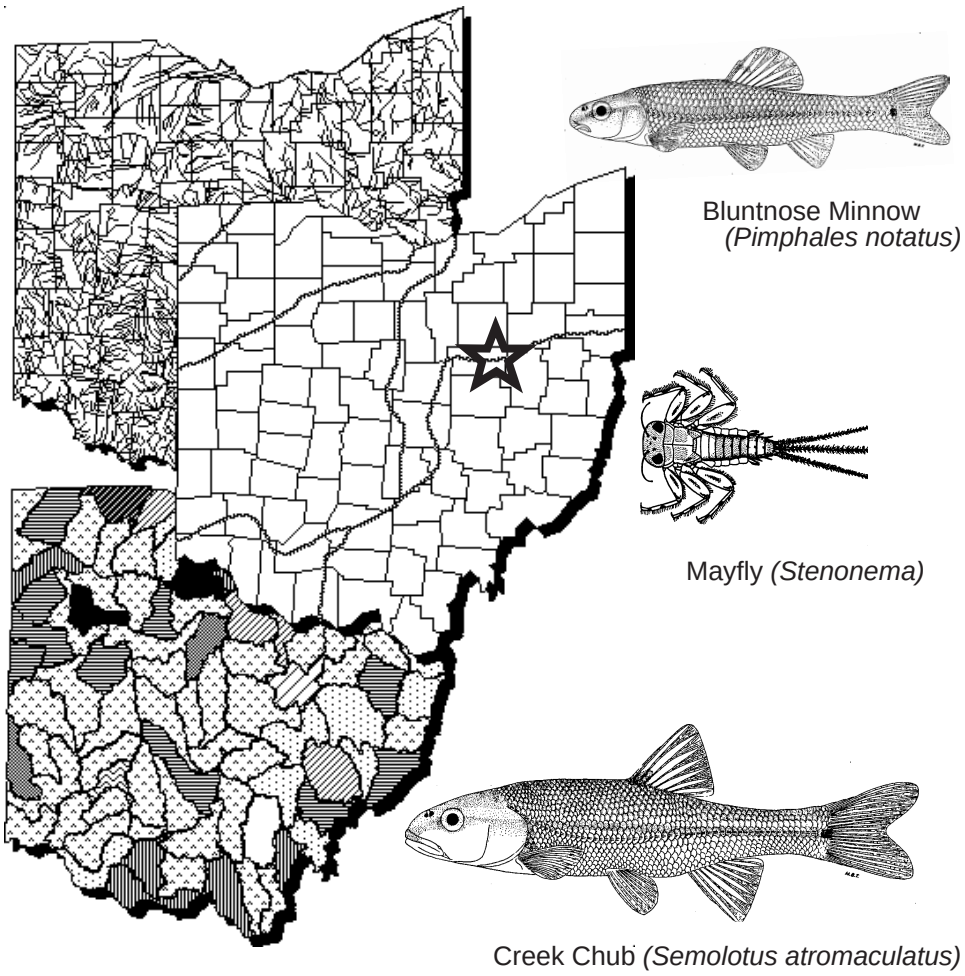
State of Ohio
Environmental Protection Agency

Ecological Assessment
Division of Surface Water

Biological and Water Quality Study of Sugar Creek 1998

Wayne, Stark, Holmes and Tuscarawas Counties, Ohio



July 15, 2000

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Wayne, Stark, Holmes and Tuscarawas Counties, Ohio

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OEPA Technical Report MAS/1999-12-4

prepared by

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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 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. Div. Water Qual. Monit. & Assess., 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. Div. Water Qual. Monit. & Assess., 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. Div. Water Qual. Plan. & Assess., 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. Div. Water Quality Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 1990. The use of biological criteria in the Ohio EPA surface water monitoring and assessment program. Div. Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Div. Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

Since the publication of the preceding guidance documents, the following new publications by the Ohio EPA have become available. These publications should also be consulted as they represent the

latest information and analyses used by the Ohio EPA to implement the biological criteria.

DeShon, J.D. 1995. Development and application of the invertebrate community index (ICI), pp. 217-243. in W.S. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Risk-based Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Rankin, E. T. 1995. The use of habitat assessments in water resource management programs, pp. 181-208. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. Biological criteria program development and implementation in Ohio, pp. 109-144. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. Biological response signatures and the area of degradation value: new tools for interpreting multimetric data, pp. 263-286. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. 1995. Policy issues and management applications for biological criteria, pp. 327-344. in W. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers, Boca Raton, FL.

Yoder, C.O. and E.T. Rankin. 1995. The role of biological criteria in water quality monitoring, assessment, and regulation. Environmental Regulation in Ohio: How to Cope With the Regulatory Jungle. Inst. of Business Law, Santa Monica, CA. 54 pp.

These documents and this report may be obtained by writing to:

Ohio EPA, Division of Surface Water
Monitoring and Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125
(614) 836-8777

ACKNOWLEDGMENTS

The following Ohio EPA staff are acknowledged for their contribution to this report:

Study Area - Dan Imhoff
Pollutant Loadings - Bob Davic, Ken Frase and Joann Montgomery
Chemical Water Quality -Bob Davic, Ken Frase and Joann Montgomery
Sediment Quality - Joann Montgomery
Physical Habitat - Brian Alsdorf and Mark Bergman
Biological Assessment:
Macroinvertebrate community - Marty Knapp,
Fish community - Brian Alsdorf.
Data Management - Dennis Mishne
TSD coordination - Brian Alsdorf.
Reviewers - Jeff DeShon, Marty Kuklis, Marc Smith, Dave Stroud, and Chris Yoder

The following individuals, employed through an Ohio EPA college internship program, are acknowledged for their assistance in field collections:

Water Chemistry Data - Jonathan Crawford, Paul Pira, and Matt Smith
Macroinvertebrate Field Samples - Jenny Finfera
Fish Community Data - Jeremy Applegate and Susan Harris

This evaluation and report was possible only with the assistance of the study team, many full and part time field staff, and the chemistry analyses provided by the Ohio EPA Division of Environmental Services. Property owners who permitted access for sampling are also acknowledged for their cooperation.

Copies of this report are located on the Ohio EPA internet web page (www.epa.state.oh.us) or may be available from:

Division of Surface Water
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Groveport, Ohio 43125

FOREWORD

What is a Biological and Water Quality Survey?

A biological and water quality survey, or "biosurvey", is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This effort may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. Each year Ohio EPA conducts biosurveys in 10-15 different study areas with an aggregate total of 250-300 sampling sites.

Ohio EPA employs biological, chemical, and physical monitoring and assessment techniques in biosurveys in order to meet three major objectives: 1) determine the extent to which use designations assigned in the Ohio Water Quality Standards (WQS) are either attained or not attained; 2) determine if use designations assigned to a given water body are appropriate and attainable; and 3) determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices. The data gathered by a biosurvey is processed, evaluated, and synthesized in a biological and water quality report. Each biological and water quality study contains a summary of major findings and recommendations for revisions to WQS, future monitoring needs, or other actions which may be needed to resolve existing impairment of designated uses. While the principal focus of a biosurvey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns, are also addressed.

The findings and conclusions of a biological and water quality study may factor into regulatory actions taken by Ohio EPA (*e.g.,* NPDES permits, Director's Orders, the Ohio Water Quality Standards [OAC 3745-1], Water Quality Permit Support Documents [WQPSDs]), and are eventually incorporated into State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the Ohio Water Resource Inventory (305[b]) report.

Hierarchy of Indicators

A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. Ohio EPA relies on a tiered approach in attempting to link the results of administrative activities with true environmental measures. This integrated approach outlined in Figure 1 includes a hierarchical continuum from administrative to true environmental indicators. The six "levels" of indicators include: 1) actions taken by regulatory agencies (permitting, enforcement, grants); 2) responses by the regulated community (treatment works, pollution prevention); 3) changes in discharged quantities (pollutant loadings); 4) changes in ambient conditions (water quality, habitat); 5) changes in uptake and/or assimilation (tissue contamination, biomarkers, wasteload allocation); and, 6) changes in health, ecology, or other effects (ecological condition, pathogens). In this process the results of administrative activities

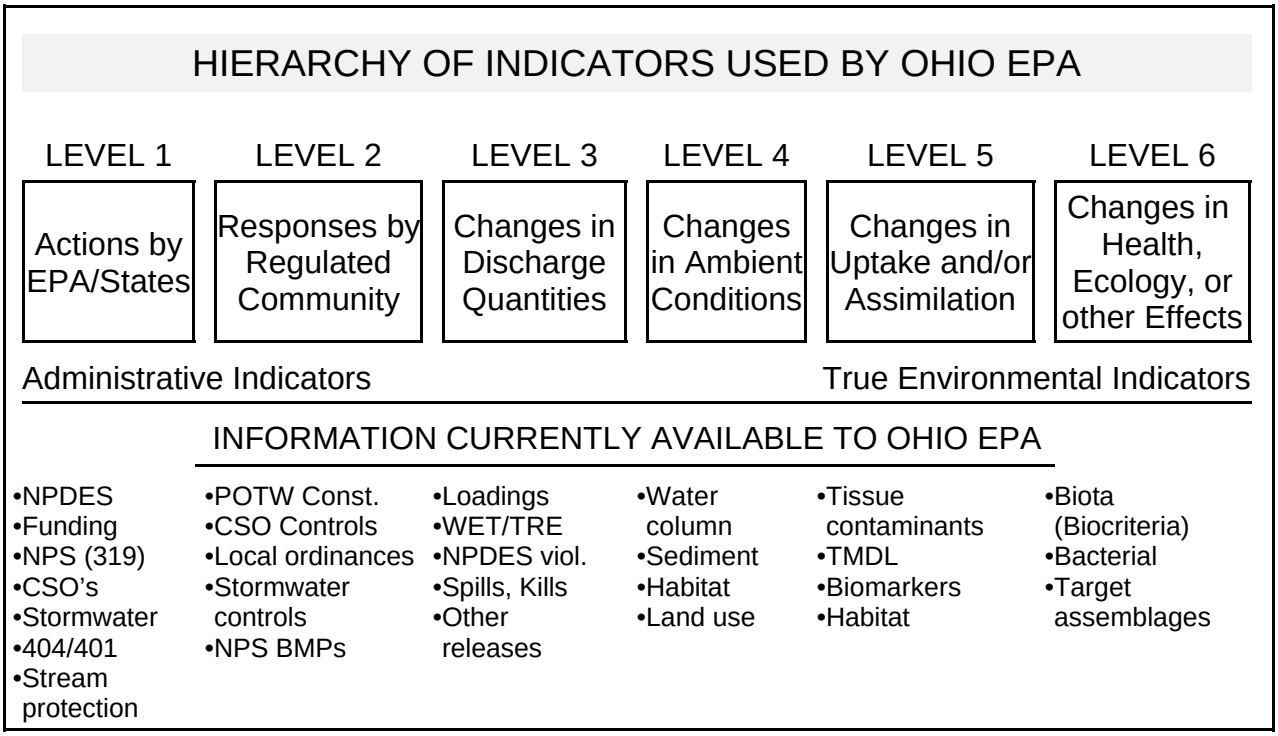

Figure 1 Hierarchy of administrative and environmental indicators used by Ohio EPA for monitoring, assessment, reporting, and evaluating program effectiveness (patterned after a model developed by the U.S. EPA, Office of Water).

(levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental "results" (level 6). Thus, the aggregate effect of billions of dollars spent on water pollution control since the early 1970s can now be determined with quantifiable measures of environmental condition.

Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications. *Exposure* indicators are those which measure the effects of stressors and can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response that are represented here by the biological indices which comprise Ohio's biological criteria. Other response indicators could include target assemblages, *i.e.,* rare, threatened, endangered, special status, and declining species or bacterial levels which serve as surrogates for the recreational uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* the roles which are most appropriate for each.

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed or subbasin scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Ohio Water Resource Inventory (305[b] report), the Ohio Nonpoint Source Assessment, and other technical bulletins.

Ohio Water Quality Standards: Designated Aquatic Life Use

The Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1) consist of designated uses and chemical, physical, and biological criteria designed to represent measurable properties of the environment that are consistent with the goals specified by each use designation. Use designations consist of two broad groups, aquatic life and non-aquatic life uses. In applications of the Ohio WQS to the management of water resource issues in Ohio's rivers and streams, the aquatic life use criteria frequently result in the most stringent protection and restoration requirements, hence their emphasis in biological and water quality reports. Also, an emphasis on protecting for aquatic life generally results in water quality suitable for all uses. The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*

2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.,* declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*

3) *Cold-water Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species

which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 mi.^{2} drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other parameters such as heavy metals, the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

Ohio Water Quality Standards: Non-Aquatic Life Uses

In addition to assessing the appropriateness and status of aquatic life uses, each biological and water quality survey also addresses non-aquatic life uses such as recreation, water supply, and human health concerns as appropriate. The recreation uses most applicable to rivers and streams are the Primary Contact Recreation (PCR) and Secondary Contact Recreation (SCR) uses. The criterion for designating the PCR use is simply having a water depth of at least one meter over an area of at least 100 square feet or where canoeing is a feasible activity. If a water body is too small and shallow to meet either criterion the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.,* fecal coliform, *E. coli)* and the criteria for each are specified in the Ohio WQS.

Water supply uses include Public Water Supply (PWS), Agricultural Water Supply (AWS), and Industrial Water Supply (IWS). Public Water Supplies are simply defined as segments within 500 yards of a potable water supply or food processing industry intake. The Agricultural Water Supply (AWS) and Industrial Water Supply (IWS) use designations generally apply to all waters unless it can be clearly shown that they are not applicable. An example of this would be an urban area where livestock watering or pasturing does not take place, thus the AWS use would not apply. Chemical criteria are specified in the Ohio WQS for each use and attainment status is based primarily on chemical-specific indicators. Human health concerns are additionally addressed with fish tissue data, but any consumption advisories are issued by the Ohio Department of Health.

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INTRODUCTION

In support of the Total Maximum Daily Load (TMDL) watershed evaluation and as part of the five-year basin approach for monitoring, assessment, and the issuance of National Pollution Discharge Elimination System (NPDES) permits, ambient biological, water column chemical, sediment, and bioassay sampling were conducted in the Sugar Creek basin from June to October 1998. This study area included a 43 mile reach of Sugar Creek from Shellin Rd. (near Smithville) downstream to the mouth, and sites on nearly all flowing tributaries in the watershed. Table 6 and Figure 3 indicate sampling locations.

Specific objectives of this evaluation were to:

1) Monitor and assess the chemical, physical and biological integrity of the streams within the 1998 Sugar Creek study area;

2) Characterize the consequences of various land uses on water quality within the Sugar Creek watershed;

3) Evaluate the influence of the Smithville, Brewster, Beach City, Strasburg, Sugar Creek and other smaller Wastewater Treatment Plants (WWTPs) within the Sugar Creek watershed;

4) Evaluate the potential impacts from industrial (Dover Chemical) and commercial discharges, spills, nonpoint source pollution (NPS), and habitat alterations on the receiving streams; and,

5) Determine the attainment status of the current designated Warmwater Habitat (WWH) aquatic life use and other non-aquatic use designations and recommend changes in use where appropriate.

The findings of this evaluation factor into regulatory actions taken by the Ohio EPA (*e.g.*, NPDES

permits, Director's Orders, the Ohio Water Quality Standards [OAC 3745-1], Water Quality Permit Support Documents [WQPSDs]) and are incorporated into State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the biennial Water Resource Inventory (305[b]) report.

SUMMARY

Aquatic Life Use Attainment Status

The 1998 Sugar Creek study area included a mainstem reach beginning at RM 42.8 (Schellin Rd., near Smithville) and extending downstream to the mouth and sites on all tributaries with a drainage area of at least five square miles. In all, 76 biological and chemical sample stations were visited. Effluent samples were also collected at 10 entities (Table 6).

A novel spatial sampling design was utilized in this survey. This design utilized both a linear approach and a stratified approach. In a linear approach, sites are arranged to achieve distance from each other and in relation to known potential pollution sources (pipes are bracketed). In a stratified approach, sites are characterized by similarities and levels of particular interest are selected for study. For instance, stream order could be stratified and all second and fourth order streams could be sampled near their confluences. Elevation , gradient, or other stream characteristics could likewise be stratified and sampled according to some interest. For the 1998 Sugar Creek study, watershed size was stratified.

Within the 357 mi^2 basin, smaller subbasins were selected for study by dividing the entire basin in half, then in turn dividing the resulting subbasin in half and so on. This sequential subdivision was called geometric site selection (Figure 2). Sites which best matched the resulting subbasin size were sampled at the most convenient access location. So, 357 divided in half is 178 and half of that is 89. Sequential subdivision yielded drainages of 44 mi^2, 22 mi^2, 11 mi^2, and 5.6 mi^2. The nature of the Sugar Creek watershed resulted in one location with a drainage of at least 178 mi^2, two locations which drained 89 mi^2, four 44 mi^2 sites, five 22 mi^2 sites, ten 11 mi^2 drainages, and 14 5.6 mi^2 locations.

Final site selection in the Sugar Creek study included all geometrically determined sites, sites selected to evaluate point source concerns, and sites which achieved a least a five to seven mile linear coverage across the mainstem. In addition some sites were situated on streams that were smaller than 5.6 mi^2. Some of these were named streams which were specifically sampled to determine attainment status, some of these were streams which drained suspected strip mine areas, and some sites were selected to characterize potential better quality reaches.

Most locations surveyed throughout the basin failed to meet assigned aquatic life uses. Exceptions were associated with physiographic features which influenced groundwater flow in some areas. Nonpoint source pollution impinged on water quality and aquatic communities throughout the basin.

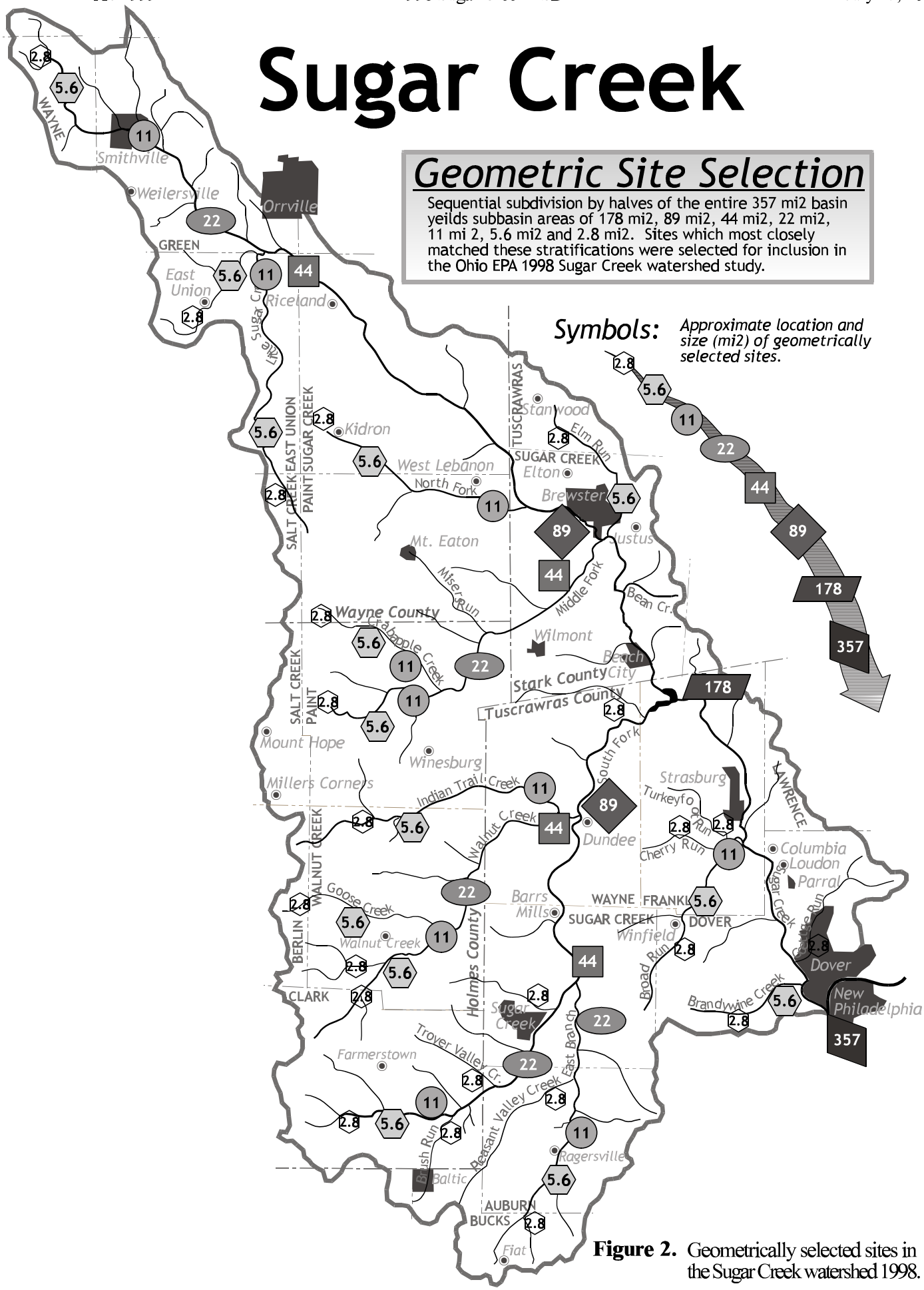

Figure 2. Geometrically selected sites in the Sugar Creek watershed 1998.

The extent of **NON** attainment throughout most of the watershed distinguished Sugar Creek as one of the most degraded basins in all of Ohio. Agricultural land use has promoted siltation and habitat destruction across most of the watershed. Polluted runoff from agricultural and mining sources further acted to suppress aquatic life use attainment.

Sugar Creek

Based on the performance of biological communities with respect to ecoregion biocriteria, only 7% (3.2 miles) of the mainstem of Sugar Creek was considered to be in FULL attainment of the WWH aquatic life use designation. 24.1 miles (54%) demonstrated PARTIAL attainment of the WWH criteria. **NON** attainment was documented in 17.7 miles (39%).

This level of performance was characterized as fair. Sugar Creek supported good macroinvertebrate communities at most sampling locations but fish communities were fair to poor. Physical habitat conditions were generally appropriate for the WWH aquatic life use designation.

5.6 mi^2

At the smallest scale (5.6mi^2) 11 of the 14 subbasins were expected to attain the WWH aquatic life use and three were recommended to be assigned the MWH designation. Attainment of the WWH designation was recorded at three sites, partial attainment was recorded at three other locations and **NON** attainment was indicated in five subbasins. Two locations were in full attainment of the MWH recommended use while one site partially achieved. Siltation, adverse habitat conditions and nutrient enrichment were responsible for the departures from attainment in most of the small streams in the watershed. Although these conditions also existed where full attainment was documented, unique mitigating circumstances associated with glacial moraine features improved biological performance in the reaches in full attainment. This was especially true in the Middle Fork Sugar Creek sub basin.

11 mi^2

Ten subbasins in the Sugar Creek watershed drain at least 11 mi^2. Half of these locations fully attained the WWH aquatic life use. These reaches were all located in the Erie Ontario Lake Plain (EOLP) ecoregion. Two similar size streams located in the Western Allegheny Plateau (WAP) ecoregion of the Sugar Creek basin achieved full attainment of the recommended MWH designation. One WAP stream was in partial attainment and another was in NON attainment of the WWH aquatic use. Two other WAP streams partially attained the MWH recommended use. The biological performance in the EOLP streams reflected the influence of glacial moraine features especially in the Middle Fork drainage and was also attributed to the continuous flow from point source discharges. Despite the downstream nutrient enriched water quality, these sources provided a sufficient volume of continuous flow which was more critical to the biological community. Many of the WAP streams exhibited reduced flow during the later part of the summer.

22 mi^2

Within the Sugar Creek watershed there were five 22 mi^2 subbasins. As with the 11 mi^2 subbasins, attainment was influenced by physiography and aspects related to flow. The mainstem and Middle

Fork at 22 mi^2 attained the WWH use designation. The South Fork, the East Branch South Fork and Walnut Creek at 22 mi^2 were in partial attainment of the MWH aquatic use designation.

44 mi^2

Full attainment was not documented in any of the four 44 mi^2 sub basins in Sugar Creek in 1998. Each was influenced by their respective upstream conditions. A substantial sediment load functionally overwhelms all of these sub basins. All received nutrient enriched concentrated flows from severely habitat degraded upstream reaches. The more subtle influences from acid mine drainage in the WAP ecoregion were difficult to discern biologically at this resolution.

89 mi^2

At an 88mi^2 drainage resolution the Sugar Creek watershed was represented by the mainstem downstream from the North Fork and by the South Fork downstream from Walnut Creek. Natural wetland habitat conditions at both of these locations limited biological performance. Upstream sources of siltation and nutrients also exacerbated conditions at both locations. As a result, non attainment of the WWH aquatic life use was documented at both sites.

178 mi^2 and 357 mi^2

The South Fork of Sugar Creek joins the mainstem in the Beach City Reservoir. Downstream from this confluence, Sugar Creek is a 300 mi^2 drainage. The dam pool capacity has been so reduced by siltation that recreational boating is impractical. Downstream silt deposition limited the fish community from achieving the ecoregion biocriterion. At the confluence with the Tuscarawas River, fish community performance was recovering from influences exerted by Dover Chemical and still reflected the limiting aspects of poor substrate quality. The macroinvertebrate community at both of these locations was good. Hence, partial attainment was recorded at both sites.

Sugar Creek

The theme of siltation, habitat degradation and nutrient enrichment was consistent throughout the Sugar Creek watershed. Across the mainstem these factors precluded WWH attainment at several sites. Natural wetland conditions between RM 23 and RM 18 were also limiting. Within the wetland reach, upstream pollutants further exacerbated the expected reduced biological performance. Contamination in the area downstream from Dover Chemical prevented WWH attainment.

Water quality standards were exceeded at all mainstem locations. Fecal coliform concentrations exceeded the primary contact recreation criterion at all mainstem locations upstream from the Beach City Reservoir. Dissolved Oxygen concentrations fell below the chronic aquatic criterion at all sites within the wetland reach. Downstream from the South Fork, which joins the mainstem in the Beach City Reservoir, total iron concentrations exceeded the agricultural water supply criterion at every location.

Primary nutrient enrichment was evident at all mainstem locations. Concentrations of ammonia-N, nitrate-N, and total phosphorus were grossly elevated at every sampling station. All mean

Table 1. Aquatic life use attainment status for the Sugar Creek basin based on biological sampling conducted during July through September, 1998.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
Sugar Creek	*Erie Ontario Lake Plain (EOLP) - WWH Use Designation*					
42.8	26*	NA	G	50.0	**NON**	Schellin Rd.
40.2	42	NA	G	53.0	FULL	CR 502
38.1	40	7.5[ns]	MG[ns]	47.0	FULL	Back Rd.
34.9	32*	6.2*	--	44.5	(**NON**)	McQuaid Rd.
34.6	33*	7.1*	44	72.5	PARTIAL	Kansas Rd.
26.8	32*	5.8*	G	65.0	**NON**	West Lebanon Rd.
23.0	25*	4.7*	38	42.5	**NON**	Alabama Ave.
19.3	13*	3.8*	44	51.5	**NON**	SR 93, Dst. N. Fork
17.6	19*	4.1*	26*	71.0	**NON**	Dst. Brewster Dairy and WWTP
13.7	23*	4.1*	40	78.5	**NON**	From park/ Dst. Beach City WWTP
	Western Allegheny Plateau (WAP) - WWH Use Designation					
12.0	32*	7.8*	38	58.0	PARTIAL	From dam access road
7.2	37[ns]	8.2[ns]	42	77.5	FULL	Dst. Strasburg WWTP
3.7	41	7.8*	42	91.0	PARTIAL	CR 80, Ohio Ave.
1.8	35*	5.8*	36	73.5	**NON**	SR 516 & 39
0.6	37*	7.0*	38	74.0	PARTIAL	SR 39
Little Sugar Creek	*Erie Ontario Lake Plain (EOLP) - WWH Use Designation*					
4.9	21*	NA	44	40.0	**NON**	Kansas Rd.
0.8	40	NA	VG	49.0	FULL	McQuaid Rd.
Little Sugar Creek Tributary at RM 0.5						
	(*Erie Ontario Lake Plain (EOLP) - WWH Use Designation Recommended*)					
1.1	34*	NA	MG[ns]	44.5	PARTIAL	McQuaid Rd.
North Fork Sugar Creek	*Erie Ontario Lake Plain (EOLP) - WWH Use Designation*					
5.4	36[ns]	NA	MG[ns]	63.5	FULL	Zuercher Rd.
3.1	40	NA	G	47.0	FULL	CR 94
1.3	34*	NA	G	48.0	PARTIAL	T-105, W. Lebanon Rd.
Middle Fork Sugar Creek	*Erie Ontario Lake Plain (EOLP) - WWH Use Designation*					
12.3	42	NA	G	40.0	FULL	From T-654
10.3	44	NA	G	46.5	FULL	T-669
7.6	44	8.7	G	60.0	FULL	T-606
1.7	35*	6.2*	50	58.5	PARTIAL	Welty Rd
Crabapple Creek	*Erie Ontario Lake Plain (EOLP) - WWH Use Designation*					
2.9	38[ns]	NA	G	45.0	FULL	T-357
0.3	44	NA	G	42.5	FULL	T-606

Table 1. (continued)

RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
Middle Fork Sugar Creek Tributary at RM 6.0						
(*Erie Ontario Lake Plain (EOLP) - WWH Use Designation Recommended*)						
0.2	40	NA	G	51.5	FULL	T-659
Misers Run	*Erie Ontario Lake Plain (EOLP) - WWH Use Designation*					
0.2	42	NA	--	56.5	(FULL)	From lane off T-659
Middle Fork Sugar Creek Tributary at RM 3.25						
(*Erie Ontario Lake Plain (EOLP) - WWH Use Designation Recommended*)						
0.5	38[ns]	NA	--	57.0	(FULL)	T-314, Alabama Ave.
Elm Run	*Erie Ontario Lake Plain (EOLP) - WWH Use Designation*					
1.7	32*	NA	MG[ns]	55.0	PARTIAL	Harmon Ave.
0.5	30*	NA	--	32.5	(**NON**)	Kings Highway
South Fork Sugar Creek						
(*Western Allegheny Plateau (WAP) - MWH Use Designation Recommended*)						
21.1	20*	NA	F	34.5	PARTIAL	CR 114
19.0	18*	NA	F	27.0	PARTIAL	T-173
15.3	20*	5.3*	MG	27.0	PARTIAL	CR 47
13.9	28	7.1	F*	27.5	PARTIAL	T-355
13.3	29	5.7*	28	47.0	PARTIAL	CR 73
Western Allegheny Plateau (WAP) - WWH Use Designation						
7.5	27*	4.4*	34[ns]	45.0	**NON**	Barrs Mills Rd
6.4[B]	20*	2.9	34[ns]	50.0	**NON**	CR 94
3.6[B]	26*	4.5*	10*	50.0	**NON**	T-62
Brush Run	*Western Allegheny Plateau (WAP) - WWH Use Designation*					
2.5	28*	NA	F*	51.5	**NON**	Shrock Rd.
0.4	28*	NA	P*	25.5	**NON**	Dst. WWTP
Brush Run Tributary at RM 1.54						
(*Western Allegheny Plateau (WAP) - LRW Use Designation Recommended*)						
0.1	12*	NA	--	38.0	(**NON**)	Entrance to abandoned mine
Troyer Valley Creek	*Western Allegheny Plateau (WAP) - WWH Use Designation*					
1.0	22*	NA	P*	34.0	**NON**	SR 93
South Fork Sugar Creek Tributary at RM 15.83						
(*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
1.1	22*	NA	--	39.5	(**NON**)	CR 71
South Fork Sugar Creek Tributary at RM 14.1						
(*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.2	20*	NA	--	22.0	(**NON**)	CR 73
0.1	28*	NA	--	35.0	(**NON**)	Dst. Ohio Whey

Table 1. (continued)

RIVER MILE	IBI Fish/Invert.	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
East Branch (South Fork Sugar Creek)						
(*Western Allegheny Plateau (WAP) - WWH Use Designation*)						
5.5	24*	NA	G	44.5	**NON**	CR 48
(*Western Allegheny Plateau (WAP) - MWH Use Designation Recommended*)						
5.0	24	NA	G	40.5	FULL	CR 52
3.3	22*	NA	--	43.5	(**NON**)	CR 46
1.7	26	3.4*	P*	23.0	PARTIAL	T-348
East Branch Tributary at RM 3.6						
(*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.7	24*	NA	--	34.0	(**NON**)	Driveway from T-336
Pleasant Valley Creek *Western Allegheny Plateau (WAP) - WWH Use Designation*						
0.2	24*	NA	F*	30.0	**NON**	From T-339
East Branch Tributary at RM 2.07						
(*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.7	20*	NA	--	37.0	(**NON**)	CR 70
South Fork Sugar Creek Tributary at RM 11.3						
(*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.2	20*	NA	--	36.0	(**NON**)	T-354
Walnut Creek						
(*Western Allegheny Plateau (WAP) - MWH Use Designation Recommended*)						
7.9	30	NA	G	27.0	FULL	Old SR 39
6.4	22*	NA	G	25.0	PARTIAL	T-444
4.5	30	5.7*	G	25.5	PARTIAL	CR 172
(*Western Allegheny Plateau (WAP) - WWH Use Designation*)						
0.6	23*	3.2*	G	47.0	**NON**	Lane from CR 94
Goose Creek (*Western Allegheny Plateau (WAP) - WWH Use Designation*						
0.3	18*	NA	G	26.5	**NON**	T-419
Walnut Creek Tributary at RM 3.92						
(*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.4	34*	NA	--	33.5	(**NON**)	CR 168
Indian Trail Creek (*Western Allegheny Plateau (WAP) - WWH Use Designation*						
6.4	34*	NA	E	51.0	PARTIAL	T-414
5.9	30*	NA	--	63.5	(**NON**)	From T-414
5.6	22*	NA	VG	41.5	**NON**	Ust. SR 515
5.3	12*	NA	--	49.0	(**NON**)	Dst. Troveris Trail Bologna
3.8	28*	NA	--	52.0	(**NON**)	Ust. Case Farms
2.6	30*	NA	VG	59.5	PARTIAL	T-66

Table 1. (continued)

RIVER MILE	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
Fish/Invert.						
Indian Trail Creek Tributary at RM 6.08						
(*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.4	12*	NA	F*	50.5	**NON**	From T-412
South Fork Sugar Creek Tributary at RM 1.0						
(*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.7	26*	NA	--	64.0	(**NON**)	T-447
Broad Run (*Western Allegheny Plateau (WAP) - WWH Use Designation*)						
2.8	30*	NA	F*	39.0	**NON**	CR 80, Dst. Trib at RM 2.85
0.2	32*	NA	P*	70.0	**NON**	T-425
Cherry Run (*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.2	12*	NA	--	60.5	(**NON**)	CR 78
Turkeyfoot Run (*Western Allegheny Plateau (WAP) -WWH Use Designation*)						
0.2	12*	NA	P*	67.0	**NON**	CR 78
Goettge Run (*Western Allegheny Plateau (WAP) - WWH Use Designation Recommended*)						
0.3	22*	NA	P*	61.0	**NON**	Davis St.
Brandywine Creek (*Western Allegheny Plateau (WAP) - WWH Use Designation*)						
2.0	30*	NA	--	31.5	(**NON**)	T-374
0.2	32*	NA	F*	44.5	**NON**	T-211

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
ns Nonsignificant departure from biocriterion (≤4 IBI or ICI units; ≤0.5 MIwb units).
a Narrative evaluation used in lieu of ICI (E=Exceptional; G=Good; MG=Marginally Good; F=Fair; P=Poor).
b Use attainment status based on one organism group is parenthetically expressed.
NA Not Applicable. The MIwb is not applicable to headwater sites.
B Boat site. Headwater - wading criteria apply to all other sites.

concentrations were greater than the 75%tile values based on ecoregional reference conditions. Ohio EPA studies indicate that this continuous loading was likely to be biologically limiting (Miltner and Rankin 1998).

Several organic contaminants were detected in the effluent and in the water column in the vicinity of Dover Chemical. Bioassays of the effluent have a record of toxicity over the past ten years. Pollutant spills and fish kills have also been reported downstream from the company during this period. A previous Ohio EPA study identified this facility as a source of water quality impairment (Ohio EPA 1992). In the earlier study, the sediments downstream from Dover were compacted and smothered by an undetermined fine material. Although substrate condition had improved marginally by 1998, the sediments were still atypical and effervesced an organic odor when disturbed. Biological performance declined downstream from the facility in 1998. Efforts to remediate this situation are warranted.

Table 2. Narrative ranges, WWH (bold), and MWH (italics) biocriteria for the Eastern Corn Belt and Erie Ontario Lake Plains ecoregions. Exceptional (EWH biocriteria), very good (EWH nonsignificant departure), poor and very poor evaluations are common statewide. For WWH, the ranges of marginally good and nonsignificant departure are the same.

IBI			**MIwb**		**ICI**	**Narrative Evaluation**
Headwater	Wading	Boat	Wading	Boat	All	
50-60	50-60	48-60	$9.4	$9.6	46-60	Exceptional
46-49	46-49	44-47	8.9-9.3	9.1-9.5	42-44	Very Good
Erie Ontario Lake Plain						
40-45	**38**-45	**40**-43	**7.9**-8.8	**8.7**-9.0	**34**-40	Good
36-39	34-37	36-39	7.4-7.8	8.2-8.6	30-32	Marginally Good
28-35	28-33	26-35	5.9-(*6.2*) 7.3	6.4-8.1	14-(*22*) 28	Fair
Western Allegheny Plateau						
44-45	**44**-45	**40**-43	**8.4**-8.8	**8.6**-9.0	**36**-40	Good
40-43	40-43	36-39	7.9-8.3	8.1-8.5	32-34	Marginally Good
28-39	28-39	26-35	5.9-(*6.2*) 7.8	6.4-8.0	14-(*22*) 30	Fair
18-(*24*) 27	18-(*24*) 27	16-(*24*) 25	4.5-5.8	5.0-(*5.8*) 6.3	2-12	Poor
12-17	12-17	12-15	0-4.4	0-4.9	<2	Very Poor

Habitat conditions in Sugar Creek were segmented based on substrate quality. Upstream from the Beach City Reservoir, two reaches of fair habitat quality were likely to exert a negative influence on biological performance. Substrates were silt covered and embedded in these reaches. Cover within the stream channel was limited at many locations. Aside from deep pools, most sites lacked other elements of instream habitat that are functionally important. Strong flow downstream from the Reservoir was credited for some improved biological performance in the lower twelve miles of Sugar Creek.

Macroinvertebrate community performance in Sugar Creek was good. Declines in index scores were recorded downstream from the Brewster Dairy and WWTP and downstream from Dover Chemical. Although it was probable that these entities influenced the decreased performance, habitat conditions were less conducive downstream from these locations. As a result, some uncertainty was associated with these assessments.

Fish community performance in Sugar Creek was poor to fair. Siltation and limited habitat

conditions were the most significant influences on fish community performance. Fish diversity was low throughout the Sugar Creek watershed. Only five adult smallmouth bass were collected in the survey. The virtual absence of this sensitive species along with the predominance of tolerant species strongly indicated that Sugar Creek was extremely degraded.

Lithophilic spawning fish require clean substrates with interstitial voids in which to deposit eggs into. This common collection of species was particularly reduced in Sugar Creek. These fish were nearly absent in the reach downstream from the Beach City Reservoir. Normally, a dam acts a sink for many water quality constituents including sediment. However, the Reservoir capacity has been so reduced that instead it served as a source of fines which highly impacted the reach immediately downstream.

Land use was determined to be the most significant source of excessive sediment in the Sugar Creek watershed. Many headwater streams began in livestock pastures where stream banks were trampled and eroded. Downstream these creeks drained intensively farmed row crop fields devoid of riparian vegetation. Upon joining the mainstem of Sugar Creek, these streams delivered a large sediment load and water which was warm and laced with nutrients.

Ironically, point source discharges were somewhat effective in diluting this impact. The best fish community in the mainstem was recorded downstream from the Smithville WWTP. As long as the WWTP discharged an acceptable quality of water, it functioned like a spring. As a result of this flow augmentation, three sensitive species were documented downstream.

The fish community also improved downstream from the Strasburg WWTP. Although the amount of flow from this plant was proportionally less important in this reach, the fish assemblage did improve despite the additional pollutant load. The improvement was more closely associated with better habitat conditions in this reach.

Inconsistent plant operation at the Beach City WWTP was indicated by the fish community as index scores were significantly different between passes. This assessment was somewhat confounded by upstream wetland influences which depressed dissolved oxygen availability. During the second pass the scores at the site upstream from the WWTP also declined.

In 1998 the condition of Sugar Creek was fair. Stream segments in attainment of ecoregional criteria were short in length. Siltation, habitat quality and nutrient enrichment restricted better stream health. The creek appeared to be unable to assimilate the various sources of pollution as populations of sensitive fish species were virtually absent. Pollution tolerant fish species predominated all samples and lithophils were especially reduced. In all, 280 macroinvertebrate taxa and 55 fish species were collected in Sugar Creek in 1998.

Sugar Creek Permitted Dischargers

Ohio EPA has permitted at least 62 entities to discharge 5.05 million gallons per day (MGD) of

treated wastewater in the Sugar Creek basin. Seven entities release wastewater directly to Sugar Creek while the others discharge to various tributaries. Only Dover Chemical had daily flows which were greater than one MGD (i.e., 1.45 MGD). The other six dischargers, Smithville WWTP, Harmony Lake WWTP, Brewster WWTP, Brewster Dairy, Beach City WWTP and Strasburg WWTP, had a combined total flow of 1.7 MGD. Among these Sugar Creek dischargers, Dover Chemical impacted the biota and some concerns were evident regarding operation at the Beach City WWTP. Macroinvertebrate community performance declined downstream from the Brewster operations. Biological performance improved downstream from Smithville and Strasburg.

Dover Chemical produces phosphites and chlorinated hydrocarbon products which are used to manufacture lubricants, plasticizers, flame retardants, and stabilizers. Hydrochloric acid and sodium hypochlorite are process by-products. Process wastewater is collected for off-site treatment. Non-contact cooling water is treated by sedimentation, oil separation, and air stripping. Sanitary wastewater is treated with a trash trap, extended aeration, clarifier, two sand filters, and chlorination. Wastewater from both systems is combined prior to discharging to Sugar Creek at RM 2.1.

