32	0.00	0.00	1.00
LOGPERCH	D	I	S	M	3	3.00	3.95	0.01	0.03	3.00
SAUGER X WALLEYE	E	P			5	5.00	6.58	0.33	0.98	65.00
<i>Mile Total</i>					76	76.00		33.05		
<i>Number of Species</i>					12					
<i>Number of Hybrids</i>					1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 70.40	Basin: Muskingum River	Date Range: 08/09/94
Data Source: 01	Time Fished: 4811 sec Drain Area: 287.0 sq mi	Thru: 10/05/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		3	2.00	3.57	0.20	0.44	99.67
QUILLBACK CARPSUCKER	C	O	M		15	10.00	17.86	9.50	20.90	950.33
SILVER REDHORSE	R	I	S	M	9	6.00	10.71	6.66	14.66	1,110.67
GOLDEN REDHORSE	R	I	S	M	3	2.00	3.57	0.50	1.11	252.33
COMMON CARP	G	O	M	T	24	16.00	28.57	23.98	52.74	1,498.46
SPOTFIN SHINER	N	I	M		1	0.67	1.19	0.00	0.00	3.00
BLUNTNOSE MINNOW	N	O	C	T	1	0.67	1.19	0.00	0.00	1.00
COM. CARP X GOLDFISH	G	O		T	1	0.67	1.19	0.46	1.01	690.00
CHANNEL CATFISH	F		C		4	2.67	4.76	1.87	4.12	702.75
YELLOW BULLHEAD		I	C	T	1	0.67	1.19	0.14	0.30	205.00
FLATHEAD CATFISH	F	P	C		3	2.00	3.57	1.16	2.55	580.00
BRINDLED MADTOM		I	C	I	1	0.67	1.19	0.00	0.01	6.00
WHITE CRAPPIE	S	I	C		3	2.00	3.57	0.11	0.24	55.33
BLACK CRAPPIE	S	I	C		1	0.67	1.19	0.02	0.04	30.00
ROCK BASS	S	C	C		2	1.33	2.38	0.30	0.66	225.50
LARGEMOUTH BASS	F	C	C		1	0.67	1.19	0.03	0.07	51.00
WARMOUTH SF	S	C	C		2	1.33	2.38	0.03	0.07	25.00
BLUEGILL SUNFISH	S	I	C	P	2	1.33	2.38	0.01	0.03	9.50
OR'GESPOTTED SUNFISH	S	I	C		1	0.67	1.19	0.01	0.01	8.00
SAUGER X WALLEYE	E	P			6	4.00	7.14	0.46	1.02	115.50
<i>Mile Total</i>					84	56.00		45.46		
<i>Number of Species</i>					18					
<i>Number of Hybrids</i>					2					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 69.40	Basin: Muskingum River	Date Range: 08/08/94
Data Source: 01	Time Fished: 5445 sec Drain Area: 291.0 sq mi	Thru: 10/05/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		31	20.67	28.70	2.47	5.58	119.32
QUILLBACK CARPSUCKER	C	O	M		12	8.00	11.11	8.18	18.51	1,022.50
SILVER REDHORSE	R	I	S	M	12	8.00	11.11	8.31	18.80	1,038.67
GOLDEN REDHORSE	R	I	S	M	7	4.67	6.48	2.44	5.52	523.14
NORTHERN HOG SUCKER	R	I	S	M	2	1.33	1.85	0.04	0.08	26.50
COMMON CARP	G	O	M	T	17	11.33	15.74	18.41	41.64	1,624.00
SPOTFIN SHINER	N	I	M		3	2.00	2.78	0.00	0.01	1.67
BLUNTNOSE MINNOW	N	O	C	T	1	0.67	0.93	0.00	0.00	1.00
CHANNEL CATFISH	F		C		6	4.00	5.56	2.93	6.64	733.67
FLATHEAD CATFISH	F	P	C		1	0.67	0.93	0.00	0.01	4.00
TROUT-PERCH		I	M		4	2.67	3.70	0.01	0.02	3.25
WHITE CRAPPIE	S	I	C		1	0.67	0.93	0.05	0.10	69.00
SMALLMOUTH BASS	F	C	C	M	1	0.67	0.93	0.05	0.12	79.00
WARMOUTH SF	S	C	C		1	0.67	0.93	0.00	0.00	1.00
OR'GESPOTTED SUNFISH	S	I	C		1	0.67	0.93	0.00	0.01	4.00
LOGPERCH	D	I	S	M	2	1.33	1.85	0.00	0.00	1.50
SAUGER X WALLEYE	E	P			6	4.00	5.56	1.31	2.96	327.33
<i>Mile Total</i>					108	72.00		44.20		
<i>Number of Species</i>					16					
<i>Number of Hybrids</i>					1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 67.30	Basin: Muskingum River	Date Range: 08/09/94
Data Source: 01	Time Fished: 7439 sec Drain Area: 313.0 sq mi	Thru: 10/05/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		16	10.67	11.51	0.95	1.93	89.31
QUILLBACK CARPSUCKER	C	O	M		12	8.00	8.63	7.16	14.54	895.17
COMMON CARP	G	O	M	T	39	26.00	28.06	36.62	74.36	1,408.55
CREEK CHUB	N	G	N	T	1	0.67	0.72	0.00	0.00	2.00
SPOTFIN SHINER	N	I	M		2	1.33	1.44	0.01	0.01	4.00
BLUNTNOSE MINNOW	N	O	C	T	8	5.33	5.76	0.00	0.01	0.88
FLATHEAD CATFISH	F	P	C		2	1.33	1.44	2.42	4.92	1,817.00
WHITE CRAPPIE	S	I	C		2	1.33	1.44	0.08	0.16	58.50
WARMOUTH SF	S	C	C		4	2.67	2.88	0.15	0.30	56.00
GREEN SUNFISH	S	I	C	T	12	8.00	8.63	0.06	0.12	7.67
BLUEGILL SUNFISH	S	I	C	P	9	6.00	6.47	0.06	0.12	9.67
OR'GESPOTTED SUNFISH	S	I	C		23	15.33	16.55	0.04	0.08	2.48
GREEN SF X BLUEGILL					2	1.33	1.44	0.03	0.05	20.00
GREEN SF X HYBRID					1	0.67	0.72	0.02	0.04	32.00
SAUGER X WALLEYE	E	P			6	4.00	4.32	1.65	3.35	412.50
<i>Mile Total</i>					139	92.67		49.25		
<i>Number of Species</i>					12					
<i>Number of Hybrids</i>					3					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 66.60	Basin: Muskingum River	Date Range: 08/09/94
Data Source: 01	Time Fished: 5844 sec Drain Area: 314.0 sq mi	Thru: 10/04/94
Purpose:	Dist Fished: 1.46 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M	19	13.07	14.40	1.09	1.88	82.47
QUILLBACK CARPSUCKER	C	O	M	13	9.07	10.00	7.40	12.75	819.31
SILVER REDHORSE	R	I	S M	12	8.17	9.01	7.07	12.19	861.75
GOLDEN REDHORSE	R	I	S M	9	6.29	6.93	3.66	6.30	579.22
COMMON CARP	G	O	M T	29	19.62	21.62	28.64	49.34	1,459.48
GOLDFISH	G	O	M T	1	0.67	0.73	0.22	0.38	331.00
SPOTFIN SHINER	N	I	M	9	6.00	6.61	0.01	0.02	2.00
BLUNTNOSE MINNOW	N	O	C T	2	1.39	1.53	0.00	0.00	2.00
CHANNEL CATFISH	F		C	10	6.84	7.54	5.25	9.04	773.00
FLATHEAD CATFISH	F	P	C	2	1.33	1.47	1.16	2.01	873.50
BRINDLED MADTOM		I	C I	1	0.67	0.73	0.00	0.00	3.00
WHITE BASS	F	P	M	1	0.67	0.73	0.11	0.18	160.00
WHITE CRAPPIE	S	I	C	10	6.67	7.35	1.65	2.84	247.60
WARMOUTH SF	S	C	C	2	1.33	1.47	0.11	0.19	81.50
BLUEGILL SUNFISH	S	I	C P	4	2.84	3.13	0.12	0.21	41.50
LOGPERCH	D	I	S M	1	0.67	0.73	0.00	0.00	3.00
SAUGER X WALLEYE	E	P		8	5.45	6.00	1.54	2.66	288.25
<i>Mile Total</i>				133	90.75		58.04		
<i>Number of Species</i>				16					
<i>Number of Hybrids</i>				1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 64.70	Basin: Muskingum River	Date Range: 08/09/94
Data Source: 01	Time Fished: 3929 sec Drain Area: 407.0 sq mi	Thru: 10/04/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		18	12.00	11.32	1.17	2.67	97.50
QUILLBACK CARPSUCKER	C	O	M		4	2.67	2.52	1.28	2.93	481.25
SILVER REDHORSE	R	I	S	M	14	9.33	8.81	7.28	16.63	780.21
GOLDEN REDHORSE	R	I	S	M	8	5.33	5.03	1.88	4.29	352.50
COMMON CARP	G	O	M	T	15	10.00	9.43	18.67	42.64	1,866.67
REDFIN SHINER	N	I	N		1	0.67	0.63	0.00	0.00	2.00
SPOTFIN SHINER	N	I	M		14	9.33	8.81	0.03	0.06	2.79
BLUNTNOSE MINNOW	N	O	C	T	15	10.00	9.43	0.01	0.03	1.47
CHANNEL CATFISH	F		C		8	5.33	5.03	4.60	10.50	861.63
FLATHEAD CATFISH	F	P	C		2	1.33	1.26	0.80	1.82	598.00
WHITE BASS	F	P	M		2	1.33	1.26	0.49	1.13	370.00
WHITE CRAPPIE	S	I	C		6	4.00	3.77	0.36	0.83	90.50
BLACK CRAPPIE	S	I	C		1	0.67	0.63	0.04	0.10	65.00
ROCK BASS	S	C	C		15	10.00	9.43	0.97	2.22	97.40
SMALLMOUTH BASS	F	C	C	M	10	6.67	6.29	4.82	11.00	722.60
WARMOUTH SF	S	C	C		1	0.67	0.63	0.01	0.03	20.00
GREEN SUNFISH	S	I	C	T	6	4.00	3.77	0.03	0.08	8.67
BLUEGILL SUNFISH	S	I	C	P	5	3.33	3.14	0.13	0.29	38.40
OR'GESPOTTED SUNFISH	S	I	C		5	3.33	3.14	0.04	0.08	10.60
LOGPERCH	D	I	S	M	2	1.33	1.26	0.00	0.01	2.00
SAUGER X WALLEYE	E	P			7	4.67	4.40	1.16	2.64	247.71
<i>Mile Total</i>					159	106.00		43.78		
<i>Number of Species</i>					20					
<i>Number of Hybrids</i>					1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 62.40	Basin: Muskingum River	Date Range: 08/09/94
Data Source: 01	Time Fished: 6929 sec Drain Area: 408.0 sq mi	Thru: 10/03/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		28	18.67	11.67	2.12	4.55	113.68
QUILLBACK CARPSUCKER	C	O	M		7	4.67	2.92	3.53	7.56	755.43
SILVER REDHORSE	R	I	S	M	14	9.33	5.83	8.23	17.66	882.14
GOLDEN REDHORSE	R	I	S	M	2	1.33	0.83	0.18	0.39	138.00