Between 1989 and 1998, Ohio EPA conducted eight bioassays of the Dover Chemical effluent. All samples were toxic. Total suspended and total dissolved solids are monitored by the Company according to their NPDES permit. Annual loadings have been low and well below permit requirements. No violations of NPDES permit limits were determined from five effluent samples collected during the survey. The effluent did contain some organic compounds including, Bis(2-ethylhexyl)phthalate (1.9 ug/l), "-BHC (0.38 ug/l), $-BHC (0.088 ug/l), d-BHC (0.025 ug/l), (-BHC (0.056 ug/l), 4-4'DDE (0.022 ug/l), heptachlor epoxide (0.0071 ug/l), and hexachlorobenzene (0.060 ug/l).

Chemical and biological sampling bracketed the company. Generally, the effluent had acceptable chemical properties. Despite this, biological scores declined downstream from Dover Chemical. The macroinvertebrate community did achieve the relevant biocriterion at both sites bracketing the facility. However, the downstream score (ICI=36) was the lowest in the twelve mile reach from the Beach City Reservoir to the Tuscarawas River confluence. The fish community failed to achieve the WWH biocriterion downstream from the plant.

The 1998 benthic results downstream from Dover Chemical were a substantial improvement over the 1991 scores. In 1991, good macroinvertebrate community performance upstream from Dover Chemical (RM 3.7 and RM 2.11) declined to poor performance immediately downstream from the outfall at RM 2.09. Farther downstream at RM 1.8 and RM 0.6 in 1991 the scores remained poor.

The fish community has not recovered as much. In 1998 at RM 3.7 a good IBI score (41) contrasted with a fair MIwb value (7.8). Here, 19 to 26 species were represented by 122 to 182 individuals. Although this upstream condition was unremarkable, the fish community performance declined from this background downstream from Dover Chemical.

In 1998 at RM 1.8 a fair IBI score (35) and a poor MIwb value (5.8) were calculated. Twelve to 19 species were represented by 71 to 138 individuals. This departure related to the proximity of Dover Chemical has been evident in past fish community data also.

In 1991, 1988, and 1983, fish community performance upstream from Dover Chemical was very good. In those years performance consistently declined to fair downstream from the facility. In a 1992 report, Investigation of Biological Communities and Toxic Impacts in Sugar Creek and Selected Tributaries, the Ohio EPA concluded Dover Chemical was the cause of this degradation. The 1998 results confirmed this condition continued to exist.

During the 1998 survey the Beach City WWTP was experiencing increased inflow. Plans have been made to expand the facility in 2000 to accommodate the growth. High concentrations of chlorine were discharged during the 1998 study. The fish community performance was sensitive to this toxicity and declined over the course of the summer.

The Brewster WWTP was upgraded in 1997. Their outfall is about 30 yards upstream from that of the Brewster Dairy. Downstream sampling was thus reflective of the combined influences of both entities. Both entities have experienced difficulty meeting their permit limits. The Brewster WWTP receives shock loadings from Shearers Food Company. These unexpected pretreatment inflows upset the plant and have resulted in some significant violations. Likewise, the Brewster Dairy has had numerous permit violations in recent years. Effluent samples in 1998 indicated the Dairy discharges high concentrations of total phosphorus and total dissolved solids.

The outfalls for these entities are located in a wetland reach. Stream biological performance in the vicinity is therefore naturally limited. However, the macroinvertebrate community did decline downstream from the outfalls and performance at this location was the lowest of any mainstem sample. Further investigation is warranted to determine the source of this impact. The fish community was less sensitive to the influence, as it was poor at both sites bracketing the outfalls.

The fish community was responsive to the increased flow downstream from the Smithville WWTP. This plant was upgraded in 1997. Prior to the upgrade, sludge deposits were documented downstream. Compliance with permit limits was reported in 1998. Although the plant delivers elevated concentrations of nitrates, the perennial flow was deemed more important to the fish community which responded to the nutrient enrichment with an increase in population.

The Village of Strasburg is planning to upgrade their treatment facility. Faulty operation of the WWTP in 1993 and 1994 was apparent in the monthly reporting data but the plant seemed to be functioning appropriately in 1998. Effluent sampling indicated the plant was a source of fecal coliform bacteria and may influence ambient D.O. concentrations. However, the discharge is located upstream from a high gradient reach and no impact to the biota was determined.

No impact was attributed to the Lake Harmony WWTP which was operating at well below capacity.

5.6 mi^2 subbasins

Fourteen 5.6 mi^2 stations were used to evaluate water quality in the Sugar Creek watershed. In total these locations drained 78.4 mi^2 (22%) of the basin. These headwater sites represented the upstream origins for subsequently larger subbasins. As such, their condition was somewhat predictive of the quality likely to be encountered downstream barring further mitigating circumstances. In general, water quality at this scale in the Sugar Creek watershed was poor to fair.

Fecal coliform bacterial concentrations exceeded the Primary Contact Recreation criterion at every site. Concentrations of iron were elevated including some locations where the agricultural water supply criterion was exceeded. Primary nutrients were also elevated at all sites. A high covariance was documented between ammonia-N and sulfate concentrations in the WAP ecoregion. At 5.6 mi^2 WAP sites these parameters were both extremely elevated. This was likely due to the prevalence of coal mining in this ecoregion, as these chemicals are by-products of a process where ammonia hydroxide is used to adjust the pH coal wash water.

The North Fork of Sugar Creek at the 5.6 mi^2 scale was more polluted than other similar streams in the basin. This location, downstream from Kidron and from a tributary into which Gerber Poultry discharged, had total phosphorus concentrations which ranged from 2.1 to 3.5 mg/l and nitrate-N values which averaged 5.5 mg/l. Despite these levels, biological performance here was marginally good. Habitat at this site was more optimal due in part to high gradient and strong flows. The fish community responded to these attributes, but demonstrated the effects of enrichment and poorly treated sewage through high relative numbers.

Habitat at most other 5.6 mi^2 sites was poor. The majority were within pastures where livestock had unrestricted access to the stream. As a result, the stream banks were typically denuded of riparian vegetation and severely eroded. Substrates were covered in silt and the streams lacked appropriate cover for aquatic organisms.

In addition to habitat, mining influences further limited macroinvertebrate performance in the upper reaches of the South Fork of Sugar Creek, Broad Run and Brandywine Creek. The fair communities at these locations had sparse mayfly populations.

The fish community was sensitive to minimum flow and did better at sites which received ground water input. The Middle Fork of Sugar Creek is situated on morainal features which contributed larger volumes of ground water to the stream on a continuous basis more so than other tributaries in the basin. Thus, the fish communities at locations in the Middle Fork and nearby reflected higher quality conditions. Without the perennial flow, fish communities at 5.6 mi^2 in the Sugar Creek watershed tended to exhibit poor qualities.

5.6 mi^2 subbasin Permitted Dischargers

Fourteen entities which discharge into small subbasins (<5.6 mi^2) in the Sugar Creek watershed were evaluated. Gerber Poultry and Case Farms both process poultry and use similar treatment

technology. Both were sources of excessive nutrient loading. Gerber Poultry discharged to an unassessed and unnamed tributary to the North Fork of Sugar Creek. Better habitat in the North Fork of Sugar Creek offset the nutrient load and the stream was able to assimilate some of the highest concentrations of pollutants documented in the basin. Case Farms discharged to an unassessed and unnamed tributary to Indian Trail Creek. Numerous permit violations were recorded at the facility in 1998 and design capacity was often exceeded. No significant impact was attributed to the company although this was difficult to discern in the already degraded Indian Trail subbasin.

Troyers Trail Bologna and Holmes ByProducts also discharge to Indian Trail Creek via unnamed tributaries. Troyers makes beef bologna and no permit violations have been reported. The unnamed tributary to which the facility discharges was not evaluated. However, dead fish were observed in the tributary downstream from the facility in 1998. Further investigation is recommended to document the effect of effluent from Troyers on water quality conditions.

Conditions in Indian Trail Creek were poor largely because Holmes ByProducts, an unpermitted processor of dead stock including offal, meat, blood, fats, oils and poultry feathers, sprayed their effluent over steep hillsides where it ran off into an unnamed tributary. Acutely toxic conditions were documented in an unnamed stream flowing through Holmes ByProducts property.

Although Indian Trail Creek has degraded habitat and nutrient enriched conditions upstream from Holmes ByProducts, the company further impacts the Indian Trail Creek subbasin by delivering a sufficient volume of organically enriched wastewater so that more than one mile of stream network is chronically impaired.

Holmes ByProducts lacks NPDES and sludge application permits. Holmes ByProducts utilizes extremely crude and environmentally ineffective methods to dispose of wastewater that is highly concentrated in ammonia. As recently as December 1998, U.S. EPA documented ammonia concentrations of 1300 mg/l in the liquid that had been sprayed onto hillside fields. This liquid kills vegetation and obviously should not be land applied without better prior treatment. Immediate corrective action is warranted.

The Baltic WWTP, built in 1981 with a design capacity of 0.10 MGD, discharges to Brush Run. The facility has had some difficulty meeting permit limits as all 1998 effluent samples violated their dissolved oxygen limit and one ammonia violation was recorded. Chemical sampling bracketing the plant indicated it is a source of organic enrichment. The macroinvertebrate community performance declined downstream from the WWTP and reflected the influence of the enrichment. The fish community was more limited by ambient habitat conditions.

Guggisberg Cheese produces swiss cheese from raw milk and discharges to Troyer Valley Creek. Their effluent contained high concentrations of ammonia-N and total phosphorous. Downstream, ammonia-N was present in toxic concentrations and total phosphorous levels were indicative of extreme organic enrichment. Poor biological communities inhabited the reach downstream from the

facility which was credited for this response.

American Whey produces dry whey from raw and condensed whey it obtains from local cheese manufacturers. They discharge to an unnamed tributary of the South Fork of Sugar Creek. Two effluent fecal coliform concentrations exceeded the Primary Contact Recreation limit and two dissolved oxygen measurements failed to meet their minimum permit limit. Some organic enrichment was evident in the chemical samples which bracketed the company. No macroinvertebrate samples were collected in the unnamed tributary. The fish assemblage improved downstream from Ohio Whey in response to increased flow. Twice as many species inhabited the unnamed tributary downstream from the facility and the community improved from poor to fair. Habitat conditions were considered more limiting than the enrichment influences.

The Holmes County Walnut Creek WWTP, built in 1987 with a design capacity of 0.90 MGD, discharges to an unnamed tributary to Walnut Creek. The plant has a long history of receiving BOD shock loadings from several Walnut Creek Village businesses and flows frequently exceed design capacity. It has been difficult for the WWTP to meet permit limits. Nineteen violations were recorded in June and July of 1998. Ambient monitoring downstream in Walnut Creek indicated the WWTP is a source of nutrient loading.

No water quality impacts were inferred from ambient monitoring results in the vicinity of the following entities: Mt. Hope WWTP, Alpine Cheese Company, Allied-Baltic Rubber, Alpine Hills, Broad Run Cheese, and Kimble Landfill

11 mi^2 subbasins

Nearly one third (31%) of the Sugar Creek watershed is contained in subbasins of 11 mi^2. Ten locations were used to evaluate the condition of the watershed at this scale. All but one (Broad Run) had exceedences of the fecal coliform Primary Contact Recreation advisory. All had elevated concentrations of primary nutrients. Concentrations of total iron, sulfates and ammonia were higher in the WAP ecoregion than in the EOLP. Overall as with the smaller 5.6 mi^2 subbasins, water quality at this scale in the Sugar Creek watershed was poor to fair.

Nutrient enrichment continued to be especially evident in the North Fork of Sugar Creek, downstream from the 5.6 mi^2 site. A similar impact was observed downstream from Case Farms in Indian Trail Creek at the 11 mi^2 site. Although this site was also downstream from other discharges in the subbasin including Holmes ByProducts, Case Farms' continuous discharge was evident in a longitudinal view of the entire stream. The macroinvertebrate community responded to the volume of flow and the enrichment in Indian Trail Creek at 11 mi^2 with good performance. The fish community suffered here from degraded habitat conditions and chronic pulses of pollutants from multiple upstream sources.

The macroinvertebrate community continued to be impaired in Broad Run by mining influences. Between the 5.6 mi^2 and 11 mi^2 sites, two essentially dead streams flow into Broad Run. Only one

EPT taxon was collected in Broad Run downstream from Cherry Run and Turkeyfoot Run.

Habitat at the 11 mi^2 scale in the Sugar Creek watershed was fair to poor. Three of the ten locations were in pastures and six were flanked by row crop agricultural fields. The substrates were embedded and covered with silt. Instream cover was limited and the riparian corridors were narrow.

The fish community continued to reflect the influence of groundwater augmented flow associated with glacial physiographic features. The assemblages in the EOLP ecoregion achieved the biocriteria while those in the WAP did not. Since habitat was similar but the EOLP communities performed at a higher level this suggested that the EWH aquatic life use standard may be the more appropriate use for EOLP streams at this scale. However, the EWH standard is a protection goal not a restoration goal. A stream must demonstrate attainment of this status in order to receive this protection. If efforts to restore habitat quality across the basin were initiated, it is probable that these EOLP streams would achieve higher biocriteria values.

11 mi^2 subbasin Permitted Dischargers

The Village of Smithville WWTP is the only entity which discharges to a subbasin between 5.6 mi^2 and 11 mi^2 in the Sugar Creek watershed. A summary of plant performance is located within the section about Sugar Creek permitted dischargers. A positive impact associated with perennial flow was attributed to the facility despite it being a source of nutrient loading.

22 mi^2 subbasins

Five sites at the 22mi^2 scale were evaluated. These drained 110 mi^2 or 31% of the Sugar Creek watershed. Chemical parameters exhibited greater variability between upstream conditions and between sites at this resolution. Fecal coliform bacteria concentrations continued to be high but minimum values at most locations were less than the Primary Contact Recreation criterion. Slightly better base flow water quality than was observed upstream was inferred from this.

Mining influences were more pronounced in the chemical data at the 22mi^2 scale than at other basin sizes. Ammonia-N and sulfate concentrations were extremely elevated at the three relevant WAP ecoregion locations. In other Ohio watersheds the same levels of these pollutants would have been expected to exert a negative influence on the aquatic biota. However, in Sugar Creek the most degraded habitat coincided with these WAP locations. Thus, distinguishing between the impacts from mining versus very poor habitat was difficult.

The macroinvertebrate community registered a significant decline longitudinally from the 11 mi^2 to 22 mi^2 locations in the East Branch of the South Fork of Sugar Creek. With only one EPT taxon and a community predominated by blackflies and tolerant midges, the downstream assemblage reflected the additional influence of several large dairy farms in the basin. This determination was not possible with fish community data. Although the upstream assemblage had higher relative numbers and the downstream location achieved a very poor MIwb score, attributing a cause beyond habitat devastation was not possible. In any case, the East Branch of the South Fork of Sugar Creek had the

poorest water quality in the entire basin excluding the few biologically dead streams. Correcting this situation will require efforts directed at the multiple sources of impact.

In general, water quality continued to decline at larger drainage area sites. Although the biological community performed better at the EOLP locations, reflecting the influence of enhanced flow from groundwater and point sources, this performance should probably be considered in regard to its EWH potential. Performance in the WAP was poor to fair. If those locations where WWH criteria were met were evaluated against EWH criteria, then all of the locations would have been in non-attainment.

22 mi^2 subbasin Permitted Dischargers
No entities discharge into subbasins between 11 mi^2 and 22 mi^2 in the Sugar Creek watershed.

44 mi^2 subbasins
Nearly half (49%) of the Sugar Creek watershed is represented by four subbasins which drain at least 44 mi^2. None of these locations attained the appropriate aquatic life use standard. Upstream influences combined at this scale to limit biological performance and yielded elevated concentrations of chemical parameters. Total suspended solids concentrations were especially high at all four sites. At this scale, the individual stream reaches all have lower gradient and reduced velocities. The higher gradient upstream tributaries deliver sediment and other suspended particles at a relatively fast rate to these slower larger stream reaches. Although deposition occurs in the slower streams so does resuspension. The large supply of suspended material from upstream sources and in place deposits yielded consistently high TSS concentrations.

Embeddedness was considered the most limiting factor to biological performance in the Sugar Creek watershed. Almost in testament to this assertion, the macroinvertebrate sampling devices which were placed in the South Fork of Sugar Creek and in Walnut Creek at 44 mi^2 locations were covered by sand and silt within six weeks. These Hester Dendy multiplate samplers consist of five, four inch cubes of stacked masonite attached to cement blocks. The blocks are placed in the stream where currents should wash deposition away. Apparently, siltation was so overwhelming that this standard technique for macroinvertebrate monitoring was not successful at the 44 mi^2 WAP sites.

The fish community also reflected the poor substrate conditions. Relative numbers were low and community traits were so simplified that interpretation based on trophic relationships and habitat associations was confounded. The influence of flow in the EOLP that buoyed performance in the smaller basins was not as apparent at the 44 mi^2 scale. As a result, fish communities declined in the EOLP while performance in the WAP exhibited a slight improvement. This improvement was hampered by a sporadic event in the Walnut Creek subbasin.

Scores significantly varied between the two fish samples collected at the 44 mi^2 Walnut Creek location which was downstream from Indian Trail Creek. Several entities including Holmes ByProducts discharge to Indian Trail Creek. It was likely that an unreported release had an acute

effect on the fish community. Ohio EPA personnel did document one such incident in the vicinity of the village of Trail . Dead fish were observed in Indian Trail Creek and in an unnamed tributary in July, 1998. Slight recovery was documented at the 44 mi^2 Walnut Creek site over the summer in 1998.

Despite the high sediment load, the macroinvertebrate communities continued to respond to the stronger flows in the EOLP. Performance at the EOLP sites, where artificial substrates were recovered, indicated very good and exceptional assemblages inhabited these locations. This contrasted with the fair and marginally good communities in the WAP ecoregion.

44 mi^2 subbasin Permitted Dischargers

The Lake Harmony WWTP and the Village of Sugar Creek WWTP were the only discharges in subbasins between 22 mi^2 and 44 mi^2 in the Sugar Creek watershed. No impact was attributed to the Lake Harmony facility.

The Village of Sugar Creek WWTP, built in 1997 with a design capacity of 0.5 MGD, discharges to the South Fork of Sugar Creek. Although the new plant has maintained compliance with its NPDES permit, effluent sampling indicated some excessive fecal coliform bacteria was discharged. Chemical sampling bracketing the plant also identified it as a source of organic enrichment. Macroinvertebrate community performance declined due to this enrichment. The fish community responded to the increased flow and improved in performance. Habitat conditions were especially poor through this reach.

89 mi^2 subbasins

Ecoregional differences were less pronounced at the two 89 mi^2 sites, which drained 94 mi^2 of Sugar Creek and 124 mi^2 of the South Fork basin, or cumulatively 62% of the Sugar Creek watershed. Coincidently, both of these sites were situated in natural wetland reaches which lacked riffles. Habitat at both sites was very similar including fine grained sediments, silty sand in Sugar Creek and muck in the South Fork, extensive embeddedness, and limited cover in rather straight channels. Although riparian vegetation was better at these locations, the pervasive wetland qualities would not be expected to support riverine biota.

The lack of dissolved oxygen is one of the strongest detriments to aquatic organisms that are not adapted for wetland habitation. Indeed, both 89 mi^2 locations had daytime D.O. concentrations which violated the water quality standards. Since daytime D.O. concentrations were low, nighttime concentrations would be expected to be even due to the respiration process. The high TSS concentrations which continued downstream to these locations also likely influenced photosynthesis.

The macroinvertebrate communities were similar at the two sites. Performance improved in the WAP and declined in the EOLP. The flow which aided EOLP communities upstream was not as influential and the more natural, albeit wetland, conditions were better for the WAP assemblages. Overall, the marginally good to good performance at these locations was consistent with WWH

expectations.

Deplorable relative numbers of fish were recorded at the two 89 mi^2 locations. Community traits were so simplified that the assemblages were more a collection of random fish than a group of interdependent species. Very poor to poor index scores were recorded at these sites. Basically, upstream impacts combined with marginal habitat created conditions which were not conducive to fish inhabiting either location.

89 mi^2 subbasin Permitted Dischargers

All of the discharges in subbasins between 44 mi^2 and 89 mi^2 in the Sugar Creek watershed are located on the mainstem. Summaries of the performance of these entities are located within the section on Sugar Creek permitted dischargers. The Brewster Dairy, Brewster WWTP and Beach City WWTP were all suspected of having some limited influences on water quality in Sugar Creek.

178 and 356 mi^2 subbasins

Sampling occurred downstream from the Beach City Reservoir where the South Fork joins Sugar Creek; as there was no actual 178 mi^2 site in the watershed. This location drains 300 mi^2 and represented 84% of the entire basin. The next downstream geometric station was located near the confluence with the Tuscarawas River. Performance here would be expected to reflect the entire Sugar Creek watershed or any immediate influences which were capable of exerting an effect on such a large drainage.

Discussion of the results at these locations is also summarized in the previous section detailing mainstem performance. The site downstream from the dam lacked riffles and displayed some wetland type characteristics. A surprising amount of silt existed in the stream in this location. Dams often starve streams of bedload material. The opposite was true in Sugar Creek. The quantity of silt, which covered downstream substrates, was high. Nutrients, TSS and total iron concentrations were also high.

The macroinvertebrate community was undeterred by these influences and performed in the good range. The fish community recovered slightly from the upstream wetland conditions but only performed in the fair range. Lithophilic fish, which need clean substrates, were absent at the site downstream from the dam.

Performance at the most downstream location demonstrated some recovery from Dover Chemical which was located about two miles upstream. Considering the fact that assimilative capacity throughout the Sugar Creek watershed was continuously taxed, it may not have required many additional pollutants to suppress biological performance in the vicinity of Dover Chemical. Still, the stream did achieve full and partial attainment upstream from the entity but declined to non-attainment immediately downstream. This condition has existed for decades.

Where Sugar Creek meets the Tuscarawas River, it is laced with high concentrations of nutrients,

carries a high volume of TSS, transports a large sediment load, and offers little biological enhancement.

178 and 356 mi^2 subbasin Permitted Dischargers

The Strasburg WWTP and Dover Chemical discharge in subbasins between 89 mi^2 and 356 mi^2 in the Sugar Creek watershed are both located on the mainstem. Summaries of the performance of these entities are located within the section on Sugar Creek permitted dischargers. The Strasburg WWTP was a source of nutrient enrichment but better downstream habitat compensated for this influence and full attainment was observed.

Dover Chemical significantly impairs Sugar Creek. This impact should be remediated.

CONCLUSIONS

- Sugar Creek supported good macroinvertebrate communities but fish assemblages were poor to fair. Only 7% (3.2 miles) of the mainstem of Sugar Creek was considered to be in full attainment of the WWH criteria. 24.1 miles (54%) demonstrated partial attainment of the WWH criteria. Non-attainment of WWH criteria was documented for 17.7 miles (39%).

- The Sugar Creek watershed is extremely degraded. Few watersheds in Ohio rival the magnitude water resource devastation. Among 61 sites evaluated excluding the mainstem, only 11 were in full attainment of the WWH aquatic life use designation.

- Substrate conditions in the Sugar Creek watershed were the most limiting aspect to biological performance. Substrates were almost universally severely embedded and covered with silt or sand.

- Habitat quality was the second most limiting factor basin wide. Most tributaries began in livestock pastures and then flowed through intensively farmed row crop agricultural fields which were devoid of riparian vegetation. Downstream, the major tributaries joined together in two large wetland reaches which further exacerbated poor biological performance.

- Nutrient enrichment was the third most limiting factor basin wide. The majority of dischargers in the Sugar Creek basin are located in small subbasins. Many of these entities were sources of gross nutrient enrichment. However, the numerous pastures, agricultural fields, and instances of poorly treated residential sewage were perhaps even more influential as sources of enrichment. Combined, these sources resulted in elevated nutrient concentrations across the entire watershed.

- Bacterial contamination caused the most significant Ohio WQS criteria violations across the watershed. Nearly every site, except where acid mine drainage inhibited biological organisms, was home to concentrations of fecal coliform bacteria which exceeded the various recreational use criteria.

- Characteristics of acid mine drainage were apparent in the chemical monitoring data. Concentrations of ammonia-n, sulfates and iron were especially high in the South Fork Sugar Creek subbasin. Despite these elevated parameters, biological performance was typically more influenced by the three previously mentioned basin wide limiting factors.

- Cherry Run and Turkeyfoot Run were unique among Sugar Creek tributaries. These streams were nearly devoid of life due to mine drainage.

- Dover Chemical is responsible for the WWH aquatic life use departure in the vicinity of their

facility. The contamination associated with their facility was previously documented in 1991. Efforts to remediate this situation are warranted.

- Holmes ByProducts chronically impairs more than a mile of the Indian Trail Creek subbasin. Their land applied effluent kills terrestrial vegetation, runs off their property and is acutely toxic to aquatic life. The Ohio Department of Health was aware of this operation in the 1960's. The Ohio EPA first contacted the entity in 1976. Between 1987 and 1997 thirteen separate water samples collected by the Ohio EPA confirmed the fact that Holmes ByProducts discharged toxic concentrations of ammonia-N to waters of the State. The Ohio EPA has repeatedly requested this company to apply for a permit and to conform to it. Efforts to remediate this situation are warranted.

- The East Branch of the South Fork of Sugar Creek exhibited very poor water resource integrity. Substrate quality, habitat attributes, nutrient enrichment, acid mine drainage, and influences associated with large dairy farms and an unsewered community were the principal sources of impairment in the subbasin. *Holistic efforts which consider of all the factors* affecting water resource integrity in the East Branch are needed to address this situation.

- The North Fork of Sugar Creek also exhibited poor water quality conditions. Despite elevated chemical parameters, WWH aquatic life use attainment was observed at two of three locations. Habitat conditions and strong flow ameliorated the deleterious effects of bacterial contamination, nutrient enrichment and high iron concentrations. Gerber Poultry was a significant source of nutrient enrichment.

- The conditions observed in Sugar Creek in 1998 did not arise gradually over the last one hundred years or more. Certainly, land use was the driving factor behind the degradation documented in all of the watershed subbasins. With the advent of mechanized farming following WWII, many of the changes in land use were spurred on. More recently, cultural practices have changed, encouraging concentrated livestock facilities. Additionally, the installation of field tile has increased. Growth in rural residential development has erupted and many small communities have almost doubled in size. Ohio EPA data is not comprehensive to the entire basin but does date back to 1983. While conditions were stable from 1983 through 1988 and 1991, a decline was evident in the 1998 data.

- The conditions in Sugar Creek can be rectified. The “fix” will require community commitment rather than water treatment technological improvements but progress is possible in both the short term and long term view.

RECOMMENDATIONS

Status of Aquatic Life Uses

Most of the streams evaluated in this study were originally designated for aquatic life use in the 1978 and 1985 Ohio WQS (Table 3). The current biological assessment methods and numerical criteria did not exist then. Since this study was the first time a standardized biological approach was used to evaluate aquatic life use designations for several subbasin streams, some changes may appear to be "upgrades" (*i.e.,* WWH to EWH). However, these changes should not be so construed because this study as an objective and robust use evaluation is precedent setting in comparison to the 1978 and 1985 designations. Ohio EPA is obligated 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.

Sugar Creek was originally assigned the WWH aquatic life use in 1985. In 1998 non and partial attainment of this use was documented throughout most of the stream. Despite this, WWH is the only appropriate aquatic life use for Sugar Creek. The mean QHEI score (63.3) is indicative of habitat conditions which should support better biological performance. It is also apparent that habitat conditions could be improved. With efforts to remediate the causes of impairment in Sugar Creek the biological community should achieve the WWH aquatic life use criteria. Hence, this use should be retained.

In the modified reaches of the South Fork, East Branch, and Walnut Creek conditions were inadequate to support the WWH designation. Significant departure from WWH attainment was attributed to the degraded habitat. It is not pragmatic to expect aquatic communities in these reaches to achieve WWH criteria within the next ten to twenty years with even the most optimistic restoration activities. Therefore, the MWH aquatic life use designation is recommended for the South Fork from its headwaters downstream to Barrs Mills (CR 76, RM 11.2). Further downstream the Creek exists as a mostly natural wetland reach and the existing WWH use should be maintained. The East Branch is recommended to be designated MWH downstream from Ragersville (CR 52, RM 5.0) to its confluence with the South Fork. Upstream from Ragersville, the stream retains natural characteristics. Walnut Creek is recommended to be designated MWH from its headwaters downstream to the confluence with Indian Trail Creek (RM 0.8). Downstream from Indian Trail Creek, Walnut Creek remains essentially natural and should remain a WWH stream.

The current WWH aquatic life use designations for most other tributaries should be maintained. These designations were considered appropriate based on ambient macrohabitat conditions and the 1998 aquatic life use attainment status.

The unnamed Indian Trail Creek tributary at RM 6.08 is presently not designated for aquatic life or other appropriate uses. Based on the habitat quality and the presence of continuous flow with

adequate pool depth to support a warmwater fish community, the warmwater habitat (WWH) aquatic life use is recommended to extend from the confluence with Indian Trail Creek upstream through the impoundment to RM 0.9. Upstream from the impoundment, pool depth in the unnamed tributary was not observed to be adequate for WWH, hence the Limited Resource Water (LRW) aquatic life use is recommended for this reach.

Secondary Contact Recreation use and Agricultural Water Supply use designations are also appropriate. The stream bisects at least one rural residential backyard and several domestic animal pastures.

An unnamed tributary to Brush Run at RM 1.54 is not presently designated for aquatic life use. This small drainage was impacted by acid mine drainage and functioned more like a roadside ditch. As such LRW is the appropriate designation.

Status of Non-aquatic Life Uses

All non-aquatic life uses should remain as presently designated in the Ohio Water Quality Standards (Table 3). The streams which previously were not designated should be designated for Agricultural and Industrial Water Supply and Primary Contact Recreation consistent with other streams in the watershed.

Future Monitoring Needs

A complete reevaluation of the Sugar Creek study area should be conducted in the year 2007 as provided in the five-year basin approach to monitoring and assessment. The urgency of the reassessment should consider the rate of land use and population changes within the watershed and the issues raised through the TMDL development scheduled for 2000. Priority should be placed on revisiting segments which are identified as impaired in this report.

Table 3. Waterbody use designations fo r the Sugar Creek basin. Designations based on the 1978 and 1985 water quality standards appear as asterisks (*). Designations based on Ohio EPA biological field assessments appear as a plus sign (+). Designations based on the 1978 and 1985 standards for which results of a biological field assessment are now available are displayed to the right of existing markers. A delta ( )) indicates a new recommendation based on the findings of this report.

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Sugar Creek													
Beach City Dam to Mouth		*+							*+	*+		*+	
all other segments		*+							*+	*+		*+	
Brandywine Creek		*+							*+	*+		*+	
Goettge Run		)							)	)		)	
Broad Run		*+							*+	*+		*+	
Turkeyfoot Run		*+							*+	*+		*+	
Cherry Run		)							)	)		)	
South Fork		*+							*+	*+		*+	
Headwaters to Barrs Mills (RM 11.2)				)					)	)		)	
all other segments		)							)	)		)	
Unnamed tributary at RM 1.0		)							)	)		)	
Walnut Creek		*+							*+	*+		*+	
Headwaters to Indian Trail Cr.				)					)	)		)	
all other segments		)							)	)		)	
Indian Trail Creek		*+							*+	*+		*+	
Unnamed tributary at RM 6.08													
RM 0.9 to Indian Trail Cr.		)							)	)			)
all other segments							)		)	)			)

Table 3. (continued)

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Unnamed tributary at RM 3.92		)							)	)		)	
Goose Creek		*+							*+	*+		*+	
Unnamed tributary at RM 11.3		)							)	)		)	
East Branch		*+							*+	*+		*+	
Headwaters to Ragersville (RM 5.0)		)							)	)		)	
Ragersville to South Fork				)					)	)		)	
Unnamed tributary at RM 2.07		)							)	)		)	
Pleasant Valley Ck		*+							*+	*+		*+	
Unnamed tributary at RM 3.6		)							)	)		)	
Unnamed tributary at RM 14.1		)							)	)		)	
Unnamed tributary at RM 15.83		)							)	)		)	
Troyer Valley Creek		*+							*+	*+		*+	
Brush Run		*+							*+	*+		*+	
Unnamed tributary at RM 1.54							)		)	)			)
Bean Creek		*							*	*		*	
Elm Run		*+							*+	*+		*+	
Middle Fork		*+							*+	*+		*+	
Unnamed tributary at RM 3.25		)							)	)		)	
Misers Run		*+							*+	*+		*+	

Table 3. (continued)

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Unnamed tributary at RM 6.0		)							)	)		)	
Crabapple Creek		*+							*+	*+		*+	
North Fork		*+							*+	*+		*+	
Little Sugar Creek		*+							*+	*+		*+	
Unnamed tributary at RM 0.5		)							)	)		)	

STUDY AREA

The Sugar Creek watershed covers 367 mi^2 in the northeast Ohio counties of: Holmes (26%), Stark (11%), Tuscarawas (35%) and Wayne (28%). Larger communities include: Brewster, Dover, Smithville, Strasburg and Sugar Creek. The mainstem is 45 miles long and flows from north near Smithville to south were it joins the Tuscarawas River near Dover.

The watershed lies in two ecoregions. The northern half is in the glaciated Erie - Ontario Lake Plain (EOLP). The southern half of the watershed is in the unglaciated Western Allegheny Plateau (WAP). The glaciated portion is characterized by rolling hills and valleys. The unglaciated portion has steeper topography with coal and clay deposits. Table 5 lists characteristics for selected streams.

Most (72 %) land use in the basin is devoted to agriculture uses including row crops, dairy , beef and poultry confined feeding operations, forage production and fruit (Table 4). Observed aquatic resource degradation from agriculture included direct manure and urine discharge to streams, milking waste discharged by pipe to streams, dumping of fruit processing waste into streams, direct habitat alteration by dredging and cattle walking in streams, and lack of wooded riparian corridor. Strip mining of coal and clay has a negative impact on the aquatic resource. This process involves removing overbearing soil and minerals, removing the clay and or coal and replacing the overburden. Previous to the mid 1970's, reclamation after mining was not required by law. Unreclaimed mine land contributes sediments, metals and acid water to the streams.

Table 4. Percentage of land use within the Sugar Creek subbasins based on Natural Resource Conservation Service (NRCS) 1994 Raster Map Data.

Watershed	Urban	Agriculture/ Open Urban Areas	Shrub/ Scrub	Wooded	Open Water	Wetlands/ Non-Forested	Barren
Sugar Creek (entire watershed)							
	1.48	71.89	0.35	24.87	0.17	0.81	0.42
Sugar Creek (upstream from Middle Fork)							
	1.49	83.19	0.22	14.29	0.19	0.54	0.06
South Fork of Sugar Creek							
	0.96	70.67	0.36	26.42	0.09	0.93	0.56
Sugar Creek (Middle Fork to Tuscarawas River, excluding South Fork)							
	2.05	64.24	0.43	31.59	0.24	0.89	0.56

Table 5. Characteristics of selected streams in the Sugar Creek study area.

Stream Name	Length (Miles)	Average Fall (Ft/Mile)	Drainage Area (Mi^2)	Stream Name	Length (Miles)	Average Fall (Ft/Mile)	Drainage Area (Mi^2)
Sugar Creek	45	6.3	356.2	Troyer Valley Ck.	3.2	20.3	2.96
Little Sugar Ck.	10.6	28.7	18.71	East Branch	9.7	12.9	28.36
North Fork	6.8	6.8	17.62	Pleasant Valley Ck.	4.9	28.0	4.14
Middle Fork	23.0	9.1	65.80	Walnut Creek	11.1	7.6	48.09
Crabapple Run	6.1	24.6	10.90	Goose Creek	4.7	9.1	6.26
Misers Run	3.0	87.7	2.19	Indian Trail Ck.	8.1	15.9	16.36
Elm Run	5.4	33.5	6.64	Broad Run	6.9	15.8	20.16
South Fork	22.7	5.2	137.0	Turkeyfoot Run	3.3	28.8	4.28
Brush Run	2.8	25.4	5.23	Brandywine Ck.	3.5	18.2	5.50

Sugar Creek

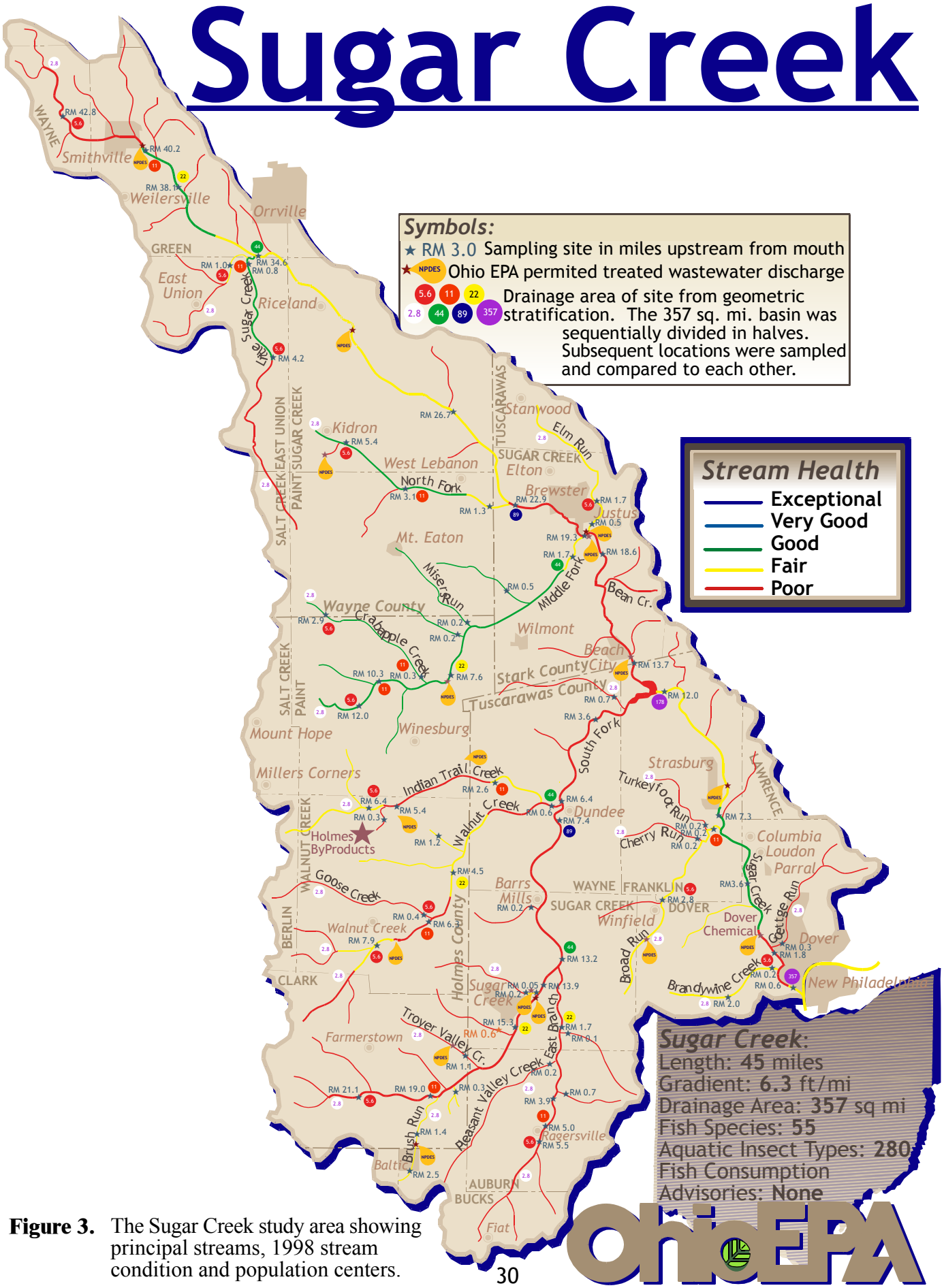

Figure 3. The Sugar Creek study area showing principal streams, 1998 stream condition and population centers.

Table 6. Sampling locations in the Sugar Creek study area, 1998 and 1999 (C - conventional water chemistry, S - sediment, B - benthic macroinvertebrates, F - fish community, D - datasonde, Sc - citizen QHEI, E - effluent, M - modeling).

Stream River Mile	Sample Type	(Ohio EPA River Code) Latitude/ Longitude	Landmark	USGS 7.5 Minute Map	STORET Number
Sugar Creek (17-400)					
43.9	Sc	405145/815342	Geyer Chapel Rd	Creston	None
42.8	C,B,F,Sc	405154/815222	Schellin	Wooster	R05S15
40.33	E	405137/815053	Smithville WWTP	Orrville	R05E13
40.18	C,B,F,Sc	405132/815053	CR 502	Orrville	R05S32
38.1	B,F	405025/814928	Back-Orrville Rd	Orrville	None
36.88	C,M,Sc	404931/814849	Orr Rd	Orrville	R05S31
34.94	M,F	404906/814647	Ust L. Sugar Cr.	Orrville	R05W34
34.69	C,B,F,Sc	404903/814630	Kansas Rd	Orrville	R05W32
28.14	M	404536/814128	SR 94	Dalton	R05P11
26.7	C,B,F	404500/814015	West Lebanon Rd	Wilmont	R05S30
22.95	C,B,F,Sc	404250/813811	Alabama Ave	Wilmont	R05S29
19.36	C,B,F	404201/813555	SR 93	Navarre	R05P09
19.03	E	404206/813540	Brewster Dairy WWTP	Navarre	R05E01
19.04	E	404207/813541	Brewster WWTP	Navarre	R05E02
18.55	C	404147/813524	US 62	Navarre	R05P08
17.6	B,F	404448/813526	Dst US 62	Navarre	None
13.80	E	403854/813423	Beach City WWTP	Navarre	R05E12
13.7	C,B,F	403849/813411	At park, Dst. WWTP	Navarre	R05S28
12.07	C,B,F,Sc	403809/813112	Dst. Beach City Lake	Navarre	R05S27
7.45	E	403521/813121	Strasburg WWTP	Strasburg	R05E11
7.28	C,B,F,M	403515/813124	US 250	Strasburg	611700
3.64	C,S,B,F,M	403300/813022	Ohio Ave, CR 80	Strasburg	R05W03
2.10	E	403152/812952	Dover Chemical-001	Dover	R05W02
1.83	C,S,B,F	403140/812944	SR 516 & 39	Dover	R05P06
0.63	C,B,F,Sc	403045/812919	SR 39	Dover	R05S26
Little Sugar Creek (17-418)					
8.6	Sc		US 250	Fredericksburg	None
4.9	B,F	404606/814630	Kansas Rd, upper	Orrville	None
4.2	C,S,Sc	404630/814631	Kansas Rd, lower	Orrville	R05S03
0.8	C,B,F,Sc	404840/814715	McQuaid Rd	Orrville	R05S81
0.29	M	404857/814648	McQuaid Rd	Orrville	R05W33

Table 6 (continued)

Stream River Mile	Sample Type	(Ohio EPA River Code) Latitude/ Longitude	Landmark	USGS 7.5 Minute Map	STORET Number
Little Sugar Creek Tributary at RM 0.5 (17-437)					
1.05	C,B,F,Sc	404825/814757	McQuaid Rd	Orrville	R05S82
North Fork Sugar Creek (17-409)					
6.5	C	404435/814449	Ust Lehman Hardware	Wilmont	R05S80
6.15	M, Sc	404424/814432	Ust Kidron Inc	Wilmont	R05S23
5.85	E	404345/814443	Gerber Poultry WWTP	Wilmont	R05E04
5.84	M	404344/814443	Gerber Trib mix-zone	Wilmont	
5.53	C,B,F,Sc,M	404409/814353	Zuercher Rd	Wilmont	R05P13
3.79	M	404320/814127	Western Rd	Wilmont	R05S20
3.15	Sc,B,F	404308/814351	CR 94	Wilmont	None
1.97	M	404303/814032	St Rt 241	Wilmont	R05W28
1.35	C,M,B,F	404300/813951	W. Lebanon Rd	Wilmont	R05W29
North Fork Sugar Creek Tributary at RM 6.11					
0.01	M	404424/814430	Jericho Rd	Wilmont	R05W31
Middle Fork Sugar Creek (17-409)					
13.8	Sc		T-665	Wilmont	None
12.0	C,B,F,Sc	403746/814432	From T-656	Wilmont	R05S74
10.25	C,B,F,Sc	403820/814301	T-669	Wilmont	R05S73
	E		Alpine Valley WWTP	Wilmont	
7.58	C,B,F,Sc	403826/814032	T-606, Dst WWTP Wilmont		R05S72
1.66	C,B,F,Sc	404110/813642	Welty Rd	Navarre	R05W30
Crabapple Creek (17-408)					
4.1	Sc		CR-109	Wilmont	None
2.96	C,B,F,Sc	404005/814335	T-357	Wilmont	R05S79
0.31	C,B,F,Sc	403830/814134	T-606	Wilmont	R05S78
Middle Fork Sugar Creek Tributary at RM 6.0 (17-428)					
0.17	C,B,F	403931/814010	T-659	Wilmont	R05S77
Misers Run (17-407)					
0.22	C,F	403950/813955	From T-659	Wilmont	R05S76
Middle Fork Sugar Creek Tributary at RM 3.25 (17-427)					
0.5	C,F	404032/813820	T-314	Wilmont	R05S75
Elm Run (17-405)					
3.9	Sc		Muffley Ave	Navarre	None
1.69	C,B,F,Sc	404317/813520	Harmon St	Navarre	R05S71
0.45	C,F	404226/813528	Kings Highway	Navarre	R05S70

Table 6 (continued)

Stream River Mile	Sample Type	(Ohio EPA River Code) Latitude/ Longitude	Landmark	USGS 7.5 Minute Map	STORET Number
South Fork Sugar Creek (17-410)					
21.8	Sc		T-180	Baltic	None
21.1	C,B,F,Sc	402806/814340	CR-114	Baltic	R05S41
18.98	C,B,F,Sc	402801/814120	T-173	Baltic	R05P23
15.26	C,B,F,Sc	403003/813815	CR-47	Sugarcreek	R05W20
14.15	E	403049/813730	Sugar Creek WWTP	Sugarcreek	R05S06
14.02	C,B,F	403056/813724	T-355	Strasburg	R05W38
13.28	C,B,F,Sc	403124/813651	CR-73	Strasburg	R05W18
7.42	C,B,F,M	403458/813655	SR-93	Strasburg	R05W37
6.43	C,B,F	403535/813650	CR-94	Strasburg	R05S40
3.64	C,B,F	403656/813606	T-62	Strasburg	R05W39
Brush Run (17-417)					
2.51	C,B,F	402604/814222	Shrock Rd	Baltic	R05S68
0.95	E	402722/814150	Baltic WWTP	Baltic	R05E13
0.3	C,B,F,Sc	402750/814126	TR-171	Baltic	R05S66
Brush Run Tributary at RM 1.54 (17-436)					
0.1	C,F	402650/814154	SR 93	Baltic	R05S69
South Fork Sugar Creek Tributary at RM 18.45					
0.01	C	402816/814046	SR-93	Baltic	R05S65
Troyer Valley Creek (17-416)					
1.47	E	402924/814102	Union Cheese WWTP	Baltic	R05E10
1.08	C,B,F	402912/814033	SR-93	Baltic	R05S64
0.4	Sc		CR-71 (Tr-78)	Baltic	None
South Fork Sugar Creek Tributary at RM 15.83 (17-431)					
0.63	C,F	402945/813915	CR-71	Baltic	R05S63
South Fork Sugar Creek Tributary at RM 14.1 (17-424)					
0.28	C,F,Sc	403058/813743	CR-73	Sugarcreek	R05S62
	E	403055/813734	Ohio Whey WWTP	Sugarcreek	R05E07
0.05	C,F	403053/813729	Dst. Ohio Whey	Sugarcreek	R05W16
East Branch South Fork Sugar Creek (17-414)					
7.8	Sc		From CR-46	Stone Creek	None
5.47	C,B,F,Sc	402650/813746	CR-48, Ust Ragersville	Baltic	R05S57
5.04	C,B,F,Sc	402708/813733	CR-52, Dst Ragersville	Baltic	R05S56
3.3	F		T-339	Stone Creek	None
1.7	C,B,F,Sc	402954/813651	T-348	Stone Creek	R05W19

Table 6 (continued)

Stream River Mile	Sample Type	(Ohio EPA River Code) Latitude/ Longitude	Landmark	USGS 7.5 Minute Map	STORET Number
East Branch Tributary at RM 3.95					
0.1	C	402733/813716	T-336	Stone Creek	R05S61
East Branch Tributary at RM 3.6 (17-435)					
0.5	C,F	402802/813640	From T-336	Stone Creek	R05S60
Pleasant Valley Creek (17-415)					
1.8	Sc		From CR-47	Baltic	None
0.24	C,B,F,M	402851/813721	From T-339	Baltic	R05S59
East Branch Tributary at RM 2.07 (17-434)					
0.14	C,F	402935/813646	CR-46	Stone Creek	R05S58
South Fork Sugar Creek Tributary at RM 11.3 (17-430)					
0.23	C,F	403248/813740	T-354	Stone Creek	R05S55
Walnut Creek (17-411)					
7.93	C,B,F	403153/814307	Old Rt. 39	Sugarcreek	R05P18
6.89	C	403208/814200	T-420	Sugarcreek	R05W21
6.32	C,B,F	403223/814126	T-444	Sugarcreek	R05S44
4.49	C,B,F	403341/814029	T-172	Sugarcreek	R05W22
2.32	C	403510/813910	T-99	Sugarcreek	R05W23
0.56	C,B,F	403512/813715	Lane from CR 94	Strasburg	R05S43
Goose Creek (17-413)					
0.35	C,B.F	403237/814139	T-419	Sugarcreek	R05P19
Walnut Creek Tributary at RM 3.92 (17-432)					
1.28	C, F	403444/814120	CR-168	Sugarcreek	R05S54
Indian Trail Creek (17-412)					
7.45	C	403511/814432	T-412	Sugarcreek	R05S50
6.33	C,B,F	403520/814319	T-414	Sugarcreek	R05S49
6.13	C	403515/814307	T-414	Sugarcreek	R05S48
6.01	C	403515/814300	Dst T-414	Sugarcreek	R05S47
5.9	F	403515/814300	From T-414	Sugarcreek	None
5.72	C	403523/814241	Ust SR 515	Sugarcreek	R05S46
5.6	B,F	403522/814228	Ust SR 515	Sugarcreek	None
5.54	C	403521/814223	SR 515	Sugarcreek	R05S45
5.3	F	403530/814202	Dst Troyers Bologna	Sugarcreek	None
3.8	F	403515/814300	Ust Case Farms	Sugarcreek	None
2.56	C,B,F	403553/814047	T-66	Sugarcreek	R05W25
0.82	C	403544/814112	Ust Trib	Sugarcreek	R05W24
0.81	C	403526/813730	CR-94, Dst Trib	Sugarcreek	R05W26

Table 6 (continued)

Stream River Mile	Sample Type	(Ohio EPA River Code) Latitude/ Longitude	Landmark	USGS 7.5 Minute Map	STORET Number
Indian Trail Creek Tributary at RM 6.08 (17-433)					
0.63	C	403449/814337	CR-168	Sugarcreek	R05S54
0.4	B,F	403500/814312	T-413	Sugarcreek	
0.27	C	403503/814312	T-413	Sugarcreek	R05S51
Indian Trial Creek Tributary at RM 6.57					
0.82	C	403659/814055	From T-414	Sugarcreek	R05E09
Hershberger Tributary at RM 0.57 (Trib. to Trib. of Indian Trail Creek)					
0.06	C	403451/814329	SW of Trail Creek	Sugarcreek	R05S53
South Fork Sugar Creek Tributary at RM 1.0 (17-429)					
0.68	M, C	403807/813511	T-447	Strasburg	R05S42
Broad Run (17-402)					
4.8	Sc		T-425	Strasburg	None
2.8	C,B,F,Sc	403337/813320	CR-80	Strasburg	R05S37
0.15	C,B,F,Sc,M	403445/813132	T-425	Strasburg	R05S36
Cherry Run (17-419)					
0.22	C,F,Sc	403428/813209	CR-78	Strasburg	R05S39
Turkeyfoot Run (17-403)					
1.9	Sc		T-434	Strasburg	None
0.23	C,B,F	403445/813152	CR-78	Strasburg	R05S38
Goettge Run (17-422)					
3.0	Sc		CR-80	Dover	None
0.25	C,B,F	403150/812934	Davis St.	Dover	R05S35
Brandywine Creek (17-401)					
2.02	C,F,Sc	403034/813127	T-374	Strasburg	R05S34
0.16	C,B,F,Sc	403111/812953	T-211	Dover	R05S33

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, 1995) for aquatic habitat assessment. Chemical, physical and biological sampling locations are listed in Table 6.

Determining Use Attainment Status

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-14). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Numerical endpoints are stratified by ecoregion, use designation, and stream or river size. Three attainment status results are possible at each sampling location - Full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the biocriteria. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria. Non-attainment means that none of the applicable indices meet the biocriteria or one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (Table 1) is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by river mile, the applicable biological indices, the use attainment status (*i.e.,* Full, partial, or non), the Qualitative Habitat Evaluation Index (QHEI), and a sampling location description.

The attainment status of aquatic life uses (*i.e.,* full, partial, and non-attainment) is determined by using the biological criteria codified in the Ohio Water Quality Standards (WQS; Ohio Administrative Code [OAC] 3745-1-07, Table 7-14). The biological community performance measures 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 1987). This fits the practical definition of biological integrity as the biological performance of the natural habitats within a region (Karr and Dudley 1981). Attainment of 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 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 habitat characteristics used to determine the QHEI score which generally ranges from 20 to less than 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 whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the WWH biological criteria. Scores greater than 75 frequently typify habitat conditions which have the ability to support exceptional warmwater faunas.

Macroinvertebrate Community Assessment

Macroinvertebrates were sampled quantitatively using multiple-plate, artificial substrate samplers (modified Hester/Dendy) at locations with drainage areas greater than 20 mi2. A qualitative assessment of the available natural substrates was conducted at all locations. During the present study, macroinvertebrates collected from the natural substrates were also evaluated using an assessment tool currently in the field validation phase. 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 0 to 60 scale of the ICI. For the

qualitative collections in the Sugar 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 Sugar Creek study area was restricted to relative comparisons between sites and was not unilaterally used to interpret quality of the sites or aquatic life use attainment status.

Fish Community Assessment

Fish were sampled once or twice at each site using pulsed DC electrofishing methods. Discussion of the fish community assessment methodology used in this report is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b).

Sugar Creek is a rather deep stream downstream from the Beach City Reservoir. Many of the pools are difficult to wade due to the depth and, yet, the frequency of riffles makes boating challenging. Standard wading methods are sometimes impractical in deep areas because the electrical field is too small to effectively capture large fish which typically inhabit such pools. Additionally, if the depth is too great to wade then under-sampling is unavoidable. To address these concerns during the second fish sampling pass on the mainstem downstream from the Reservoir , a small boat 2500 watt electrofishing generator was used in combination with a Smith Root 5.0 GPP pulse box instead of the standard wading T&J 1736 VDC unit. A longer electrode wand was also used to sample those pools which were to deep to wade with the standard electrode.

This method was previously used at selected sites and for the entire mainstem surveys in Twin Creek and Walnut Creek in 1995 and 1996, respectively. The larger electrical field created by the small boat unit combined with the long wand is more effective at capturing fish than the T&J unit in deep pools. The use of other typical wading gear allows for effective sampling of riffle areas. The obvious drawback is that the higher electrical power of the unit creates an additional safety concern. Other aspects including gear configuration and electrotaxic response continue to make the T&J the preferable wading unit, but this approach is useful in specific circumstances.

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 (Figure 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 expressed as

ADV/mile to normalize comparisons between segments, sampling years, 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 used to judge aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria, 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, land use data, and biological results (Yoder and Rankin 1995). Thus the assignment of principal causes and sources of impairment in this report represent the association of impairments (based on response indicators) with stressor and exposure indicators. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified, or have been experimentally or statistically linked together. The ultimate measure of success in water resource management is the 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), in this document we are referring to the process for evaluating biological integrity and causes or sources associated with observed impairments, not whether human health and ecosystem health are analogous concepts.

RESULTS AND DISCUSSION

Pollutant Loadings: 1976-1998

Monthly effluent loadings are reported to Ohio EPA by all NPDES (National Pollutant Discharge Elimination System) permitted entities. About sixty four permitted facilities discharge into the Sugar Creek basin. Appendix Table A-1 is Ohio EPA's most complete list of NPDES permit holders in the basin. Annual Monthly Operating Report (MOR) data was used to evaluate the quantity and character of pollutant loadings from 1976 through 1998 for selected dischargers within the Sugar Creek study area (Table 7). Figures are provided for those facilities with a design flow of at least 0.2 MGD (the eight largest dischargers). Entities are discussed from upstream to downstream as each discharge reaches Sugar Creek.

Pollutant loading trends analysis included the 95th and 50th percentiles of four parameters when available: Ammonia-nitrogen (NH_3-N), Five-day Biochemical Oxygen Demand (BOD_5)/ Five-day Carbonaceous Biochemical Oxygen Demand ($cBOD_5$), Total Suspended Solids (TSS), and Annual discharge (MGD). Note that BOD_5 and $cBOD_5$ are combined on the same figure and reflect permit parameter changes emphasizing only carbonaceous BOD_5 not total BOD_5.

Village of Smithville WWTP (Sugar Creek RM 40.33)

The Village of Smithville WWTP is an extended aeration secondary treatment system that was constructed in 1962 and upgraded in 1982 and again in 1997. The most recent improvements included replacing the comminutor with influent grinder, equalization basin restoration, new aeration tank and final settling tank, grease trap replacement, conversion of the chlorine tank to UV disinfection, and replacing coarse bubble digester diffusers with fine bubble diffusers. Other treatment processes include aerated sludge and sludge drying beds. The average design flow is 0.300 MGD. The location of the discharge is at river mile 40.33 to Sugar Creek (Lat:405137/Long:815053).

The NPDES permit expired January 31, 1999. Current permit limits include $cBOD_5$=11/17 mg/l; TSS=17/26 mg/l; NH_3-N (summer)2/3 mg/l, (winter) 11/16.5 mg/l. No violations of NPDES permit limits were reported for 1998, although prior to the 1997 upgrade, extensive sludge deposits were observed in Sugar Creek downstream from the WWTP outfall during a September, 1996 inspection.

Four grab compliance samples collected by the Ohio EPA in 1998 (7/9, 7/21, 8/11, 8/27) showed the following ranges for select parameters: DO (5.0-7.6 mg/l); BOD_5 (<2-4.7 mg/l); TSS (<5-7 mg/l); TDS (462-764 mg/l); Ammonia-N (<0.05-0.41 mg/l); Total Phosphorus (0.7-2.09 mg/l); Nitrate-Nitrite (6.67-15.7 mg/l); and fecal coliform bacteria, 2 samples, (380-5000). These data indicate a potential for nutrient enrichment in Sugar Creek. Long term trends show a slight increase in flow and loadings of BOD and TSS in 1997 and 1998 compared to historical

Table 7. Selected NPDES permitted dischargers in the Sugar Creek study area, 1998.

Entity	Flow (MGD)	Receiving Stream	River Mile Tributary	River Mile Mainstem
Smithville WWTP	0.30	Sugar Creek		40.33
Harmony Lake WWTP	0.036	Sugar Creek		32.15
Gerber Poultry	0.25	North Fork Sugar Creek	5.85	23.22
Mt. Hope WWTP	0.22	Middle Fork Sugar Creek	10	19.38
Alpine Cheese Co.	0.22	Middle Fork Sugar Creek	7	19.38
Brewster WWTP.	0.665	Sugar Creek		19.05
Brewster Dairy	0.30	Sugar Creek		19.04
Beach City WWTP	0.20	Sugar Creek		13.8
Baltic Rubber Co.	NA	Brush Run (2)		
		to South Fork Sugar Creek	18.94	12.3
Baltic WWTP	0.01	Brush Run (1.5)		
		to South Fork Sugar Creek	18.94	12.3
Gugisberg (Union)	0.014	Troyer Valley Creek (1.47)		
Cheese		to South Fork Sugar Creek	17.16	12.3
Sugar Creek WWTP	0.50	South Fork Sugar Creek	14.15	12.3
American Whey	0.065	Unnamed trib (0.19)		
		to South Fork Sugar Creek	14.10	12.3
Holmes County Walnut	0.090	Unnamed trib		
Creek WWTP		to Walnut Creek (7)		
		to South Fork Sugar Creek	6.57	12.3
Holmes ByProducts	No permit	Unnamed trib (0.5)		
		to Indian Trail Creek (6.08)		
		to Walnut Creek (0.82)		
		to South Fork Sugar Creek	6.57	12.3
Troveris Trail Bologna	0.005	Unnamed trib (0.25)		
		to Indian Trail Creek (5.42)		
		to Walnut Creek (0.82)		
		to South Fork Sugar Creek	6.57	12.3
Case Farms Inc	0.50	Unnamed trib (1.4)		
		to Indian Trail Creek (3.2)		
		to Walnut Creek (0.82)		
		to South Fork Sugar Creek	6.57	12.3
Strasburg WWTP	0.225	Sugar Creek		7.45
Alpine Hills	NA	Unnamed trib		
		To Broad Run	6.0	6.5
Broad Run Cheese	--	Broad Run		6.5
Dover Chemical Co.	1.45	Sugar Creek		2.1
Kimble Landfill	NA	Brandywine Creek	2	1.26

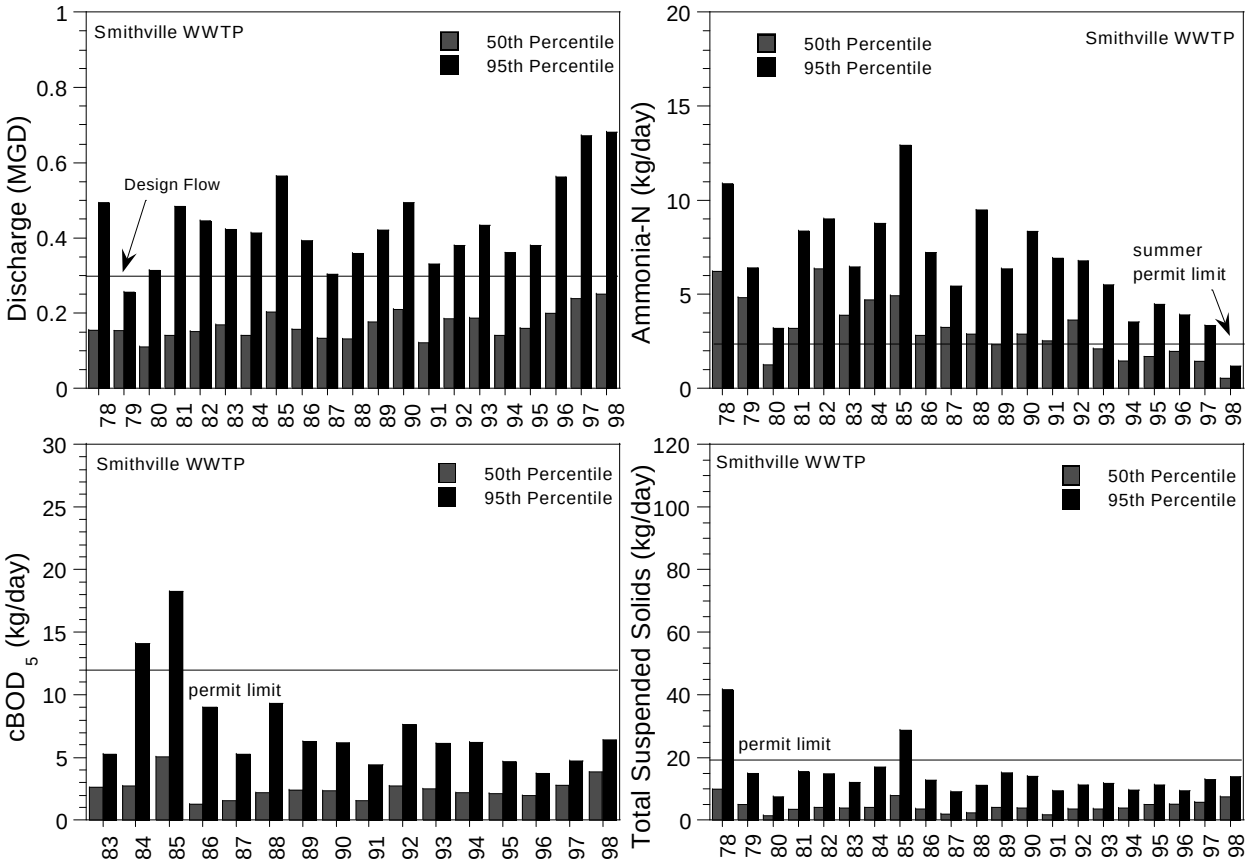

Figure 4 Annual median and 95th percentile discharge and pollutant loadings of NH_3-N, cBOD5 and TSS to Sugar Creek from the Smithville WWTP, 1978-1998.

data, but all loadings are well below 30-day average NPDES permit values (Figure 4).

Despite the Smithville WWTP nutrient loading, fish community performance improved downstream from the facility. The upstream assemblage was poor (IBI=26). The good (IBI=42) downstream community included three sensitive species which were infrequently collected anywhere in the basin. Increased perennial flow of adequate quality from the WWTP was credited for this improvement. The macroinvertebrate community reflected good conditions both upstream and downstream from the discharge.

Lake Harmony WWTP (Sugar Creek RM 31.85)

The Lake Harmony WWTP is a 0.036 MGD design flow plant with discharge to Sugar Creek at RM 31.85 (Lat: 404738/Long: 814401). The plant was constructed in 1968 and upgraded in 1980. Treatment processes include trash trap, extended aeration, fixed media filter, slow sand filter, and chlorination.

The NPDES permit expired September 27, 2000. Final permit limits include TSS=12/18 mg/l, $cBOD_5$=10/15, ammonia-N=2/3 mg/l summer. There is no documentation of permit violations during the time of the 1998 survey. From the period of June to September, 1998, the range of values for select chemicals from Monthly Operating Reports were: flow(0.009-0.0294 MGD; $cBOD_5$ (<2.2 mg/l); TSS=(<5 mg/l); NH_3-N (0.06-0.46 mg/l). No effluent samples were collected during the 1998 survey due to problems locating the final discharge to the river. No impact was attributed to the facility based on a 1998 sampling station four miles downstream.

Gerber Poultry Inc.
(Unnamed tributary RM 0.83, North Fork Sugar Creek RM 5.85, Sugar Creek RM 23.22)
Gerber Poultry is a manufacturer of processed poultry with about 40,000 to 50,000 birds processed per day. Process wastewater and sanitary wastewater are treated by rotary screen, flow equalization, aeration, clarifiers, chlorination and dechlorination. Discharge from outfall 002 is at RM 0.83 (Lat: 404345/Long: 814443) to an unnamed tributary of the North Fork Sugar Creek, which enters the North Fork at RM 5.85. The discharge is downstream from the unsewered area of Kidron, which has documented problems with nutrient enrichment and high fecal coliform bacteria from both human and animal sources.

The NPDES permit expired June 30, 1999. The average design flow of the current treatment plant is 0.09 MGD, although the company has requested approval to increase design flow to 0.250 MGD up to 0.800 MGD over the next five years. Current final effluent limits for outfall 002 include DO=5.0 mg/l, Ultimate oxygen demand (UOD)=summer 23.2 mg/l, winter 28.6 mg/l; TSS=12/18mg/l; ammonia-N 2.6 mg/l summer, 4.0 mg/l winter. Long term trends show relatively constant loadings of TSS, ammonia-N, and BOD from 1995 to 1998.

Gerber Poultry discharges extremely high concentrations of total phosphorus and nitrates to the North Fork of Sugar Creek. However, this nutrient enrichment is offset by strong groundwater flow and did not impair the fish and macroinvertebrate communities in the reach immediately downstream from the confluence with the unnamed tributary.

Mt. Hope WWTP (Unnamed tributary, Middle Fork Sugar Creek RM, Sugar Creek RM 19.38)
The Mt. Hope WWTP is a 0.022 MGD design flow plant with discharge to an unnamed tributary to the Middle Fork Sugar Creek. Treatment processes include trash trap, extended aeration, dual sand filters, chlorination, and sludge drying beds.

The NPDES permit expired June 27, 1998. Final permit limits include TSS=12/18 mg/l, $cBOD_5$=10/15 mg/l, ammonia (summer)=3.6/5.4 mg/l, (winter) 8.7/13.0 mg/l. The plant has a long history of intermittent discharge violations for DO, TSS, and ammonia due to binding of sand filters with subsequent bypassing of filters. In the three months from June to August 1998, violations were recorded for TSS (#=10), DO (#=3), ammonia (#=6), BOD (#=2). A July 16, 1998 inspection observed that the receiving stream was being impacted by sewage sludge that had been previously bypassed; sludge and sludge worms were observed in pooled areas of the

stream. Analysis of long term MOR data revealed relatively constant loadings of TSS and ammonia-N with a slight increase in loadings of BOD in 1997 and 1998. Annual effluent flow has decreased slightly and is well below design capacity. No impact to fish or macroinvertebrate communities was attributed to the facility in 1998.

Alpine Cheese Co. (Unnamed tributary, Middle Fork Sugar Creek RM, Sugar Creek RM 19.38)
The Alpine Cheese company (a.k.a. Alpine Alpa) is a manufacturer of cheeses, with a production rate of about 200,000 pounds/day. During the 1998 Sugar Creek survey, the cheese company process wastewater was combined with the wastewater from a 175 seat restaurant. Treatment processes included aerated lagoons and settling ponds. In September, 1998, a PTI was issued for the cheese company to install a new treatment system to include flow equalization, vertical loop reactor, flash mix flocculation, clarification, UV disinfection and post aeration. The cheese company wastewater is also to be separated from the restaurant. The 1998 discharge was to an unnamed tributary to the Middle Fork Sugar Creek (Lat:403830/Long:814130). The two new discharges will be at about the same location.

The NPDES permit for the new process water treatment system expires January 28, 2004. The average design flow of the new system is 0.022 MGD; the design flow of the old system was 0.028 MGD. Final permit limits for the new system at outfall 002 include TSS=26.8/40.2 mg/l; ammonia-N (summer)=2.0/3.0 mg/l; $cBOD_5$=18.6/27.9 mg/l. An analysis of MOR data from 1998 showed two TSS loading violations from outfall 001. Long term trend data show relatively constant loadings of BOD and TSS over time. No aquatic impact was attributed to the facility in 1998.

Village of Brewster WWTP (Sugar Creek RM 19.05)
The Village of Brewster WWTP is an extended aeration secondary treatment system that was constructed in 1959 and upgraded in 1988 and 1997. The most recent improvements included a new clarifier, expanded chlorine contact tank, and new sludge pumps. Treatment processes include: comminutor, bar screen, flow equalization, extended aeration, clarifier, chlorination, de-chlorination, aerated sludge, and sludge drying beds. The average design flow is 0.665 MGD.

The discharge to Sugar Creek is located at RM 19.05 (Lat:404209/Long:813540). The WWTP outfall is located about 30 yards upstream from the Brewster Dairy 002 discharge; thus, the two effluents have an interactive effect on the water quality of Sugar Creek.

The NPDES permit expires June 27, 2001. Current permit limits include $cBOD_5$=15/23 mg/l; TSS=20/30 mg/l; NH_3-N(summer)=6.5/9.7 mg/l, (winter)=15/22.5 mg/l. In September 1997, the Ohio EPA Compliance Assistance Unit conducted a detailed audit of the WWTP processes and found that a local industry, Shearers Food Company, significantly increased loadings of

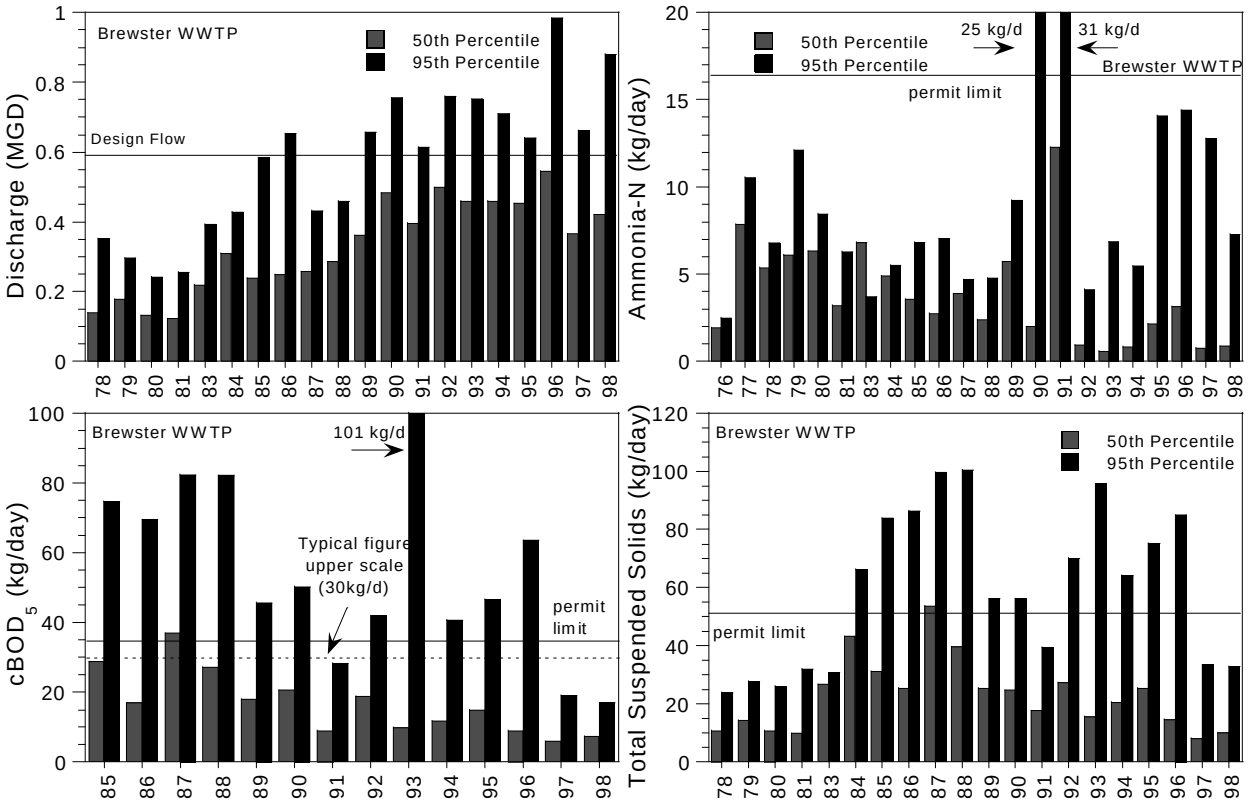

Figure 5 Annual median and 95th percentile discharge and pollutant loadings of NH_3-N, $cBOD_5$ and TSS to Sugar Creek from the Brewster WWTP, 1976-1998.

BOD and TSS to the WWTP between 1997 and 1998. This pretreatment discharge resulted in "an organic overload of the aeration basin" (Ohio EPA March 4, 1998 report, Compliance Assistance Unit, DSW).

A review of 1998 MOR data indicated a May 1998 violation for cBOD concentration and a December 1998 violation for TSS concentration. More recent data indicated multiple NPDES permit violations for TSS, BOD, and fecal coliform bacteria in May 1999. A May 1999 letter from the Village to the Ohio EPA indicated that an unexpected pretreatment discharge from Shearers Foods upset the Brewster WWTP resulting in a discharge of TSS at 412 mg/l, a highly significant violation of their NPDES permit. Bypasses at the WWTP are not common and only occur after a significant rainfall, such as the August 24, 1998 bypass of 0.043 MGD after 5.1 inches of rain over a 31 hour time period.

Four grab compliance samples collected by the Ohio EPA in 1998 (7/9, 7/21, 8/11, 8/27) showed the following ranges for select parameters: DO (5.7-6.6 mg/l); BOD_5 (4.3-8.1 mg/l);

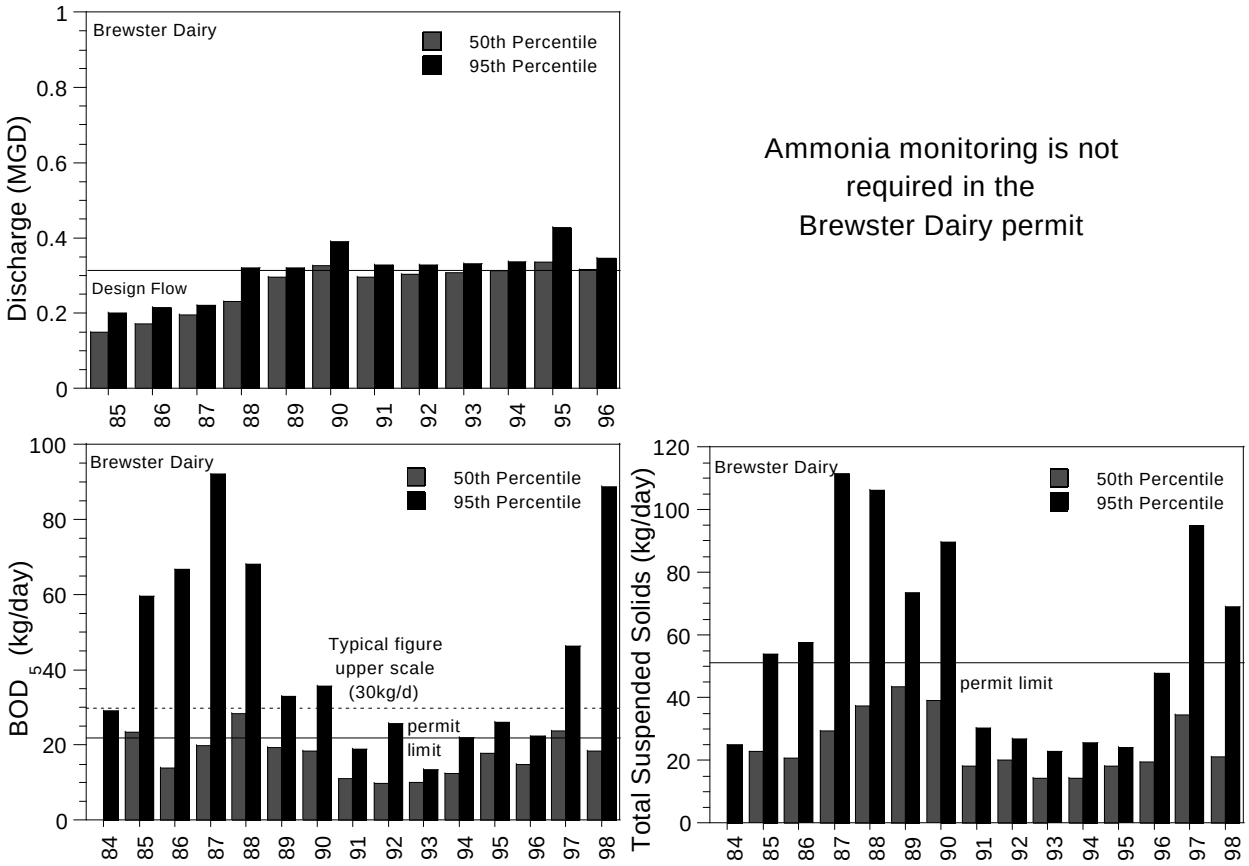

Figure 6 Annual median and 95th percentile discharge and pollutant loadings of $cBOD_5$ and TSS to Sugar Creek from the Brewster Dairy, 1984-1998.

TSS (<5-7mg/l); TDS (422-762 mg/l); Ammonia-N (.07-1.86 mg/l); Total Phosphorus (0.75-3.61 mg/l); Nitrate-Nitrite (<0.1-21.9 mg/l), and fecal coliform bacteria (300-21,000 #/100 ml). Three of the four fecal coliform values were above 2000 #/100 ml. Long term trends of discharge show relatively constant effluent flow over the past 10 years with slight reductions of BOD, TSS, and ammonia-N loadings in 1997 and 1998 compared to historical MOR data (Figure 5).

Natural wetland habitat exists in the reach of Sugar Creek where Brewster WWTP and Dairy discharge. At the sites bracketing these outfalls, chemical parameters increased downstream. However, the fair habitat conditions mask this influence and the limitations typical of wetland aquatic communities were reflected in the 1998 biological sampling results.

Brewster Dairy (Sugar Creek RM 19.04)

Brewster Dairy produces 27 varieties of natural cheeses with a raw milk capacity of 2 million pounds per day. Cheese making processes include pasteurizing, culturing, coagulation, pressing, and whey production by condensing. Process wastewater is treated by mixing, three aerated

lagoons, two clarifiers, aerated sludge holding, sludge press, and discharge to Sugar Creek from outfall 002 at RM 19.04(Lat:403045/Long:813030). The Dairy company 002 discharge is about 30 yards downstream from the Village of Brewster WWTP discharge; thus the two effluents have an interactive effect on the water quality of Sugar Creek. The majority of sanitary wastewater from Brewster Dairy goes to the Village of Brewster WWTP, although an unknown amount is mixed with the process water for treatment.

The average design flow is 0.3 MGD. The NPDES permit expires April 28, 2001. NPDES parameter limits include: DO = 5.0 mg/l daily minimum; BOD_5 = 20/30 mg/l; TSS summer = 45/60 mg/l, winter = 30/45; and ammonia-N = 8.5 mg/l daily maximum. Three grab compliance samples were collected by Ohio EPA in 1998 (7/9, 7/21, 8/11) and showed the following ranges for select parameters: DO (6.0-6.2 mg/l); BOD_5 (5.5-16.0 mg/l); TSS (13.0-53.0 mg/l); TDS (2310-2370 mg/l); Ammonia-N (0.20-0.64 mg/l); Total Phosphorus (9.4-11.6 mg/l); Nitrate-Nitrite (0.75-12.9 mg/l); and fecal coliform bacteria (150-250 #/100 ml).

The level of phosphorus being discharged could impact downstream biological communities in Sugar Creek as a result of population responses to nutrient enrichment. The level of TDS being discharged is above the 1500 mg/l Ohio WQS criterion and could have a negative impact on biological communities during low stream flow conditions.

A review of MOR data submitted to Ohio EPA between July 1997 and August 1998 shows a number of NPDES violations including 9 violations of the BOD_5 loadings and concentration limits; and 4 violations for TSS loadings and/or concentration. There is also wide variation of total phosphorus reported on the MOR data, with values ranging from greater than 30 mg/l to less than 0.5 mg/l. An analysis of long term MOR data shows constant effluent flow over the previous five years, with average discharge greater than the 0.3 MGD design flow capacity. Average annual loading of BOD_5 for 1997 was higher than the 30-day average limits, and the 95th percentile loadings of both BOD_5 and TSS were significantly elevated compared to mid 1990 values (Figure 6).

As mentioned previously, both the Brewster Dairy and WWTP discharge into a natural wetland reach of Sugar Creek. Downstream chemical monitoring indicated that the facilities contribute to increased concentrations of several chemical parameters. Despite this loading, the fair habitat conditions tend to mask the influence. The fish community was essentially the same at the sites bracketing these outfalls.

The macroinvertebrate assemblage significantly declined downstream from these facilities. The fair performance here was the only location in Sugar Creek where the macroinvertebrate community departed so significantly from expectations. However, the data was inconclusive concerning causes for this departure beyond the habitat limitations.

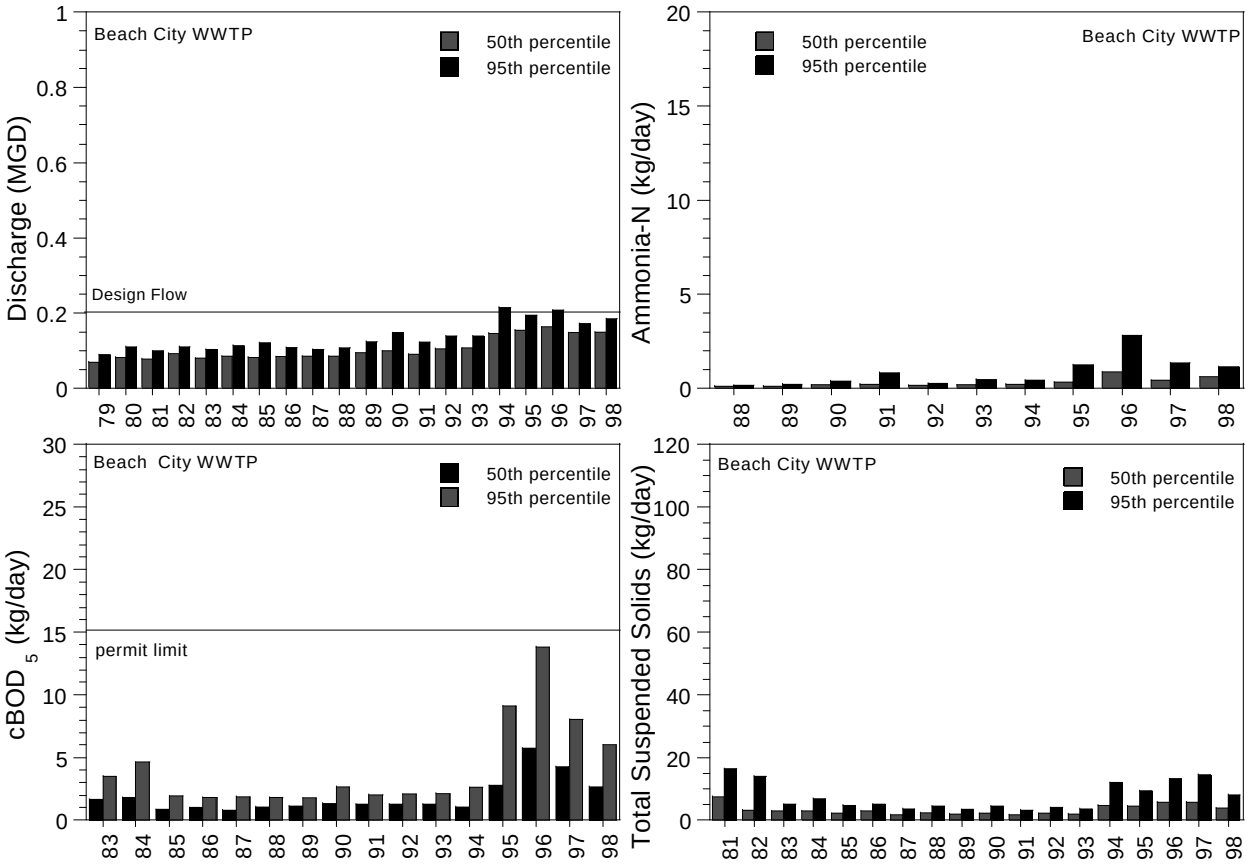

Figure 7 Annual median and 95th percentile discharge and pollutant loadings of NH_3-N, $cBOD_5$, and TSS to Sugar Creek from the Beach City WWTP, 1979-1998.