NORTHERN HOG SUCKER	R	I	S	M	15	10.00	6.25	0.35	0.75	35.07
COMMON CARP	G	O	M	T	23	15.33	9.58	26.15	56.08	1,705.43
SPOTFIN SHINER	N	I	M		21	14.00	8.75	0.03	0.06	2.08
BLUNTNOSE MINNOW	N	O	C	T	83	55.33	34.58	0.08	0.17	1.45
CHANNEL CATFISH	F		C		6	4.00	2.50	3.91	8.38	976.67
TROUT-PERCH		I	M		3	2.00	1.25	0.01	0.02	5.00
WHITE BASS	F	P	M		1	0.67	0.42	0.16	0.34	235.00
WHITE CRAPPIE	S	I	C		1	0.67	0.42	0.02	0.04	25.00
ROCK BASS	S	C	C		5	3.33	2.08	0.09	0.19	26.00
SMALLMOUTH BASS	F	C	C	M	2	1.33	0.83	0.08	0.17	58.50
LARGEMOUTH BASS	F	C	C		1	0.67	0.42	0.01	0.02	11.00
WARMOUTH SF	S	C	C		1	0.67	0.42	0.07	0.14	98.00
GREEN SUNFISH	S	I	C	T	2	1.33	0.83	0.01	0.01	4.00
BLUEGILL SUNFISH	S	I	C	P	4	2.67	1.67	0.07	0.15	26.75
OR'GESPOTTED SUNFISH	S	I	C		7	4.67	2.92	0.03	0.06	5.71
LOGPERCH	D	I	S	M	3	2.00	1.25	0.02	0.04	10.33
GREENSIDE DARTER	D	I	S	M	3	2.00	1.25	0.00	0.01	2.33
SAUGER X WALLEYE	E	P			8	5.33	3.33	1.50	3.22	281.63
<i>Mile Total</i>					240	160.00		46.63		
<i>Number of Species</i>					21					
<i>Number of Hybrids</i>					1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 61.90	Basin: Muskingum River	Date Range: 08/10/94
Data Source: 01	Time Fished: 7289 sec Drain Area: 408.0 sq mi	Thru: 10/02/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		16	10.67	8.47	0.82	1.23	76.94
QUILLBACK CARPSUCKER	C	O	M		32	21.33	16.93	22.70	34.08	1,064.13
SILVER REDHORSE	R	I	S	M	15	10.00	7.94	11.88	17.84	1,188.11
COMMON CARP	G	O	M	T	25	16.67	13.23	27.93	41.94	1,676.00
SPOTFIN SHINER	N	I	M		36	24.00	19.05	0.05	0.08	2.19
BLUNTNOSE MINNOW	N	O	C	T	23	15.33	12.17	0.01	0.02	0.96
CHANNEL CATFISH	F		C		3	2.00	1.59	1.35	2.03	677.00
TROUT-PERCH		I	M		4	2.67	2.12	0.01	0.01	3.25
BLACK CRAPPIE	S	I	C		1	0.67	0.53	0.03	0.05	50.00
ROCK BASS	S	C	C		2	1.33	1.06	0.11	0.17	85.00
LARGEMOUTH BASS	F	C	C		1	0.67	0.53	0.39	0.59	590.00
WARMOUTH SF	S	C	C		2	1.33	1.06	0.06	0.10	48.00
GREEN SUNFISH	S	I	C	T	4	2.67	2.12	0.02	0.03	8.25
BLUEGILL SUNFISH	S	I	C	P	4	2.67	2.12	0.03	0.04	10.25
OR'GESPOTTED SUNFISH	S	I	C		8	5.33	4.23	0.01	0.02	2.75
GREEN SF X HYBRID					1	0.67	0.53	0.01	0.01	10.00
LOGPERCH	D	I	S	M	2	1.33	1.06	0.00	0.00	2.00
SAUGER X WALLEYE	E	P			10	6.67	5.29	1.16	1.74	174.20
<i>Mile Total</i>					189	126.00		66.61		
<i>Number of Species</i>					16					
<i>Number of Hybrids</i>					2					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 61.50	Basin: Muskingum River	Date Range: 08/10/94
Data Source: 01	Time Fished: 2764 sec Drain Area: 408.0 sq mi	Thru: 10/03/94
Purpose:	Dist Fished: 0.30 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M	1	3.33	1.37	0.26	0.27	77.00
QUILLBACK CARPSUCKER	C	O	M	3	10.00	4.11	12.02	12.60	1,201.67
SILVER REDHORSE	R	I	S M	4	13.33	5.48	14.53	15.24	1,090.00
GOLDEN REDHORSE	R	I	S M	1	3.33	1.37	1.79	1.88	538.00
NORTHERN HOG SUCKER	R	I	S M	5	16.67	6.85	2.97	3.12	178.40
COMMON CARP	G	O	M T	7	23.33	9.59	49.67	52.08	2,128.57
SPOTFIN SHINER	N	I	M	25	83.33	34.25	0.20	0.21	2.44
BLUNTNOSE MINNOW	N	O	C T	8	26.67	10.96	0.02	0.02	0.88
CENTRAL STONEROLLER	N	H	N	2	6.67	2.74	0.02	0.02	2.50
CHANNEL CATFISH	F		C	4	13.33	5.48	8.85	9.28	663.75
ROCK BASS	S	C	C	1	3.33	1.37	0.53	0.56	160.00
SMALLMOUTH BASS	F	C	C M	1	3.33	1.37	0.24	0.25	72.00
LOGPERCH	D	I	S M	4	13.33	5.48	0.09	0.09	6.75
JOHNNY DARTER	D	I	C	1	3.33	1.37	0.00	0.00	1.00
GREENSIDE DARTER	D	I	S M	1	3.33	1.37	0.02	0.02	7.00
SAUGER X WALLEYE	E	P		5	16.67	6.85	4.14	4.34	248.60
<i>Mile Total</i>				73	243.33		95.37		
<i>Number of Species</i>				15					
<i>Number of Hybrids</i>				1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 61.40	Basin: Muskingum River	Date Range: 08/10/94
Data Source: 01	Time Fished: 8649 sec Drain Area: 409.0 sq mi	Thru: 10/03/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M	20	13.33	7.66	2.06	3.45	154.65
QUILLBACK CARPSUCKER	C	O	M	4	2.67	1.53	1.51	2.53	566.75
SILVER REDHORSE	R	I	S M	20	13.33	7.66	16.07	26.88	1,205.15
GOLDEN REDHORSE	R	I	S M	1	0.67	0.38	0.38	0.63	565.00
COMMON CARP	G	O	M T	29	19.33	11.11	27.39	45.82	1,416.84
SPOTFIN SHINER	N	I	M	56	37.33	21.46	0.08	0.14	2.25
BLUNTNOSE MINNOW	N	O	C T	57	38.00	21.84	0.03	0.06	0.91
CHANNEL CATFISH	F		C	20	13.33	7.66	9.02	15.09	676.85
FLATHEAD CATFISH	F	P	C	3	2.00	1.15	0.95	1.60	477.00
WHITE CRAPPIE	S	I	C	1	0.67	0.38	0.00	0.00	1.00
ROCK BASS	S	C	C	9	6.00	3.45	0.61	1.02	101.44
SMALLMOUTH BASS	F	C	C M	1	0.67	0.38	0.05	0.08	72.00
LARGEMOUTH BASS	F	C	C	1	0.67	0.38	0.01	0.02	18.00
WARMOUTH SF	S	C	C	1	0.67	0.38	0.05	0.08	69.00
GREEN SUNFISH	S	I	C T	8	5.33	3.07	0.07	0.11	12.50
BLUEGILL SUNFISH	S	I	C P	4	2.67	1.53	0.02	0.04	8.50
OR'GESPOTTED SUNFISH	S	I	C	5	3.33	1.92	0.02	0.04	7.40
GREEN SF X BLUEGILL				1	0.67	0.38	0.01	0.02	20.00
LOGPERCH	D	I	S M	7	4.67	2.68	0.02	0.03	4.29
GREENSIDE DARTER	D	I	S M	3	2.00	1.15	0.01	0.01	3.00
SAUGER X WALLEYE	E	P		10	6.67	3.83	1.41	2.36	211.50
<i>Mile Total</i>				261	174.00		59.79		
<i>Number of Species</i>				19					
<i>Number of Hybrids</i>				2					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 59.40	Basin: Muskingum River	Date Range: 08/10/94
Data Source: 01	Time Fished: 7102 sec Drain Area: 470.0 sq mi	Thru: 10/03/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M	13	8.67	5.94	1.24	2.12	142.69
QUILLBACK CARPSUCKER	C	O	M	8	5.33	3.65	4.15	7.11	778.13
SILVER REDHORSE	R	I	S M	22	14.67	10.05	13.04	22.32	888.82
GOLDEN REDHORSE	R	I	S M	31	20.67	14.16	10.52	18.02	509.26
NORTHERN HOG SUCKER	R	I	S M	8	5.33	3.65	0.10	0.18	19.25
COMMON CARP	G	O	M T	15	10.00	6.85	11.30	19.35	1,130.00
GOLDFISH	G	O	M T	1	0.67	0.46	0.00	0.00	2.00
SPOTFIN SHINER	N	I	M	22	14.67	10.05	0.04	0.06	2.50
BLUNTNOSE MINNOW	N	O	C T	22	14.67	10.05	0.01	0.02	0.82
CHANNEL CATFISH	F		C	31	20.67	14.16	15.22	26.06	736.29
FLATHEAD CATFISH	F	P	C	3	2.00	1.37	1.26	2.16	631.33
BRINDLED MADTOM		I	C I	1	0.67	0.46	0.00	0.00	4.00
TROUT-PERCH		I	M	3	2.00	1.37	0.01	0.01	2.67
WHITE CRAPPIE	S	I	C	1	0.67	0.46	0.09	0.16	142.00
ROCK BASS	S	C	C	7	4.67	3.20	0.30	0.51	63.57
GREEN SUNFISH	S	I	C T	1	0.67	0.46	0.00	0.01	7.00
BLUEGILL SUNFISH	S	I	C P	1	0.67	0.46	0.03	0.05	40.00
OR'GESPOTTED SUNFISH	S	I	C	6	4.00	2.74	0.02	0.04	5.33
REDEAR SUNFISH	E	I	C	1	0.67	0.46	0.01	0.02	20.00
YELLOW PERCH			M	1	0.67	0.46	0.00	0.01	5.00
LOGPERCH	D	I	S M	4	2.67	1.83	0.01	0.02	3.50
JOHNNY DARTER	D	I	C	1	0.67	0.46	0.00	0.00	1.00
GREENSIDE DARTER	D	I	S M	5	3.33	2.28	0.01	0.01	1.80
SAUGER X WALLEYE	E	P		11	7.33	5.02	1.03	1.77	140.82
<i>Mile Total</i>				219	146.00		58.40		
<i>Number of Species</i>				23					
<i>Number of Hybrids</i>				1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 57.10	Basin: Muskingum River	Date Range: 08/11/94
Data Source: 01	Time Fished: 4140 sec Drain Area: 472.0 sq mi	Thru: 09/15/94
Purpose:	Dist Fished: 0.41 km No of Passes: 2	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M	7	5.04	0.94	0.44	2.43	86.57
QUILLBACK CARPSUCKER	C	O	M	2	1.43	0.27	0.00	0.01	1.00
SILVER REDHORSE	R	I	S M	1	0.71	0.13	1.21	6.75	1,690.00
GOLDEN REDHORSE	R	I	S M	4	2.93	0.54	0.83	4.62	280.25