Beach City WWTP (Sugar Creek RM 13.8)

The Beach City WWTP is a 0.200 MGD design flow plant which discharges to Sugar Creek at RM 13.8. The location of the outfall (Lat: 40°38'15"/Long: 81°33'45") is upstream from the reach impounded by the Beach City Reservoir. Treatment processes include comminutor, extended aeration, clarification, chlorination, sludge digestion and drying. The permit expired May 28, 2000.

Due to increased flow, the WWTP will expand and upgrade to a design flow of 0.297 MGD, with construction scheduled to be started in early 2000. The extended aeration unit will be converted to oxygen ditches. Rapid sand filter, flow equalization, and UV disinfection will be added.

A review of 1998 MOR data indicated that the WWTP discharge had permit violations for chlorine, low dissolved oxygen, and fecal coliform bacteria. The interim NPDES permit limit for total chlorine during the 1998 survey was 0.5 mg/l, and the MOR data indicates values being discharged as high as 0.6 to 1.0 mg/l. Biological communities downstream may have been

affected by chlorine toxicity during the 1998 Sugar Creek survey. The switch to UV disinfection scheduled in the year 2000 should have eliminated this source of pollution to the stream. NPDES permit limits include $cBOD_5$ of 20/30 mg/l (15.2/22.7 kg/day) and total suspended solids of 25/39 mg/l (18.9/29.5 kg/day).

Long term trend data indicates flow has increased in recent years. Loadings have also increased and the need for the expansion and upgrade of the wastewater treatment plant is warranted. (Figure 7).

Three fecal coliform bacteria and five chemical samples were collected as grab samples during 1998. One fecal coliform sample (2600 organisms/100 ml) violated permit limits. No other violations were noted. The plant did not influence downstream chemical parameter concentrations. Likewise, no impact to the macroinvertebrate community was observed downstream from the Beach City WWTP.

The fish community did exhibit an impact over the course of the 1998 summer downstream from the facility. In July, 14 species (35 fish) were collected which resulted in a fair IBI score (32). In September, 7 species (22 fish) were collected which scored very poorly (IBI=14). In general, the second pass mainstem samples all scored lower than the first but this site exhibited the largest decline.

Allied-Baltic Rubber
(Brush Run RM 1.8, South Fork Sugar Creek RM 18.94, Sugar Creek RM 12.3)
Allied-Baltic Rubber is a producer of molded rubber products for the automotive industry. Rubber processing includes mixing, mastication, calendering, extrusion, and vulcanization. Non-contact cooling water and storm water run-off is discharged to Brush Run at RM 1.8. Sanitary wastewater is discharged into the Village of Baltic's sanitary sewer system.

The NPDES permit expired May 21, 1996. The permit requires the facility to monitor flow, temperature, oil & grease, and maintain pH limitations. The re-issuance of this permit should have occurred sometime in 2000. Effluent and ambient sampling did not target this facility in 1998. Brush Run was in non-attainment of the WWH criteria due to habitat and flow alteration, siltation, nutrient enrichment, and acid mine drainage.

Baltic WWTP
(Brush Run RM 0.9, South Fork Sugar Creek RM 18.94, Sugar Creek RM 12.3)
The Baltic WWTP, built in 1981, has a design capacity of 0.10 MGD. Treatment includes a comminutor/bar screen, two oxidation ditches, two clarifiers, two rapid sand filters, chlorination, dechlorination, three aerobic sludge tanks, and sludge drying beds. Two of the three sludge tanks were installed during 1996-1997. The collection system consists of 100% separate sewers and serves 659 people. Effluent is discharged to Brush Run at RM 0.9. The Village is currently under a compliance schedule to address I/I problems in their collection system. Eventually, the

Village plans to install a third oxidation ditch and clarifier.

The NPDES permit expires on January 28, 2003. The permit contains the following limits: $cBOD_5$ of 10/15 mg/l (3.79/5.68 kg/day); suspended solids of 12/18 mg/l (4.54/ 6.81 kg/day); ammonia of 1.6/2.4 mg/l (0.61/0.91 kg/day) for summer, and 5.5/8.3 mg/l (2.1/3.1 kg/day) for winter; and a minimum dissolved oxygen level of 6.0 mg/l. Occasional violations have been reported by this facility in their self-monitoring reports.

Five effluent samples including two fecal coliform bacteria analyses and were collected from this facility. All samples violated the dissolved oxygen limit (ranging from 1.34 mg/l to 5.5 mg/l) and one ammonia violation (4.13 mg/l) was recorded. Chemical sampling bracketing the facility indicated the plant is a source of organic enrichment.

The macroinvertebrate community was influenced by this enrichment. Upstream from the plant at Shrock Road (RM 2.5), fair community performance with 4 EPT taxa was documented. Here, caddisflies and midges were predominant although only one individual mayfly was collected. Downstream from the WWTP (RM 0.8), only one EPT taxon (a single individual mayfly) and no caddisflies were collected. Tolerant midges predominated natural substrates and obvious signs of gross organic pollution were apparent. The plant effluent was gray which contrasted with the brown stream color. Large populations of the sewage bacteria genus *Sphaerotilus* covered the riffles and red hemoglobin pigmented midges were abundant.

The enrichment was less evident in the fish community which was more limited by ambient habitat conditions. Between the sites bracketing the plant, the downstream community was twice as numerous and populated by species (creek chub and bluntnose minnow) which are particularly tolerant of enriched conditions.

Guggisberg Cheese
(Troyer Valley Creek RM 1.47, South Fork Sugar Creek RM 17.16, Sugar Creek RM 12.3)
Guggisberg Cheese is a producer of Swiss cheese from raw milk. Between 30,000 to 50,000 pounds of raw milk are processed per day. Process wastewater and sanitary wastewater are treated by pre-aeration, clarifiers, and three aerated lagoons in series. Discharge is to Troyer Valley Creek, at river mile 1.47 (Lat: 402938/Long: 814038), which is a tributary of South Fork Sugar Creek. The average design flow of the treatment system is 0.014 MGD

The NPDES permit expires July 28, 2001. On September 11, 1996, ownership of the company and NPDES permit were transferred from Union Cheese Company to Guggisberg Cheese Incorporated. NPDES permit limits include: DO=5.0 mg/l; BOD_5=20/30 mg/l; and TSS summer =45/60, winter.

Two effluent samples in 1998 indicated the company discharged extremely high concentrations of ammonia-N and total phosphorous. Downstream chemical samples indicated the effluent was

not adequately diluted. Ammonia-N was present in toxic concentrations (1.2 mg/l to 3.1 mg/l, n=5). Likewise total phosphorus (3.53 mg/l) was indicative of extreme organic enrichment that would be expected to impair biological activity.

The presence of a poor macroinvertebrate community downstream from Guggisberg Cheese confirmed the organically enriched conditions. Red hemoglobin pigment midges of the *Chironomus riparius* group predominated the natural substrates. Only 2 EPT taxa (mayflies) were collected in very low densities. On July 27, 1998, the creek was bright green in color, a further indication of enrichment demonstrated by the algal community. Two days later, on July 29, the water was brown, suggesting that this pollution is episodic and associated with Guggisberg Cheese effluent flow.

The downstream fish community was also impaired by the organic enrichment although poor habitat conditions were equally influential. The poor assemblage (IBI=22) was predominated by species (creek chub and bluntnose minnow) which are particularly tolerant of enriched conditions.

Village of Sugarcreek WWTP (South Fork Sugar Creek RM 14.15, Sugar Creek RM 12.3)
The Village of Sugarcreek WWTP was originally built in 1973 and upgraded in 1987. In 1997, the Village put their new wastewater treatment plant on-line. The system has a design capacity of 0.50 MGD. Treatment includes a bar screen, grit removal, two oxidation ditches, two final clarifiers, UV disinfection, aerobic digestion, and cascade aeration. The collection system consists of 100% separate sewers and serves 2200 people. Effluent is discharged to the South Fork of Sugar Creek at RM 14.15.

The NPDES permit expired on January 31, 1996. It was anticipated that a draft permit would be issued sometime in 2000. Current effluent limits include total suspended solids of 12/18 mg/l (10/15.1 kg/day); $cBOD_5$ of 10/15 mg/l (8.4/12.5 kg/day); ammonia of 4/6 mg/l (3.3/5 kg/day); and a dissolved oxygen level of not less than 5.0 mg/l. The new plant has maintained compliance with the NPDES permit.

Five effluent samples including three fecal coliform bacteria analyses and were collected from the WWTP in 1998. One fecal coliform violation (2900/100 ml) was documented. Some organic enrichment was attributed to the facility based on chemical sampling which bracketed the facility.

The macroinvertebrate community was influenced by this enrichment. Upstream from the WWTP marginally good macroinvertebrate performance with 9 EPT taxa was observed. Caddisflies, blackflies, and midges were predominant. Downstream from the facility, only 4

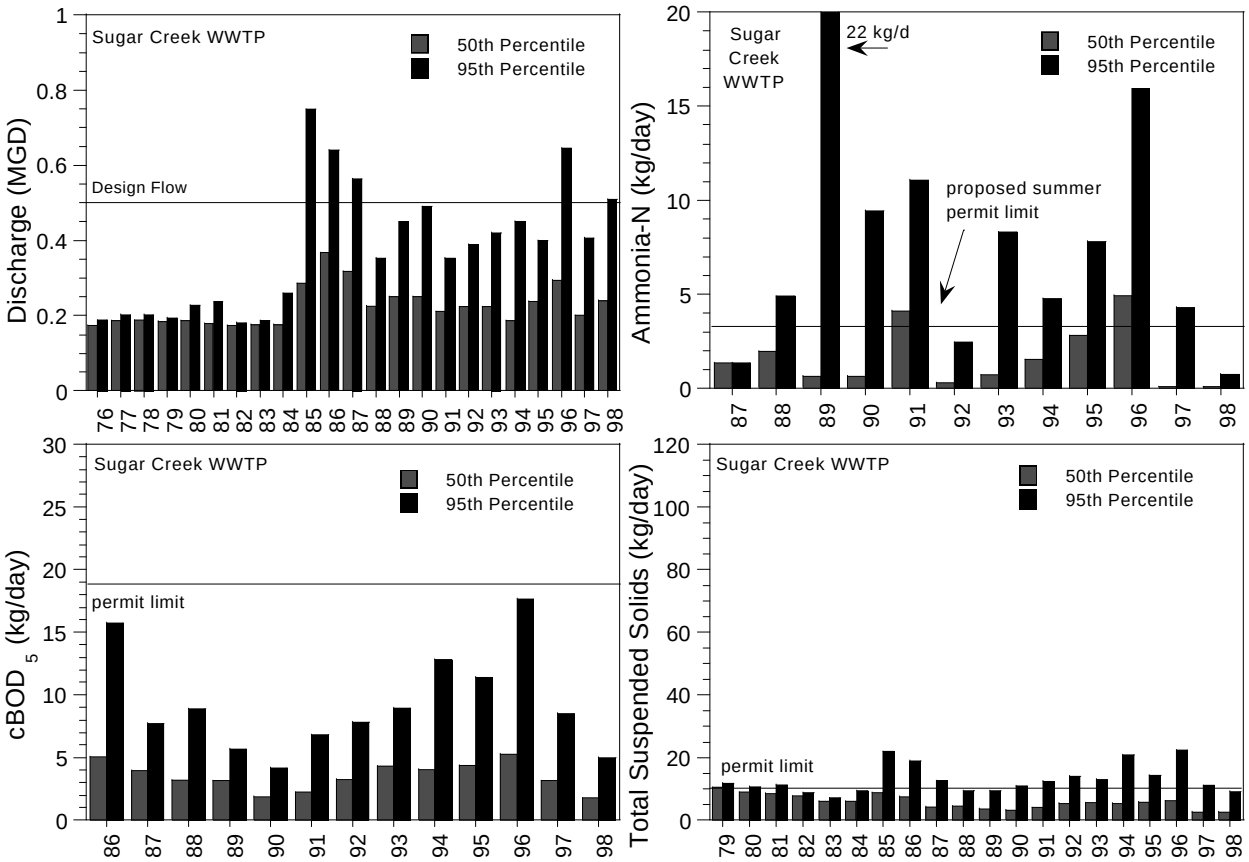

Figure 8 Annual median and 95th percentile discharge and pollutant loadings of NH_3-N, $cBOD_5$, and TSS to Sugar Creek from the Sugar Creek WWTP, 1976-1998.

EPT taxa were collected from the natural substrates with blackflies and midges predominant. Caddisflies and mayflies were uncommon.

The fish community actually improved downstream from the facility. Upstream, 11 species combined to mark a poor IBI score (20). Downstream, 14 species earned a fair score (28). Both assemblages were limited by very poor habitat conditions.

American Whey Co.
(Unnamed tributary RM 0.19, South Fork Sugar Creek RM 14.1, Sugar Creek RM 12.3)
American Whey is a producer of dry whey. The facility receives raw and condensed whey from local cheese manufacturers. Whey processing includes pasteurization, condensing, drying, and packaging. Process wastewater is treated by grit removal, an aerated lagoon and a facultative lagoon, a clarifier, and sludge holding; the facility discharges to an unnamed tributary of the South Fork of Sugar Creek at RM 0.19.

The Whey facility discharge, via the unnamed tributary, enters the South Fork of Sugar Creek at

RM 14.1, approximately 100 yards downstream from the Village WWTP discharge. As a result, the two effluents are interactive in their effect on the water quality of the South Fork of Sugar Creek. The sanitary wastewater from the facility is discharged to the Village's sanitary sewer system.

The facility has been experiencing strong septic odors from their sludge and wastewater treatment plant for the past several summers and is working to address the problem. They are negotiating a lease agreement for use of the Village's old wastewater treatment plant which could be used to enhance their treatment capabilities.

The NPDES permit expired on December 1, 1994. Loadings are based on an average design flow of 0.065 MGD. Permit limits include BOD_5 of 33/60 mg/l (8.14/14.7 kg/day) for summer and 28/51 mg/l (7.01/12.5 kg/day) for winter; suspended solids of 53/100 mg/l (13.1/24.8 kg/day); and a dissolved oxygen of not less than 5.0 mg/l. is required by the permit.

Three fecal coliform bacteria analyses were performed along with five effluent evaluations during the stream survey. Two fecal coliform values (3400 and 2100 organisms/100 ml) exceeded the Primary Contact Recreation Ohio WQS criterion (2000 organisms/100 ml). Two dissolved oxygen measurements (4.9 mg/l and 2.76 mg/l) failed to meet the minimum permit limit. Some organic enrichment was evident in the chemical samples which bracketed the company.

No macroinvertebrate samples were collected in the unnamed tributary. The fish assemblage was evaluated at sites which bracketed the discharge. Coincidently, as observed downstream from the Sugar Creek WWTP, the fish community also improved downstream from Ohio Whey. Upstream, 5 species combined to yield a poor IBI score (20). Downstream, 11 species earned a fair score (28). Both assemblages were limited by the very poor habitat conditions.

Walnut Creek WWTP
(Unnamed tributary, Walnut Creek RM 7. ,South Fork Sugar Creek RM 6.57, Sugar Creek RM 12.3)
The Holmes County Walnut Creek WWTP is a 0.090 MGD design flow plant with a discharge to an unnamed tributary to Walnut Creek and then to the South Fork Sugar Creek at RM 6.57. The location of the outfall is Lat: 403203/Long: 814239. The plant was constructed in 1987. Treatment processes include trash trap, extended aeration, settling, slow surface sand filters, chlorination, and sludge drying beds.

The NPDES permit expires on September 27, 2003. Final permit limits include TSS=12/18 mg/l, $_CBOD_5$=10/15 mg/l, and ammonia-N=2/3 mg/l. The plant has a long history of receiving shock loadings of BOD from a 500 seat restaurant, an inn, and nursing home. Flow frequently exceeds the 0.090 MGD design capacity. For example, in May 1998, the average flow was 0.137 MGD. Analysis of long term trends shows that annual discharge has increased over the past ten

years to near design capacity.

The WWTP has a long history of NPDES violations. For the months of June and July 1998, thirteen TSS violations, four $cBOD_5$ violations, and two DO violations were reported. The plant has a history of problems with the sand filters being off line for maintenance. In January 1999 detailed plans were approved by Ohio EPA for an upgrade at the WWTP to include a new flow splitter box, flow equalization basin to better control the shock BOD loadings, new clarifier, and UV disinfection to replace chlorine.

Chemical and biological samples bracketed the unnamed tributary in Walnut Creek. Downstream chemical results were indicative of some increases in nutrient loading. The fish community declined from fair (IBI=30) to poor (IBI=22) while the macroinvertebrates were similar at both sites. Although it is likely that some decline in the fish assemblage was due to the loading, it is difficult to discern due to the more severe habitat limitations.

Holmes ByProducts (Unnamed tributary RM 0.5, Indian Trail Creek RM 6.08*, Walnut Creek RM 0.82, South Fork Sugar Creek RM 6.57, Sugar Creek RM 12.3)*
Holmes ByProducts, located at 3175 TR 411 in Walnut Creek Twp., Holmes Co., manufactures filler for pet foods. About 30 people are employed to render dead stock including offal, meat, blood, fats, oils and poultry feathers. The majority of Holmes ByProducts business involves rendering blood and feathers from three large northeast Ohio chicken processors: Case Farms, Park Farms and Gerber Poultry.

In the rendering process, these materials are cooked and dried. Cooling water is recirculated from an open pond. Wastewater is generated through equipment cleaning, from condenser and sanitary wastewater and from truck wash water. Collected water is skimmed for grease and oils and then flows in an open ditch down a hill into a pit. The pit, which was originally dug to facilitate coal strip mining, now serves as an anaerobic lagoon.

Liquid from the pit is pumped through a network of leaky temporary pipes and sprayed onto steep hillsides. Following saturation, this liquid runs off into several natural drainage ways and then into either an unnamed tributary to Indian Trail Creek at RM 6.08 or directly into Indian Trail Creek. Some of the liquid is also hauled for land application to another Holmes ByProducts property in Tuscarawas County near Dundee.

Obviously, the pit which has been used since 1958 to store liquid waste does not meet any best technology standard. Wastewater leaches through a twenty foot high berm on one side of the pit and flows into a tributary to the unnamed Indian Trail Creek tributary on a continuous basis. Additionally, the volume of wastewater occasionally exceeds the capacity of the pit which results in the rendering liquids spilling over the berm and flowing directly into the unnamed stream. A monitoring well indicates that this liquid is also contaminating groundwater.

Wastewater that is sprayed over the hillside pastures and forested areas frequently runs off into Indian Trail Creek and the unnamed tributary . The rendering liquid has a tannin rust color which distinctly contrasts with the normally clear or slightly turbid conditions otherwise present in area streams. Area residents report the receiving streams turn this characteristic color at least weekly. Occasionally the liquid influences the formation of foam on water surfaces. Foam four foot in depth above the course of Indian Trail Creek was reported several times. Ohio EPA personnel observed several instances of foam formation on drainage ways across the northern hillside flowing into Indian Trail Creek in 1998.

The fact that this liquid is toxic to vegetation reduces the absorption capacity of the hillsides. The facility attempts to limit the amount of liquid sprayed on a specific field to avoid a total plant kill by rotating the spray application amongst numerous fields. However, this has not been successfully achieved as several fields were barren of vegetation or in some degree of minimal regrowth in the summer of 1998. Several forested areas also exhibited the toxic effects of past liquid applications. The hillside course over which the liquid flowed was highlighted by vertical swaths of dead mature trees in an otherwise green canopy.

In addition to the primary liquid storage pit, at least three other basins on Holmes ByProducts property retain wastewater. Another coal strip mine pit located northeast from the factory appears to be used to store excess rendering liquid. It is flanked by dead vegetation, contains blackish water, and has no visible signs of aquatic life. It is apparent that the network of temporary pipes could be diverted to empty into this pit.

Another basin which is also bordered by dead vegetation and in which the water appears blackish is an impoundment located downstream from the primary pit on the unnamed Indian Trail Creek tributary at RM 6.08. This unnamed stream originates as a road side ditch along C-168; a hilltop road which provides the southern access, after turning onto T-411, to Holmes ByProducts. Several swales across the northern exposure of the C-168 hill form small streams which gain some spring flow with decreasing elevation. The principal small stream in this network flows along an abandoned township road (T-412, now used to access southeastern parts of the Holmes ByProducts property). This small stream gains size with additional flow from the cooling water pond discharge, from leachate and overflow from the primary pit, from sprayed wastewater runoff, and from springs before it is impounded. Flow immediately upstream into the impoundment and downstream was continuous in 1997. This stream is joined by several other small unnamed streams before confluencing with Indian Trail Creek at RM 6.08.

A third basin is reported to have been used to store liquid waste until as recently as 1994 according to area residents. This basin is west of the facility and is another coal strip mine pit. Ohio EPA personnel have not investigated this area.

Beyond the avenues for stream contamination already described, another facet of the Holmes ByProducts operation involves the land filling and spreading of composted waste across their

property. Two sites, each more than two acres in surface area, represent the greatest concern. One of these sites overlays a steep hillside. The material in this landfill was largely comprised of wood fibers and other materials including hard animal parts.

The other site is adjacent to the unnamed Indian Trail Creek tributary at RM 6.08. This landfill is upstream from the impoundment and contained material that appeared to include fly ash as well as animal parts. The animal parts were clearly distinguishable including fur, hide, teeth, a variety of bones and bone shards, etc. These uncomposted parts were laying on the land surface and many were within a few feet from the unnamed stream.

A result of these varied activities is that a nausea inducing odor pervades the local region and is noticeable more than a mile from the facility.

Holmes By Products lacks an NPDES permit. Hence, monthly operating report data is not available. The company has never applied for a permit to install any wastewater treatment facilities or for land application of any sludge. Ohio EPA records indicate a grease skimmer was installed prior to August 1987. In response to Directors Findings and Orders issued in 1994 on behalf of the Division of Air Pollution Control, Holmes ByProducts installed condensers to reduce nuisance odors mostly emanating from feather processing. No additional treatment was installed to address the resulting condenser wastewater which may frequently contain BOD_5 concentrations exceeding 500 mg/l.

Ohio EPA records mention Holmes ByProducts was a known source of water pollution in the 1960's when the Ohio Department of Health's mission included issuance of wastewater permits. Holmes ByProducts was requested to apply for an NPDES permit in 1976. Between 1987 and 1997, at least thirteen separate water samples were collected from various locations on Holmes ByProducts property and from Indian Trail Creek tributaries. With ammonia concentrations ranging from 24.0 mg/l to 528.0 mg/l, all of these samples exceeded the most minimum water quality criteria.

Water column chemical analysis occurred at eight Indian Trail Creek sites, at two locations on the unnamed Indian Trail Creek tributary at RM 6.08, at a site on a branch to this stream, and at the base of a hillside seep in 1998. The unnamed tributary at RM 6.08 is the principal stream which drains much of the Holmes By Products property including the wastewater pit, both previously mentioned landfills, and several irrigated hillside fields. The hillside seep sample location was at the base of the swath of dead trees about 30 feet from Indian Trail Creek at RM 6.36.

Extremely high nutrient values, poor D.O. concentrations, and elevated total suspended solids (TSS) levels were consistently recorded at the hillside seep. In 1998, five grab samples had ammonia concentrations ranging from 0.83 mg/l to 27.0 mg/l, nitrate concentrations ranging from 21.7 mg/l to 119 mg/l, and phosphorus concentrations ranging from less than detectable to

2.62 mg/l. Concentrations of D.O. were recorded between 1.9 mg/l and 5.62, while TSS values averaged 18 mg/l. Additionally, two low pH levels (6.3 and 6.4 ranging to 7.6) were documented. Among all of these abnormal chemical parameter readings, at least 14 values exceeded water quality criteria.

Despite these elevated concentrations, during normal flow conditions the volume of water from the seep did not influence Indian Trail Creek. Indian Trail Creek maintained good groundwater flow throughout the summer and sufficient volume was inferred to dilute the seep impact. Groundwater sources like the seep were abundant in the vicinity of Holmes ByProducts. The fact that this particular groundwater source is contaminated suggests local area groundwater is also likely to have elevated chemical parameter values. The safety of using area groundwater as a drinking source should be investigated further. All of the nitrate concentrations measured in the seep exceeded the Public Water Supply criterion (10 mg/l) and one of the values exceeded the Agricultural Water Supply criterion (100 mg/l). Furthermore, sampling timed to capture the runoff from the seep following a rainstorm is recommended to assess the influence during high flow conditions.

As with the seep, high nutrient values, low D.O. concentrations, and unusual TSS levels were also documented in the unnamed Indian Trail Creek tributary at RM 6.08 and in the unnamed tributary branch to this stream. Based on three sample locations, ammonia concentrations ranged from 0.41 mg/l to 27.0 mg/l, nitrate concentrations ranged from 19.6 mg/l to 127 mg/l, and phosphorus concentrations ranged from less than detectable to 2.88 mg/l. Two extremely low D.O. concentrations were recorded (1.2 mg/l and 3.3 mg/l) and TSS values averaged 36 mg/l. At least nine of these values exceeded water quality criteria.

Compared with Ohio EPA data from other similar streams in the same ecoregion, all of these concentrations were greater than the associated 95%tile values. Essentially, these concentrations are generally toxic to many forms of aquatic life. Like the seep, the nitrate concentrations were documented in excess of the Agricultural Water Supply criterion. This is significant because livestock were observed drinking from this stream within the reach bracketed by the sampling locations.

The influence of the unnamed tributary network on Indian Trail Creek was evident at the sample locations which bracketed the tributary confluence. All downstream samples increased in ammonia and nitrate concentrations. Overall, Indian Trail Creek is a nutrient enriched stream. The additional load from the unnamed tributary exacerbates this condition. Recovery to upstream concentrations is confounded in Indian Trail Creek by more loading from other downstream sources. Longitudinally, nutrient levels in Indian Trail Creek increase downstream. Sampling to characterize the comparative pulses following a rain storm is recommended to further assess the relative contributions from the various nutrient sources.

Biological performance in Indian Trail Creek was influenced by strong groundwater flow,

reflected organically enriched conditions, and was limited by habitat quality. The macroinvertebrate community exhibited exceptional or very good qualities at three sites (RM 6.4, RM 5.4 and RM 2.6). Fish community performance was fair, poor, or very poor at six locations. The immediate influence of Holmes ByProducts downstream from the confluence with the unnamed Indian Trail Creek tributary at RM 6.08 was clearly evident in the fish community. This influence was less dramatically demonstrated by the macroinvertebrates.

A very good macroinvertebrate community at RM 5.4 was indicative of a slight decline from otherwise exceptional performance. Each of the three sample locations were represented by 11 to 14 pollution sensitive EPT taxa and 49 to 62 total taxa. Caddisflies were predominant while mayflies and tanytarsini midges were common. The modest decline at RM 5.4 resulted from an increase in pollution tolerant blackfly larvae. While it is probable that the greater abundance of this pollution tolerant organism was attributable to runoff from Holmes By Products, the volume of groundwater in Indian Trail Creek was sufficient to offset the potential impact of this source to the macroinvertebrate community.

Groundwater flow was not adequate to maintain a good fish community. Instead, the nutrient enriched background conditions supported a large number of fish (relative number =3,592) and good species richness (15) at the site (RM 7.3) upstream from the confluence with the unnamed Indian Trail Creek tributary at RM 6.08. The additional organically enriched runoff from Holmes-By Products flowing in the tributary into Indian Trail Creek resulted in a substantial reduction in diversity at RM 5.9 (relative number =250, 9 species). This degradation continued downstream (RM 5.6, relative number =398, 5 species) with an obvious sag evident at RM 5.3 (relative number =66, 4 species). Some recovery was apparent at RM 3.8 (relative number =726, 10 species) and at RM 2.6 (relative number =972, 10 species).

The Index of Biotic Integrity (IBI) scores demonstrated this trend also. Upstream (RM 7.3) the fish community was characterized as fair (IBI=34). Downstream from the tributary the fish community performance declined longitudinally with very poor (IBI=12) results recorded at RM 5.3. The fish assemblage at this site was considered evidence of chronically impaired conditions. The repeated organic enrichment from Holmes ByProducts so severely affects diel D.O. availability that fish are unable to inhabit this location on a continuous basis.

This impairment was even more apparent in the unnamed Indian Trail Creek tributary at RM 6.08. No fish were collected in this stream at RM 0.4 immediately downstream from Holmes By Products property. The absence of fish at this location was indicative of acute toxicity. Although habitat conditions here (QHEI=50.5) were less than optimal for a warmwater fish community (i.e. QHEI$60), flow remained continuous through the summer and adequate pool depth was present to support at least a vestige of a fish community. The only plausible explanation for the complete lack of fish at this site is that runoff and spills from Holmes ByProducts operations prevent fish from inhabiting this reach.

When this impact is considered longitudinally beginning at this tributary location downstream to the Indian Trail Creek site at RM 5.3, it is apparent that Holmes ByProducts is responsible for the elimination or degradation of the fish community in at least one mile of the Indian Trail Creek watershed.

Similar to the mainstem, the impact in the tributary was not as severe for the macroinvertebrate assemblage. Fair performance was determined at RM 0.3. This location also reflected the additional flow from an eastern branch tributary which does not drain Holmes-By Products property. Despite this augmentation, only one mayfly taxon and one caddisfly taxon in low densities were collected at the site. Pollution tolerant organisms predominated the location. Blackfly larvae, midges (*Chironomus spp*, *Polypedilum (P.) illinoense, Psectrotanypus dyari*), snails (*Physella* sp), and oligochaete worms were commonly encountered.

Habitat conditions in Indian Trail Creek and the unnamed tributary at RM 6.08 have been degraded by unrestricted livestock access. Some reaches have been channelized and riparian vegetation is limited to a few woodlots which border the stream. However, all sample locations had a good assortment of substrates and most sites had relatively deep pools with at least a moderate amount of cover. The mean QHEI score for mainstem Indian Trail Creek sites (52.8) was consistent with the QHEI score at the tributary location (50.5).

This fair habitat quality does limit some biological performance. The fish community at each site was extremely tolerant, comprised by mostly generalist or omnivorous fish, and lacked pollution sensitive species. Only one darter species (johnny darter) was collected in the sub-basin and it was infrequently collected. The combination of the reduced habitat quality and organic enrichment resulted in fair to very poor fish community performance in the Indian Trail Creek basin. These influences on the macroinvertebrate community were ameliorated by strong groundwater flow.

Troyers Trail Bologna (Unnamed tributary RM 0.25, Indian Trail Creek RM 5.42, Walnut Creek RM 0.82, South Fork Sugar Creek RM 6.57, Sugar Creek RM 12.3)
Troyers Trail Bologna is a manufacturer of bologna from beef with a production rate of about 100,000 to 120,000 pounds per month. Process and sanitary wastewater are treated by trash traps, aeration, sand filter, chlorination, and dechlorination. Discharge from outfall 001 is to an unnamed tributary (RM 0.25) of Indian Trail Creek (RM 5.42, Lat:403510/ Long:814222).

The NPDES permit expires August 28, 2001. The average design flow is 0.0045 MGD. Final effluent limits include BOD_5 = 10.57/20.55; TSS 11.7/35.23; ammonia-N (summer)=2/3 mg/l. An analysis of MOR data for 1998 indicated no problems meeting permit limits. Analysis of long term data shows a slight increase in loadings of BOD and TSS during 1997 and 1998 but at levels well below permit limits.

Chemical and fish samples bracketed the unnamed tributary in Indian Trail Creek. As discussed

above, the influence of Holmes ByProducts masks other downstream nutrient loads which are further confounded by influences of fair habitat conditions. Nutrient enriched conditions exist in Indian Trail Creek at the confluence with the unnamed tributary. Any additional load from Troyers Trail Bologna was not distinguished from background conditions. However, the poorest fish community in Indian Trail Creek was recorded downstream from the unnamed tributary. Additionally, dead fish were observed in the unnamed tributary and in Indian Trail Creek in the vicinity of the confluence during the 1998 sampling period. Additional sampling is needed to exclude the possibility that effluent from Troyers exacerbates these conditions.

Case Farms (Unnamed tributary RM 1.4, Indian Trail Creek RM 3.2, Walnut Creek RM 0.82, South Fork Sugar Creek RM 6.57, Sugar Creek RM 12.3)
Case Farms (previously Poultry Processing Inc.) is a manufacturer of fresh poultry products, with about 80,000 broilers processed daily. Process wastewater, sanitary waste, and contaminated storm water are treated by screening, air flotation (DAF unit), flow equalization, activated sludge basin, clarification, and chlorine disinfection and dechlorination. The design flow of the treatment system is 0.500 MGD. The outfall discharges to an unnamed tributary at RM 1.4 of Indian Trail Creek (RM 3.2, Lat:403510/Long:815053).

The NPDES permit expires August 28, 2002. The final permit limits include: BOD_5=15/23 mg/l, TSS 20/30 mg/l, ammonia-N (summer)=1.49/4.5 mg/l, (winter)=5.0/8.0 mg/l. An analysis of MOR data indicates numerous violations over the twelve months of 1998 including (BOD 40 violations of either concentration or loading), TSS (21 violations), ammonia-N (33 violations), oil and grease (6 violations), and fecal coliform bacteria (23 violations). The flow of the treatment plant was also at or exceeding design capacity in 1998. Long term trends of MOR data (Figure 9) show a rapid increase in discharge flow over the past ten years (1989-1998) with significant increases in TSS and BOD in 1997 and 1998.

Fish sampling bracketed the tributary in Indian Trail Creek. Chemical and macroinvertebrate sampling was not conducted to specifically target this entity in 1998. Even so, based on samples from Indian Trail Creek RM 5.4 and RM 2.56, it appeared that some excessive nutrient loading from Case Farms was occurring. The downstream site had increased nutrient concentrations in several samples.

The fish community was similar at RM 3.8 and RM 2.6. Both assemblages included by the

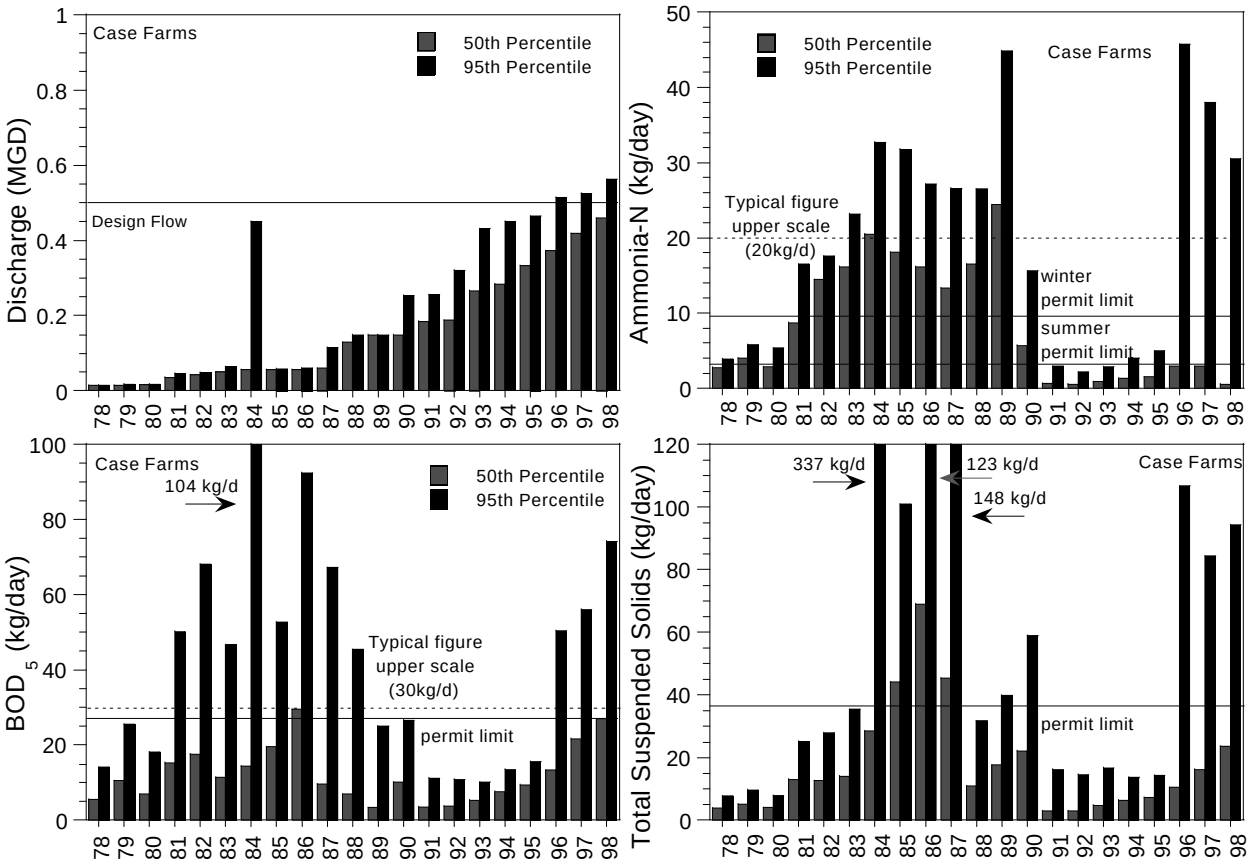

Figure 9 Annual median and 95th percentile discharge and pollutant loadings of NH_3-N, $cBOD_5$, and TSS to Sugar Creek from Case Farms, 1978-1998.

same10 species and scored in the fair range (RM 3.8, IBI=28 and RM 2.6 IBI=30). Habitat conditions were fair at both sites. Overall, the additional load from Case Farms did not impair the fish community beyond the already diminished conditions in the Indian Trail sub-basin.

Village of Strasburg WWTP (Sugar Creek RM 7.45)

The Village of Strasburg WWTP, built in 1974 and upgraded in 1993, has a design capacity of 0.225 MGD. Treatment includes a comminutor, a manual bar screen, grit removal, two oxidation ditches, two final clarifiers, chlorination, sludge holding, and sludge drying beds. The collection system consists of 100% separate sewers and serves 2,120 people. Effluent is discharged to Sugar Creek at RM 7.45. The Village is currently designing an upgrade to the wastewater treatment plant which will include a mechanical bar screen, grit removal, a third oxidation ditch, four additional rotors for the two existing oxidation ditches, two final clarifiers, UV disinfection, and additional sludge storage. The design capacity of the system after the upgrade will be 0.3375 MGD.

The NPDES permit expired on November 27, 2000. Current effluent limits are as follows: total

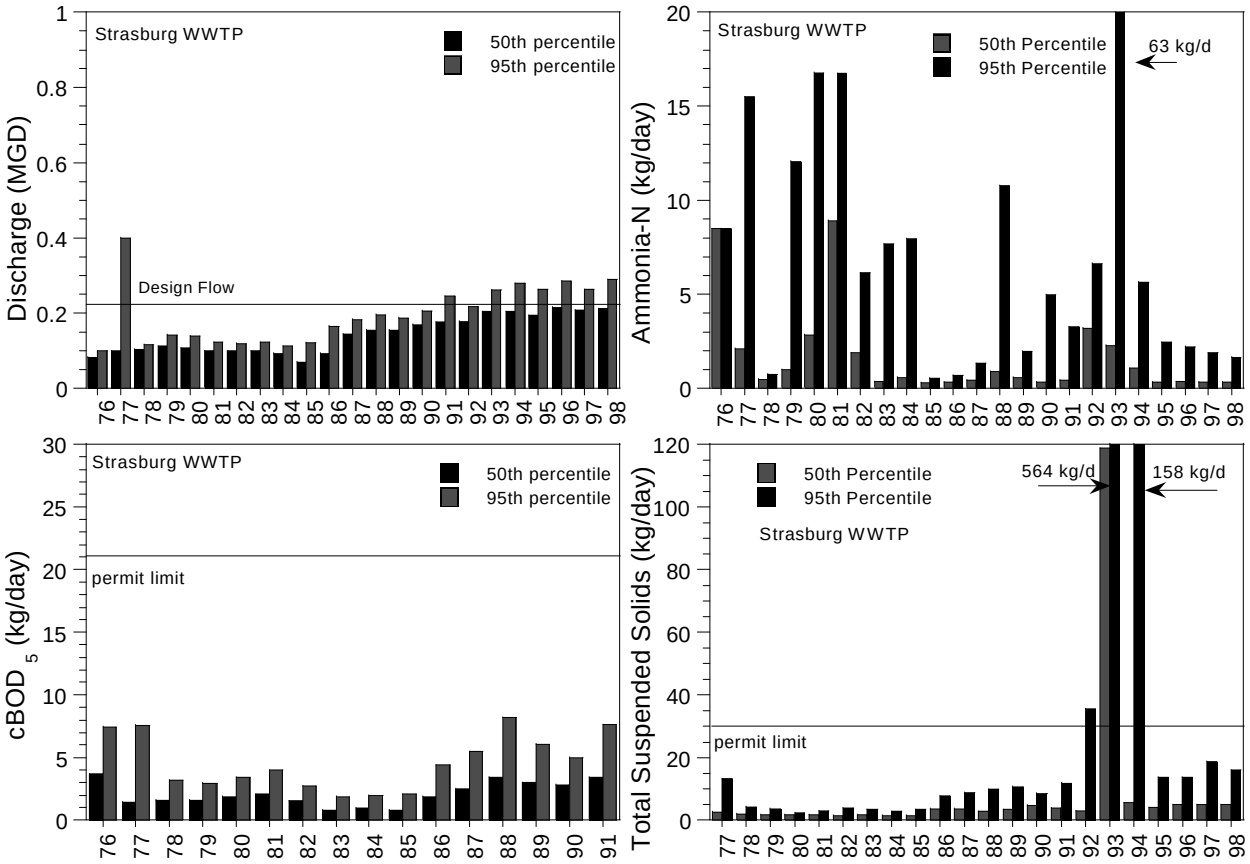

Figure 10 Annual median and 95th percentile discharge and pollutant loadings of NH_3-N, $cBOD_5$, and TSS to Sugar Creek from the Strasburg WWTP, 1976-1998.

suspended solids of 30/45 mg/l (26/38 kg/day); $cBOD_5$ of 25/40 mg/l (21/34 kg/day); and a minimum dissolved oxygen of 5.0 mg/l.

A review of the annual trend analysis shows that flows have steadily increased since 1976, representing growth within the community (Figure 10). BOD_5 loadings were constant throughout the monitoring period. $CBOD_5$ increased substantially in 1993, as did ammonia and total suspended solids which were discharged from Outfall 001. This was a result of poor operational practices and lack of sludge removal at the treatment plant. $CBOD_5$ dropped in 1994, but has steadily increased through 1998. Ammonia has shown a steady decline through 1998, while suspended solids dropped in 1994, and has now remained at a constant level.

Three fecal coliform bacteria samples and five chemical samples were collected at this facility during the basin survey work in 1998. Two fecal coliform violations were noted (7500, 2000 organisms/ 100 ml). All five dissolved oxygen values were less than 5.0 mg/l, but all samples were taken at the end of the chlorine contact tank before the weir and outfall cascade, which increase the oxygen level prior to the effluent entering Sugar Creek. Values ranged from 2.66 to

4.15 mg/l. All other parameters were within limits.

Chemical and biological sampling bracketed the facility in 1998. Nutrient loading was evident in downstream samples. Sugar Creek is an enriched stream. The additional load from Strasburg only confounds this situation. Biological performance improved downstream from the WWTP which was consistent with much improved habitat conditions.

Alpine Hills (Unnamed tributary, Broad Run RM 6.0, Sugar Creek RM 6.5)
Alpine Hills is an outdoor concert arena and campground for the public. Wastewater generated in the restrooms and shower houses is discharged to an on-site package wastewater treatment plant. The treatment system consists of a trash trap, flow equalization, extended aeration, clarifier, sand filters, chlorination, dechlorination, aerated sludge holding and sludge drying beds. The effluent from the treatment system is discharged to an unnamed tributary, and enters Broad Run at RM 6.0.

The NPDES permit expired on January 31, 2000. Permit limits include suspended solids of 12/18 mg/l (0.23/0.34 kg/day); $cBOD_5$ of 10/15 mg/l (0.19/0.28 kg/day); ammonia 1.0/1.5 mg/l (0.02/0.03 kg/day) for summer and 3.0/4.5 mg/l (0.06/0.09 kg/day) for winter; and a dissolved oxygen level of not less than 6.0 mg/l. This facility was not evaluated during the 1998 field season.

Broad Run Cheese (Unnamed tributary, Broad Run RM 6.0, Sugar Creek RM 6.5)
Broad Run Cheese is a producer of natural cheeses. Cheese making processes include pasteurizing, culturing, coagulation and pressing. Whey is hauled off-site for further processing. Process wastewater is treated in a package wastewater treatment plant. The system consists of a trash trap, three aeration tanks, a settling tank, two sand filters and a Sanuril chlorinator. The facility plans to install dechlorination equipment. The facility discharges to Broad Run at RM 6.0. Sanitary wastewater is also discharged to this wastewater treatment system. The facility has recently hired a licensed operator to maintain the system. An NPDES permit for this facility was to be issued in 2000. This facility was not evaluated during the 1998 survey.

Dover Chemical (Sugar Creek RM 2.1)
Dover Chemical produces phosphites and chlorinated hydrocarbon products which are used in the manufacture of lubricants, plasticizers, flame retardants, and light and heat stabilizers. Hydrochloric acid and sodium hypochlorite are produced as ByProducts. Process wastewater from the metal soap manufacturing process is collected in 55-gallon drums and hauled off-site for treatment. Non-contact cooling water is treated by sedimentation, oil separation, and air stripping prior to discharging to Sugar Creek from outfall 002. Sanitary wastewater from the facility is treated in an on-site package wastewater treatment system consisting of a trash trap, extended aeration, clarifier, two sand filters, and chlorination. Wastewater from this treatment system combines with the treated non-contact cooling water prior to discharging to Sugar Creek at RM 2.1.

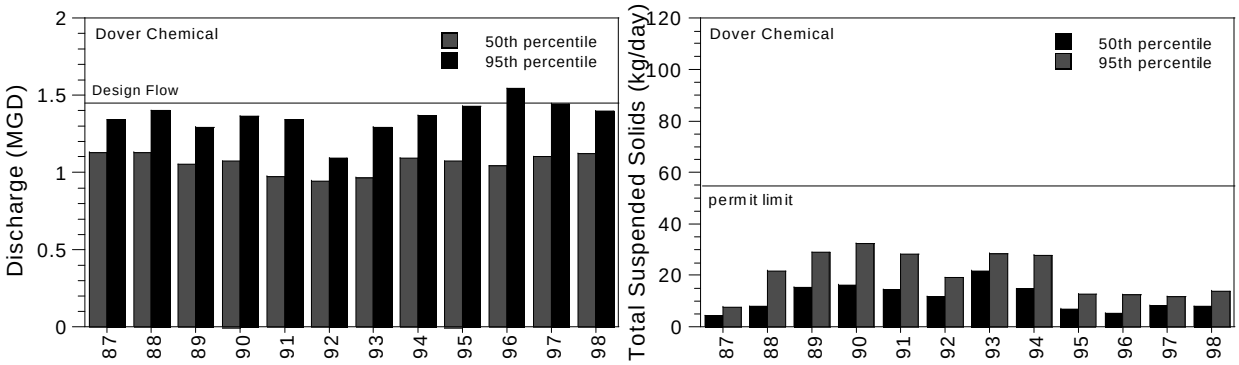

Figure 11 Annual median and 95th percentile discharge and pollutant loadings of TSS to Sugar Creek from Dover Chemical, 1987-1998.

Recent bioassays conducted by Ohio EPA have shown consistent toxicity. February 1989 results were acutely toxic to both *P. promelas* and *C. dubia*. Dechlorination of the effluents eliminated the acute toxicity. Effluents were also acutely toxic for the August 1993 samples. Both grabs were toxic during the October 1997 bioassays. The most recent bioassay, conducted March 1998, also showed acute toxicity of their effluents with all of the *C. dubia* dead at the end of the test period. Specific results for each of the bioassays can be found in the following reports: Bioassay Number 89-643-SE, Bioassay Number 93-1152-SE, Bioassay Number 97-1963-SE, or Bioassay Number 98-2019-SE.

The NPDES permit expired on October 31, 1999. The average flow from this facility is 1.45 MGD. Final effluent limits are suspended solids of 10/20 mg/l (54.9/109.8 kg/day); total dissolved solids of 750/1500 mg/l (4116/8232 kg/day). Compliance with the NPDES permit was indicated in 1998 MOR data. Flow has remained consistent over the last ten years although some 1996 peak discharges exceeded design capacity (Figure 11). Annual loadings for total suspended solids have been low and well below permit requirements.

Five effluent samples including three fecal coliform bacteria analyses were collected from the facility in 1998. No violations of NPDES permit limits were noted. The effluent contained some organic compounds which persist in surface water sources including, Bis(2-ethylhexyl)phthalate (1.9 ug/l), "-BHC (0.38 ug/l), $-BHC (0.088 ug/l), d-HC (0.025 ug/l), (-BHC (0.056 ug/l), 4-4'DDE (0.022 ug/l), heptachlor epoxide (0.0071 ug/l), and hexachlorobenzene (0.060 ug/l)..

Chemical and biological sampling bracketed the company. Generally, the effluent had better chemical properties for the parameters analyzed than the ambient conditions at the outfall in Sugar Creek. Despite this, biological scores declined downstream from Dover Chemical. The macroinvertebrate community did achieve the relevant biocriterion at both sites bracketing the facility. However, the downstream score (ICI=36) was the lowest in the twelve mile reach from the Beach City dam to the Tuscarawas River confluence. The fish community failed to achieve the WWH biocriteria downstream from the plant.

All five sites sampled in the reach downstream from the Beach City dam in 1998 had good to very good macroinvertebrate performance. ICI scores ranged from 36 to 42 and 9 to 17 total EPT taxa were present at each site. This was a substantial improvement over the 1991 benthic results downstream from Dover Chemical. In 1991, good macroinvertebrate community performance upstream from Dover Chemical (RM 3.7 and RM 2.11) declined to poor immediately downstream from the outfall at RM 2.09, as well as farther downstream at RM 1.8 and RM 0.6.

The fish community has not recovered as much as have the macroinvertebrates. Marginally good fish community performance (IBI=37, MIwb=8.2) was recorded upstream at RM 7.2. At RM 3.7 a good IBI score (41) contrasted with a fair MIwb value (7.8). Among the four samples comprising these results, 19 to 26 species were represented by 122 to 182 individuals. Although this upstream condition was unremarkable, the fish community performance declined from this background downstream from Dover Chemical. At RM 1.8 a fair IBI score (35) and a poor MIwb (5.8) were calculated from two samples. Twelve and 19 species were represented by 71 and 138 individuals.

This departure related to the proximity of Dover Chemical has been evident in past data also. In 1991, 1988, and 1983, fish community performance upstream from Dover Chemical was very good. In those years performance consistently declined to fair downstream from the facility. In a 1992 report, "Investigation of Biological Communities and Toxic Impacts in Sugar Creek and Selected Tributaries," the Ohio EPA concluded that Dover Chemical was the cause of this degradation. The 1998 results confirm this condition continues to exist.

Kimble Sanitary Landfill (Brandywine Creek RM. 2.0)
Kimble Landfill accepts solid waste from numerous communities in the area. Storm water run-off from the landfill is collected in three retention ponds where solids are allowed to settle out prior to discharging to Crooked Run and Brandywine Creek. The facility has been issued a Permit to Install to construct a fourth retention pond, which has not been completed to date. The NPDES permit expires January 31, 2000. The only parameters that are limited are suspended solids of 30/45 d/mg/l and oil & grease, with a daily maximum of 10 mg/l. This permit contains no loading limits. The facility is typically in compliance with its permit. Samples were not collected at this facility during the 1998 survey work.

Pollutant Spills and Unauthorized Releases
In addition to NPDES permit violations and water quality criteria exceedences, a review of the Ohio EPA Division of Emergency and Remedial Response (DERR) Release Reporting System (RRS) database indicated four unpermitted releases of toxic or oxygen-demanding substances occurred in 1998 in the Sugar Creek study area. Accidental spills and unauthorized discharges of pollutants represent a potential impact to aquatic life which may or may not be traceable to a specific source. Spills occur at random and may significantly impact aquatic and terrestrial organisms without leaving obvious physical signs. It is likely that the reported spills represent a fraction of the actual spill occurrences within the Sugar Creek study area.

Of the four releases, one with unknown origin resulted in a fish kill. (See discussion below.) Two spills were from Kidron, Inc.; one occurred in February and a second one in June from Outfall 002, discharging to the North Fork of Sugar Creek tributary. In February 1998, an accidental spill of approximately 4000 gallons occurred from Dover Chemical.

Fish Kills

A review of Water Pollution, Fish Kill and Stream Litter Investigation Reports from the Ohio Department of Natural Resources Division of Wildlife indicated that only four fish kills were reported in the Sugar Creek basin between 1990-1998. In addition, dead fish were documented in Indian Trail Creek at SR 515 by Ohio EPA personnel on July 29, 1999. These fish were present in the tributary which drains the Troyers Trail Bologna property and in Indian Trail Creek upstream from the tributary. No source was determined for this influence.

Manure spills were responsible for two of the fish kills and the accidental release of liquid nitrogen fertilizer caused another incident. These three kills associated with agricultural activities primarily impacted smaller streams. The other kill occurred downstream from Dover Chemical in 1995. This kill was detected over a two mile reach downstream from the facility.

Chemical Water Quality

Sugar Creek

Water column chemical sampling stations were selected to provide information about ambient water quality and to assess impacts from point source and nonpoint source pollution. Five sets of grab samples were collected at fourteen sites on the mainstem between July 9 and September 8, 1998. Effluents from six primary point source facilities were also collected two to five times during this same period. Analyses included inorganic parameters (solids, nutrients, and metals) and one collection of organic parameters (BNA's, pesticides, and herbicides) upstream and downstream from Dover Chemical, as well as Dover Chemical's effluent. Three to four fecal coliform bacteria samples were collected at the same fourteen sites during the sampling period. Effluents were sampled two to four times for fecal coliform bacteria, as well. Results of the analyses are presented in Appendix A-1 and A-2.

The primary point sources evaluated in the area were the municipal wastewater treatment plants at Smithville, Brewster, Beach City, and Strasburg. Two industrial facilities, Brewster Dairy and Dover Chemical, make up the remainder of the point source dischargers. The non-point source influences consist mostly of agricultural practices, mining (lower end), and some urban run-off (upper end).

Analytical results were reviewed to determine the occurrence of violations and exceedences of Ohio Water Quality Standards (OAC 3745-1) as they relate to Warmwater Habitat (WWH), aquatic life, Primary Contact Recreation (PCR), Secondary Contact Recreation (SCR), Agricultural Water Supply (AWS), and Public Water Supply (PWS) use designations (Table 8).

Numerical chemical criteria exist for the prevention of acute and chronic toxicity for most pollutants. The appropriate acute aquatic criterion (AAC) and chronic aquatic criterion (CAC) apply to samples outside of mixing zones. Minimum and average criteria exist for dissolved oxygen. Primary and secondary contact recreation criteria apply to fecal coliform bacteria counts. Primary contact waters are protected for full body contact recreational activities and will pose minimal threat to public health as a result of the water quality. Secondary contact waters are protected for limited activities, such as wading, with minimal threat to public health.

Flows on Sugar Creek are monitored at the USGS station located at Strasburg. During the period of July through September of 1998, flows ranged from a high of 1870 cfs on July 2 to a low of 30 cfs on August 23 and September 30. Flows also increased for a brief time beginning on August 24 and declined beginning on August 27. Sampling was conducted during this period, and many of the parameters reflect higher concentrations as a result of the increased flows (Figure 12).

Mean concentrations of dissolved oxygen, fecal coliform bacteria, total iron, ammonia N, nitrate-nitrite, and total phosphorus were determined and plotted longitudinally to display trends in these physical and chemical properties (Figures 13 and 14). In calculating mean concentrations, a value equal to the analytical method detection limit (MDL) was used for results reported less than the MDL. Geometric means were used to calculate the fecal coliform values.

BOD_5 values ranged from below detection to 10 mg/l at all in-stream samples on Sugar Creek. The higher values occurred during the high flow conditions in late August. No pH violations were noted and all ammonia values met the warmwater habitat criteria. Ambient total phosphorus values in stream ranged from below the detection level to 2.85 mg/l at RM 7.28 downstream from the Strasburg WWTP.

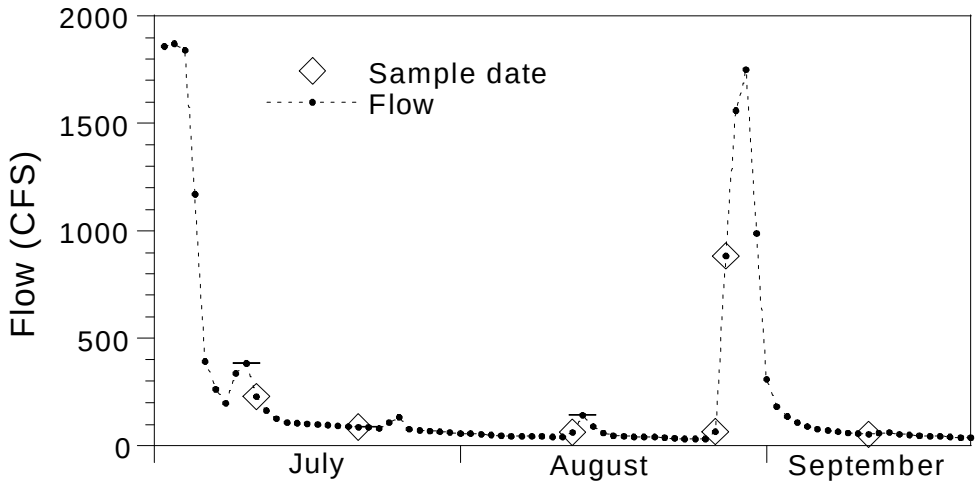

Figure 12 Flow hydrograph for Sugar Creek at Strasburg, July through September 15, 1998. Sampling dates are indicated on the figure.

Table 8. Exceedences and violations of Ohio EPA Warmwater Habitat (WWH) criteria (OAC 3745-1) for chemical, physical and bacteriological water quality parameters measured in the Sugar Creek study area during 1998 (units are : g/l for metals and organics, # organisms/100 ml for fecal coliform and E. coli bacteria, S.U. for pH, and mg/l for all other parameters).

Stream (code) RM	Parameter (value)
Sugar Creek (17-400)	
42.8	fecal coliform (5800•••, >6700 •••)
40.18	fecal coliform (>6700 •••, 5400•••)
36.88	fecal coliform (3700••, >4000 ••)
34.69	fecal coliform (2400••, 8000•••, 30000•••)
26.7	fecal coliform (1400••, 2300••, 14000•••, 18000•••)
22.9	dissolved oxygen (4.1+, 4.8+); fecal coliform (2300••, 7500•••,7900•••)
19.3	dissolved oxygen (4.5+); fecal coliform (2700••, 3900••, 4600••)
18.6	dissolved oxygen (4.6+); fecal coliform (1200••, 1900••, 2200••, 7600•••)
13.7	fecal coliform (2000••); total iron (7040#, 19500#)
12.0	*E. coli* (140••); total iron (8070#, 12500#)
7.28	total iron (8100#, 26700#)
3.64	total iron (24100#)
1.8	dissolved oxygen (4.69+); total iron (23800#)
0.6	*E. coli*(280••); total iron (23800#)
Brandywine Creek (17-401)	
2.0	total iron (7560#)
0.2	fecal coliform (2500••, 2700••, 4500••); total iron (17000#)
Broad Run (17-402)	
2.8	fecal coliform (4200••, 3000••, >60000•••); *E. coli* (690••); total iron (5780#)
0.15	total iron (17700#)
Turkeyfoot Run (17-403)	
0.2	pH (5.8*, 6.4*, 6.08*, 6.3*); total iron (6690#)
Elm Run (17-405)	
1.7	fecal coliform (2600••, 19000•••); Total Iron (6140#)
Middle Fork Sugar Creek (17-406)	
12.3	fecal coliform (28000•••, 21000•••)

Table 8. (continued)

Stream (code) RM	Parameter (value)
Middle Fork Sugar Creek (17-406) continued	
10.3	fecal coliform (9300• • •, 22000• • •)
7.9	fecal coliform (18000• • •, 8000• • •)
1.7	fecal coliform (3100• •)
Misers Run (17-407)	
0.2	fecal coliform (2800 • •, 18000• • •)
Crabapple Creek (17-408)	
3.0	total copper (136*); fecal coliform (150000• • •, 13000• • •)
0.3	fecal coliform (3300• •, 32000• • •)
North Fork Sugar Creek (17-409)	
6.5	NH_3-N (0.56*), dissolved oxygen (3.8++), fecal coliform (92000• • •, 21000• • •, 13000• • •, 3000• •)
5.5	fecal coliform (310000• • •, 75000• • •, 60000• • •, 11000• • •),total iron (8330#)
1.35	fecal coliform (7200• • •, 10000• • •, 29000• • •)
South Fork Sugar Creek (17-410)	
21.1	fecal coliform (5750• • •, 20000• • •, 7500• • •); E. coli (640 • • •); total iron (5660#)
19.0	fecal coliform (5800• • •, 2800• •); *E. coli* (590• • •); total iron(5600#)
15.3	fecal coliform (4300• •, 10000• • •); *E. coli* (890• • •); total iron(12500#)
13.9	fecal coliform (4000• •, 27000• • •); *E. coli* (1100• • •); total iron(18000#)
13.2	NH_3-N (0.53*); dissolved oxygen (4.68+), pH (9.2*); fecal coliform (2200• •, 21000• • •); *E. coli* (2600• • •); total iron (14800#)
7.4	dissolved oxygen (4.7+); fecal coliform (6900• • •); *E. coli* (820 • • •); total iron (13400#)
6.4	fecal coliform (4600• •); *E. coli* (510• • •); total iron (18500#)
3.6	dissolved oxygen (4.17+, 4.8+); total iron (13500#)
Walnut Creek (17-411)	
7.9	fecal coliform (3900• •, 5200• • •; *E. coli* (850• • •); total iron 5540#)
6.32	fecal coliform (2500• •, 4600• •); total iron (6340#, 6860#)
4.5	fecal coliform (6000• • •, 3900• •, 5900• • •); *E coli* (2300• • •);Total iron (11200#)
0.6	fecal coliform (1030• •, 2200• •, 12000• • •); *E coli* (430• • •);Total iron (11900#)

Table 8. (continued)

Stream (code) RM	Parameter (value)
Indian Trail Creek (17-412)	
6.4	fecal coliform (2000• •); *E. coli* (950• • •)
6.13	fecal coliform (3300• •), (19000• • •)
5.4	NH_3-N (2.53*); fecal coliform (3600• •, 1100• •); *E.coli* (720 • • •); total iron (5770#
2.6	fecal coliform (2500• •, 3100• •, 2500• •); *E. coli* (450• •); total iron (10900#)
Goose Creek (17-413)	
0.3	fecal coliform (2600• •, 2000• •, 5000• • •); total iron (5990#)
East Branch South Fork Sugar Creek (17-414)	
5.5	fecal coliform (2000• •, >60000• • •); total iron (5270#)
5.0	fecal coliform (6500• • •, 5000• • •, >60000• • •)
1.7	fecal coliform (3600• •, 5200• • •); total iron (7750#)
Pleasant Valley Creek (17-415)	
0.20	dissolved oxygen (3.90++); fecal coliform (3600• •, 2300• •,5500• • •); *E. coli* (210• •)
Troyer Valley Creek (17-416)	
1.01	NH_3-N (3.1*, 2.94*); fecal coliform (4500• •, 2300• •); total iron (6220#)
Brush Run (17-417)	
2.5	fecal coliform (2700• •, 2300• •)
0.4	fecal coliform (57000• • •, 36000• • •, 44000• • •)
Little Sugar Creek (17-418)	
4.2	fecal coliform (3300• •, 5700• • •)
0.8	total dissolved solids (); fecal coliform (3500• •, 4600• •,6400• • •, 65000• • •)
Cherry Run (17-419)	
0.2	pH (5.54*, 5.44*, 6.3*, 6.35*)
Goettge Run (17-422)	
0.3	*E. coli* (360• • •)
Unnamed Trib. To South Fork Sugar Creek (RM 14.1)(17-424)	
0.28	fecal coliform (4800• •, 7180• • •, 20000• • •); *E. coli* (10000• • •); total iron (10400#)

Table 8. (continued)

Stream (code) RM	Parameter (value)
Unnamed Trib. To South Fork Sugar Creek (RM 14.1)(17-424)	
0.05	fecal coliform (4400• •, 5000• • •, 9600• • •); *coli* (2500• • •); total iron (14200#, 13700#)
Unnamed Trib to South Fork Sugar Creek (RM 1.0)(17-429)	
0.7	total dissolved solids (1640*, 2010*, 2100*); fecal (2000• •, 2300• •, 4200• •); *E. coli* (670• • •); total iron (5000#)
Unnamed Trib to Indian Trail Creek (RM 6.08)-west Holmes By-Product Trib (17-433)	
0.63	NH_3-N (5.92*,*); dissolved oxygen (1.2++); pH (5.18*, 5.04*); total zinc (325*); total nickel (202*, 129*);fecal coliform (3600• •)
Unnamed Trib to Indian Trial Creek (RM 6.33)-east Holmes By-Product Trib (None)	
0.01	NH_3-N (19.7**, 20.7**, 21.3**, 27.0**); total dissolved solids (1880*); fecal coliform (5000• • •)
Hershberger Trib-Trib to Unnamed Trib to Indian Trail Creek at RM 6.08 (None)	
0.01	NH_3-N (4.22*, 9.03*); total dissolved solids (1530*); nickel (135*); fecal coliform (1400• •)
Unnamed Trib to Little Sugar Creek (17-437)	
1.0	fecal coliform (4200• •, 27000• • •, 28000• • •, 65000• • •)

* Exceedence of numerical criterion for prevention of chronic toxicity (Chronic Aquatic Criteria [CAC]).

** Exceedence of numerical criterion for prevention of acute toxicity (Acute Aquatic Criteria [AAC]).

\+ Indicates that the value is less than the average WWH dissolved oxygen (D.O.) criterion (5 mg/l).

++ **Violation of the minimum WWH D.O. criterion (4 mg/l).**

"" Exceedence of the maximum Primary Contact Recreational criterion (fecal coliform 2000/100 ml).

""" Exceedence of the maximum Secondary Contact Recreational criterion (fecal coliform 5000/100 ml).

\# Exceedence of the maximum Agricultural criterion for Total Iron (5000 ug/l)

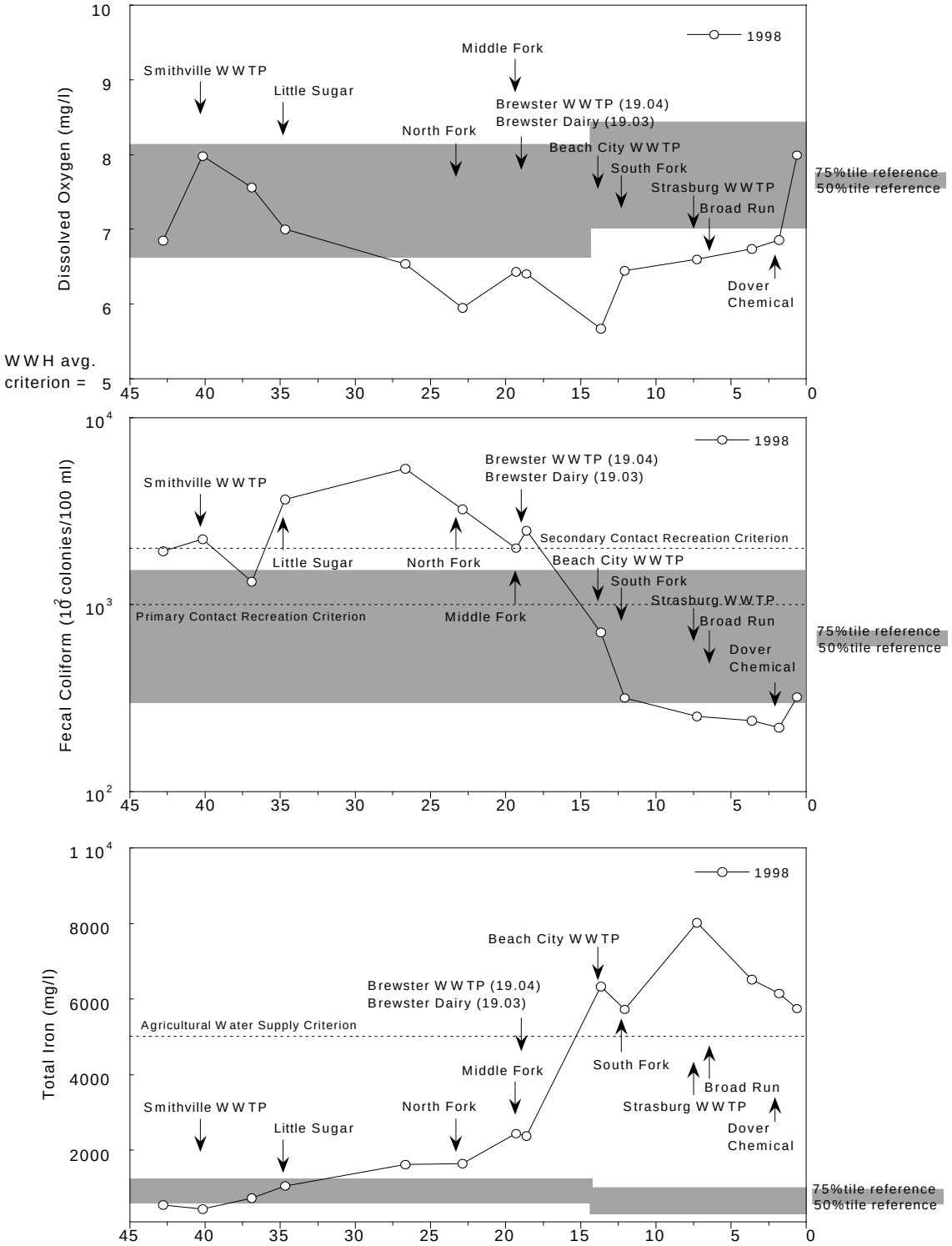

Figure 13. Longitudinal summary of mean concentrations of D.O., fecal coliform bacteria, and total iron in Sugar Creek, 1998.

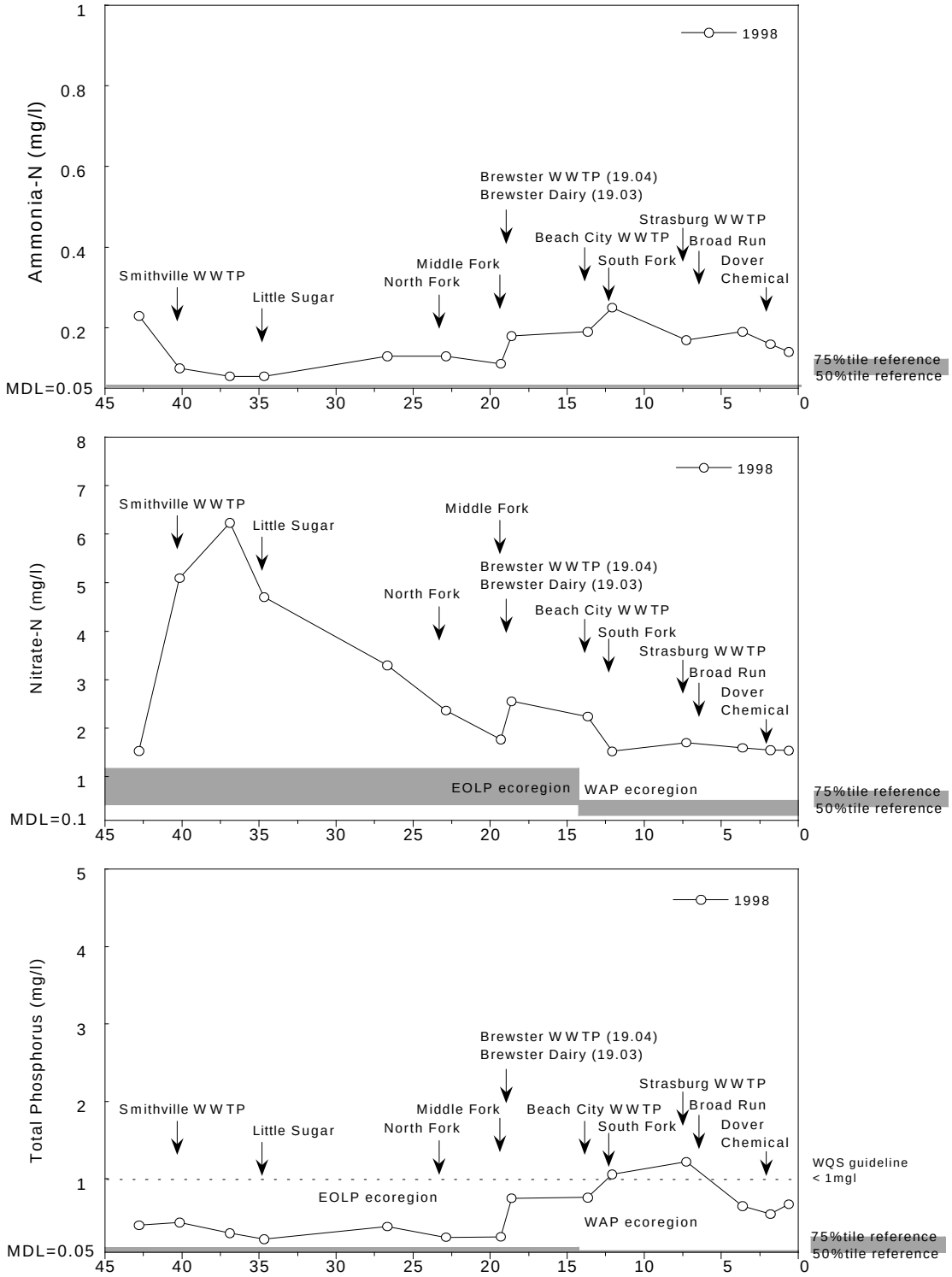

Figure 14 Longitudinal summary of mean concentrations of ammonia-N, nitrate-N, and total phosphorus in Sugar Creek, 1998.

While some point source dischargers do influence the nitrate-nitrite and the phosphorus levels in Sugar Creek, the contributions being carried by the tributaries should raise more concern. This is especially true when you look at the graphs for iron and to a lesser extent, fecal coliform. Refer to the violations table and the Appendix for specific chemical data.

Many of the samples for metals were consistently at or below detection level. Arsenic, cadmium, nickel, selenium, chromium, and copper fell into this category. On one occasion, arsenic, cadmium, and lead were somewhat higher in concentration at RM 22.9 than what was noted on all other sampling dates at this same location. Nickel was never above detection limit, except on August 25 at RM 3.64, RM 1.83, and RM 0.63. Samples for copper and lead were similar, with levels consistently above detection occurring on August 25 at all sites from RM 13.7 to, and including, RM 0.63. Many of the tributaries that empty into Sugar Creek in the lower portion of the basin have current or past mining activities that are influencing these streams as well as the mainstem of Sugar Creek.

Zinc, iron, aluminum, and manganese had the highest concentrations during the rainfall event in late August; again , these were more apparent in the lower end of Sugar Creek, below the confluence with the South Fork of Sugar Creek. Sulfates were consistently higher from RM 12.07 to the mouth, not only during rainfall, but for all sampling events. Sulfates were also high in the tributaries along the lower reaches of Sugar Creek.

Fecal coliform bacteria levels were elevated in the upper stem of Sugar Creek, with only the lower sites from RM 13.7 to the mouth meeting Primary Contact Recreation criteria. Almost half (24/50) of the fecal coliform samples which were collected did not meet primary contact recreation criterion. Livestock and inadequate or failing sewage systems contributed to this problem along with some violations from municipal wastewater treatment plants.

The organic analysis revealed d-BHC(0.012 ug/l) and atrazine (0.72 ug/l) present at levels just slightly above detection levels at RM 3.64. Bis(2-ethylhexyl)phthalate (1.9 ug/l), "-BHC (0.38 ug/l), $-BHC (0.088 ug/l), d-BHC (0.025 ug/l), (-BHC (0.056 ug/l), 4-4'DDE (0.022 ug/l), heptachlor epoxide (0.0071 ug/l), and hexachlorobenzene (0.060 ug/l) was noted in Dover Chemical's effluent. At RM 1.83, "-BHC (0.012 ug/l), d-BHC (0.0098 ug/l), (-BHC (0.0072 ug/l), heptachlor epoxide (0.0029 ug/l), atrazine (0.21 ug/l), and bis(2-ethylhexyl)phthalate (0.88 ug/l) were detected.

Sugar Creek Tributaries

Chemical water quality sampling was conducted five times between July 9 and September 8, 1998 in the Sugar Creek basin from 47 stations on 26 tributary streams (Table 6). All tributary samples from both the EOLP and WAP ecoregions were sampled within two days of each other as follows: (7/8-7/9; 7/20-7/21; 8/10-8/11; 8/24-8/25; 9/8-9/9), except during late August where some EOLP samples were collected on 8/27. Fecal coliform bacteria samples were collected on 7/9, 7/21, 8/11, 8/27 in the EOLP ecoregion and on 8/4, 8/19, and 9/8 in the WAP ecoregion.

Raw data for all chemical samples collected are found in Appendix Table A-1.

Water quality data collected from tributaries sites were analyzed by segregating the Sugar Creek watershed into five sequential geometric subdivisions as follows (drainage area/# stations): 5.6 mi^2(#14), 11.0 mi^2 (#10), 22.0 mi^2 (#5), 44.0 mi^2 (#4), and 89.0 mi^2 (#2). Additional Sugar Creek mainstem samples were collected at the 300 mi^2 and 357 mi^2 drainage locations, however the 300 mi^2 station for the Sugar Creek mainstem at RM 12.0 is designated 178 mi^2 to be consistent with the geometric progression established. Habitat data only were collected at 23 stations in the extreme headwaters of the watershed at the 2.8 mi^2 drainage size. The location of these sites is shown in Figure 2.

Water samples at the tributary sites were collected under low stream flow conditions except during the 7/8-7/9 and 8/24- 8/25- 8/27 sample dates which followed basin-wide rain events. USGS daily discharge records (1998 water year) at the Sugar Creek Strasburg station indicate an annual seven day minimum flow of 17 cfs, and a daily average flow of 253 cfs. Average daily flows at the Strasburg gage at times when water chemistry samples were collected in 1998 were as follows: 7/8-7/9 (336-382 cfs); 7/20-7/21 (88-86 cfs); 8/10-8/11 (63-143 cfs); 8/24-8/25 (65-884 cfs); 9/8-9/9 (54-59 cfs). The lowest background flow conditions for tributary sampling occurred during the 7/20-7/21 and 9/8-9/9 time periods.

Chemical data were evaluated using Ohio Water Quality Standards criteria (OAC 3745-1) and data presented in Appendix Table A-3 that represent background concentrations at biological reference sites for selected chemical and bacteria parameters in the EOLP and WAP ecoregions. A subbasin summary of chemical and bacteriological conditions is presented below.

5.6 mi^2 subbasins

Results of selected chemical parameters collected at 14 streams at the 5.6 mi^2 watershed size are shown in Figures 15 - 19. These sites represent the most upstream headwater locations in the Sugar Creek basin where water chemistry was sampled. The total drainage area upstream from these 14 locations represents 78.4 mi^2, or 21.96 % of the Sugar Creek watershed.

Both the EOLP and WAP tributaries showed dissolved oxygen concentrations well above 6.0 mg/l and average TSS was below the 75th percentile regional background concentrations. TSS was elevated in both ecoregions when stream turbidity increased due to runoff of soil after rainfall events, with the highest values at North Fork Sugar Creek (RM 5.4) in the EOLP and Brandywine Creek in the WAP. The lowest minimum dissolved oxygen was found at Elm Run (RM 1.7), but exceeded 5.0 mg/l, which suggests that dissolved oxygen was present at acceptable levels in all 14 of these headwater locations in the Sugar Creek watershed.

Exceedences of WQS criteria for fecal coliform bacteria were found at all 14 sites at the 5.6 mi^2 subbasin size, with the highest average fecal coliforms at the North Fork Sugar Creek RM 5.4, downstream from the unsewered area of Kidron. Other streams with average fecal coliforms

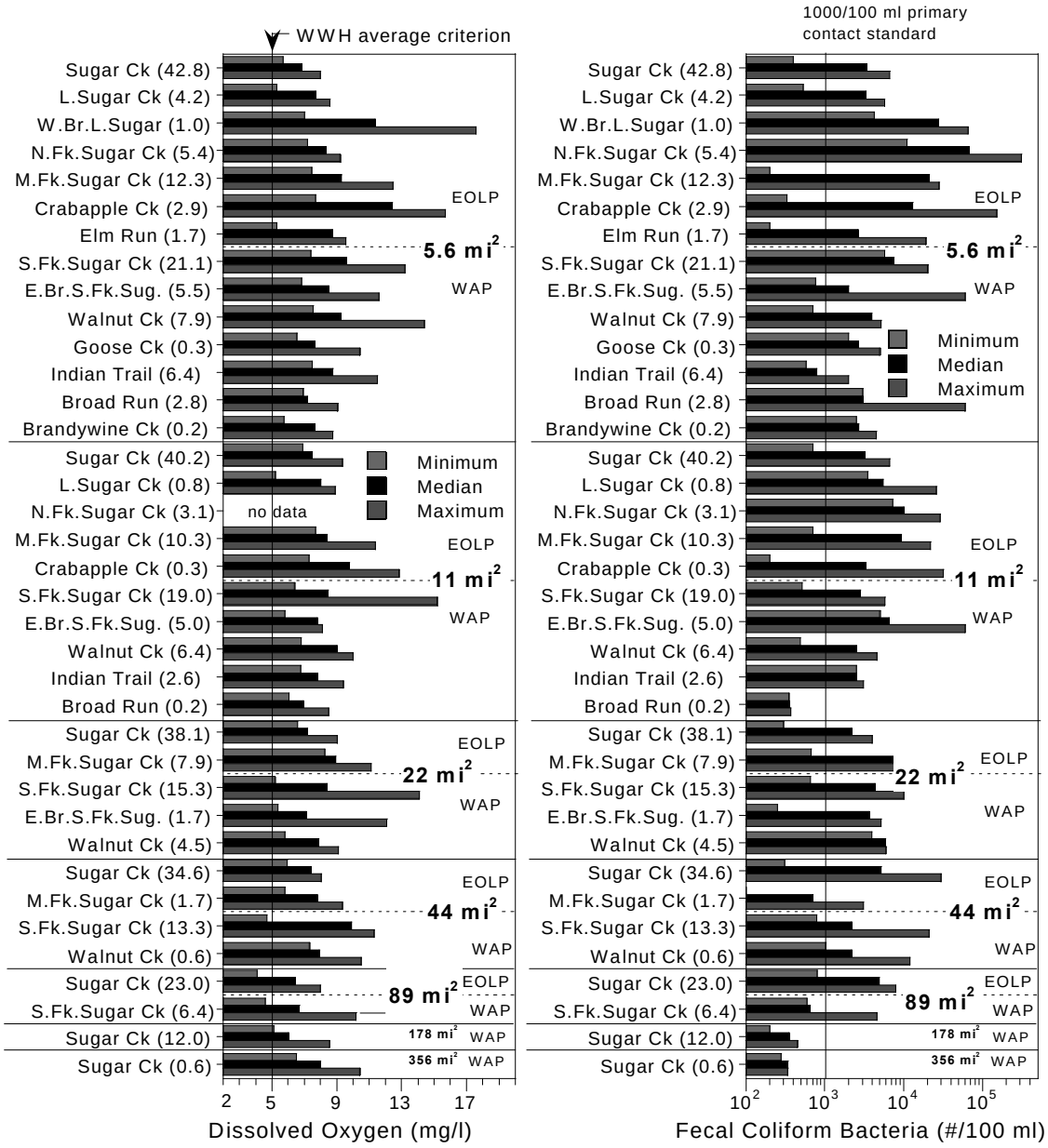

Figure 15 Minimum, mean, and maximum concentrations of D.O. and fecal coliform bacteria at geometrically stratified sites in the Sugar Creek basin, 1998.