NORTHERN HOG SUCKER	R	I	S M	48	35.11	6.52	1.89	10.58	53.42
COMMON CARP	G	O	M T	3	2.14	0.40	4.29	23.97	2,000.67
CREEK CHUB	N	G	N T	2	1.46	0.27	0.00	0.01	1.50
REDFIN SHINER	N	I	N	1	0.71	0.13	0.00	0.00	1.00
SPOTFIN SHINER	N	I	M	123	88.82	16.50	0.20	1.09	2.20
SAND SHINER	N	I	M M	16	11.82	2.20	0.01	0.08	1.13
SILVERJAW MINNOW	N	I	M	1	0.71	0.13	0.00	0.00	1.00
BLUNTNOSE MINNOW	N	O	C T	441	317.32	58.96	0.35	1.95	1.10
CHANNEL CATFISH	F		C	20	14.54	2.70	6.23	34.85	428.85
FLATHEAD CATFISH	F	P	C	7	5.04	0.94	1.21	6.76	241.14
STONECAT MADTOM		I	C I	1	0.71	0.13	0.01	0.06	14.00
BRINDLED MADTOM		I	C I	1	0.71	0.13	0.00	0.02	4.00
ROCK BASS	S	C	C	6	4.36	0.81	0.11	0.63	25.83
LARGEMOUTH BASS	F	C	C	2	1.43	0.27	0.01	0.05	6.00
GREEN SUNFISH	S	I	C T	1	0.71	0.13	0.00	0.00	1.00
BLUEGILL SUNFISH	S	I	C P	1	0.71	0.13	0.01	0.08	20.00
OR'GESPOTTED SUNFISH	S	I	C	4	2.86	0.53	0.02	0.11	7.00
LOGPERCH	D	I	S M	7	5.14	0.96	0.05	0.28	9.57
JOHNNY DARTER	D	I	C	3	2.14	0.40	0.00	0.00	0.33
GREENSIDE DARTER	D	I	S M	33	24.32	4.52	0.06	0.34	2.53
SAUGER X WALLEYE	E	P		10	7.29	1.35	0.95	5.33	129.60
<i>Mile Total</i>				745	538.18		17.89		
<i>Number of Species</i>				24					
<i>Number of Hybrids</i>				1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 53.40	Basin: Muskingum River	Date Range: 08/11/94
Data Source: 01	Time Fished: 6207 sec Drain Area: 486.0 sq mi	Thru: 10/04/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
LEAST BROOK LAMPREY		F	N	2	1.33	0.78	0.02	0.03	16.50
GIZZARD SHAD		O	M	15	10.00	5.88	1.22	1.74	121.60
QUILLBACK CARPSUCKER	C	O	M	6	4.00	2.35	4.32	6.19	1,079.17
SILVER REDHORSE	R	I	S M	28	18.67	10.98	19.28	27.66	1,033.04
GOLDEN REDHORSE	R	I	S M	19	12.67	7.45	5.77	8.27	455.37
NORTHERN HOG SUCKER	R	I	S M	9	6.00	3.53	0.31	0.45	52.44
COMMON CARP	G	O	M T	24	16.00	9.41	22.80	32.70	1,424.85
SPOTFIN SHINER	N	I	M	53	35.33	20.78	0.08	0.12	2.30
SAND SHINER	N	I	M M	10	6.67	3.92	0.01	0.01	1.50
BLUNTNOSE MINNOW	N	O	C T	28	18.67	10.98	0.04	0.06	2.35
CHANNEL CATFISH	F		C	27	18.00	10.59	10.08	14.47	560.26
FLATHEAD CATFISH	F	P	C	1	0.67	0.39	0.35	0.50	520.00
TROUT-PERCH		I	M	4	2.67	1.57	0.02	0.03	7.25
STRIPED BASS	E	P	M	1	0.67	0.39	1.47	2.10	2,200.00
BLACK CRAPPIE	S	I	C	2	1.33	0.78	0.03	0.04	19.50
ROCK BASS	S	C	C	2	1.33	0.78	0.05	0.08	40.00
SMALLMOUTH BASS	F	C	C M	1	0.67	0.39	0.11	0.16	171.00
BLUEGILL SUNFISH	S	I	C P	2	1.33	0.78	0.01	0.02	8.00
OR'GESPOTTED SUNFISH	S	I	C	4	2.67	1.57	0.02	0.02	6.00
GREENSIDE DARTER	D	I	S M	2	1.33	0.78	0.00	0.00	1.50
SAUGER X WALLEYE	E	P		15	10.00	5.88	3.72	5.33	371.87
<i>Mile Total</i>				255	170.00		69.71		
<i>Number of Species</i>				20					
<i>Number of Hybrids</i>				1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 46.80	Basin: Muskingum River	Date Range: 08/11/94
Data Source: 01	Time Fished: 7370 sec Drain Area: 554.0 sq mi	Thru: 10/04/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI	Feed Grp	Breed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
LEAST BROOK LAMPREY		F	N			1	0.67	0.49	0.01	0.01	8.00
GIZZARD SHAD		O	M			4	2.67	1.95	0.27	0.53	103.00
QUILLBACK CARPSUCKER	C	O	M			4	2.67	1.95	2.55	4.95	956.25
SILVER REDHORSE	R	I	S	M		20	13.33	9.76	9.44	18.35	708.35
COMMON CARP	G	O	M	T		26	17.33	12.68	26.15	50.80	1,508.65
SPOTFIN SHINER	N	I	M			62	41.33	30.24	0.08	0.15	1.82
SAND SHINER	N	I	M	M		1	0.67	0.49	0.00	0.00	1.00
BLUNTNOSE MINNOW	N	O	C	T		12	8.00	5.85	0.01	0.02	1.58
CHANNEL CATFISH	F		C			23	15.33	11.22	8.73	16.97	569.57
FLATHEAD CATFISH	F	P	C			6	4.00	2.93	3.63	7.06	908.00
TROUT-PERCH		I	M			1	0.67	0.49	0.00	0.01	5.00
BLACK CRAPPIE	S	I	C			1	0.67	0.49	0.09	0.17	130.00
ROCK BASS	S	C	C			2	1.33	0.98	0.04	0.08	31.50
WARMOUTH SF	S	C	C			2	1.33	0.98	0.00	0.01	3.00
GREEN SUNFISH	S	I	C	T		1	0.67	0.49	0.02	0.03	26.00
BLUEGILL SUNFISH	S	I	C	P		2	1.33	0.98	0.00	0.00	1.00
OR'GESPOTTED SUNFISH	S	I	C			30	20.00	14.63	0.12	0.23	5.90
YELLOW PERCH			M			1	0.67	0.49	0.00	0.01	7.00
LOGPERCH	D	I	S	M		2	1.33	0.98	0.00	0.01	2.00
SAUGER X WALLEYE	E	P				4	2.67	1.95	0.32	0.62	118.75
<i>Mile Total</i>						205	136.67		51.48		
<i>Number of Species</i>						19					
<i>Number of Hybrids</i>						1					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 38.00	Basin: Muskingum River	Date Range: 08/16/94
Data Source: 01	Time Fished: 6220 sec Drain Area: 671.0 sq mi	Thru: 10/04/94
Purpose:	Dist Fished: 1.51 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		37	24.39	20.98	1.41	3.96	57.46
QUILLBACK CARPSUCKER	C	O	M		1	0.67	0.57	0.07	0.19	100.00
SILVER REDHORSE	R	I	S	M	22	14.64	12.59	11.44	32.15	780.50
GOLDEN REDHORSE	R	I	S	M	10	6.64	5.71	2.43	6.84	366.80
NORTHERN HOG SUCKER	R	I	S	M	2	1.31	1.12	0.06	0.17	47.00
COMMON CARP	G	O	M	T	14	9.28	7.98	12.72	35.76	1,369.86
SPOTFIN SHINER	N	I	M		21	13.83	11.90	0.01	0.04	0.95
BLUNTNOSE MINNOW	N	O	C	T	2	1.31	1.12	0.00	0.00	0.50
CHANNEL CATFISH	F		C		13	8.63	7.42	3.52	9.88	407.08
FLATHEAD CATFISH	F	P	C		2	1.33	1.15	0.27	0.77	206.00
TROUT-PERCH		I	M		2	1.33	1.15	0.00	0.01	3.50
WHITE BASS	F	P	M		1	0.67	0.57	0.15	0.42	226.00
WHITE CRAPPIE	S	I	C		1	0.65	0.56	0.06	0.17	91.00
BLACK CRAPPIE	S	I	C		4	2.64	2.27	0.17	0.47	63.75
LARGEMOUTH BASS	F	C	C		1	0.65	0.56	0.31	0.87	472.00
GREEN SUNFISH	S	I	C	T	9	5.90	5.07	0.08	0.22	13.22
BLUEGILL SUNFISH	S	I	C	P	20	13.14	11.30	0.83	2.34	63.15
OR'GESPOTTED SUNFISH	S	I	C		2	1.32	1.14	0.01	0.02	4.50
LONGEAR SF X B'GILL					1	0.67	0.57	0.06	0.18	94.00
GREEN SF X HYBRID					2	1.31	1.12	0.05	0.13	35.00
SAUGER	F	P	S		1	0.67	0.57	0.68	1.92	1,025.00
SAUGER X WALLEYE	E	P			8	5.28	4.54	1.24	3.49	234.38
<i>Mile Total</i>					176	116.25		35.57		
<i>Number of Species</i>					19					
<i>Number of Hybrids</i>					3					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 27.40	Basin: Muskingum River	Date Range: 08/16/94
Data Source: 01	Time Fished: 6994 sec Drain Area: 738.0 sq mi	Thru: 10/04/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M	8	5.33	4.94	0.39	0.75	72.38
QUILLBACK CARPSUCKER	C	O	M	6	4.00	3.70	3.00	5.84	750.00
SILVER REDHORSE	R	I	S M	21	14.00	12.96	7.83	15.23	558.94
GOLDEN REDHORSE	R	I	S M	2	1.33	1.23	0.98	1.90	732.50
COMMON CARP	G	O	M T	39	26.00	24.07	31.49	61.30	1,211.10
SPOTFIN SHINER	N	I	M	16	10.67	9.88	0.01	0.02	0.75
BLUNTNOSE MINNOW	N	O	C T	1	0.67	0.62	0.00	0.00	1.00
CHANNEL CATFISH	F		C	11	7.33	6.79	3.45	6.72	470.45
FLATHEAD CATFISH	F	P	C	3	2.00	1.85	0.68	1.32	339.33
TROUT-PERCH		I	M	11	7.33	6.79	0.02	0.03	2.09
BROOK SILVERSIDE		I	M M	2	1.33	1.23	0.00	0.00	1.00
WHITE BASS	F	P	M	2	1.33	1.23	0.25	0.49	190.50
WHITE CRAPPIE	S	I	C	7	4.67	4.32	0.65	1.26	138.29
WARMOUTH SF	S	C	C	1	0.67	0.62	0.00	0.00	2.00
GREEN SUNFISH	S	I	C T	10	6.67	6.17	0.03	0.06	4.90
BLUEGILL SUNFISH	S	I	C P	5	3.33	3.09	0.23	0.46	70.40
OR'GESPOTTED SUNFISH	S	I	C	4	2.67	2.47	0.01	0.03	5.50
GREEN SF X BLUEGILL				1	0.67	0.62	0.01	0.01	9.00
LOGPERCH	D	I	S M	4	2.67	2.47	0.01	0.01	2.50
JOHNNY DARTER	D	I	C	2	1.33	1.23	0.00	0.00	0.50
SAUGER X WALLEYE	E	P		6	4.00	3.70	2.34	4.56	586.00
<i>Mile Total</i>				162	108.00		51.37		
<i>Number of Species</i>				19					
<i>Number of Hybrids</i>				2					