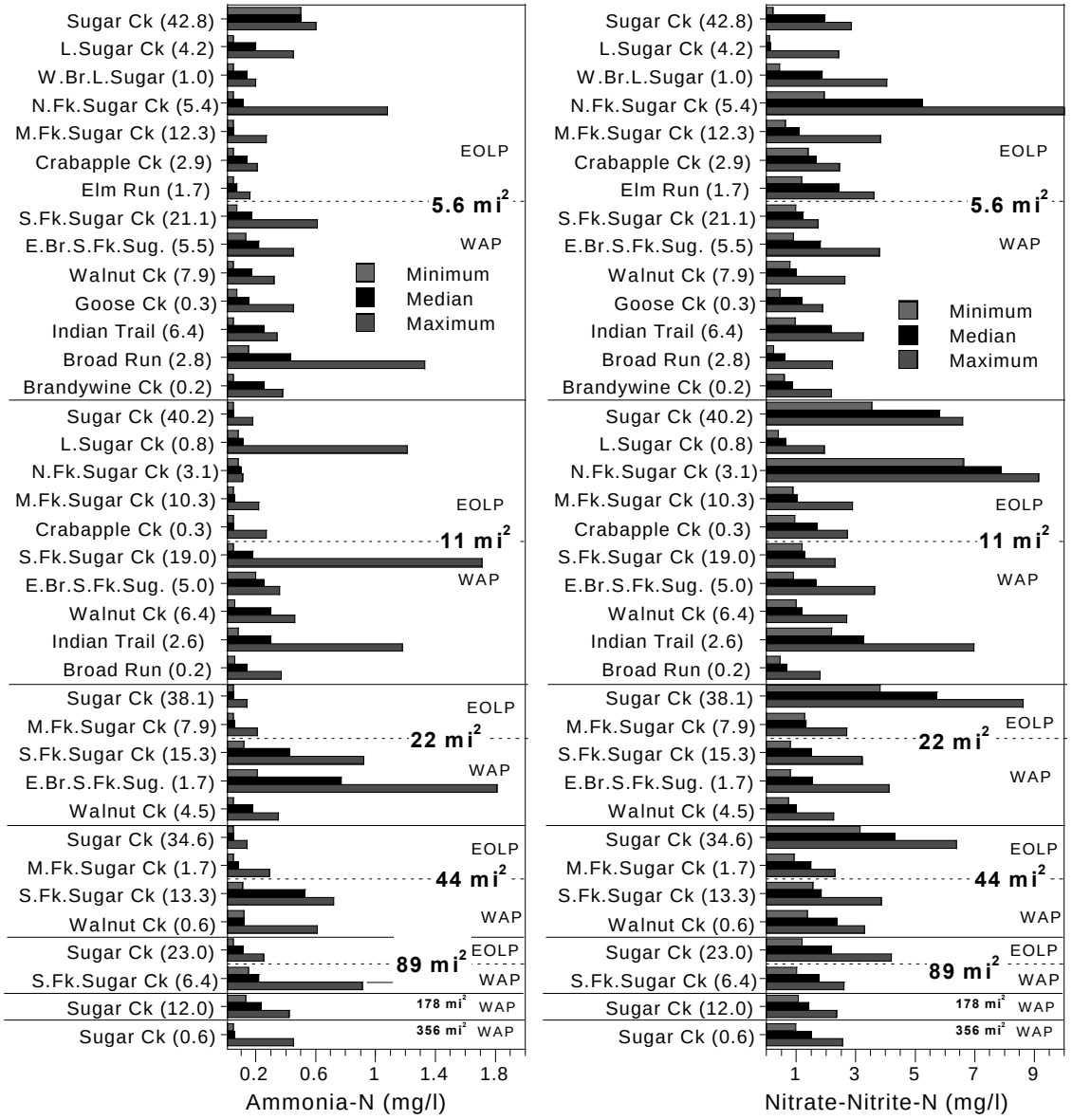

Figure 16 Minimum, mean, and maximum concentrations of ammonia-N and Nitrate-Nitrite-N at geometrically stratified sites in the Sugar Creek basin, 1998.

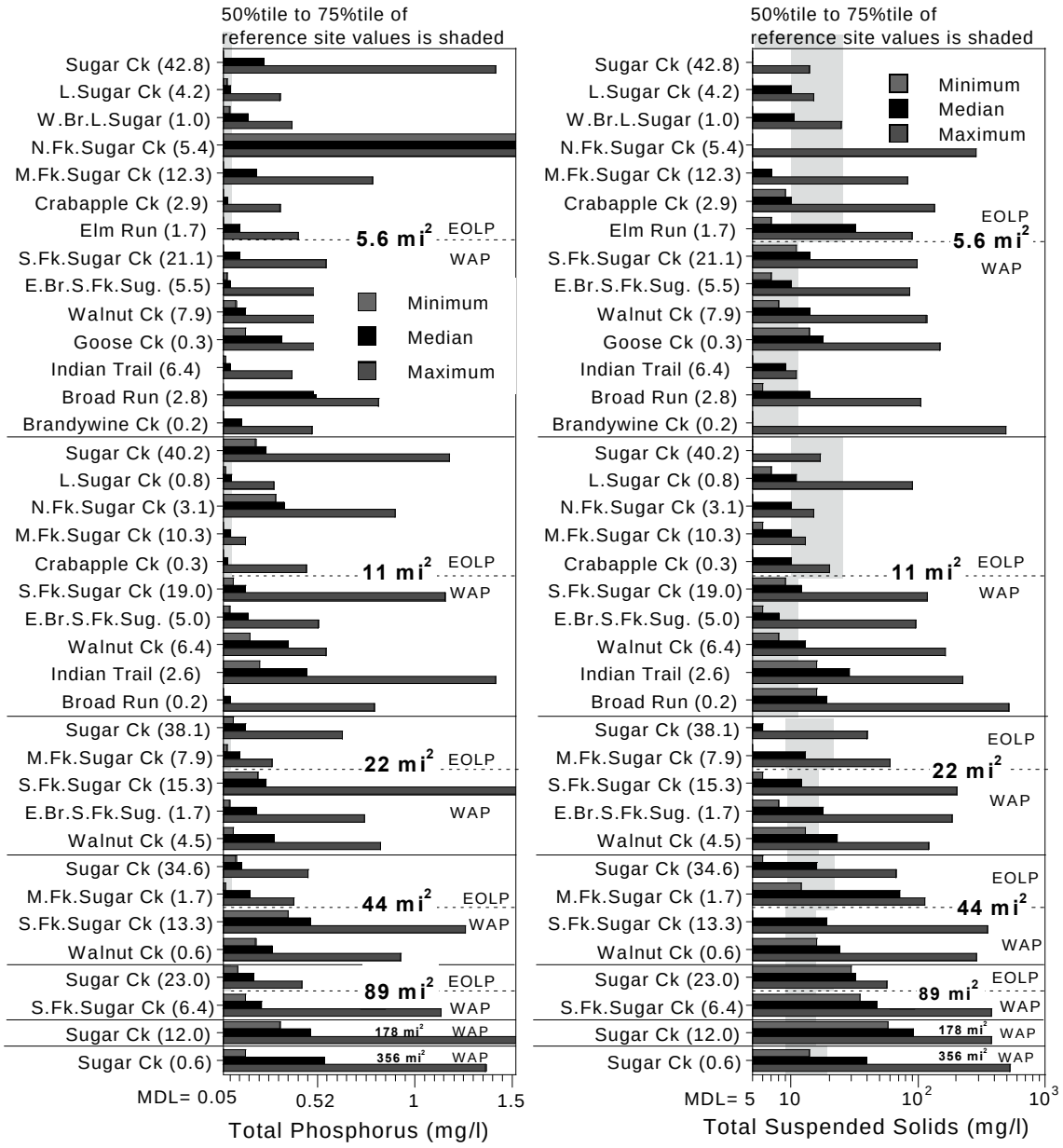

Figure 17 Minimum, mean, and maximum concentrations of total phosphorus and total suspended solids at geometrically stratified sites in the Sugar Creek basin, 1998.

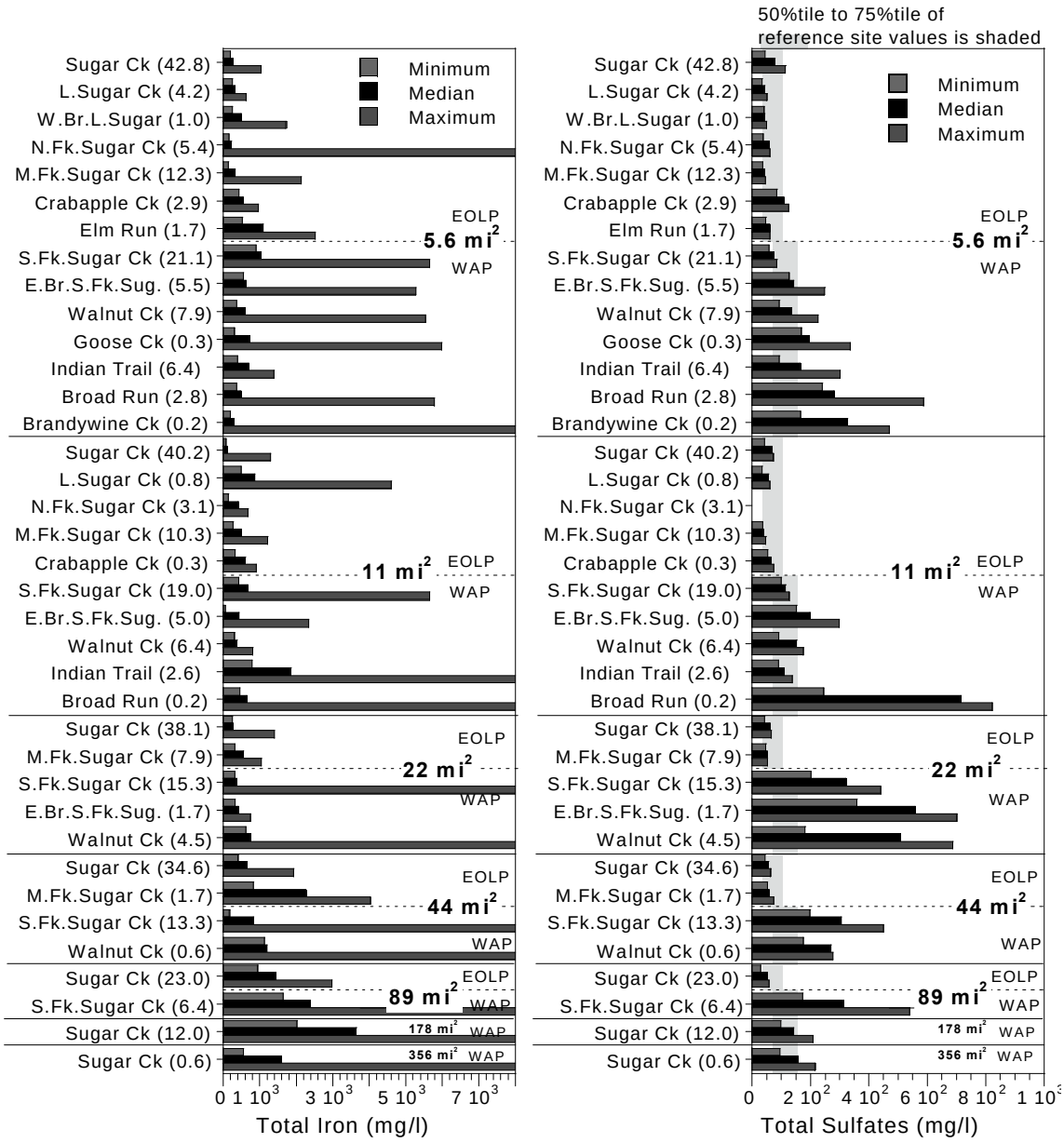

Figure 18 Minimum, mean, and maximum concentrations of total iron and total sulfates at geometrically stratified sites in the Sugar Creek basin, 1998.

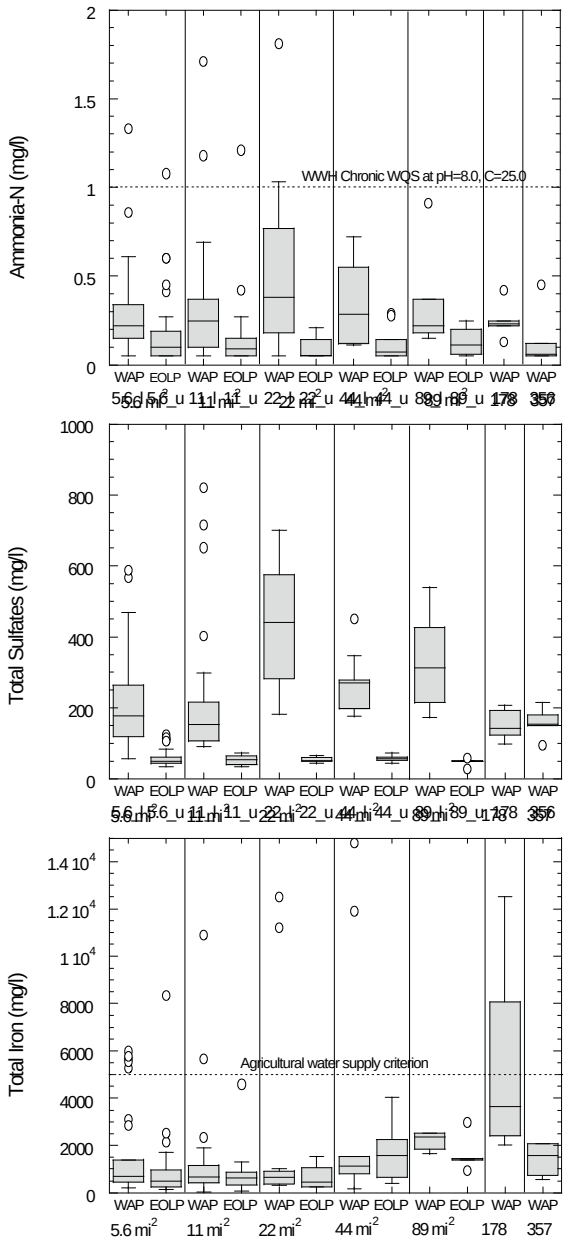

Figure 19 Box and whisker plots of all data from geometrically selected sites for concentrations of ammonia -n, total sulfates, and total iron in the Sugar Creek basin, 1998.

above 10,000 counts were West Branch Little Sugar Creek at RM 1.0, Middle Fork Sugar Creek at RM 12.3, and Crabapple Creek at RM 2.9. There were significant difference between the EOLP and WAP ecoregions for bacteria with higher mean and variance in the EOLP sample locations.

Total iron exceeded the AWS Ohio WQS criterion (5000 mg/l) at the 5.6 mi^2 subbasin size at the

following locations: Brandywine Creek (RM 0.2), Elm Run (RM 1.7), North Fork Sugar Creek (RM 5.5), South Fork Sugar Creek (RM 21.1), Walnut Creek (RM 7.9), Goose Creek (RM 0.3), and East Branch South Fork Sugar Creek (RM 5.5). The highest average total iron was found at Elm Run (RM 1.7) and South Fork Sugar Creek (RM 21.1). Exceedences of the agricultural iron criterion might affect livestock that would drink from these streams at times when iron concentration was elevated. The high total iron was primarily associated with high levels of water turbidity from suspended soils after rain runoff. There was no significant difference between the EOLP and WAP regions for total iron at the 5.6 mi^2 subbasin size. The only other heavy metal that exceeded WQS criteria was an acute value of 136 ug/l for total copper in Crabapple Creek (RM 3.0); the source of this copper was unknown, but could be related to the use of copper sulfate in upstream private ponds.

The nutrient parameters (total phosphorus and nitrate) were similar between the EOLP and WAP ecoregions at the 5.6 mi^2 subbasin size. Both ecoregions showed average values above the 75th percentile regional background concentrations, most likely due to runoff from agricultural land use throughout the headwaters of the Sugar Creek watershed. The highest concentrations of both total phosphorus and nitrate were found at North Fork Sugar Creek (RM 5.4), which is downstream from the Gerber Poultry WWTP discharge and the unsewered area of Kidron. Limited effluent sampling by the company showed elevated levels for both of these nutrients, but neither parameter is required to be monitored in their NPDES permit. Goose Creek (RM 0.3) and Brandywine Creek (RM 0.2), both in the WAP ecoregion, also showed elevated total phosphorus in relation to other 5.6 mi^2 subbasin streams. There are no known point sources on Goose Creek upstream from this sample station. The Brandywine Creek station is downstream from the Willow Glen area.

There were significant differences between the EOLP and WAP ecoregions for both total sulfates and ammonia nitrogen, with higher values for both parameters in the WAP region. Higher background concentrations of sulfates naturally occur in the WAP ecoregion (70-156 mg/l range), than in the EOLP ecoregion (35-101 mg/l), but the same is not true for ammonia-N. Sulfate levels in the WAP sites greatly exceeded background levels for this ecoregion and this pattern was present at all subbasins, with a peak at the 22 mi^2 subbasin size. The greatest difference in sulfate concentrations between ecoregions was also at the 22 mi^2 subbasin size, with a nearly 400 mg/l sulfate ion differential. While ammonia-N values were slightly above 75th percentile regional background concentrations in the EOLP ecoregion, ammonia concentrations were highly elevated in the WAP ecoregion, again at all subbasin sizes.

One possible explanation for the high level of covariance between elevated ammonia and sulfates in the WAP ecoregion would be that both of these chemicals are associated with active coal mining operations, where ammonia hydroxide is sometimes used for pH adjustment of the sulfuric acid that is produced from washing coal. This wash water is ponded at the mine sites and discharged to nearby streams. As shown in Figure 19 this trend of higher sulfates and ammonia in the WAP ecoregion, as compared to the EOLP, cascades downstream through the

Sugar Creek watershed all the way to the 89 mi^2 subbasin size.

11.0 mi^2 subbasins

Concentrations of select chemical parameters collected at 10 streams at the 11.0 mi^2 watershed size are shown in Figures (15 to 19). Routine grab sampling was not conducted at the North Fork Sugar Creek RM 3.1 station; however two samples were collected for water quality modeling use and were included in the analysis of data. Bacteria samples collected at RM 1.3 on the North Fork were used in the analysis of data for the RM 3.1 station. The total drainage area upstream from these 10 stations represents 110 mi^2, or 30.81 % of the Sugar Creek watershed.

As was found for the 5.6 mi^2 subbasin samples, typical background levels of dissolved oxygen and TSS were observed during baseflow condition, with elevated stream turbidity after rain events. The high gradients of the headwater streams in the Sugar Creek basin, in both the EOLP and WAP ecoregions, provide good reaeration and flushing of suspended soils.

With the exception of the Broad Run RM 0.2 station, all other locations at the 11.0 mi^2 drainage size showed exceedences of the fecal coliform bacteria WQS criteria. The highest average bacteria counts were found in the EOLP ecoregion at North Fork Sugar Creek (RM 3.1), Little Sugar Creek (RM 0.8), and Middle Fork Sugar Creek (RM 10.3). Fecal bacteria were higher on average and showed greater variance in the EOLP ecoregion than the WAP at the 11.0 mi^2, which is the same trend observed for the 5.6 mi^2 streams.

Exceedences of the 5000 mg/l total iron AWS criterion were found at four of the ten 11.0 mi^2 stations: Broad Run (RM 0.15), South Fork Sugar Creek (RM 19.0), Walnut Creek (RM 6.32), and Indian Trail Creek (RM 2.6). The South Fork Sugar Creek and Walnut Creek stations had exceedences of the 5000 mg/l agricultural criterion, which indicated that the upstream influence of mine drainage continues into downstream waters. Exceedences for total iron observed at Broad Run and Indian Trial Creek at the 11.0 mi^2 drainage size were not found further upstream at 5.6 mi^2, which indicates potential sources of mine runoff between these two subbasin sizes. Indian Trail Creek at RM 2.6 showed the highest average level of total iron of all 10 streams sampled at the 11.0 mi^2 drainage size. There was no significant difference in the average concentration of total iron between the 5.6 and 11.0 mi^2 streams (Figure 19) for either ecoregion.

The concentrations of total phosphorus and nitrates were similar between the EOLP and WAP ecoregions at the 11.0 mi^2 subbasin size, and, like the smaller 5.6 mi^2 streams, showed average values above the 75th percentile regional background concentrations. There were no significant differences in nutrient concentrations between the 11.0 mi^2 and 5.6 mi^2 streams. Elevated nutrients were found in the North Fork Sugar Creek (RM 3.1), a continuation of problems observed at the upstream station. The concentration of nitrates, but not total phosphorus, significantly increased at the Sugar Creek RM 40.2 station, which is immediately downstream from the discharge of the Smithville WWTP. The highest average concentration of total phosphorus was found in Walnut Creek (RM 6.4) and Indian Trail Creek (RM 2.6). The Indian

Trail Creek location is downstream from the Case Farms, Troyer Bologna, and Holmes ByProducts discharges.

The concentrations of sulfates and ammonia at the 11.0 mi^2 streams were identical to that found at the upstream 5.6 mi^2 streams, with higher ammonia and sulfates in the WAP ecoregion and near background levels in the EOLP streams.

22.0 mi^2 subbasins

Results of select chemical parameters collected at 5 streams at the 22.0 mi^2 watershed size are shown in Figures 15 - 19. These sites, identical to the 11.0 mi^2 streams, have a combined drainage area of 110 mi^2, or 30.81% of the entire Sugar Creek watershed.

There was a significant difference between the EOLP and WAP ecoregions for ammonia (higher in WAP), sulfates (higher in WAP), and nitrates (higher in EOLP). All three of these chemicals reached their highest average concentrations at the 22.0 mi^2 basin size. Within the WAP ecoregion, ammonia nitrogen was significantly higher in the South Fork Sugar Creek (RM 15.3) and in the East Branch South Fork (RM 1.7) than in Walnut Creek (RM 4.5).

As found at the upstream stations, the most significant exceedences of WQS criteria continued to be for fecal coliform bacteria and total iron above the 5000 mg/l agricultural criteria. However, it was at this 22.0 mi^2 subbasin size that fecal coliform bacteria counts during baseflow conditions was lower than the 1000organisms/100 ml PCR criterion at all streams sampled. This would suggest that upstream sources of bacteria have the potential to die back to normal levels during baseflow conditions throughout the Sugar Creek watershed once stream size reaches 22 mi^2.

Total suspended solids concentrations exceeded 75th percentile regional background concentrations in the WAP ecoregion at East Branch South Fork (RM 1.7) and Walnut Creek (RM 4.5), a trend continued from the upstream locations at 11.0 mi^2 drainage area size.

The highest level of total nitrate of all streams sampled at the 22.0 mi^2 subbasin size was the Sugar Creek mainstem at RM 38.1. This would represent a continuation of the elevated nitrate loading from the upstream Smithville WWTP.

There were no significant differences in average levels of dissolved oxygen, total phosphorus, total iron, fecal coliform bacteria, and total suspended solids between the 11.0 mi^2 and 22.0 mi^2 sample stations for either ecoregion.

44.0 mi^2 subbasins

Results of select chemical parameters collected at 4 streams at the 44.0 mi^2 watershed size are shown in Figures 15 - 19. The total drainage area upstream from these four locations represents 176 mi^2, or 49.30 % of the total Sugar Creek watershed.

Perhaps the most significant difference in chemical water quality at the 44.0 mi^2 subbasin size, compared to upstream locations, was the large increase in both average and variance of TSS concentrations, a trend observed in both the EOLP and WAP ecoregion. The elevated TSS continued downstream to the mouth of Sugar Creek near Dover. A possible explanation was that the stream gradient has lowered to such an extent that soil particles remain in suspension for a longer time.

Exceedences of WQS criteria for fecal coliform bacteria were found at all four stations, and the 5000 mg/l total iron AWS criterion was exceeded at the South Fork Sugar Creek (RM 13.2) and Walnut Creek (RM 0.6) stations. The first occurrence of low dissolved oxygen is also found at the 44.0 mi^2 subbasin size, with a value of 4.68 mg/l recorded at South Fork Sugar Creek at RM 13.2. This station on the South Fork also had exceedences for pH (9.2 S.U.) and ammonia nitrogen (0.53 mg/l), indicating multiple chemical impacts on aquatic life.

As was found at the upstream stations, elevated sulfate and ammonia nitrogen continued to be found in the WAP ecoregion streams compared to the EOLP streams. There was also a significant increase in total phosphorus in the WAP streams which could have been caused by upstream point source discharges and/or agricultural runoff.

89.0 mi^2 subbasins

Results of select chemical parameters collected at 2 streams at the 89.0 mi^2 watershed size are shown in Figures 15 - 19. The two locations are South Fork Sugar Creek (RM 6.4, actual basin size = 124 mi^2) and Sugar Creek (RM 23.0, actual basin size = 97.4 mi^2). Based on actual basin areas these two locations represent 221.4 mi^2 or 62.0 % of the total Sugar Creek watershed. The 89.0 mi^2 subbasin size is the most downstream location where chemistry samples were collected for the geometric analysis of data. The next downstream site at 178 mi^2 was located on the mainstem of Sugar Creek at RM 12.0, downstream from the confluence of the South Fork. Fecal coliform exceedences continued to stand out in the two 89.0 mi^2 sample locations and TSS values were elevated.

The most significant difference in chemical water quality at the 89.0 mi^2 subbasin size compared to upstream samples was the drastic drop in both average and minimum dissolved oxygen, with values as low as 4.2 mg/l recorded during daytime sampling in both the South Fork and Sugar Creek mainstem stations. Much lower minimum oxygen levels would be expected at night when photosynthesis stops. It is possible that wetland hydrology, low gradient, and elevated TSS turbidity (thus lower oxygen producing photosynthesis) at the 89.0 mi^2 locations resulted in lower dissolved oxygen levels that are potentially detrimental to aquatic life. Thus the control of upstream sources of oxygen demanding materials will be required to allow full attainment of aquatic life at the 89.0 mi^2 areas in the Sugar Creek watershed.

There was also a significant increase in average total iron in the WAP streams, but not the EOLP streams, compared to the upstream locations at 44.0 mi^2, which suggested a significant source of

iron exists between the two 44.0 mi^2 stations and the single 89.0 mi^2 station on the South Fork at RM 6.4. For all other parameters, there was no significant difference.

Geometric Sites Watershed Wide Summary
The most widespread problem with water quality throughout the Sugar Creek watershed was the elevated levels of fecal coliform bacteria found in most streams at most sample locations. While some of these problems were related to runoff after rain, many samples with elevated bacteria were collected during baseflow conditions. Because fecal coliform bacteria are found in the intestinal tracts of all warm blooded mammals and birds, many multiple potential sources exist, such as direct access of farm animals to streams and isolated home septic systems. The only basin wide trend in bacteria levels was that bacteria counts fell significantly downstream from the Beech City Reservoir, and remained low down to the mouth for the lower 12 miles of the Sugar Creek mainstem.

The WAP ecoregion at all five subbasin sizes had significantly higher concentrations of sulfates than streams in the EOLP ecoregion. This was most likely due to a larger percentage of mining land use in the WAP region. The WAP ecoregion also had significantly higher concentrations of ammonia nitrogen than the EOLP. The reasons for this were unclear, but could be related to mining activities.

The headwater streams in both the WAP and EOLP ecoregions at the 5.6 to 22 mi^2 subbasin sizes were very similar to each other for total phosphorus, total iron, total suspended solids, and dissolved oxygen. Noteworthy exceptions are isolated problems with elevated TSS in Elm Run (RM 1.7), and elevated total phosphorus in North Fork Sugar Creek (RM 5.4).

A significant dissolved oxygen sag was observed at the 89 mi^2 subbasin size in both the WAP and EOLP ecoregion. This finding suggested that similar wetland hydrology and low stream gradient exist at the 89 mi^2 subbasin size. There was a significant increase in total suspended solids as basin size increased throughout the WAP and EOLP ecoregions. This suggests widespread problems with excessive turbidity at larger stream sites. There was a significant increase in total iron in the WAP between the 44 mi^2 subbasin stream and the 89 mi^2 subbasin streams. The level of total phosphorus increased at the most downstream mainstem stations in Sugar Creek and was significantly higher than background concentrations. This suggested that Sugar Creek is a source of nutrient enrichment to the Tuscarawas River.

Two-Pass Sites
Eight unnamed streams within the Sugar Creek basin were chemically sampled on two occasions to determine the extent of impact from mining activity (Table 6.). The chemical data which was collected during 1998 can be found in Appendix Table A-3. Overall, elevated levels for conductivity, sulfates, and total dissolved solids were consistent at these sites. Conductivity ranged from 817 umhos/cm^3 to 3280 umhos/cm^3, while total dissolved solids were 648 mg/l to 3300 mg/l. The high and low for both conductivity and total dissolved solids occurred at the

South Fork trib. at RM 11.3. Sulfates ranged from 243 mg/l (East Branch trib. at RM 3.92) to a high of 2030 mg/l (S. Fork trib. at RM 11.3). Aluminum, manganese, and iron were elevated at many sites. Their values ranged from <200 ug/l (at E.Branch trib. at RM 3.6) to 29,100 ug/l (Brush Run trib.) for aluminum; 399 ug/l (S. Fork trib. at RM 11.3) to 75,200 ug/l (Brush Run trib.) for iron; and 588 ug/l (E. Branch trib. at RM 3.92) to 68,500 ug/l (Walnut Creek trib.) for manganese.

Stream flows were also determined at the same time these sites were chemically sampled. Flow measurements were taken at several cross sections of the stream, using a pygmy flow meter. Calculations were made, based on depth, width, time, and number of revolutions, to arrive at an approximate flow, in cubic feet per second (cfs). Flows ranged from a low of 0.014 cfs at the Brush Run tributary and a high of 3.33 cfs at the South Fork of Sugar Creek tributary at RM 11.3. These values convert to 9048 gallons per day and 2.15 MGD, respectively. It's not surprising to see that the higher flows occurred on the August 26th sampling since heavy rainfall (2+ inches) occurred in much of the basin on the day prior to this sampling. The high concentrations of dissolved solids, sulfates, aluminum, manganese, and iron could result in increased loadings to downstream tributaries, especially during high flow events in which pollutants are flushed downstream.

Chemical Sediment Quality

Sediment samples were collected at two mainstem sites and one tributary location within the Sugar Creek basin (Tables 9 and 10). Samples were collected from a variety of locations at a given site where sediment could be found, composited into a stainless steel pan, gently mixed, and placed into the sampling containers for analysis. The chemical analysis included heavy metals, organics, and pesticides. Sediment contamination was characterized with respect to appropriate literature (Kelly and Hite, 1984; Persaud, *et al.*, 1994) and metal concentrations were compared with statewide Ohio EPA data (Appendix Table A-6).

The Kelly and Hite stream sediment classification system (Illinois EPA) ranks relative pollutant concentrations, from non-elevated to extremely elevated, based on mean values. It does not directly assess toxicity. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*, Persaud, *et al.* define two levels of ecotoxic effects, and are based on the chronic, long-term effects of contaminants on benthic organisms. A "Lowest Effect Level (LEL)" is a level of sediment contamination that can be tolerated by the majority of benthic organisms. A "Severe Effect Level (SEL)" indicates a level at which pronounced disturbance of the sediment-dwelling community can be expected. When any parameters are at or above the SEL Guideline, the material tested is considered highly contaminated and will likely have significant effects on a majority of the benthic species.

U.S. EPA method 8270 indicated twelve different tentatively identified compounds (TICs) were found in Sugar Creek or Little Sugar Creek sediments. Their concentration values are approximate, not actual, numbers. Most of the compounds were fatty acids and long chain

alkanes. Also found were Vitamin E, cholesterol, octadecanal, and gamma-sitosterol. Three polycyclic aromatic hydrocarbons (PAH's) were detected at RM 1.8 in Sugar Creek.

Sugar Creek
Sediment samples were collected in Sugar Creek at County Road 80 (RM 3.64), above Dover Chemical and at SR 39 (RM 1.8), downstream from Dover Chemical. All heavy metals concentrations were below the severe effect level, with the exception of manganese. It exceeded the severe effect level at both locations. All metals at County Road 80 exceeded the lowest effect level, except cadmium. Nickel could not be evaluated at this site, since the detection limit exceeded the LEL. At the downstream site, only arsenic and nickel exceeded the LEL. The Kelly and Hite system indicated arsenic and chromium to be highly elevated at the County Road 80 site. Iron, lead, and zinc were elevated. At the SR 39 site, arsenic, chromium, iron, and zinc were slightly elevated. All other metals were considered non-elevated. The Kelly and Hite system does not evaluate nickel. The three organic compounds detected at RM 1.8 were fluoranthene, pyrene, and phenanthrene. Only fluoranthene and phenanthrene were at values slightly greater than the lowest effect level, based on the literature in *Persaud, et al.* (See Table 10).

Little Sugar Creek
One sediment sample was collected in Little Sugar Creek at Kansas Road (RM 4.2). All heavy metals were less than the severe effect level, except for iron. Nickel and lead exceeded the lowest effect level (Persaud, *et al.)*. The Kelly and Hite system indicated extremely elevated levels for iron and lead, while zinc was considered to be only slightly elevated. Chromium and copper were non-elevated. Arsenic and cadmium were not analyzed.

When comparing results with Ohio data, iron was highly elevated at the Little Sugar Creek site, while chromium was elevated at RM 3.64 and manganese was elevated at RM 1.8 at the Sugar Creek sites. All other values ranged from non-elevated to slightly elevated.

It appears that the elevated metal parameters may have been a result of mining influences, both past and present. Possible seeps from previously mined areas may also have been a contributing factor. These values must be taken into consideration when evaluating the presence or absence of aquatic life within these streams.

Table 9. Dry weight concentrations (mg/kg) of heavy metals in sediments in the Sugar Creek study area, 1998. Parameter concentrations were characterized in comparison with values described by Kelly and Hite (1984), Persaud, *et.al.*(1994), and with Ohio EPA statewide data (Appendix Table A-6).

Stream	**Sediment Concentration (mg/kg dry weight)**								
River Mile	**As**	**Cd**	**Cr**	**Cu**	**Fe**	**Pb**	**Ni**[1]	**Zn**	**Mn**
(LEL/SEL)	(6/33)	(0.6/10)	(26/110)	(16/110)	(20000/40000)	(31/250)	(16/75)	(120/820)	(460/1100)
Sugar Creek									
3.64	22[d]**	0.476[a]	41.2[d]**	23.8[a]*	28300[c]	41.2[c]*	<36.6	129[c]*	**1640[b]Ë***
1.8	10.2[b]	0.282[a]	19.5[b]	11.8[a]	18900[b]	20.5[a]	36.9*	99.4[b]	**2440[c]Ë****
Little Sugar Creek									
4.2	--	--	15.3[a]	9.47[a]	**65700[e]Ë*****	**211[e]******	24.4	90.2[b]	**1720[b]Ë***

1 The Kelly and Hite classification system does not evaluate Ni..
Letter codes correspond to Kelly and Hite as follows:
a - nonelevated, b - slightly elevated, c - elevated, **d - highly elevated, e - extremely elevated**
Ë Indicate that the result exceeded the **severe effect level**, based on the Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario (Persaud, *et al.*, 1994).
* value is (slightly elevated) above the parameter median plus 1 interquartile in the Ohio EPA sediment database.
** value is (elevated) above the parameter median plus 2 interquartiles in the Ohio EPA sediment database.
***** value is (highly elevated) above the parameter median plus 4 interquartiles in the Ohio EPA sediment database.**
****** value is (extremely elevated) above the parameter median plus 8 interquartiles in the Ohio EPA sediment database.**

Table 10. Dry weight concentrations (mg/kg) of priority organic pollutants detected in sediments in the Sugar Creek study area, 1998. Parameter concentrations were characterized in comparison with values described by Kelly and Hite (1984)[1] and Persaud, *et al.* (1994).

Stream/ River Mile	**Class**	**Detected Compound**	**Concentration (mg/kg)**
Sugar Creek			
3.64		None detected	
1.8	BNA	Pyrene	0.94*
		Fluoranthene	1.2**
		Phenanthrene	0.83**
Little Sugar Creek			
4.2		None detected	

1 Kelly and Hite (1984) principally address metals and organochlorine compounds. Pesticides and PCBs were absent in Sugar Creek study area samples.

*Value is less than the lowest effect level in Persaud, *et al.*

**Value is greater than the lowest effect level but less than severe effect level in Persaud, *et al.*

Physical Habitat for Aquatic Life

Sugar Creek

In 1998 the quality of the habitat in Sugar Creek was evaluated at 15 fish sampling sites extending from a site at Schellin Rd. (RM 42.8) downstream to a site near the confluence with the Tuscarawas River (RM 0.4). Good quality stream habitat were present at many locations (Table 11). QHEI scores ranged from 91.0 upstream from Dover to 42.5 at Alabama Ave., downstream from the North Fork. Including all sites, the mean QHEI was 66.3. Generally, QHEI scores above 60 reflect habitat conditions which are able to support aquatic communities consistent with the WWH use designation. Scores of 75 and above are typical of very good to extraordinary macrohabitat conditions (Rankin 1989).

Six fairly distinct reaches were apparent based on habitat attributes (Table 12). The most upstream locations had fair QHEI scores ($\bar{x}$=48.6, n=4). The next two sites averaged good conditions (QHEI $\bar{x}$=68.8). The subsequent reach again resulted in fair QHEI scores ($\bar{x}$=47.0, n=2). The next two following locations reflected very good conditions (QHEI $\bar{x}$=74.8, n=2) and this fair to good pattern was repeated one more time (QHEI $\bar{x}$=58.0, n=1) before Sugar Creek joined the Tuscarawas River (QHEI =79.0, n=4).

Substrate quality was a significant dividing factor between these reaches. The amount of instream cover and channel modification were also indicative of habitat disjuncts. Additionally, the reach from RM 23 to RM 18 was limited by natural wetland characteristics and the lowest reach had a distinctly better overall array of habitat qualities.

The smothering of stream bottom was common across most of the Sugar Creek watershed. Sand, silt, or organic fines including coal fines variously embedded the substrates and was considered likely to influence biological performance. Silt free unembedded conditions were only documented at a couple of locations in the entire basin. The amount of bedload was particularly evident in the Beach City dam pool where reservoir capacity is so diminished that it precludes recreational boating. Turbidity hides the fact that water depth is generally only about six inches as most of the capacity is filled with sediment.