Species List

River Code: 17-800	Stream: Wills Creek	Sample Date: 1994
River Mile: 0.30	Basin: Muskingum River	Date Range: 07/27/94
Data Source: 01	Time Fished: 6682 sec Drain Area: 853.0 sq mi	Thru: 09/22/94
Purpose:	Dist Fished: 1.50 km No of Passes: 3	Sampler Type: A

Species Name / ODNR Status	IBI	Feed Grp	Breed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		34	22.67	6.24	0.58	0.57	25.41
HIGHFIN CARPSUCKER	C	O	M		3	2.00	0.55	0.89	0.88	444.00
SILVER REDHORSE	R	I	S	M	9	6.00	1.65	3.42	3.38	569.44
GOLDEN REDHORSE	R	I	S	M	38	25.33	6.97	6.60	6.52	260.38
SHORHEAD REDHORSE	R	I	S	M	13	8.67	2.39	1.35	1.34	156.00
NORTHERN HOG SUCKER	R	I	S	M	7	4.67	1.28	0.08	0.08	17.57
COMMON CARP	G	O	M	T	29	19.33	5.32	51.05	50.45	2,640.52
GRAVEL CHUB	N	I	S	M	2	1.33	0.37	0.01	0.01	7.50
CREEK CHUB	N	G	N	T	2	1.33	0.37	0.00	0.00	1.00
EMERALD SHINER	N	I	S		19	12.67	3.49	0.05	0.05	4.00
SPOTFIN SHINER	N	I	M		123	82.00	22.57	0.24	0.23	2.87
SAND SHINER	N	I	M	M	32	21.33	5.87	0.03	0.03	1.56
MIMIC SHINER	N	I	M	I	46	30.67	8.44	0.05	0.05	1.59
BULLHEAD MINNOW	N	O	C		6	4.00	1.10	0.00	0.00	1.17
BLUNTNOSE MINNOW	N	O	C	T	25	16.67	4.59	0.02	0.02	1.36
CHANNEL CATFISH	F		C		45	30.00	8.26	23.63	23.35	787.68
FLATHEAD CATFISH	F	P	C		4	2.67	0.73	0.65	0.64	242.50
BLACK CRAPPIE	S	I	C		4	2.67	0.73	0.53	0.52	197.75
ROCK BASS	S	C	C		11	7.33	2.02	0.63	0.62	85.27
SMALLMOUTH BASS	F	C	C	M	11	7.33	2.02	0.17	0.17	22.82
LARGEMOUTH BASS	F	C	C		2	1.33	0.37	0.23	0.23	175.50
GREEN SUNFISH	S	I	C	T	1	0.67	0.18	0.01	0.01	10.00
BLUEGILL SUNFISH	S	I	C	P	8	5.33	1.47	0.28	0.27	51.75
DUSKY DARTER	D	I	S	M	1	0.67	0.18	0.01	0.01	10.00
LOGPERCH	D	I	S	M	6	4.00	1.10	0.03	0.03	6.67
JOHNNY DARTER	D	I	C		4	2.67	0.73	0.00	0.00	1.00
BANDED DARTER	D	I	S	I	3	2.00	0.55	0.00	0.00	0.67
SAUGER X WALLEYE	E	P			50	33.33	9.17	7.69	7.60	230.62
FRESHWATER DRUM			M	P	7	4.67	1.28	2.97	2.94	637.29
<i>Mile Total</i>					545	363.33		101.18		
<i>Number of Species</i>					28					
<i>Number of Hybrids</i>					1					

Species List

River Code: 17-820	Stream: Salt Fork Wills Creek	Sample Date: 1994
River Mile: 20.80	Basin: Muskingum River	Date Range: 08/04/94
Data Source: 01	Time Fished: 3000 sec Drain Area: 47.0 sq mi	
Purpose:	Dist Fished: 0.22 km No of Passes: 1	Sampler Type: D