Throughout Sugar Creek, inordinately high amounts of silt and sand smothered many places which otherwise should have afforded diverse habitat niches. Streambank erosion was an obvious source of some of the depositional fines. Most tributary streams to Sugar Creek flow through livestock pastures where animals have degraded the physical condition of the riparian corridor and created false banks. The resulting severe erosion results in large amounts of bedload

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing warmwater and modified habitat attributes for the Sugar Creek study area, 1998

Key QHEI Components

			WWH Attributes											MWH Attributes																		
														High Influence					*Moderate Influence*													
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No 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 Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(WWH+1) Ratio**	**(MWH M.I.+1)/(WWH+1) Ratio**
(17-400) Sugar Creek																																		
Year: 1998																																		
0.4	**71.0**	6.04	■	■		■	■	■	■	■	■	■	9						0		■								■			2	0.10	0.30
0.6	**77.0**	6.04	■	■		■	■	■	■	■	■		8						0		■								■	■		3	0.11	0.44
1.8	**73.5**	6.04	■	■		■	■	■	■		■		7						0		■								■	■		3	0.13	0.50
3.7	**91.0**	6.54	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
7.2	**77.5**	4.96	■	■		■	■	■	■		■	■	8						0					■	■				■			3	0.11	0.44
12.0	**58.0**	2.48	■	■							■		3				◆		1		■			■	■	■		■	■	■		7	0.50	2.25
13.7	**78.5**	2.48	■	■		■	■	■		■	■	■	8				◆		1		■							■				2	0.22	0.44
17.6	**71.0**	2.48	■	■		■	■	■	■		■	■	8				◆		1		■			■					■			3	0.22	0.56
19.3	**51.5**	2.48	■				■	■			■		4		◆		◆		2		■			■				■	■		■	5	0.60	1.60
23.0	**42.5**	2.62									■		1		◆		◆		2	■	■			■	■			■	■		■	7	1.50	5.00
26.8	**65.0**	2.62	■	■				■			■		4				◆		1		■			■	■			■	■	■		6	0.40	1.60
34.6	**72.5**	4.02	■	■		■		■			■		5						0		■					■		■	■	■		5	0.17	1.00
34.9	**44.5**	4.02						■					2		◆		◆		3	■	■			■	■			■	■	■		7	1.33	3.67
38.1	**47.0**	3.60		■				■			■		3				◆		1	■	■			■	■			■	■	■	■	8	0.50	2.50
40.2	**53.0**	12.82		■		■	■	■			■		5				◆		1	■	■			■				■	■	■		6	0.33	1.33
42.8	**50.0**	8.47	■	■		■	■						4				◆	◆	2		■			■				■	■	■		5	0.60	1.60

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing warmwater and modified habitat attributes for the Sugar Creek study area, 1998

Key QHEI Components

			WWH Attributes											MWH Attributes																	
														High Influence				*Moderate Influence*													
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No 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 Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(WWH+1) Ratio**	**(MWH M.I.+1)/(WWH+1) Ratio**
(17-406) Middle Fork Sugar Creek																																		
Year: 1998																																		
12.3	**40.0**	12.58	■	■			■				■		4				◆		1	■			■				■	■	■		5	0.40	1.40
10.3	**46.5**	15.63	■	■			■				■		4				◆		1	■			■		■		■	■	■	■	7	0.40	1.80
7.9	**60.0**	9.13	■	■		■	■		■		■		6				◆		1	■								■	■		3	0.29	0.71
1.7	**58.0**	4.63	■	■			■	■	■		■		6				◆		1	■			■					■	■		4	0.29	0.86
(17-409) North Fork Sugar Creek																																		
Year: 1998																																		
5.4	**63.5**	32.79	■	■		■	■	■					6					◆	1	■						■		■	■	■	5	0.29	1.00
3.1	**47.0**	11.63	■	■			■						3				◆	◆	2	■			■		■	■		■	■	■	6	0.75	2.25
1.3	**48.0**	5.00	■	■			■				■		4				◆		1	■			■					■	■	■	5	0.40	1.40

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing warmwater and modified habitat attributes for the Sugar Creek study area, 1998

Key QHEI Components

			WWH Attributes										MWH Attributes																		
													High Influence					*Moderate Influence*													
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No 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 Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(WWH+1) Ratio**	**(MWH M.I.+1)/(WWH+1) Ratio**
(17-410) South Fork Sugar Creek																																		
Year: 1998																																		
21.1	**34.5**	9.30	■				■						2	◆		◆	◆	◆	4	■	■			■	■	■		■	■	■	■	9	1.67	4.67
19.0	**27.0**	5.42											0	◆		◆	◆	◆	4		■			■	■			■	■	■		6	5.00	*.**
15.3	**27.0**	3.57											0	◆			◆	◆	3		■			■	■	■		■	■	■		7	4.00	*.**
13.9	**27.5**	3.32											0	◆			◆	◆	3		■			■	■	■		■	■	■		7	4.00	*.**
13.3	**47.0**	3.32	■				■	■			■		4				◆		1		■			■				■	■	■	■	6	0.40	1.60
7.5	**45.0**	2.02	■				■	■			■		4		◆		◆		2		■			■	■			■	■		■	6	0.60	1.80
6.4	**50.0**	2.02	■				■	■			■		4		◆		◆		2		■			■				■	■		■	5	0.60	1.60
(17-411) Walnut Creek																																		
Year: 1998																																		
7.9	**27.0**	9.85											0	◆	◆	◆	◆	◆	5		■			■	■			■	■	■	■	7	6.00	*.**
6.4	**25.0**	4.14											0	◆	◆	◆	◆	◆	5		■			■	■	■		■	■	■	■	8	6.00	*.**
4.5	**25.5**	4.14									■		1	◆	◆		◆		3		■			■	■			■	■	■		6	2.00	5.00
0.6	**47.0**	1.25	■					■			■		3				◆		1		■			■	■			■	■	■	■	7	0.50	2.25
(17-414) East Branch South Fork Sugar Creek																																		
Year: 1998																																		
5.5	**44.5**	12.99	■				■				■		3				◆		1		■			■				■	■	■	■	6	0.50	2.00
5.0	**40.5**	12.99									■		1	◆		◆	◆		3	■	■			■	■			■	■	■	■	8	2.00	6.00
3.3	**43.5**	7.04						■			■		2	◆		◆	◆		3		■			■	■			■	■	■		6	1.33	3.33
1.7	**23.0**	18.18											0	◆	◆		◆	◆	4		■			■	■	■		■	■		■	7	5.00	*.**

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing warmwater and modified habitat attributes for the Sugar Creek study area, 1998

Key QHEI Components

			WWH Attributes											MWH Attributes																							
														High Influence						*Moderate Influence*																	
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	**Total HI. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total MI. MWH Attributes**	**(MWH HI.+1)/(WWH+1) Ratio**	**(MWH MI.+1)/(WWH+1) Ratio**
(17-401) Brandywine Creek																																					
Year: 1998																																					
2.0	**31.5**	13.07											0	◆	◆	◆	◆	◆	5		■			■	■	■		■	■	■		7	6.00	*.**
0.2	**44.5**	9.80	■								■		2			◆	◆		2		■			■	■			■	■	■		6	1.00	3.00
(17-402) Broad Run																																					
Year: 1998																																					
2.8	**39.0**	8.03		■							■		2			◆	◆		2	■	■			■	■			■	■	■		7	1.00	3.33
0.2	**70.0**	3.49	■			■	■	■			■		5						0		■							■	■	■		4	0.17	0.83
(17-403) Turkeyfoot Run																																					
Year: 1998																																					
0.2	**67.0**	18.35	■	■		■	■	■			■		7						0		■							■	■	■		4	0.13	0.63
(17-405) Elm Run																																					
Year: 1998																																					
1.7	**55.0**	10.26	■	■			■	■			■		5				◆		1		■			■				■	■	■	■	6	0.33	1.33
0.4	**32.5**	10.26									■		1	◆		◆	◆		3		■			■	■	■		■	■		■	7	2.00	5.50
(17-407) Misers Run																																					
Year: 1998																																					
0.2	**56.5**	12.50	■	■		■	■	■		■	■	■	8			◆	◆		2							■			■			2	0.33	0.56
(17-408) Crabapple Creek																																					
Year: 1998																																					
2.9	**45.0**	13.70	■	■			■						3				◆	◆	2		■			■			■	■	■	■		6	0.75	2.25
0.3	**42.5**	13.42	■	■			■						3		◆		◆	◆	3		■			■				■	■	■	■	6	1.00	2.50

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing warmwater and modified habitat attributes for the Sugar Creek study area, 1998

Key QHEI Components

			WWH Attributes											MWH Attributes																						
														High Influence					*Moderate Influence*																	
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	**Total HI. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total MI. MWH Attributes**	**(MWH HI.+1)/(WWH+1) Ratio**	**(MWH MI.+1)/(WWH+1) Ratio**
(17-418) Little Sugar Creek																																				
Year: 1998																																				
4.9	**40.0**	10.53	■	■									2				◆	◆	◆	3		■			■	■	■		■	■	■	■	8	1.33	4.00
0.8	**49.0**	9.35		■								■	2				◆	◆		2	■	■			■	■			■	■	■	■	8	1.00	3.67
(17-419) Cherry Run																																				
Year: 1998																																				
0.2	**60.5**	15.15		■		■	■	■		■		■	6					◆	◆	2	■	■							■				3	0.43	0.86
(17-422) Goettge Run																																				
Year: 1998																																				
0.3	**61.0**	21.74	■	■		■	■	■		■	■		8					◆		1									■	■	■		3	0.22	0.56
(17-424) Trib. to S. Fk. Sugar Creek (RM 14.14)																																				
Year: 1998																																				
0.2	**22.0**	4.63		■									1	◆	◆	◆	◆	◆	5		■			■	■				■	■		■	6	3.00	6.00
0.1	**35.0**	4.63		■			■	■				■	4	◆	◆		◆		3		■			■					■	■	■		5	0.80	1.80
(17-427) Trib. to M. Fk. Sugar Creek (RM 3.25)																																				
Year: 1998																																				
0.5	**57.0**	23.81	■					■				■	3				◆	◆		2					■	■			■	■	■	■	6	0.75	2.25
(17-428) Trib. to M. Fk. Sugar Creek (RM 6.00)																																				
Year: 1998																																				
0.2	**51.5**	15.15	■	■							■		4				◆	◆	◆	3					■	■	■		■				4	0.80	1.60

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing warmwater and modified habitat attributes for the Sugar Creek study area, 1998

Key QHEI Components

			WWH Attributes											MWH Attributes																		
														High Influence					*Moderate Influence*													
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No 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 Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(WWH+1) Ratio**	**(MWH M.I.+1)/(WWH+1) Ratio**
(17-429) Trib. to S. Fk. Sugar Creek (RM 1.00)																																		
Year: 1998																																		
0.7	**64.0**	38.46	■	■		■	■	■	■		■		7						0		■								■	■		3	0.13	0.50
(17-430) Trib. to S. Fk. Sugar Creek (RM 11.30)																																		
Year: 1998																																		
0.2	**36.0**	9.71		■			■						2		◆		◆	◆	3	■	■			■					■	■	■	6	1.33	3.33
(17-431) Trib. to S. Fk. Sugar Creek (RM 15.83)																																		
Year: 1998																																		
1.1	**39.5**	14.71		■									1		◆	◆	◆	◆	4	■	■			■	■				■	■	■	7	2.50	6.00
(17-432) Trib. to Walnut Creek (RM 3.92)																																		
Year: 1998																																		
0.4	**33.5**	9.57					■	■					2	◆	◆			◆	3		■			■					■	■		■	5	1.33	3.00
(17-433) Trib. to Indian Trail Creek (RM 6.08)																																		
Year: 1998																																		
0.4	**50.5**	52.63	■	■			■	■					4			◆	◆	◆	3		■				■				■	■	■	5	0.80	1.80
(17-434) Trib to E Br S Fk Sugar Creek (RM 2.07)																																		
Year: 1998																																		
0.7	**37.0**	17.54								■			1	◆		◆	◆	◆	4		■			■	■	■			■	■		6	2.50	5.50

Table 11. Qualitative Habitat Evaluation Index (QHEI) matrix showing warmwater and modified habitat attributes for the Sugar Creek study area, 1998

Key QHEI Components

			WWH Attributes										MWH Attributes																	
													High Influence					*Moderate Influence*												
River Mile	QHEI	Gradient (ft/mile)	No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	**Total HI. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total ML MWH Attributes**	**(MWH HI.+1)/(WWH+1) Ratio**	**(MWH ML+1)/(WWH+1) Ratio**
(17-435) Trib to E Br S Fk Sugar Creek (RM 3.60)																																			
Year: 1998																																			
0.7	**34.0**	8.97		■									1			◆	◆	◆	◆	4	■	■			■	■			■	■	■	■	8	2.50	6.50
(17-436) Trib. to Brush Run (RM 1.54)																																			
Year: 1998																																			
0.1	**38.0**	21.28		■									1	◆			◆	◆	◆	4		■			■	■	■		■	■	■		7	2.50	6.00
(17-437) Trib. to L. Sugar Creek (RM 0.50)																																			
Year: 1998																																			
1.0	**44.5**	16.95	■	■			■				■		4				◆			1		■			■		■		■	■	■		6	0.40	1.60

material being delivered to the mainstem.

Gravel substrates predominated Sugar Creek. Boulders and cobbles, which should have been present given the glacial till substrate origin, were comparatively absent. Instead the gravel sand mixture created a homogenous condition on the stream bottom which would only be conducive to a limited array of aquatic life. A high QHEI score (91) at RM 3.7 reflected the presence of better substrate heterogeneity in this steeper gradient reach where smaller bedload material was transported downstream. This contrast in substrate size was even more noticeable downstream at RM 0.6. Prior to the confluence with the Tuscarawas River, the gradient is reduced and differential sorting occurs. As a result, large areas of washed gravel have been deposited in the stream channel and wide shallow silt flats have formed along the stream margin.

Aside from substrate condition, the next most distinguishing habitat feature in Sugar Creek was the sparseness of cover along the banks and within the channel in several reaches. Although most sites had deep pools, undercut banks and large stable structures were uncommon. Root mats and wads were unusual at the same site. While woody debris was present in patches, it seemed to have a temporary quality and most was composed of smaller debris. These conditions were better downstream from the South Fork but flows in this lowest reach were considered to be

Table 12. Average QHEI scores for relatively homogenous segments of Sugar Creek based on sampling conducted during July to October, 1998.

Segment Location					Narrative Range	Average QHEI
Segment 1: Schellin Rd. to McQuaid Rd.						
River Mile	42.8	40.2	38.1	34.9		
QHEI Score	50.0	53.0	47.0	44.5	Fair	**48.6**
Segment 2: Kansas Rd. to West Lebanon Rd.						
River Mile	34.6	26.8				
QHEI Score	72.5	65.0			Good	**68.8**
Segment 3: Alabama Ave. to SR 93, Dst. N. Fork						
River Mile	23.0	19.3				
QHEI Score	42.5	51.5			Fair	**47.0**
Segment 4: Dst. Brewster Dairy and WWTP to Dst. Beach City WWTP						
River Mile	17.6	13.7				
QHEI Score	71.0	78.5			Very Good	**74.8**
Segment 5: Dst Beach City Reservoir						
River Mile	12.0					
QHEI Score	58.0				Fair	**58.0**
Segment 6: Dst. Strasburg WWTP to SR 39						
River Mile	7.2	3.7	1.8	0.6		
QHEI Score	77.5	91.0	73.5	74.0	Very Good	**79.0**

a stronger influence on habitat quality.

The upper reach of Sugar Creek has been modified. Recovery from the channelization has occurred to varying degrees. Some maintenance of the modified condition was apparently continuing by individual landowners. No recovery has taken place at these locations while a narrow riparian corridor has been permitted to regrow in others.

Natural wetland conditions were present in the reach downstream from the North Fork and extended to a site downstream from the Middle Fork (approximately RM 23 to RM 18). Here, an absence of riffles, little functional cover, and silty sand substrates combined to create habitat that is unfavorable to riverine species.

Agricultural land use was prevalent in the watershed although areas adjacent to the stream were interspersed with rural residences and wetland forested tracts. Riparian corridor tended to be wide in wetland areas and narrow in agricultural reaches.

In summary, habitat conditions in Sugar Creek were adequate in some reaches to support the WWH use designation. In other reaches, habitat degradation and natural wetland qualities were expected to influence the ability of a biological community to achieve the WWH criteria. However, no other aquatic life use designation is appropriate for Sugar Creek. Therefore, efforts to prevent polluted runoff from entering the stream and to increase and maintain the width of the riparian corridor in the watershed are recommended as the most effective ways to improve habitat conditions in Sugar Creek.

Sugar Creek Tributaries

Habitat conditions were evaluated at 60 tributary locations where fish sampling also occurred. Data from these sites are condensed in the QHEI matrix presented in Table 14. Additional habitat evaluation also occurred at 17 headwater locations. An assessment of these sites follows the explanation of habitat quality at the geometrically stratified sites.

Sites were selected within the Sugar Creek watershed based on similar drainage size. To determine what drainage sizes to use, the entire basin size was divided in half and this value was halved and so on. This geometric division yielded sites which should be 5.6 mi^2, 11 mi^2, 22 mi^2, 44 mi^2, 89 mi^2, 178 mi^2, and 356 mi^2. Locations which best matched these drainages were selected for evaluation.

Other sites were also investigated. However, discussion of the habitat quality at these sites is located within the Pollutant Loadings Section if the site was used to assess the performance of a specific entity. Some sites were included in the study to satisfy other interests including the influence of mining, to document a least impacted condition, or because the stream seemed likely capable of supporting a WWH aquatic life use designation. Discussion of the quality of habitat at these sites is considered within the context of the geometric stratification dialogue.

5.6 mi^2 subbasins

In general the quality of habitat for aquatic life in the tributaries to Sugar Creek was poor (Figure 20). This was especially true regarding the smallest streams. At 5.6 mi^2, only one site out of 14 was considered likely able to support an aquatic community consistent with a WWH use designation. Fair conditions were recorded at three other stations while the remaining 71 % (10 of 14) had poor habitat attributes.

Most of these sites were situated within pastures where livestock had unrestricted access to the stream. As a result, the stream banks were typically denuded of riparian vegetation and severely eroded. A few locations were not in pastures but intensive agricultural land use adjacent to the stream had the same effect - no riparian buffer and heavy erosion. Substrates at these sites were silty and embedded. All of these locations also lacked appropriate cover for aquatic organisms.

The only 5.6 mi^2 site where a good QHEI score was recorded was on the North Fork at RM 5.4. Gradient at this location was exceptionally steep (32.8 ft/mi) and the unusually large substrates included boulders. Even so, the reach was moderately embedded and silty. The site was within a pasture and few trees grew along the stream margin. Better development combined with the gradient and substrates were sufficient, however, to yield a good QHEI score (63.5)

11 mi^2 subbasins

Only one of ten locations with a drainage area of at least 11 mi^2 was determined able to support a WWH aquatic community. Five sites had fair habitat conditions while the other four stations had poor qualities. Three of the ten locations were in pastures and six were flanked by agricultural fields. As with the 5.6 mi^2 sites, these stations lacked riparian corridor, had eroded banks with embedded substrates, and had limited instream cover.

Broad Run at RM 0.2 actually drains 20 mi^2 but this site was grouped with the 11 mi^2 subbasins because there was no other access upstream and it was not as big as the 22 mi^2 subbasins. In any case, the habitat at this location was unusual. The stream was shaded by a moderately wide riparian corridor, part of the reach flowed over bedrock riffles and a wide deep pool had formed upstream. Although silt was prevalent here and some embeddedness was probably limiting, a QHEI score of 70 indicated the habitat was consistent with the WWH aquatic life use designation.

Conditions at the other nine locations were similar to the 5.6 mi^2 sites. These reaches had few trees, were eroded and embedded, lacked instream cover and generally appeared enriched. Most of these sites had abundant algal growth, greenish water or diatom enhanced brownish water.

22 mi^2 subbasins

One of the five 22mi^2 basins had habitat attributes that were consistent with the WWH aquatic life use designation. Three of the locations were noteworthy for very poor conditions and the fifth site had fair qualities. The essential difference between these locations was that the best site

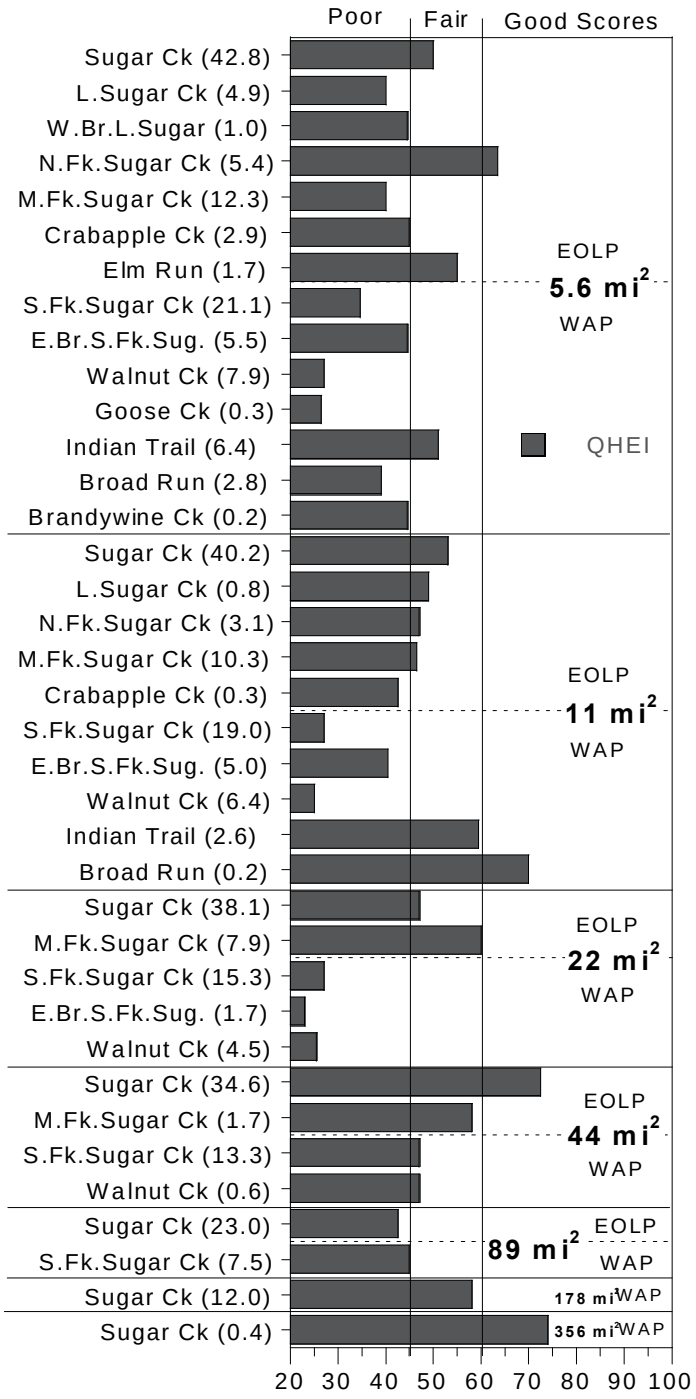

Figure 20 Habitat quality as determined with the Qualitative Habitat Evaluation Index at geometrically stratified sites within the Sugar Creek basin, 1998.

was in a cattle pasture while the others had been channelized. The difference between the fair and very poor locations was that the fair site has some recovery where small shrubs and trees had been permitted to recolonize the stream banks. The very poor locations with an upstream heritage of pasture and intensive row crop land use were maintained ditches.

All five 22 mi^2 locations had silty substrates and were embedded. Cover within the stream and along the banks was sparse. The pasture site with better attributes had cobble substrates, good development, and some fast current. This site on the Middle Fork at RM 7.9 also had good gradient and the water temperature was more stable than at other similar locations.

The channelized reaches exhibited a trapezoidal form with a flat wide base. There were few redeeming habitat qualities at these sites beyond conveyance for water. The reach with some second growth woody vegetation which merited a QHEI score of 47.0 was on Sugar Creek at RM 38.1. The ditch here was not as thoroughly maintained. As a result, slump block of grass had sloughed into the stream which in turn were colonized by woody vegetation. Pools and runs had formed around these constrictions and the QHEI score reflected this difference.

44 mi^2 subbasins

At 44 mi^2, one site was assessed to have good habitat and three locations had fair conditions. Sugar Creek at RM 34.6 scored 72.5 QHEI points. The Middle Fork at RM 1.7 scored 58 while both the South Fork at RM 13.3 and Walnut Creek at RM 0.6 scored 47. Substrate quality was again the factor which most distinguished these sites from each other. The Sugar Creek site was comprised of moderately silty and embedded gravel. The Middle Fork site was extensively embedded with silt incorporated with the gravel. The South Fork and Walnut Creek sites were predominated by sand substrates which lacked interstitial voids and were extremely silty.

The South Fork remained channelized at this scale and was flanked by agricultural and rural residential land use. The Middle Fork site was in a cattle pasture with better riparian vegetation than was typical of grazed areas; flow remained strong. Sugar Creek at 44 mi^2 was in a rural residential area surrounded by a large wood lot. Natural land with some wetland characteristics were adjacent to the Walnut Creek site. Essentially at this size, the streams were too large to ignore potential flooding issues. Fewer conflicting land uses encroached on the riparian corridor at this scale.

Since human influenced intrusion into the stream channel was reduced at this point, habitat values tended to improve but the upstream negative attributes continued to have overriding aspects. None of the sites which were at least 44 mi^2 had comprehensively poor habitat qualities. However, the bedload material from upstream locations smothered the substrates and the amount of instream cover remained sparse to moderate.

89 mi^2 subbasins

The Sugar Creek watershed can be split in two halves at 89 mi^2. The mainstem at RM 23.0

(QHEI=42.5) and the South Fork at RM 7.5 (QHEI=45.0) are rather similar streams. Both reaches were situated in wetland areas and lacked riffles. Both had fine grained substrates, silty sand at the Sugar Creek site and muck at the South Fork location, and both were extensively embedded. Both sites had natural riparian margins although row crop fields were situated in the immediate flood plain. Cover was limited at both locations and channel morphology was rather straight with poor to fair development. These wetland qualities were not expected to be conducive to supporting the WWH aquatic life use.

178 mi^2 subbasin

After the South Fork joins the mainstem, Sugar Creek has a drainage area of 300 mi^2. Effectively there is no location with the desired 178 mi^2 drainage, so a site downstream from the Beach City Reservoir was used instead. Sugar Creek at RM 12.0 had fair habitat (QHEI=58.0). This site also lacked a riffle, had sparse instream cover, and exhibited fair development in a fairly straight channel. The site was within a wetland forest reach and had mostly gravel substrates which were moderately embedded despite the upstream dam. The amount of silt was surprising considering that the dam should have served as a sink for these fines and downstream locations should have been relatively unembedded and silt free. Again, the habitat here was limiting with regard to supporting WWH biological communities.

356 mi^2 basin

As discussed previously, the most downstream location in the Sugar Creek watershed exhibited spatial sorting with washed gravel deposits in the center channel and silt flats along the margin. The moderate amount of cover was comprised of deep pools in combination with logs or woody debris and rootwads. Good development with moderate sinuosity and strong current were atypical for most of the stream reaches in the basin. A QHEI score of 74 here suggested the habitat was adequate for a WWH aquatic community.

Stream Screening

In 1997, the Nonpoint Source Assessment Section within the Division of Surface Water developed a form for citizens to use to evaluate stream habitat. The four page Stream Reach Screening Survey (SRSS) guides the user in evaluating a 150 to 500 meter stream reach. In addition to general information and a sketch of the location, the user is asked to characterize riparian quality and complete a simplified habitat evaluation (citizen QHEI). The SRSS also includes an assessment of land use surrounding the site.

As part of the Sugar Creek study, 17 SRSS forms were completed at sites which drained about 2.8 mi^2 (Figure 22). An additional 38 forms were completed at larger basin sites where more robust habitat evaluations were also performed. The SRSS results were compared to QHEI scores where the two analyses were conducted at the same site. A reasonable regression analysis suggested the SRSS had a good basis for further development. In general, a citizen QHEI score less than 30 indicated a stream with poor habitat while a score above 60 suggested good habitat. This form has the potential to provide credible information about more streams than Ohio EPA

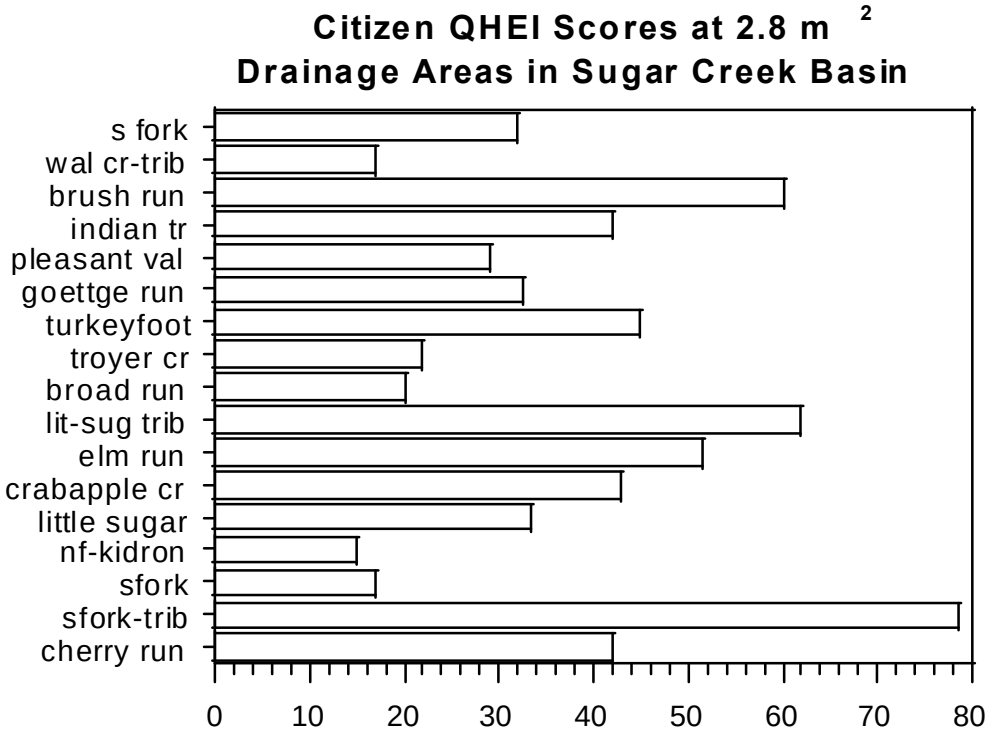

Figure 21 Stream Reach Screening Scores (SRSS) at 2.8 mi^2 subbasins in the Sugar Creek watershed, 1998.

staff can evaluate personally.

Although the form was developed with the intent of acquiring information beyond the scope of a typical Ohio EPA survey, the SRSS also has educational value. To properly conduct the evaluation, the user must walk the entire reach of the stream, often in the water, and then complete the form as accurately as possible. As a result, a familiarity with the stream is gained which may inspire a deeper understanding of natural processes.

Since the Sugar Creek survey was the first time this tool was used, Ohio EPA staff conducted all of the evaluations. In so doing, these personnel were requested to identify any streams which should be considered for the WWH aquatic life use designation. The intent was to follow up their observation with a biological evaluation to confirm the attainment status. However, none of the 2.8 mi^2 streams in the Sugar Creek basin appeared to merit follow-up sampling.

Three of the 17 sites (18%) resulted in citizen QHEI scores greater than 54, five (28%) scored

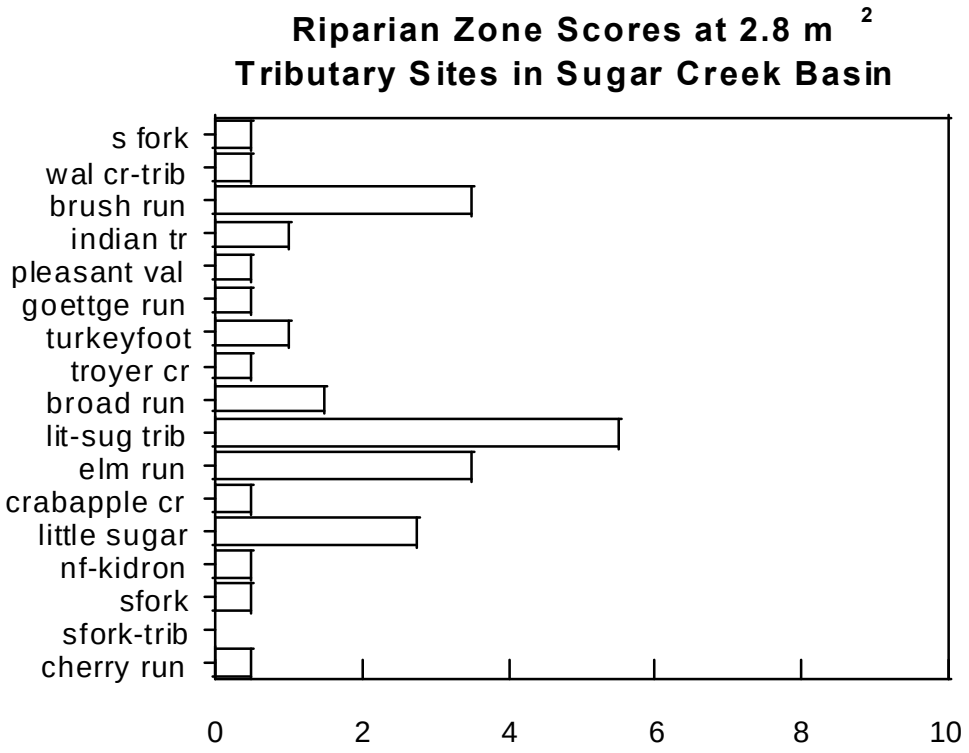

Figure 22 Riparian quality scores from the Stream Reach Screening Survey conducted at 2.8mi2 subbasins in the Sugar Creek watershed, 1998.

between 53 and 36 and nine sites (54%) had scores in the poor range. Effectively, 82% of these smallest headwater locations appeared to have fair habit conditions at best. Regarding the three with higher scores, these locations were biologically evaluated at a downstream 5.6 mi^2 location. Performance at the downstream locations was inconsistent with WWH. Hence, there was no compelling reason to sample further upstream despite the SSRS information.

Figure 22 displays the results of the riparian component of the SSRS. High scores were not recorded at the 2.8 mi^2 locations. In fact, only one site had sufficient stream margin vegetation to score above four. The overall poor quality of the riparian zone in the Sugar Creek basin was deemed likely to exert a negative influence on biological performance.

Another component of the SRSS characterizes land use in the area immediately around the stream reach. In this exercise, the user is requested to identify all land uses among a set of choices and to rank the relative impact these uses appear to have on the stream. Agricultural

impacts were evident at most of the locations in the watershed (Table 13). Urban, waste disposal and mining influences were evident at some locations but the impact from these uses was

Table 13 Results of the land use component from 55 Stream Reach Screening Surveys completed in the Sugar Creek basin, 1998. The user identifies land uses and ranks the perceived impact these uses have on stream habitat quality.

Land uses	Perceived magnitude of influence						**Total**	
	High		Moderate		Slight			
	#sites	%	#sites	%	#sites	%	#sites	%
Agriculture	40	68	6	10	2	3	48	81
Urban	2	3	4	7	4	7	10	17
Waste Disposal	2	3	3	5	4	7	9	15
Mining and Extraction	1	2	3	5	4	7	8	13
Other	0	--	1	2	2	3	3	5
Logging	0	--	0	--	0	--	0	--

perceived to be more moderate overall. Logging was not observed near any streams in the basin.

Biological Assessment: Macroinvertebrate Community

Sugar Creek

Macroinvertebrate performance was good to very good at 12 of the 14 Sugar Creek mainstem sites (Figure 23). ICI scores ranged from 26 at SR 62 (RM 18.6) to 44 at Kansas Road (RM 34.7) and 44 at SR 93 (RM 19.3). The highest number of EPT taxa (17) was collected downstream from Strasburg at SR 250 (RM 7.3). The highest number of mussel species (6) were observed at West Lebanon Road (RM 26.7).

Macroinvertebrate collections at the two uppermost Sugar Creek sites, Schellin Road (RM 42.8) and County Road 502 (RM 40.2), were evaluated as good with 8 to 10 EPT taxa and caddisflies and mayflies predominant on the natural substrates. Good riparian cover was observed upstream from Schellin Road. No apparent impact to the benthos was observed at RM 40.2 downstream from the Smithville WWTP (RM 40.33).

At County Road 502, the upstream areas of sampling had partial riparian cover, but the downstream side had few trees. The lack of riparian cover appeared to dominate the next few miles as Sugar Creek flowed through agricultural fields. The next site was located at Orr Road, RM 36.9, which lacked a good riparian buffer zone. This site had the least riparian cover of the 14 macroinvertebrates sites sampled on the mainstem. The benthic collections at Orr Road represented only marginally good performance with 6 EPT taxa and caddisflies predominant. Mayflies were present, but were not common or predominant.

Sugar Creek at Kansas Road (RM 34.7) and West Lebanon Road (RM 26.7) were evaluated as very good and good, respectively. Samplers at West Lebanon Road were located near a sandbar that shifted during the six weeks and partially buried them. Qualitative sampling yielded 10 EPT taxa with caddisflies and mayflies predominant.

The next three sites, Alabama Avenue (RM 22.9), State Route 93 (RM 19.3), and State Route 62 (RM 18.6) were located in a section of Sugar Creek with slower current velocity and long pool/run areas. Riffle areas were created by logs and sticks in faster flow areas, but there were no rock type riffles observed in this area. Some areas near these sites had extensive wetlands bordering the stream. ICI scores at Alabama Avenue and S.R.93 were 38 (good) and 44 (very good), respectively. The ICI score dropped to 26 (fair) at S.R. 62, which is located downstream from Brewster Dairy (RM 19.05) and the Brewster WWTP (RM 19.04).

Macroinvertebrate communities improved to the good range at RM 13.7 (ICI = 38) downstream from the Beach City WWTP and upstream from the Beach City Reservoir. No apparent impact from the Beach City WWTP was observed.

All sites sampled downstream from the Beach City Reservoir (RMs 12.0, 7.3, 3.6, 1.8, and 0.6) had good to very good macroinvertebrate performance, with 9 to 17 total EPT taxa and ICI scores

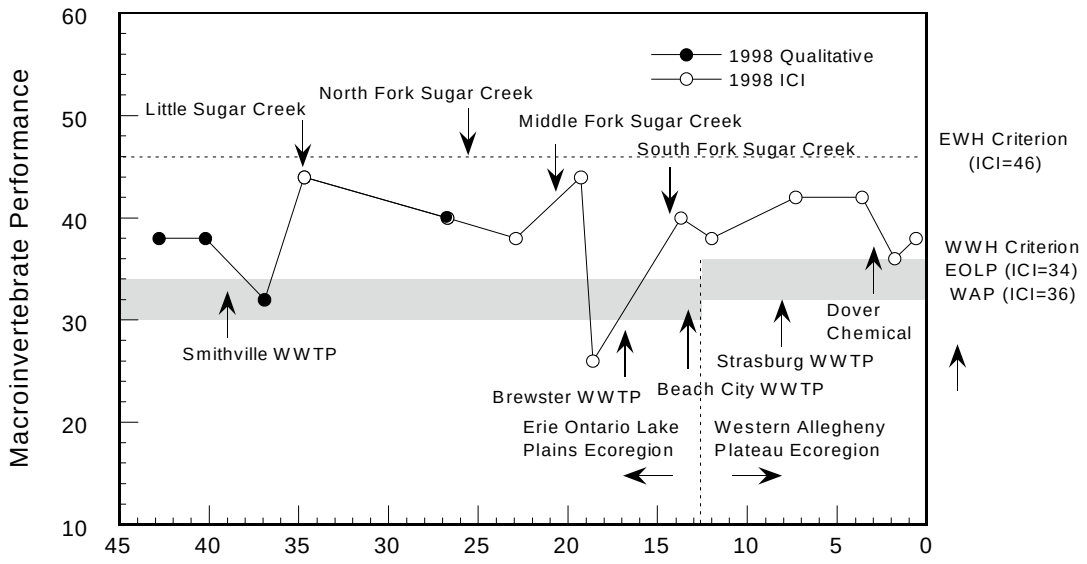

Figure 23 Longitudinal performance of the Invertebrate Community Index (ICI) and qualitative invertebrate community index in Sugar Creek, 1998.

ranging from 36 to 42.

Sugar Creek Tributaries

5.6 mi^2 subbasins

The seven 5.6 mi^2 drainage basin sites sampled for macroinvertebrates in the EOLP ecoregion were evaluated as attaining or in non-significant departure of WWH expectations (Figure 24). The good and very good sites had 10 to 12 qualitative EPT taxa with mayflies and caddisflies predominant. The three sites assessed as having only marginally good communities (West Branch Little Sugar Creek RM 4.9, North Fork Sugar Creek RM 5.4, and Elm Run RM 1.7) had between 5 and 8 EPT taxa with caddisflies, but not mayflies, predominant. Biological performance at these three sites was influenced by an unsewered community, agricultural, or farm animal operations.

In the 5.6 mi^2 drainage basin sites sampled for macroinvertebrates in the WAP ecoregion, good to exceptional macroinvertebrate communities were characterized by 8 to 14 EPT taxa with caddisflies predominant. Mayflies were also predominant or at least common. At three sites assessed as having fair community performance (South Fork Sugar Creek RM 21.1, Broad Run RM 2.8, and Brandywine Creek RM 0.2) between 3 and 7 EPT taxa were collected, with

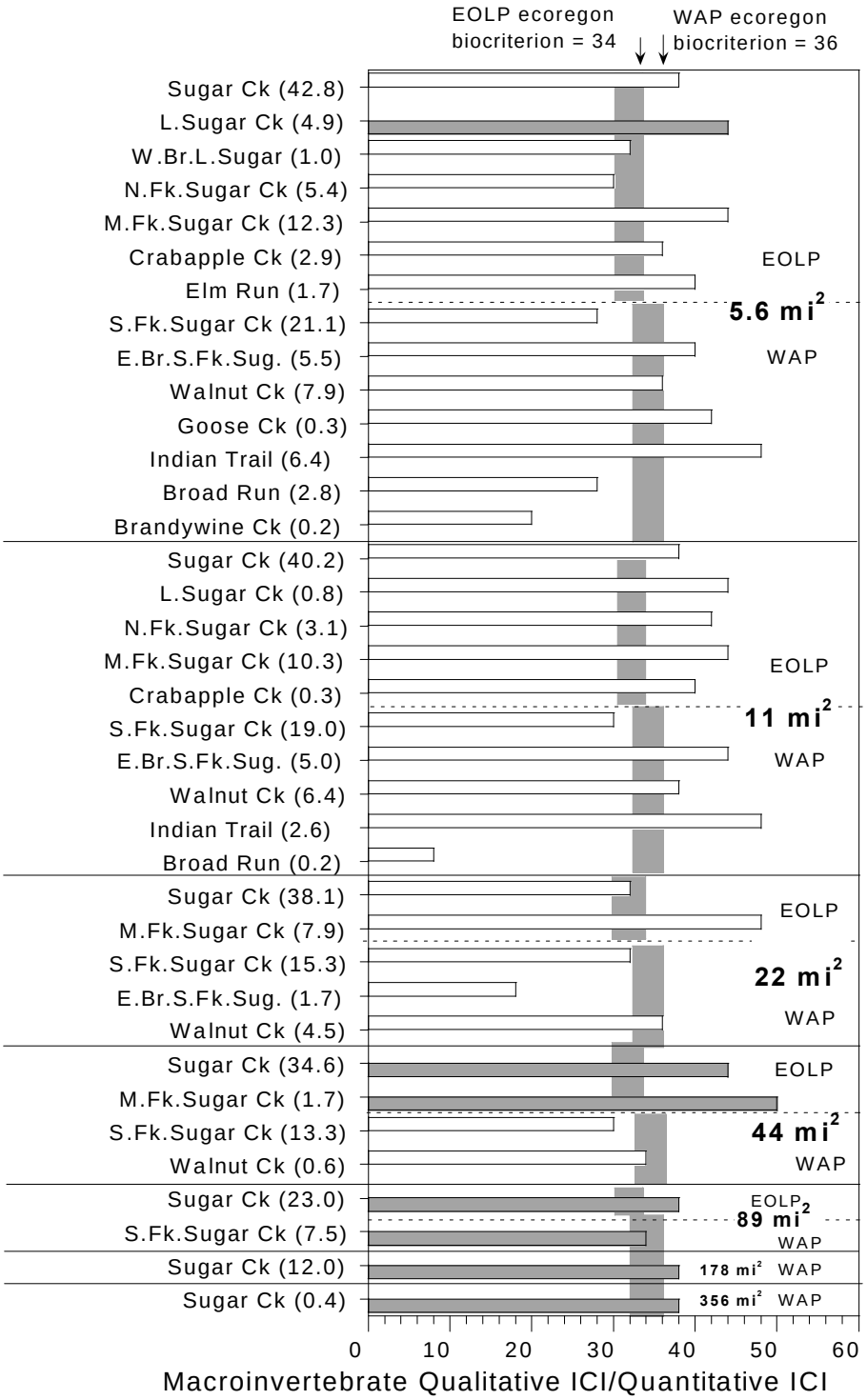

Figure 24. Macroinvertebrate community performance at geometrically stratified sites in the Sugar Creek basin, 1998. Solid bars indicate ICI scores. Open bars are based on qualitative evaluations.

Table 14. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Sugar Creek study area, 1998. Biocriteria and narrative ranges are in Table 2.

Stream River Mile	Drainage Area (mi.^{2})	Rel. Density (#/ft.^{2})[a]	No. Quant. Taxa	No. Qual. Taxa	Total No. Taxa	Qual. EPT[b]	Total EPT[b]	Qualitative Predominant Organisms[c]	QCTV[d]	*QICI*[e] **ICI**	Narrative Evaluation [f]
Sugar Creek EOLP											
42.8	5.9	Low		32		10		Cad,May,Elmids	39.1	*38*	Good
40.2	14.4	Low-Mod		39		8		Cad, May,	37.3	*38*	Good
36.9	25	Low		38		6		Cad	37.3	*32*	Marg.Good
34.7	46.0	803	50	40	62	11	11		39.1	**44**	Very Good
26.7	68	Moderate		49		10		Cad, May,	38.8	*40*	Good
22.9	93.0	609	47	39	68	8	11		33.4	**38**	Good
Sugar Creek WAP											
19.3	145.0	384	42	29	56	8	13		38.8	**44**	Very Good
18.6	152.0	285	30	36	52	8	9		39.1	**26***	Fair
13.7	161.0	371	30	37	47	8	10		38.6	**40**	Good
12.0	300.0	1251	31	45	61	9	12		33.4	**38**	Good
7.3	311.0	667	34	48	61	11	17		38.6	**42**	Very Good
3.6	340.0	657	34	44	58	12	14		39.1	**42**	Very Good
1.8	350.0	575	37	44	60	8	10		37.3	**36**	Good
0.6	356.0	518	36	48	61	7	9		34.9	**38**	Good
Little Sugar Creek EOLP											
4.2	9.0	168	35	47	59	10	11		33.5	**44**	Very Good
0.8	13.3	Low		46		11		Cad, May	37.3	*44*	Very Good
Little Sugar Creek Tributary at RM 0.5 (Existing WWH) EOLP											
1.1	4.9	Low-Mod		37		8		Cad,	33.2	*32*	Marg.Good
North Fork Sugar Creek EOLP											
5.4	5.5	Low		25		5		Cad,	35.1	*30*	Marg.Good
3.1	10.5	Low-Mod		44		9		Cad, May	35.7	*42*	Good
1.3	16.5	Low-Mod		43		7		Cad, May	38.1	*44*	Good
Middle Fork Sugar Creek EOLP											
12.1	8	Low-Mod		40		12		Cad, May, Mid	39.1	*44*	Very Good
10.3	10.3	Low-Mod		36		8		Cad, May ,Mid	39.1	*44*	Good
7.6	30	Low-Mod		38		11		Cad, May, Mid	38.8	*48*	Very Good
1.7	63.0	346	42	25	52	11	16		42.5	*50*	Exceptional
Crabapple Creek EOLP											
3.0	5.1	Low-Mod		38		10		Cad, May ,Mid	38.1	*36*	Good
0.3	10.8	Low-Mod		40		8		Cad, May ,Mid	35.3	*40*	Good

Table 14. continued.