Species Name / ODNR Status	IBI	Feed Grp	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		308	420.00	53.29	4.74	8.10	11.28
GRASS PICKEREL		P	M	P	3	4.09	0.52	0.02	0.04	5.33
SILVER REDHORSE	R	I	S	M	3	4.09	0.52	0.28	0.48	69.00
GOLDEN REDHORSE	R	I	S	M	4	5.46	0.69	0.06	0.09	10.00
WHITE SUCKER	W	O	S	T	1	1.36	0.17	0.00	0.01	2.00
COMMON CARP	G	O	M	T	24	32.73	4.15	28.99	49.53	885.67
GOLDEN SHINER	N	I	M	T	2	2.73	0.35	0.01	0.01	2.50
CREEK CHUB	N	G	N	T	1	1.36	0.17	0.00	0.00	1.00
SPOTFIN SHINER	N	I	M		5	6.82	0.87	0.00	0.01	0.40
BLUNTNOSE MINNOW	N	O	C	T	59	80.46	10.21	0.17	0.29	2.08
CHANNEL CATFISH	F		C		27	36.82	4.67	21.72	37.12	590.00
YELLOW BULLHEAD		I	C	T	2	2.73	0.35	0.25	0.42	91.00
BLACK BULLHEAD		I	C	P	10	13.64	1.73	0.76	1.30	55.56
WHITE CRAPPIE	S	I	C		1	1.36	0.17	0.10	0.17	71.00
BLACK CRAPPIE	S	I	C		3	4.09	0.52	0.11	0.19	27.67
LARGEMOUTH BASS	F	C	C		8	10.91	1.38	0.59	1.01	54.25
WARMOUTH SF	S	C	C		4	5.46	0.69	0.09	0.16	17.00
GREEN SUNFISH	S	I	C	T	19	25.91	3.29	0.34	0.59	13.22
BLUEGILL SUNFISH	S	I	C	P	68	92.73	11.76	0.16	0.27	1.69
OR'GESPOTTED SUNFISH	S	I	C		1	1.36	0.17	0.01	0.01	5.00
REDEAR SUNFISH	E	I	C		2	2.73	0.35	0.02	0.03	6.50
HYBRID X SUNFISH					2	2.73	0.35	0.01	0.02	3.50
YELLOW PERCH			M		3	4.09	0.52	0.04	0.07	10.00
LOGPERCH	D	I	S	M	11	15.00	1.90	0.06	0.10	3.73
JOHNNY DARTER	D	I	C		6	8.18	1.04	0.00	0.01	0.33
FANTAIL DARTER	D	I	C		1	1.36	0.17	0.00	0.00	1.00
<i>Mile Total</i>					578	788.18		58.52		
<i>Number of Species</i>					25					
<i>Number of Hybrids</i>					1					

Species List

River Code: 17-821	Stream: Sugartree Fork	Sample Date: 1994
River Mile: 12.20	Basin: Muskingum River	Date Range: 08/04/94
Data Source: 01	Time Fished: 2280 sec Drain Area: 18.1 sq mi	
Purpose:	Dist Fished: 0.15 km No of Passes: 1	Sampler Type: D

Species Name / ODNR Status	IBI	Feed	Breed		# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
	Grp	Guild	Guild	Tol						
SILVER REDHORSE	R	I	S	M	3	6.00	0.17	0.14	0.99	23.00
GOLDEN REDHORSE	R	I	S	M	4	8.00	0.23	0.10	0.75	13.00
NORTHERN HOG SUCKER	R	I	S	M	28	56.00	1.62	0.45	3.21	7.96
WHITE SUCKER	W	O	S	T	87	174.00	5.04	3.55	25.52	20.40
BLACKNOSE DACE	N	G	S	T	9	18.00	0.52	0.04	0.30	2.33
CREEK CHUB	N	G	N	T	186	372.00	10.78	2.50	17.97	6.72
COMMON SHINER	N	I	S		33	66.00	1.91	0.49	3.54	7.45
SILVERJAW MINNOW	N	I	M		474	948.00	27.46	0.62	4.49	0.66
BLUNTNOSE MINNOW	N	O	C	T	534	1,068.00	30.94	1.83	13.18	1.72
CENTRAL STONEROLLER	N	H	N		59	118.00	3.42	0.43	3.08	3.63
CHANNEL CATFISH	F		C		1	2.00	0.06	0.61	4.41	307.00
YELLOW BULLHEAD		I	C	T	2	4.00	0.12	0.10	0.75	26.00
BLACK BULLHEAD		I	C	P	2	4.00	0.12	0.08	0.55	19.00
WHITE CRAPPIE	S	I	C		1	2.00	0.06	0.46	3.31	230.00
ROCK BASS	S	C	C		7	14.00	0.41	0.63	4.51	44.86
LARGEMOUTH BASS	F	C	C		11	22.00	0.64	0.08	0.55	3.45
GREEN SUNFISH	S	I	C	T	105	210.00	6.08	1.21	8.71	5.77
BLUEGILL SUNFISH	S	I	C	P	11	22.00	0.64	0.14	1.02	6.45
LOGPERCH	D	I	S	M	6	12.00	0.35	0.07	0.53	6.17
JOHNNY DARTER	D	I	C		85	170.00	4.92	0.18	1.28	1.05
GREENSIDE DARTER	D	I	S	M	39	78.00	2.26	0.10	0.69	1.23
FANTAIL DARTER	D	I	C		39	78.00	2.26	0.09	0.66	1.18
<i>Mile Total</i>					1,726	3,452.00		13.91		
<i>Number of Species</i>					22					
<i>Number of Hybrids</i>					0					

Species List

River Code: 17-822	Stream: Rocky Fork Salt Fork	Sample Date: 1994
River Mile: 5.60	Basin: Muskingum River	Date Range: 08/17/94
Data Source: 01	Time Fished: 2280 sec Drain Area: 14.4 sq mi	
Purpose:	Dist Fished: 0.20 km No of Passes: 1	Sampler Type: D

Species Name / ODNR Status	IBI	Feed Grp	Breed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
LEAST BROOK LAMPREY		F	N			12	18.00	1.22	0.16	2.46	8.67
GOLDEN REDHORSE	R	I	S	M		6	9.00	0.61	0.90	14.18	100.00
WHITE SUCKER	W	O	S	T		22	33.00	2.23	1.49	23.39	45.00
CREEK CHUB	N	G	N	T		59	88.50	5.98	0.52	8.13	5.83
REDSIDE DACE	N	I	S	I		1	1.50	0.10	0.00	0.03	1.00
COMMON SHINER	N	I	S			226	339.00	22.92	0.92	14.52	2.72
SILVERJAW MINNOW	N	I	M			79	118.50	8.01	0.21	3.34	1.78
FATHEAD MINNOW	N	O	C	T		12	18.00	1.22	0.07	1.13	4.00
BLUNTNOSE MINNOW	N	O	C	T		393	589.50	39.86	1.04	16.35	1.76
BLACK CRAPPIE	S	I	C			1	1.50	0.10	0.02	0.24	10.00
ROCK BASS	S	C	C			5	7.50	0.51	0.06	1.01	8.50
LARGEMOUTH BASS	F	C	C			3	4.50	0.30	0.01	0.08	1.00
GREEN SUNFISH	S	I	C	T		122	183.00	12.37	0.75	11.77	4.08
BLUEGILL SUNFISH	S	I	C	P		6	9.00	0.61	0.11	1.75	12.33
LOGPERCH	D	I	S	M		3	4.50	0.30	0.02	0.36	5.00
JOHNNY DARTER	D	I	C			23	34.50	2.33	0.05	0.79	1.43
GREENSIDE DARTER	D	I	S	M		5	7.50	0.51	0.01	0.14	1.20
FANTAIL DARTER	D	I	C			8	12.00	0.81	0.02	0.38	2.00
<i>Mile Total</i>						986	1,479.00		6.35		
<i>Number of Species</i>						18					
<i>Number of Hybrids</i>						0					

Species List

River Code: 17-823	Stream: Yellow Water Creek	Sample Date: 1994
River Mile: 0.80	Basin: Muskingum River	Date Range: 08/16/94
Data Source: 01	Time Fished: 1764 sec Drain Area: 4.9 sq mi	
Purpose:	Dist Fished: 0.15 km No of Passes: 1	Sampler Type: D

Species Name / ODNR Status	IBI	Feed Grp	Breed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
LEAST BROOK LAMPREY		F	N			9	18.00	0.78	0.13	1.30	7.44
GOLDEN REDHORSE	R	I	S	M		1	2.00	0.09	0.03	0.33	17.00
WHITE SUCKER	W	O	S	T		128	256.00	11.03	3.69	35.90	14.41
CREEK CHUB	N	G	N	T		117	234.00	10.09	1.22	11.87	5.21
SOUTH. REDBELLY DACE	N	H	S			3	6.00	0.26	0.01	0.12	2.00
REDSIDE DACE	N	I	S	I		17	34.00	1.47	0.03	0.29	0.88
COMMON SHINER	N	I	S			345	690.00	29.74	1.52	14.77	2.20
SILVERJAW MINNOW	N	I	M			38	76.00	3.28	0.12	1.13	1.53
FATHEAD MINNOW	N	O	C	T		2	4.00	0.17	0.03	0.27	7.00
BLUNTNOSE MINNOW	N	O	C	T		265	530.00	22.84	1.08	10.52	2.04
CENTRAL STONEROLLER	N	H	N			1	2.00	0.09	0.04	0.37	19.00
BLACK BULLHEAD		I	C	P		1	2.00	0.09	0.01	0.14	7.00
BLACK CRAPPIE	S	I	C			6	12.00	0.52	0.19	1.87	16.00
ROCK BASS	S	C	C			6	12.00	0.52	0.33	3.23	27.67
LARGEMOUTH BASS	F	C	C			4	8.00	0.34	0.03	0.27	3.50
GREEN SUNFISH	S	I	C	T		134	268.00	11.55	1.56	15.21	5.83
BLUEGILL SUNFISH	S	I	C	P		2	4.00	0.17	0.05	0.49	12.50
BLACKSIDE DARTER	D	I	S			5	10.00	0.43	0.02	0.18	1.80
LOGPERCH	D	I	S	M		5	10.00	0.43	0.08	0.76	7.80
JOHNNY DARTER	D	I	C			66	132.00	5.69	0.08	0.82	0.64
FANTAIL DARTER	D	I	C			5	10.00	0.43	0.02	0.18	1.80
<i>Mile Total</i>						1,160	2,320.00		10.28		
<i>Number of Species</i>						21					
<i>Number of Hybrids</i>						0					

Species List

River Code: 17-824	Stream: Clear Fork	Sample Date: 1994
River Mile: 1.90	Basin: Muskingum River	Date Range: 08/17/94
Data Source: 01	Time Fished: 1755 sec Drain Area: 13.3 sq mi	
Purpose:	Dist Fished: 0.16 km No of Passes: 1	Sampler Type: D

Species Name / ODNR Status	IBI	Feed Grp	Breed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
QUILLBACK CARPSUCKER	C	O	M		13	24.38	0.69	0.25	1.40	10.23
SILVER REDHORSE	R	I	S	M	3	5.63	0.16	0.02	0.13	4.00
GOLDEN REDHORSE	R	I	S	M	4	7.50	0.21	0.17	0.96	22.75
NORTHERN HOG SUCKER	R	I	S	M	9	16.88	0.48	0.51	2.85	30.00
WHITE SUCKER	W	O	S	T	42	78.75	2.22	0.98	5.51	12.40
COMMON CARP	G	O	M	T	2	3.75	0.11	5.39	30.41	1,437.50
BLACKNOSE DACE	N	G	S	T	3	5.63	0.16	0.01	0.06	2.00
CREEK CHUB	N	G	N	T	130	243.75	6.86	1.42	7.99	5.81
REDSIDE DACE	N	I	S	I	2	3.75	0.11	0.00	0.02	1.00
COMMON SHINER	N	I	S		172	322.50	9.08	1.65	9.28	5.10
SILVERJAW MINNOW	N	I	M		666	1,248.75	35.16	2.45	13.81	1.96
BLUNTNOSE MINNOW	N	O	C	T	769	1,441.88	40.60	3.52	19.84	2.44
CENTRAL STONEROLLER	N	H	N		9	16.88	0.48	0.05	0.29	3.00
ROCK BASS	S	C	C		16	30.00	0.84	0.90	5.09	30.06
LARGEMOUTH BASS	F	C	C		3	5.63	0.16	0.03	0.15	4.67
GREEN SUNFISH	S	I	C	T	14	26.25	0.74	0.23	1.28	8.64
BLUEGILL SUNFISH	S	I	C	P	2	3.75	0.11	0.08	0.47	22.00
LOGPERCH	D	I	S	M	1	1.88	0.05	0.02	0.08	8.00
JOHNNY DARTER	D	I	C		24	45.00	1.27	0.04	0.23	0.92
GREENSIDE DARTER	D	I	S	M	7	13.13	0.37	0.02	0.12	1.57
FANTAIL DARTER	D	I	C		3	5.63	0.16	0.00	0.02	0.67
<i>Mile Total</i>					1,894	3,551.25		17.73		
<i>Number of Species</i>					21					
<i>Number of Hybrids</i>					0					

Species List

River Code: 17-825	Stream: Turkey Run	Sample Date: 1994
River Mile: 0.80	Basin: Muskingum River	Date Range: 08/04/94
Data Source: 01	Time Fished: 1860 sec Drain Area: 2.3 sq mi	
Purpose:	Dist Fished: 0.15 km No of Passes: 1	Sampler Type: E

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S T	24	48.00	1.91	0.32	4.01	6.65
BLACKNOSE DACE	N	G	S T	140	280.00	11.15	0.68	8.59	2.44
CREEK CHUB	N	G	N T	293	586.00	23.33	3.71	46.69	6.33
SOUTH. REDBELLY DACE	N	H	S	82	164.00	6.53	0.35	4.39	2.13
REDSIDE DACE	N	I	S I	11	22.00	0.88	0.08	1.06	3.82
COMMON SHINER	N	I	S	31	62.00	2.47	0.31	3.90	5.00
SILVERJAW MINNOW	N	I	M	101	202.00	8.04	0.64	8.10	3.19
BLUNTNOSE MINNOW	N	O	C T	298	596.00	23.73	1.07	13.51	1.80
CENTRAL STONEROLLER	N	H	N	1	2.00	0.08	0.02	0.25	10.00
LARGEMOUTH BASS	F	C	C	2	4.00	0.16	0.01	0.13	2.50
GREEN SUNFISH	S	I	C T	15	30.00	1.19	0.18	2.32	6.13
JOHNNY DARTER	D	I	C	114	228.00	9.08	0.28	3.50	1.22
FANTAIL DARTER	D	I	C	144	288.00	11.46	0.28	3.55	0.98
<i>Mile Total</i>				1,256	2,512.00		7.95		
<i>Number of Species</i>				13					
<i>Number of Hybrids</i>				0					

Species List

River Code: 17-826	Stream: Beeham Run	Sample Date: 1994
River Mile: 1.70	Basin: Muskingum River	Date Range: 08/03/94
Data Source: 01	Time Fished: 1500 sec Drain Area: 2.1 sq mi	
Purpose:	Dist Fished: 0.15 km No of Passes: 1	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S T	135	270.00	13.01	0.26	8.02	0.97
BLACKNOSE DACE	N	G	S T	47	94.00	4.53	0.09	2.82	0.98
CREEK CHUB	N	G	N T	397	794.00	38.25	1.16	35.35	1.45
SOUTH. REDBELLY DACE	N	H	S	30	60.00	2.89	0.11	3.24	1.77
SILVERJAW MINNOW	N	I	M	4	8.00	0.39	0.03	0.80	3.25
BLUNTNOSE MINNOW	N	O	C T	29	58.00	2.79	0.16	4.78	2.69
CENTRAL STONEROLLER	N	H	N	167	334.00	16.09	0.25	7.71	0.75
GREEN SUNFISH	S	I	C T	124	248.00	11.95	1.04	31.83	4.19
BLUEGILL SUNFISH	S	I	C P	3	6.00	0.29	0.02	0.55	3.00
JOHNNY DARTER	D	I	C	44	88.00	4.24	0.08	2.45	0.91
FANTAIL DARTER	D	I	C	58	116.00	5.59	0.08	2.45	0.69
<i>Mile Total</i>				1,038	2,076.00		3.27		
<i>Number of Species</i>				11					
<i>Number of Hybrids</i>				0					

Species List

River Code: 17-817	Stream: Chapman Run	Sample Date: 1994
River Mile: 0.10	Basin: Muskingum River	Date Range: 09/14/94
Data Source: 01	Time Fished: 3061 sec Drain Area: 19.3 sq mi	Thru: 10/04/94
Purpose:	Dist Fished: 1.00 km No of Passes: 2	Sampler Type: A

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M	8	8.00	17.39	0.37	2.52	46.75
QUILLBACK CARPSUCKER	C	O	M	1	1.00	2.17	0.01	0.09	14.00
WHITE SUCKER	W	O	S T	1	1.00	2.17	0.00	0.01	2.00
COMMON CARP	G	O	M T	12	12.00	26.09	13.37	89.92	1,114.25
REDFIN SHINER	N	I	N	1	1.00	2.17	0.00	0.02	3.00
SPOTFIN SHINER	N	I	M	1	1.00	2.17	0.00	0.01	2.00
BLUNTNOSE MINNOW	N	O	C T	1	1.00	2.17	0.00	0.01	1.00
WHITE CRAPPIE	S	I	C	1	1.00	2.17	0.00	0.01	1.00
WARMOUTH SF	S	C	C	3	3.00	6.52	0.01	0.07	3.67
GREEN SUNFISH	S	I	C T	2	2.00	4.35	0.02	0.11	8.00
BLUEGILL SUNFISH	S	I	C P	6	6.00	13.04	0.02	0.11	2.83
OR'GESPOTTED SUNFISH	S	I	C	1	1.00	2.17	0.00	0.01	1.00
JOHNNY DARTER	D	I	C	1	1.00	2.17	0.00	0.01	1.00
SAUGER X WALLEYE	E	P		7	7.00	15.22	1.06	7.10	150.86
<i>Mile Total</i>				46	46.00		14.87		
<i>Number of Species</i>				13					
<i>Number of Hybrids</i>				1					

Species List

River Code: 17-827	Stream: Brushy Fork	Sample Date: 1994
River Mile: 3.20	Basin: Muskingum River	Date Range: 08/03/94
Data Source: 01	Time Fished: 2280 sec Drain Area: 32.8 sq mi	
Purpose:	Dist Fished: 0.20 km No of Passes: 1	Sampler Type: D

Species Name / ODNR Status	IBI	Feed Grp	Breed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
SILVER REDHORSE	R	I	S	M	3	4.50	0.15	4.59	20.20	1,020.33
GOLDEN REDHORSE	R	I	S	M	26	39.00	1.33	0.65	2.85	16.60
NORTHERN HOG SUCKER	R	I	S	M	1	1.50	0.05	0.19	0.84	128.00
WHITE SUCKER	W	O	S	T	36	54.00	1.85	0.90	3.95	16.63
COMMON CARP	G	O	M	T	4	6.00	0.21	11.33	49.83	1,887.50
BLACKNOSE DACE	N	G	S	T	5	7.50	0.26	0.01	0.06	1.80
CREEK CHUB	N	G	N	T	9	13.50	0.46	0.10	0.46	7.67
COMMON SHINER	N	I	S		66	99.00	3.39	0.68	2.98	6.85
SPOTFIN SHINER	N	I	M		20	30.00	1.03	0.05	0.20	1.50
SILVERJAW MINNOW	N	I	M		1	1.50	0.05	0.01	0.02	3.00
BLUNTNOSE MINNOW	N	O	C	T	1,679	2,518.50	86.19	2.48	10.92	0.99
CHANNEL CATFISH	F		C		3	4.50	0.15	0.39	1.70	86.00
YELLOW BULLHEAD		I	C	T	2	3.00	0.10	0.14	0.62	47.00
BLACK BULLHEAD		I	C	P	1	1.50	0.05	0.09	0.40	60.00
ROCK BASS	S	C	C		1	1.50	0.05	0.05	0.22	34.00
SMALLMOUTH BASS	F	C	C	M	1	1.50	0.05	0.03	0.13	19.00
LARGEMOUTH BASS	F	C	C		14	21.00	0.72	0.32	1.40	15.14
GREEN SUNFISH	S	I	C	T	11	16.50	0.56	0.23	1.00	13.73
BLUEGILL SUNFISH	S	I	C	P	3	4.50	0.15	0.10	0.46	23.00
GREEN SF X HYBRID					7	10.50	0.36	0.27	1.17	25.43
LOGPERCH	D	I	S	M	3	4.50	0.15	0.04	0.18	9.00
JOHNNY DARTER	D	I	C		23	34.50	1.18	0.02	0.08	0.52
GREENSIDE DARTER	D	I	S	M	15	22.50	0.77	0.04	0.18	1.80
FANTAIL DARTER	D	I	C		14	21.00	0.72	0.04	0.16	1.71
<i>Mile Total</i>					1,948	2,922.00		22.73		
<i>Number of Species</i>						23				
<i>Number of Hybrids</i>						1				

Species List

River Code: 17-828 River Mile: 0.20 Data Source: 01 Purpose:	Stream: Christian Creek Basin: Muskingum River Time Fished: 960 sec Drain Area: 1.4 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: 1994 Date Range: 08/03/94 Sampler Type: E
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Species Name / ODNR Status	IBI	Feed	Breed	# of	Relative	% by	Relative	% by	Ave(gm)	
	Grp	Guild	Guild	Fish	Number	Number	Weight	Weight	Weight	
WHITE SUCKER	W	O	S	T	30	60.00	6.79	0.10	6.34	1.67
BLACKNOSE DACE	N	G	S	T	1	2.00	0.23	0.00	0.13	1.00
CREEK CHUB	N	G	N	T	384	768.00	86.88	1.00	63.37	1.30
COMMON SHINER	N	I	S		8	16.00	1.81	0.08	5.20	5.13
GREEN SUNFISH	S	I	C	T	11	22.00	2.49	0.22	13.94	10.00
BLUEGILL SUNFISH	S	I	C	P	4	8.00	0.90	0.17	10.65	21.00
JOHNNY DARTER	D	I	C		3	6.00	0.68	0.00	0.13	0.33
FANTAIL DARTER	D	I	C		1	2.00	0.23	0.00	0.25	2.00
<i>Mile Total</i>					442	884.00		1.58		
<i>Number of Species</i>					8					
<i>Number of Hybrids</i>					0					

Species List

River Code: 17-829 River Mile: 0.80 Data Source: 01 Purpose:	Stream: Coon Run Basin: Muskingum River Time Fished: 2400 sec Drain Area: 1.8 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: 1994 Date Range: 08/03/94 Sampler Type: D
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Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S T	35	70.00	8.56	0.31	15.32	4.43
GOLDEN SHINER	N	I	M T	34	68.00	8.31	0.22	10.77	3.21
BLACKNOSE DACE	N	G	S T	16	32.00	3.91	0.02	1.09	0.69
CREEK CHUB	N	G	N T	42	84.00	10.27	0.16	7.81	1.88
BLUNTNOSE MINNOW	N	O	C T	199	398.00	48.66	0.48	23.72	1.21
WARMOUTH SF	S	C	C	1	2.00	0.24	0.01	0.59	6.00
GREEN SUNFISH	S	I	C T	38	76.00	9.29	0.35	17.19	4.58
BLUEGILL SUNFISH	S	I	C P	35	70.00	8.56	0.37	18.18	5.26
OR'GESPOTTED SUNFISH	S	I	C	3	6.00	0.73	0.04	1.98	6.67
PUMPKINSEED SUNFISH	S	I	C P	2	4.00	0.49	0.04	1.98	10.00
GREEN SF X BLUEGILL				1	2.00	0.24	0.02	1.19	12.00
JOHNNY DARTER	D	I	C	3	6.00	0.73	0.00	0.20	0.67
<i>Mile Total</i>				409	818.00		2.02		
<i>Number of Species</i>					11				
<i>Number of Hybrids</i>					1				

APPENDIX TABLE A-5

**Index of Biotic Integrity (IBI) metrics and scores by river mile for locations
sampled in the Wills Creek study area, 1994**

River Mile	Type	Date	Drainage area (sq mi)	Number of				Percent of Individuals							Rel.No. minus tolerants /(1.0 km)	IBI	Modified lwb
				Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni- vores	Top carnivores	Insect- ivores	DELT anomalies			
Wills Creek - (17-800)																	
Year: 94																	
75.70	A	08/08/94	281	8(1)	1(1)	2(1)	0(1)	29(3)	35(3)	9(5)	15(5)	6(3)	71(5)	2.9(3)	62(1) *	32	6.4
75.70	A	09/13/94	281	8(1)	0(1)	4(3)	0(1)	45(5)	48(3)	19(3)	29(1)	10(3)	50(3)	11.9(1)	68(1) *	26	6.9
70.40	A	08/09/94	287	14(3)	5(5)	2(1)	1(1)	13(1)	13(1)	31(1)	44(1)	19(5)	31(3)	6.3(1)	44(1) *	24	6.8
70.40	A	09/13/94	287	8(1)	2(3)	3(3)	0(1)	21(3)	21(1)	29(1)	54(1)	17(1)	25(1)	0.0(1)	34(1) **	18	6.5
70.40	A	10/05/94	287	9(1)	3(3)	3(3)	0(1)	11(1)	11(1)	36(1)	61(1)	14(5)	21(1)	0.0(5)	36(1) *	24	6.2
69.40	A	08/08/94	291	8(1)	2(3)	3(3)	0(1)	28(3)	28(3)	17(1)	39(1)	17(1)	39(1)	5.6(1)	30(1) **	20	5.9
69.40	A	09/13/94	291	12(3)	1(1)	4(3)	0(1)	20(3)	24(1)	12(5)	63(1)	6(3)	27(3)	2.0(3)	90(1) *	28	7.6
69.40	A	10/05/94	291	8(1)	0(1)	4(3)	0(1)	15(1)	15(1)	23(3)	56(1)	8(3)	28(3)	0.0(5)	60(1) *	24	7.0
67.30	A	08/09/94	313	8(1)	3(3)	1(1)	0(1)	0(1)	0(1)	57(1)	57(1)	5(3)	32(3)	0.0(5)	48(1) *	22	6.2
67.30	A	09/14/94	313	10(3)	5(5)	1(1)	0(1)	0(1)	0(1)	36(1)	45(1)	9(3)	45(3)	0.0(5)	68(1) *	26	5.0
67.30	A	10/05/94	313	8(1)	4(5)	1(1)	0(1)	0(1)	0(1)	30(1)	63(1)	13(5)	20(1)	0.0(5)	42(1) *	24	5.5
66.60	A	08/09/94	314	11(3)	2(3)	2(1)	1(1)	10(1)	13(1)	49(1)	56(1)	15(5)	21(1)	0.0(5)	40(1) *	24	5.5
66.60	A	09/13/94	314	10(3)	3(3)	3(3)	0(1)	16(1)	16(1)	12(5)	38(1)	9(3)	47(3)	0.0(5)	102(1) *	30	8.2
66.60	A	10/04/94	314	7(1)	1(1)	3(3)	0(1)	22(3)	22(1)	17(3)	56(1)	6(3)	31(3)	2.8(3)	65(1) *	24	7.3
64.70	A	08/09/94	407	17(3)	7(5)	2(1)	0(1)	7(1)	8(1)	26(3)	33(1)	22(5)	38(3)	8.3(1)	106(1) *	26	8.1
64.70	A	09/14/94	407	15(3)	5(5)	3(3)	0(1)	15(1)	17(1)	23(3)	33(1)	19(5)	46(3)	1.9(3)	80(1) *	30	7.9
64.70	A	10/04/94	407	11(3)	3(3)	3(3)	0(1)	26(3)	26(3)	14(5)	31(1)	31(5)	31(3)	0.0(5)	60(1) *	36	7.7
62.40	A	08/09/94	408	12(3)	4(5)	4(3)	0(1)	11(1)	14(1)	51(1)	60(1)	8(3)	32(3)	1.6(3)	62(1) *	26	6.0
62.40	A	09/14/94	408	12(3)	4(5)	3(3)	0(1)	19(1)	23(1)	11(5)	39(1)	9(3)	47(3)	0.0(5)	124(1) *	32	7.5
62.40	A	10/03/94	408	15(3)	3(3)	3(3)	0(1)	10(1)	11(1)	64(1)	71(1)	7(3)	21(1)	0.0(5)	78(1)	24	6.2
61.90	A	08/10/94	408	11(3)	5(5)	2(1)	0(1)	5(1)	5(1)	46(1)	46(1)	2(1)	51(3)	1.2(3)	88(1) *	22	6.1
61.90	A	09/14/94	408	10(3)	3(3)	2(1)	0(1)	7(1)	9(1)	9(5)	56(1)	15(5)	30(3)	0.0(5)	98(1) *	30	7.0

▲ - IBI is low end adjusted.

River Mile	Type	Date	Drainage area (sq mi)	Number of				Percent of Individuals							Rel.No. minus tolerants / (1.0 km)	IBI	Modified lwb
				Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies			
61.90	A	10/02/94	408	11(3)	3(3)	2(1)	0(1)	13(1)	15(1)	19(3)	54(1)	9(3)	31(3)	0.0(5)	88(1) *	26	7.5
61.50	A	08/10/94	408	9(1)	0(1)	3(3)	0(1)	11(1)	11(1)	24(3)	29(1)	8(3)	61(5)	0.0(5)	290(3)	28	7.6
61.50	A	09/14/94	408	9(1)	0(1)	4(3)	0(1)	20(3)	30(3)	15(3)	25(3)	10(3)	55(5)	5.0(1)	170(1)	28	8.0
61.50	A	10/03/94	408	7(1)	1(1)	2(1)	0(1)	13(1)	33(3)	20(3)	20(3)	13(5)	47(3)	0.0(5)	120(1) *	28	6.9
61.40	A	08/10/94	409	16(3)	5(5)	2(1)	0(1)	7(1)	10(1)	41(1)	42(1)	8(3)	44(3)	2.0(3)	180(1)	24	7.8
61.40	A	09/14/94	409	11(3)	3(3)	3(3)	0(1)	9(1)	18(1)	18(3)	37(1)	14(5)	40(3)	0.0(5)	94(1) *	30	7.5
61.40	A	10/03/94	409	10(3)	5(5)	1(1)	0(1)	10(1)	10(1)	41(1)	49(1)	10(3)	29(3)	0.0(5)	60(1) *	26	6.8
59.40	A	08/10/94	470	17(3)	5(5)	4(3)	1(1)	22(3)	25(3)	30(1)	36(1)	8(3)	52(3)	2.0(3)	138(1) *	30	8.4
59.40	A	09/14/94	470	13(3)	2(3)	2(1)	0(1)	32(3)	37(3)	11(5)	19(3)	11(5)	46(3)	0.0(5)	112(1) *	36	7.6
59.40	A	10/03/94	470	12(3)	2(3)	4(3)	0(1)	33(3)	39(3)	4(5)	19(3)	11(5)	47(3)	1.8(3)	110(1) *	36	8.0
53.40	A	08/11/94	486	14(3)	3(3)	4(3)	0(1)	16(1)	16(1)	15(5)	21(3)	12(5)	52(3)	1.2(3)	138(1) *	32	7.9
53.40	A	09/14/94	486	15(3)	4(5)	4(3)	0(1)	24(3)	24(1)	21(3)	30(1)	8(3)	53(3)	5.0(1)	158(1)	28	8.2
53.40	A	10/04/94	486	13(3)	1(1)	4(3)	0(1)	26(3)	28(3)	26(3)	35(1)	3(1)	51(3)	1.4(3)	110(1) *	26	8.0
46.80	A	08/11/94	554	12(3)	3(3)	2(1)	0(1)	11(1)	11(1)	16(3)	19(3)	7(3)	57(5)	5.3(1)	158(1) *	26	7.9
46.80	A	09/15/94	554	13(3)	4(5)	2(1)	0(1)	9(1)	12(1)	14(5)	18(3)	4(1)	71(5)	2.6(3)	130(1) *	30	7.1
46.80	A	10/04/94	554	9(1)	4(5)	2(1)	0(1)	9(1)	9(1)	37(1)	40(1)	11(5)	34(3)	2.9(3)	44(1) *	24	6.2
38.00	A	08/16/94	671	13(3)	5(5)	3(3)	0(1)	7(1)	7(1)	17(3)	33(1)	6(3)	55(5)	1.2(3)	135(1) *	30	7.2
38.00	A	09/15/94	671	13(3)	4(5)	2(1)	0(1)	27(3)	29(3)	7(5)	18(3)	13(5)	55(5)	0.0(5)	104(1) *	40	7.9
38.00	A	10/04/94	671	7(1)	0(1)	3(3)	0(1)	35(3)	35(3)	19(3)	46(1)	3(1)	43(3)	0.0(5)	60(1) *	26	6.5
27.40	A	08/16/94	738	11(3)	4(5)	1(1)	0(1)	0(1)	0(1)	38(1)	25(3)	5(3)	59(5)	0.0(5)	70(1) *	30	6.6
27.40	A	09/15/94	738	15(3)	4(5)	2(1)	0(1)	16(1)	21(1)	26(3)	34(1)	7(3)	53(3)	0.0(5)	100(1) *	28	7.1
27.40	A	10/04/94	738	9(1)	1(1)	3(3)	0(1)	32(3)	34(3)	29(1)	45(1)	11(5)	39(3)	0.0(5)	54(1) *	28	6.3
0.30	A	07/27/94	853	20(3)	3(3)	3(3)	1(1)	7(1)	11(1)	15(5)	15(5)	18(5)	58(5)	5.8(1)	234(3)	36	6.7

River Mile	Type	Date	Drainage area (sq mi)	Number of				Percent of Individuals						Rel.No. minus tolerants /(1.0 km)	IBI	Modified lwb	
				Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni- vores	Top carnivores	Insect- ivores				DELT anomalies
0.30	A	08/29/94	853	23(5)	4(5)	5(3)	1(1)	20(3)	26(3)	13(5)	25(3)	16(5)	52(3)	4.3(1)	290(3)	40	8.8
0.30	A	09/22/94	853	22(5)	3(3)	4(3)	2(3)	10(1)	16(1)	6(5)	15(5)	11(5)	63(5)	4.1(1)	452(5)	42	8.8

Index of Biotic Integrity (IBI) metrics and scores by river mile for locations sampled in the Wills Creek study area, 1994.

River Mile	Type	Date	Drainage area (sq mi)	Number of					Percent of Individuals					Rel.No. minus tolerants / (0.3km)	IE	
				Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores			DELT anomalies
Wills Creek - (17800)																
Year: 94																
57.10	D	08/11/94	472	23(5)	4(5)	4(3)	2(1)	3(1)	7(1)	66(1)	67(1)	3.1(3)	27(3)	0.4(3)	279(3)	30
57.10	D	09/15/94	472	12(3)	1(1)	2(1)	0(1)	2(1)	30(3)	39(1)	39(1)	4.1(3)	52(3)	0.6(3)	155(1)	22

Index of Biotic Integrity (IBI) metrics and scores by river mile for locations sampled in the Wills Creek study area, 1994.

River Mile	Type	Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants / (0.3km)	
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies		
Clear Fork - (17-824)																
Year: 94																
1.90	D	08/17/94	13.3	21(5)	7(5)	3(3)	6(5)	4(3)	9(5)	51(3)	44(1)	85(1)	48(5)	0.9(3)	1751(5)	
Turkey Run - (17-825)																
Year: 94																
0.80	E	08/04/94	2.3	13(5)	8(5)	4(5)	1(1)	2(3)	5(5)	61(1)	26(1)	65(1)	33(5)	0.0(5)	972(5)	
Beeham Run - (17-826)																
Year: 94																
1.70	D	08/03/94	2.1	11(5)	6(5)	3(3)	0(1)	2(3)	3(3)	71(1)	16(3)	58(1)	23(3)	0.0(5)	612(5)	
Christian Creek - (17-828)																
Year: 94																
0.20	E	08/03/94	1.4	8(5)	3(3)	2(3)	0(1)	2(5)	3(5)	96(1)	7(5)	90(1)	6(1)	0.0(5)	32(1)	
Coon Run - (17-829)																
Year: 94																
0.80	D	08/03/94	1.8	11(5)	4(3)	1(1)	0(1)	1(3)	2(3)	89(1)	57(1)	69(1)	28(5)	0.0(5)	90(3)	

Index of Biotic Integrity (IBI) metrics and scores by river mile for locations sampled in the Wills Creek study area, 1994.

River Mile	Type	Date	Drainage area (sq mi)	Number of				Percent of Individuals						Rel.No. minus tolerants / (1.0 km)	IBI	
				Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores			DELT anomalies
Chapman Run - (17-817)																
Year: 94																
0.10	A	09/14/94	19	8(1)	4(0)	1(0)	0(1)	0(0)	5(1)	45(3)	50(1)	18(0)	32(1)	0.0(5)	24(1)*	18
0.10	A	10/04/94	19	8(1)	4(0)	1(0)	0(1)	0(0)	0(1)	25(5)	50(1)	25(0)	25(1)	0.0(5)	36(1)*	20

▲ - IBI is low end adjusted.

Index of Biotic Integrity (IBI) metrics and scores by river mile for locations sampled in the Wills Creek study area, 1994.

River Mile	Type	Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants / (0.3km)
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	
Sugartree Fork - (17-821)															
Year: 94															
12.20	D	08/04/94	18.1	22(5)	6(3)	2(3)	5(3)	4(3)	8(5)	53(1)	36(1)	80(1)	48(3)	0.0(5)	1606(5)
Rocky Fork Salt Fork - (17-822)															
Year: 94															
5.60	D	08/17/94	14.4	18(5)	6(3)	3(3)	4(3)	4(3)	6(3)	62(1)	43(1)	70(1)	49(5)	0.2(3)	567(3)
Yellow Water Creek - (17-823)															
Year: 94															
0.80	D	08/16/94	4.9	21(5)	8(5)	4(5)	3(3)	4(5)	7(5)	56(3)	34(1)	54(3)	54(5)	0.1(5)	1028(5)

Index of Biotic Integrity (IBI) metrics and scores by river mile for locations sampled in the Wills Creek study area, 1994.

River Mile	Type	Date	Drainage area (sq mi)	Number of					Percent of Individuals					Rel.No. minus tolerants / (0.3km)	
				Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores		DELT anomalies
Brushy Fork - (17827)															
Year: 94															
3.20	D	08/03/94	32	22(5)	3(3)	4(5)	0(1)	4(3)	8(1)	90(1)	88(1)	0.8(1)	10(1)	0.0(5)	303(3)