Stream River Mile	Drainage Area (mi.^{2})	Rel. Density (#/ft.^{2})[a]	No. Quant. Taxa	No. Qual. Taxa	Total No. Taxa	Qual. EPT[b]	Total EPT[b]	Qualitative Predominant Organisms[c]	QCTV[d]	*QICI*[e] **ICI**	Narrative Evaluation [f]
Middle Fork sugar Creek Tributary at RM 6.0 EOLP											
0.2	2.3	Low-Mod		48		9		Cad, May, Mid	39.4	*48*	Good
Elm Run EOLP											
1.7	5.5	Low-Mod		38		5		Cad, Fingernail	39.1	*40*	Marg.Good
South Fork Sugar Creek WAP											
21.1	5.9	Low-Mod		44		7		Cad,Blackflies,	32.8	*28*	Fair
19.0	14.4	Low		41		6		Cad,Blackflies,	32.9	*30*	Fair
15.3	25	Low-Mod		49		9		Cad,Blackflies,	32.9	*32*	Marg.Good
13.9	46	Low		43		4		Blackflies,Mid	28.1	*20*	Fair
13.2	63.3	73	29	44	56	8	8		31.9	**28***	Fair
7.4	75.0	363	31	33	48	6	7		33.4	**34**[ns]	Marg.Good
6.4	124.0	440	29	26	40	5	7		33.2	**34**[ns]	Marg.Good
3.6	131.0	147	25	19	33	0	0		28.3	**10***	Poor
Brush Run WAP											
2.5	0.6	Low		33		4		Cad, Mid	34.1	*30*	Fair
0.8	5.0	Low		27		1		Tolerant Midges	28.1	*6*	Poor
Troyer Valley Creek WAP											
1.1	2.4	Moderate		31		2		Blackflies,Mid	22.3	*10*	Poor
East Branch (South Fork Sugar Creek) WAP											
5.5	10	Low-Mod		33		9		Cad,Blackflies,	39.1	*40*	Good
5.0	10.8	Low-Mod		36		7		Cad, May,Mid	35.3	*44*	Good
1.7	25.4	Moderate		34		1		Blackflies,Mid	30.9	*18*	Poor
Pleasant Valley Creek WAP											
0.2	4.1	Low		46		4		Cad, Mid	36.0	*38*	Fair
Walnut Creek WAP											
7.9	9.1	Low-Mod		61		8		Cad,Blackflies,	34.9	*36*	Good
6.3	10.6	Moderate		53		11		Cad,Blackflies,	35.3	*38*	Good
4.5	22	Moderate		45		11		Cad,Blackflies,	35.1	*36*	Good
0.6	48	Low-Mod		37		7		Caddisflies	34.5	*34*	Marg.Good
Goose Creek WAP											
0.4		Low-Mod		53		9		Cad, May,Mid	35.3	*42*	Good
Indian Trail Creek WAP											
6.4		Low-Mod		62		14		Cad, Mid	37.7	*48*	Exceptional
5.4		Low-Mod		49		12		Cad,Blackflies,	35.7	*44*	Very Good
2.6		Low-Mod		49		12		Cad,Blackflies,	36.3	*48*	Very Good

Table 14. continued.

Stream River Mile	Drainage Area (mi.^{2})	Rel. Density (#/ft.^{2})[a]	No. Quant. Taxa	No. Qual. Taxa	Total No. Taxa	Qual. EPT[b]	Total EPT[b]	Qualitative Predominant Organisms[c]	QCTV[d]	*QICI*[e] **ICI**	Narrative Evaluation [f]
Indian Trail Creek Tributary at RM 6.08 WAP											
0.3		Moderate		40		2		Blackflies,Mid	29.4	*16*	Fair
Broad Run WAP											
2.8	8.2	Low		44		5		Midges	35.1	*28*	Fair
0.2	20	Low		14		1		None	*32.8*	*8*	Poor
Turkeyfoot Run WAP											
0.2	4.2	Low		10		2		Caddisflies	29.5	*10*	Poor
Goettge Run WAP											
0.3	4.6	Low		22		2		Nonred Midges	35.3	*18*	Poor
Brandywine Creek WAP											
0.2	5.5	Low-Mod		33		3		Blackflies,Mid	35.1	20	Fair

Ecoregion Biological Criteria

	Eastern Corn Belt Plains- EOLP			Western Allegheny Plateau- WAP		
	WWH	EWH	MWH	WWH	EWH	MWH
ICI	34	46	22	36	46	22

[a] Relative density is the number of organisms per square foot on the artificial substrates or the relative density (low-medium-high) of organisms on the natural substrates for qualitative sites only.
[b] EPT = total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness
[c] Qualitative predominant organisms on the natural substrates. Cad = caddisflies, May = mayflies, Mid = midges, Elmid = elmid beetles, Fingernail = fingernail clams.
[d] Qualitative Community Tolerance Value (QCTV) derived as the median of the tolerance values calculated for each qualitative taxon present
[e] The Qualitative ICI is a new qualitative assessment tool which is currently being developed for use with qualitative only sites. Narrative evaluation based on quantitative ICI score, or qualitative data. Marg.Good = marginally good.
ns Nonsignificant departure from biocriteria (≤4 IBI or ICI units, or ≤0.5 MIwb units).
* Indicates significant departure from applicable biocriteria (>4 or ICI units). Underlined scores are in the Poor or Very Poor range.

caddisflies predominant or at least common. Mayflies were less common. These fair sites were influenced by unsewered communities, agricultural, or farm animal operations.

Macroinvertebrate communities at Little Sugar Creek RM 4.2 in the EOLP ecoregion and Indian Creek RM 6.4 in the WAP ecoregion were evaluated as very good to exceptional. They had good riparian zones without agricultural or farm animal operations adjacent to the stream at the

locations sampled. Another site in the EOLP ecoregion, Middle Fork Sugar Creek RM 12.1, also scored very good, but had bank slippage caused by loss of a riparian corridor and unlimited livestock access. Cool water may have improved this site's performance.

Cool water macroinvertebrate species were present at 9 of the 14 sites at this drainage area size. Some of the streams without good riparian corridor which resulted in bank slippage and increased siltation, had good performance (Crabapple Creek, Goose Creek, and Walnut Creek) and one (Middle Fork Sugar Creek RM 12.1) had very good performance. These streams lie in an area that with cooler water temperatures than some of the other areas in the survey. The cooler water may mitigate the effects of the absence of instream cover that usually results in warmer water temperatures.

11.0 mi^2 subbasins

The five 11.0 mi^2 drainage basin sites sampled for macroinvertebrates in the EOLP ecoregion were evaluated as good to very good. Qualitative sampling at these sites yielded 8 to 11 EPT taxa, with mayflies and caddisflies predominant on the natural substrates. Three of the five WAP sites of the 11.0 mi^2 drainage basin were evaluated as good to very good with 7 to 12 EPT taxa, and with mayflies and caddisflies predominant on the natural substrates.

The South Fork Sugar Creek site at RM 19.0 was assessed as fair with 6 EPT taxa. Caddisflies, facultative flatworms, blackflies and tolerant midges were predominant on the natural substrates, and mayflies were uncommon. The South Fork Sugar Creek basin from the 5.6 mi^2 basin to the 11.0 mi^2 basin was heavily farmed with unlimited access to the stream by farm animals. Macroinvertebrate collections at Broad Run RM 0.2 were evaluated as poor with only 1 EPT taxon collected. This site was heavily impacted by Cherry Run and Turkeyfoot Run, two mining impacted tributaries.

The two sites scoring very good at the 11.0 mi^2 drainage basin size were Little Sugar Creek (RM 0.8) and Indian Trail Creek (RM 2.6), both which scored very good to exceptional at the 5.6 mi^2 drainage basin. These sampling locations had good riparian cover. There were sections of these streams where agriculture and animal farm operations existed with no riparian corridor, but these streams were not dominated by their influence. This was opposed to the South Fork Sugar Creek which was impacted throughout the upper reach from RM 21.1 to RM 13.2 where the stream was channelized and lacked a riparian buffer.

22.0 mi^2 subbasins

At the 22.0 mi^2 drainage basin size, macroinvertebrate performance was good at Walnut Creek (RM 4.5) and very good at Middle Fork Sugar Creek (RM 7.9); each had 11 EPT taxa with caddisflies and mayflies predominant. Marginally good sites had 6 EPT taxa at Sugar Creek (RM 36.9) and 9 EPT taxa at South Fork Sugar Creek (RM 15.3); both sites were predominated by caddisflies. These marginal sites were located in previously channelized sections adjacent agricultural fields with no riparian corridor. The East Branch South Fork Sugar Creek (RM 1.7)

was evaluated as poor with only 1 EPT taxon and facultative blackflies and tolerant midge species predominant. This was a change from the good performance noted at the East Branch South Fork Sugar Creek RM 5.0. The impact on the community at RM 1.7 was attributed to a dairy farm operation.

44.0 mi^2 subbasins

In the EOLP ecoregion at the 44.0 mi^2 drainage basin size, Sugar Creek (RM 34.7, ICI = 44) and Middle Fork Sugar Creek (RM 1.7, ICI = 50) were evaluated as very good and exceptional, respectively.

At both sites in the WAP ecoregion at the 22.0 mi^2 drainage basin size, the artificial substrate samplers were covered by shifting sand or increased siltation bedload. Macroinvertebrate assemblages from the natural substrates were evaluated as fair at the South Fork Sugar Creek site (RM 13.2), and as marginally good at Walnut Creek (RM 0.6).

It was at this watershed size that comparison in land use and riparian cover appeared to affect siltation loadings. Sugar Creek and the Middle Fork Sugar Creek had some areas lacking a good riparian zone and where agricultural and farm animal operations caused bank slippage; however, these habitat impaired areas did not dominate these creeks throughout the reaches. However, the Walnut Creek and South Fork Sugar Creek basins were dominated by lack of riparian cover, bank slippage, channel and ditch like morphology, and had unlimited livestock access throughout their reaches at the 5.6, 11.0, 22.0, and the 44.0 mi^2 drainage basin sizes.

89.0 mi^2 subbasins

At the 89.0 mi^2 drainage basin size both streams sampled, Sugar Creek and South Fork Sugar Creek, have less gradient than upstream sites. These streams in this section of the Sugar Creek basin were characterized with slower current velocity and long pool/slow run areas. Riffle areas were created by logs and sticks in faster flow areas, but there were no rock type riffles observed in this area. Some areas near these sites had extensive wetlands bordering the stream. Sugar Creek RM 22.9 at Alabama Avenue scored an ICI of 38 (good) and the South Fork Sugar Creek RM 7.4 at SR 93 scored an ICI of 34 (marginally good).

178 and 358 mi^2 subbasins

The 178 and 358 mi^2 drainage basin areas were located on Sugar Creek RM 12.0 downstream from the reservoir and Sugar Creek RM 0.6 at SR 39. These sites were located downstream from the Beach City Reservoir; both scored an ICI of 38 (good).

Biological Assessment: Fish Community

Sugar Creek

Fifty five species and two hybrid types of fish (4,673 individuals) were collected from Sugar Creek in 1998. Sampling occurred once at four upstream sites with drainage areas of less than 40 mi^2 and twice at 11 sites from Kansas Road (RM 34.6; 46 mi^2) downstream to a site near the confluence with the Tuscarawas River (RM 0.6; 356 mi^2). Overall, the fish assemblage in Sugar Creek was poor to fair (Table 15). This characterization was based on fish community indices which ranged from good (IBI=42 at RM 40.2) to poor at several locations (MIwb=3.8; IBI=13 at RM 19.3 and MIwb=4.1; IBI=19 at RM 17.6). Including all sites, the mean MIwb was 6.1. The mean IBI was 31 (Figure 25).

Ecoregional expectations for the WWH use designation were only met in a reach downstream from Smithville and at a site downstream from Strasburg. Otherwise the fish community reflected fair composition at best. The factors which influenced the poor to fair performance were associated with siltation, habitat degradation, and polluted runoff principally from agricultural land use. The limiting aspects of a natural wetland reach also affected fish indices scores. Habitat conditions were degraded in reaches but tended to improve longitudinally downstream (ΘQHEI=63.3). Additionally, fish community performance suffered downstream from Dover Chemical where historic contamination was previously documented (OEPA EAS/1992-7-3).

Study objectives included evaluating the potential influences of discharges from the Smithville, Brewster, Brewster Dairy, Beach City and Strasburg WWTPs and from other entities via tributaries to Sugar Creek. Fish community data indicated these entities were sources of dilution and of continuous flow. These aspects were helpful to the fish community as long as the discharged water quality was as good as the ambient condition in the creek.

Siltation and habitat destruction were the most significant influences on the fish community. These factors and polluted runoff from agricultural land use and other nonpoint sources acted together to significantly impair the fish assemblage throughout Sugar Creek and the rest of the watershed.

Fish diversity in Sugar Creek and in the basin was low. Site species richness was rarely more than 20. Mainstem sample relative numbers were usually between 50 to 350. Healthy similar sized basins around Ohio tend to support 25 species per site and relative numbers range from 300 to 750 or more at individual sites. Intolerant species have been nearly extirpated from the basin. Only five adult smallmouth bass, a sensitive species, were collected in the survey and these were restricted to the lowest four miles of the stream. Effectively, due to land use, the ability anywhere in the entire watershed to support a reasonable array and quantity of fish has been eliminated.

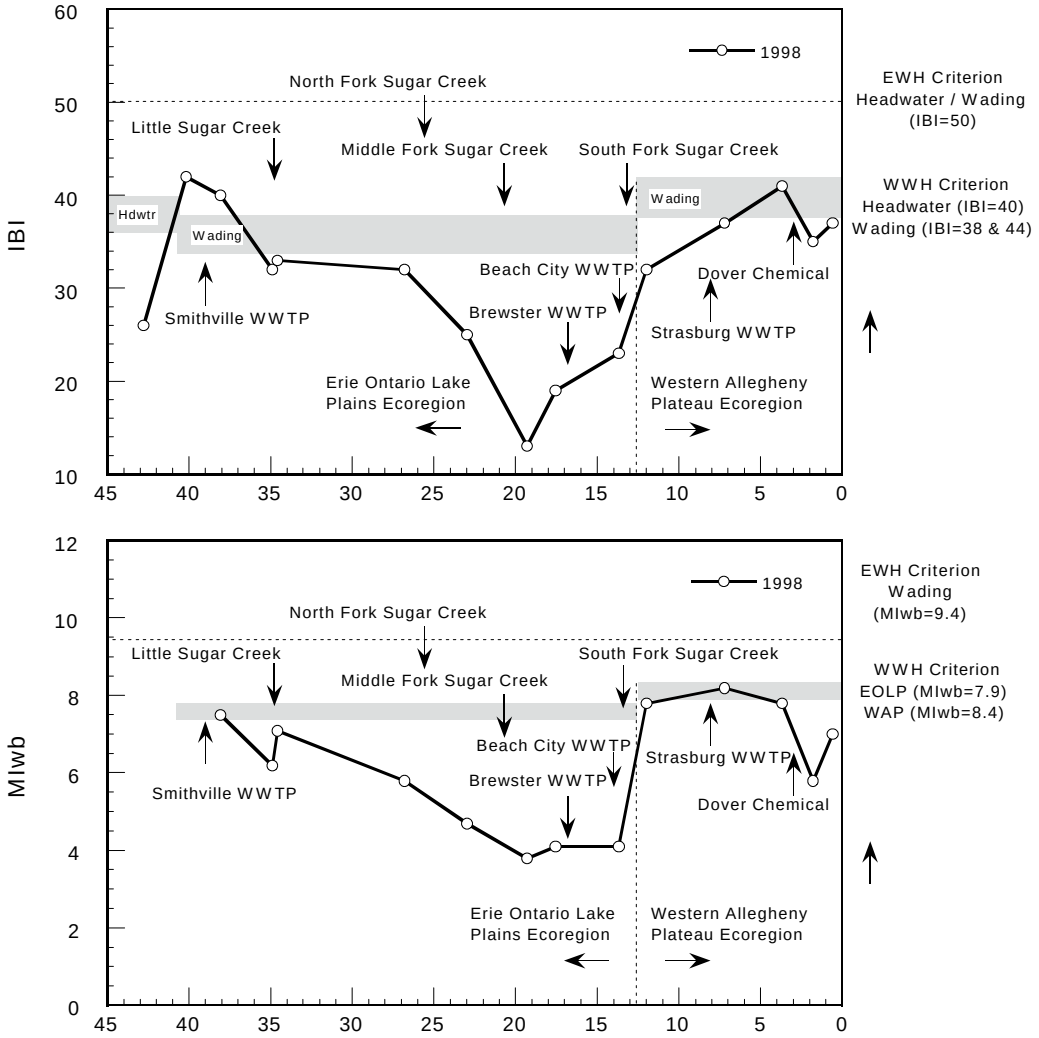

Figure 25 Longitudinal performance of the Index of Biotic Integrity (IBI, upper plot), the Modified Index of Well-being (MIwb, middle plot), in Sugar Creek, 1998.

Table 15. Fish community indices based on pulsed D.C. electrofishing samples collected by Ohio EPA within the Sugar Creek study area 1998. Biocriteria and narrative ranges are in Table 2.

Stream River Mile	Mean Number Species	Cumulative Species	Mean Rel. No. (No./0.3Km)	Mean Rel. Wt. (Wt./0.3Km)	QHEI	Mean MIwb	Mean IBI	Narrative Evaluation[a]
Sugar Creek 1998								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
42.8	-	8	342	4.6	50.0	NA	26*	Poor
40.2	-	14	2472	11.2	53.0	NA	42	Good
38.1	-	19	1296	16.2	47.0	7.5[ns]	40	M.Good-Good
34.9	-	13	291	6.0	44.5	6.2*	32*	Fair
34.6	19.0	21	386	11.5	72.5	7.1*	33*	Fair
26.8	16.0	17	266	5.9	65.0	5.8*	32*	Poor- Fair
23.0	13.5	18	98	48.6	42.5	4.7*	25*	Poor
19.3	7.5	12	32	15.7	51.5	3.8*	13*	Very Poor
17.6	10.0	15	44	22.5	71.0	4.1*	19*	V.Poor-Poor
13.7	10.5	17	43	17.8	78.5	4.1*	23*	V.Poor-Poor
Western Allegheny Plateau (WAP) - WWH Use Designation								
12.0	16.0	21	188	16.1	58.0	7.8*	32*	Fair
7.2	19.5	26	253	23.6	77.5	8.2[ns]	37[ns]	Marginally Good
3.7	24.0	31	224	41.3	91.0	7.8*	41	Fair-Good
1.8	15.5	22	157	8.0	73.5	5.8*	35*	Poor-Fair
0.6	21.5	31	172	12.1	74.0	7.0*	37*	Fair
Little Sugar Creek								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
4.9	8.0	8	620	-	40.0	NA	21*	Poor
0.8	-	17	2510	12.2	49.0	NA	40	Good
Little Sugar Creek Tributary at RM 0.5								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
1.1	-	11	3641	11.9	44.5	NA	34*	Fair
North Fork Sugar Creek								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
5.4	-	10	4164	9.3	63.5	NA	36[ns]	Marginally Good
3.1	-	14	5452	21.4	47.0	NA	40	Good
1.3	-	14	1300	7.2	48.0	NA	34*	Fair
Middle Fork Sugar Creek								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
12.3	-	13	3542	10.8	40.0	NA	42	Good
10.3	-	14	1580	11.6	46.5	NA	44	Good
7.6	-	18	1816	21.5	60.0	8.7	44	Good

Table 15. (continued)

Stream River Mile	Mean Number Species	Cumulative Species	Mean Rel. No. (No./0.3Km)	Mean Rel. Wt. (Wt./0.3Km)	QHEI	Mean MIwb	Mean IBI	Narrative Evaluation[a]
Middle Fork Sugar Creek (continued).								
1.7	14.5	17	168	11.7	58.5	6.2*	35*	Fair
Crabapple Creek								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
2.9	-	15	5636	24.7	45.0	NA	38[ns]	Marginally Good
0.3	-	15	1568	10.2	42.5	NA	44	Good
Middle Fork Sugar Creek Tributary at RM 6.0								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
0.2	-	10	2410	4.7	51.5	NA	40	Good
Misers Run								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
2.0	-	10	1284	8.5	56.5	NA	42	Good
Middle Fork Sugar Creek Tributary at RM 3.25								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
0.5	-	12	598	3.8	57.0	NA	38[ns]	M.Good
Elm Run								
Erie Ontario Lake Plain (EOLP) - WWH Use Designation								
1.7	-	13	648	7.2	55.0	NA	32*	Fair
0.5	-	12	400	-	32.5	NA	30*	Fair
South Fork Sugar Creek								
Western Allegheny Plateau (WAP) - WWH Use Designation								
21.1	-	9	556	-	34.5	NA	20*	Poor
19.0	-	5	222	-	27.0	NA	18*	Poor
15.3	-	11	2366	-	27.0	5.3*	20*	Poor
13.9	-	14	1975	19.8	27.5	7.1*	28*	Fair
13.3	10.5	14	272	6.8	47.0	5.7*	29*	Poor-Fair
7.5	11.0	12	101	24.3	45.0	4.4*	27*	V.Poor
6.4[B]	-	9	163	114.2	50.0	2.9	20*	V.Poor
3.6[B]	10.5	12	125	49.5	50.0	4.5*	26*	V.Poor-Fair
Brush Run								
Western Allegheny Plateau (WAP) - WWH Use Designation								
2.5	-	9	902	-	51.5	NA	28*	Fair
0.4	-	10	2100	8.3	25.5	NA	28*	Fair
Brush Run Tributary at RM 1.54								
Western Allegheny Plateau (WAP) - WWH Use Designation								
0.1	-	0	0	0.0	38.0	NA	12*	V.Poor

Table 15. (continued)

Stream River Mile	Mean Number Species	Cumulative Species	Mean Rel. No. (No./0.3Km)	Mean Rel. Wt. (Wt./0.3Km)	QHEI	Mean MIwb	Mean IBI	Narrative Evaluation[a]
Troyer Valley Creek								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
1.0	-	8	814	-	34.0	NA	22*	Poor
South Fork Sugar Creek Tributary at RM 15.83								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
1.1	-	4	420	-	39.5	NA	22*	Poor
South Fork Sugar Creek Tributary at RM 14.1								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.2	-	5	88	-	22.0	NA	20*	Poor
0.1	-	11	688	-	35.0	NA	28*	Fair
East Branch (South Fork Sugar Creek)								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
5.5	-	9	326	-	44.5	NA	24*	Poor
5.0	-	8	964	-	40.5	NA	24*	Poor
3.3	-	8	1080	-	43.5	NA	22*	Poor
1.7	-	10	389	-	23.0	3.4*	26*	V.Poor-Poor
East Branch Tributary at RM 3.6								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.7	-	3	375	-	34.0	NA	24*	Poor
Pleasant Valley Creek								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.2	-	6	388	-	30.0	NA	24*	Poor
East Branch Tributary at RM 2.07								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.7	-	3	80	-	37.0	NA	20*	Poor
South Fork Sugar Creek Tributary at RM 11.3								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.2	-	4	78	-	36.0	NA	20*	Poor
Walnut Creek								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
7.9	-	12	3080	-	27.0	NA	30*	Fair
6.4	-	7	774	-	25.0	NA	22*	Poor
4.5	-	15	900	17.5	25.5	5.7*	30*	Fair
0.6	8.0	13	48	3.5	47.0	3.2*	23*	V.Poor-Poor
Goose Creek								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.3	-	4	332	-	26.5	NA	18*	Poor

Table 15. (continued)

Stream River Mile	Mean Number Species	Cumulative Species	Mean Rel. No. (No./0.3Km)	Mean Rel. Wt. (Wt./0.3Km)	QHEI	Mean MIwb	Mean IBI	Narrative Evaluation[a]
Walnut Creek Tributary at RM 3.92								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.4	-	6	453	-	33.5	NA	34*	Fair
Indian Trail Creek								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
6.4	-	15	3592	14.1	51.0	NA	34*	Fair
5.9	-	9	250	2.7	63.5	NA	30*	Fair
5.6	-	5	398	-	41.5	NA	22*	Poor
5.3	-	4	66	-	49.0	NA	12*	V.Poor
3.8	-	10	726	4.4	52.0	NA	28*	Fair
2.6	-	10	972	10.8	59.5	NA	30*	Fair
Indian Trail Creek Tributary at RM 6.08								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.4	-	0	0	0.0	50.5	NA	12*	V.Poor
South Fork Sugar Creek Tributary at RM 1.0								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.7	-	7	792	12.1	64.0	NA	26*	Poor
Broad Run								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
2.8	-	16	1366	-	39.0	NA	30*	Fair
0.2		15	184	-	70.0	NA	32*	Fair
Cherry Run								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.2	-	1	10	-	60.5	NA	12*	Poor
Turkeyfoot Run								
		Western Allegheny Plateau (WAP) - WWH Use Designation						
0.2	-	1	6	-	67.0	NA	12*	Poor
Goettge Run								
		Eastern Corn Belt Plains (ECBP) - WWH Use Designation						
0.3	-	5	94	-	61.0	NA	22*	Poor
Brandywine Creek								
		Eastern Corn Belt Plains (ECBP) - WWH Use Designation						
2.0	-	9	2010	-	31.5	NA	30*	Fair
0.2	-	12	536	-	44.5	NA	32*	Fair

*	Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
ns	Nonsignificant departure from biocriterion (≤4 IBI units; ≤0.5 MIwb units).
a	Narrative evaluation is based on both MIwb and IBI scores, respectively.
NA	Not Applicable. The MIwb is not applicable to headwater sites.
B	Boat site. Headwater - wading criteria apply to all other sites.

Most of the sites in Sugar Creek were predominated by tolerant fish. Not surprisingly, lithophils were not abundant. Redhorse and other sucker species were rarely represented by more than one or two types. Darter species were absent within the wetland reach and sunfish species were most numerous downstream. Insectivores declined in the wetland area while omnivores were particularly abundant. Carnivores were generally sparse with more juveniles than adults in all samples. In general the fish community exhibited indications of chronic stressors which prevented achievement of the biocriteria.

Sugar Creek exists as a natural wetland stream from approximately RM 23 to RM 18. Wetland fish assemblages are different from those in more riverine areas. However, the very poor performance (IBI=13, MIwb=3.8) at RM 19.3 was indicative of more than the typical decline associated with wetland reaches. Performance this poor results from acute influences which disrupt fish from inhabiting an area. Dissolved oxygen concentrations are often low in wetland reaches. However, it is likely that D.O. concentrations in this area, exacerbated by nutrient enrichment, exceeded the minimum threshold of tolerance for most fish.

The low percentage of lithophilic spawning fish at all sites was a compelling indication of the poor quality of the stream bed. These fish need clean substrates with interstitial voids in which to deposit their eggs. In the reach downstream from the dam where sediments should have been relatively clean, these fish were nearly absent. Apparently, fine material in the dam pool remains in suspension and is conveyed downstream where lithophils were especially sensitive.

Other fish also need clean substrates on which to forage. Bits of detritus trapped in the interstitial voids are food for some macroinvertebrate and fish species. In turn, other fish eat the detritivores. Although simplistic, this explains the scarcity of carnivores, suckers and darter species. Since the substrates were embedded and covered with silt, these fish had a reduced forage base.

Likewise, other elements of the habitat in the stream and along the margin influenced the abundance of various fish species. Sunfish need quiet pools with structure in which to hide and to forage on. Shallow areas along the stream margin provide protection from predation for many minnow species. If these areas are unshaded, water temperature along the margin can make the shallows uninhabitable. Hogsuckers and redhorse prefer fast flowing currents formed by a constricted channel. These areas of the stream are known as runs. Stream processes which form runs are complex but it sometimes occurs as a result of a tree toppling over along the bank. If it is a large mature tree and the root mass remains anchored, then flow is constricted in the channel and a run forms. A pool may subsequently develop downstream.

As these examples illustrate, fish diversity in Sugar Creek is reduced because habitat attributes related to the ability of the fish population to reproduce, forage, gain protection from predation, etc. are reduced. In the upper reach of Sugar Creek and in its tributaries, agricultural land use has encroached to the stream bank and into the water in many areas. Livestock with unrestricted

access to the stream directly promote bank erosion and siltation. Row crop fields without a buffer of trees between the stream and the cultivated acreage also contribute to siltation and erosion. Both situations are sources of nutrient enrichment.

Less encroachment on the Sugar Creek margin occurs in the wetland reach where agricultural practices are economically unproductive. However, this type of aquatic environment is not conducive to fostering recovery from the upstream land use impacts. Downstream from the wetland reach and from the Beach City reservoir, habitat attributes were improved and the fish community exhibited some subtle positive responses.

Dilution was somewhat effective in countering the land use influence. Overall, fish community performance was best downstream from the Smithville WWTP. As long as the WWTP discharged acceptable quality water, it functioned like a spring. Within a background of siltation, habitat degradation and nutrient enrichment, flow from the WWTP provided some remediation and the fish community responded.

The WWTP discharge is located within a headwater reach. With three sensitive species in this location, it was rivaled by only one other headwater stream in the watershed. Crabapple Creek at RM 0.3 also had three sensitive fish species. A high relative number of fish (2472) downstream from Smithville indicated the plant was a source of enrichment. However, the fish community was apparently more affected by the continuous well oxygenated flow. Otherwise, the assemblage in this location was similar to those documented at other sites.

The fish community downstream from the Strasburg WWTP also improved although the amount of flow from the plant was probably less influential in this stream reach. Downstream from Strasburg, Sugar Creek has good gradient (5 ft/mi) and a strong base flow. Three intolerant species inhabited this reach. It was the only location in the basin with even a modest representation by such fish. Better substrate conditions existed in this reach. In response, four darter species inhabited the area and lithophil numbers increased.

These better habitat conditions extended downstream from Strasburg to upstream from Dover. Habitat conditions at RM 3.7 were excellent (QHEI=91). The fish assemblage at that site exhibited good richness (31, n=2: Θ=24) but lacked abundance (rel.no.=224). The fair MIwb score (7.8) reflected this condition despite the good IBI value (41). The relative absence of larger adult fish at the site is also indicated by the depressed MIwb number. Such a condition suggests the existence of stressors which act to prevent resident fish from reaching maturity and which precludes other fish from migrating into the area.

The siltation, habitat destruction and enrichment across the Sugar Creek basin were a potent combination of stressors. In addition, Dover Chemical, located downstream from this site, was another source of environmental stress. It is plausible that the contaminated reach in the Dover Chemical vicinity retards upstream fish movement. The poor to fair fish community downstream

from the facility confirmed that pollution continued to impair biological health. The substrates here had a strange silt incorporated in the larger aggregate and an organic odor was emitted when the bed was disturbed.

Some impairment was also suggested downstream from the Beach City WWTP. An 18 IBI point differential was determined between the two fish samples collected at this site. Generally, IBI scores at the same site within the same year do not vary by more than a few points. In July, a fair IBI score (32) was calculated with 14 fish species and a relative number of 53 fish at the site. In September, a very poor IBI score (14) with 7 fish species and a relative number of 33 suggested some disruption in water quality. Faulty operation at the WWTP likely accounted for this disparity. In addition, the wetland reach immediately upstream from this location probably induced additional stress by virtue of greater oxygen depletion later in the summer. The site immediately upstream, within the wetland area, also shifted six IBI points between samples.

These reaches of impaired condition should be considered against the background of poor substrate quality, degraded habitat conditions and nutrient enrichment. In another watershed with better background conditions the assimilative capacity of the stream would certainly have been tested by these types of impairment sources. However, the perturbation would have to be even more significant in order to have the same effect as witnessed in Sugar Creek. Basically, the fish assemblage in Sugar Creek is depressed. Any additional pulses are sufficient to cause the fish community to perform in the poor range. Recovery from an episodic event is also prolonged.

In summary, Sugar Creek in 1998 supported a poor to fair fish community. Siltation and basin wide habitat degradation were considered the most influential factors affecting fish community performance. Nutrient enrichment from polluted agricultural runoff also contributed to the impaired performance. At sites which bracketed the Smithville and Strasburg WWTPs, the fish communities improved downstream. Faulty operation at the Beach City WWTP was indicated by a large disparity between two downstream sample results. The reach near Dover Chemical Corp. remained contaminated as previously documented. The severity of overall departure from reasonable expectations in Sugar Creek and its tributaries is nearly unmatched in Ohio. Efforts to remediate this situation are encouraged.

Sugar Creek Tributaries

The status of the fish community was evaluated at 60 tributary locations. Data from these sites is presented in Table 15 and in Appendix tables A-9.

Sites were selected within the Sugar Creek watershed based on similar drainage size. To determine what drainage sizes to use, the entire basin size was divided in half and this value was halved and so on. This geometric division yielded sites which should be 5.6 mi^2, 11 mi^2, 22 mi^2, 44 mi^2, 89 mi^2, 178 mi^2, and 356 mi^2. Locations which best matched these drainages were selected for evaluation.

Other sites were also investigated. However, discussion of the fish community at these sites is located within the Pollutant Loadings Section if the site was used to assess the performance of a specific entity. Some sites were included in the study to satisfy other interests including the influence of mining, to document a least impacted condition, or because the stream seemed likely to be capable of supporting a WWH aquatic life use designation. Discussion of the fish assemblage at these sites will be considered within the context of the following geometric stratification dialogue.

5.6 mi^2 subbasins

Of 14 5.6 mi^2 sites, only one achieved the relevant biocriterion. Two sites registered nonsignificant departure, 6 had fair performance and 5 had poor fish communities (Figure 26). The effects of siltation and habitat destruction were pronounced at this scale. One of the sites with nonsignificant departure had acceptable habitat. Otherwise, 71% of the locations had poor habitat conditions while three sites exhibited fair habitat attributes. These small streams lack the resiliency of a larger subbasin and suffer greatly from perturbations which a larger stream might resist.

In another context, there are more small subbasins in a watershed, so the chances that at least one (or some) will retain an array of natural characteristics is more likely than the chances that one of a smaller subset of larger subbasins in a watershed will do the same. This appealing concept invites speculation as to why one stream within a small geographic area would perform differently than its neighbors. In the Sugar Creek watershed the most significant difference in fish community quality between 5.6 mi^2 sites was best associated with stream flow (Table 16).

The Middle Fork subbasin had good flow. As a result, species indicative of colder continuously flowing water existed in this subwatershed which were not collected or as well represented in other areas of the Sugar Creek drainage. Brook stickleback inhabit cold water. They were recorded in Misers Run, in the Middle Fork Tributary at RM 3.25 and coincidently in the mainstem at RM 38.1. Blacknose dace and southern redbelly dace were prolific in the Middle Fork subbasin. These fish are indicative of continuous flow.

At 5.6 mi^2, the site on the Middle Fork of Sugar Creek at RM 12.3 appeared similar to its subbasin peers. It was within a cattle pasture, was devoid of riparian vegetation and exhibited severe bank erosion. However, it was the only 5.6 mi^2 site to achieve a good IBI score (42). Performance at this site which actually drained 8.0 mi^2 might better be compared to other larger basins in the watershed. The fish community here included species which were better represented at other larger size locations in the watershed. For instance, this was the only 5.6 mi^2 site inhabited by a hogsucker. Common shiners and silverjaw minnow were also plentiful. The combination of these species here but not at other similar sites suggests pool quality was better and that the shallows were probably less silty. The disproportional abundance of dace at this location was interpreted as a factor of location within the subbasin. Had the site been closer to an actual 5 mi^2 drainage, these headwater fish would have been more prolific.

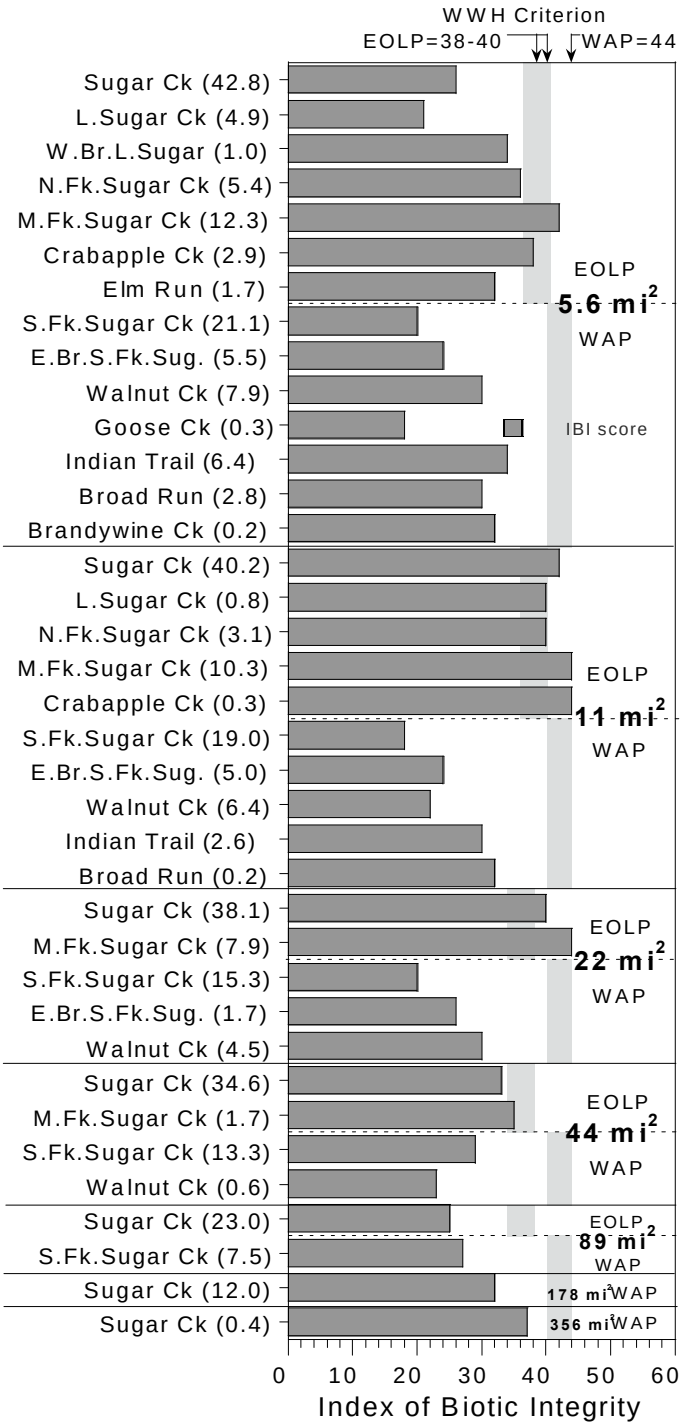

Figure 26 Relative fish community performance as determined with the Index of Biotic Integrity at geographically stratified sites in the Sugar Creek watershed, 1998.

This was the case in Crabapple Creek at RM 2.9. Here, 29% of the fish collected were dace. The 5.1 mi^2 drainage at this location also supported large numbers of common shiners and silverjaw minnows. Strong groundwater flow contributed to better fish community performance and, despite the degraded habitat conditions (QHEI=45), nonsignificant departure from the biocriterion (IBI=38) was recorded at this site.

Flow and better habitat conditions helped fish community performance in the North Fork at RM 5.4. This site was geographically close to the Middle Fork. It is likely that groundwater also contributed to the flow in this reach. Additionally, this site was downstream from Gerber Poultry which discharges a large proportional volume (0.1 MGD) of nutrient enriched effluent to the North Fork. High gradient coupled with flow laced with nutrients produced a relative number of almost 3,000 dace at this site. This site was also downstream from the unsewered community of Kidron. A high number of bluntnose minnow indicated there was an excessive amount of detritus in the stream. Although the dace were one source of detritus, livestock manure and human sewage were other possible sources which merit further investigation.

Of the six 5.6 mi^2 locations evaluated as fair, four were also likely downstream from sources of manure or sewage. Indian Trail Creek at RM 6.4, the West Branch of Little Sugar Creek at RM 1.0, Broad Run at RM 2.8 and Walnut Creek at RM 7.9 all had high numbers of bluntnose minnows.

Indian Trail Creek was adjacent to the Middle Fork and appeared to also have good continuous flow as evidenced by a large population of dace at this location. A mudminnow here was another indication of wetland qualities which would aid flow augmentation. Finally, stoneroller minnows were better represented here than at other 5.6 mi^2 sites. Their presence in proportionally large numbers suggests better substrates in a reach open to sunlight with a source of nutrients upstream.

The West Branch of Little Sugar Creek had fewer dace but enough to suggest reliable flow. Populations of silverjaw minnow and common shiner indicated an adequate insect forage base with deeper pools. Performance in both Indian Trail Creek and the West Branch of Little Sugar Creek could be enhanced with efforts to improve habitat. Both locations were within cattle pastures.

The Broad Run and Walnut Creek locations were in rowcrop agricultural areas. Habitat here was also degraded. Walnut Creek had fewer dace, suggestive of flow limitations and was predominated by tolerant creek chubs. Broad Run appeared to be flow limited especially compared to other similar size streams in the basin.

Elm Run earned a fair IBI score with balanced species representation but may also have diminished flow compared to the other sites discussed thus far since fewer dace were collected here. Historically, brook stickleback were documented at this location so some groundwater

Table 16. Comparison of relative numbers and percentage of selected species caught at 5.6 mi^2 drainage area sites in the Sugar Creek watershed, 1998.

		Relative number and percentage caught of selected species											
Stream	RM	Blacknose Dace		Creek Chub		Silverjaw Minnow		Bluntnose Minnow		Common Shiner		Stoneroller Minnow	
Atypical species		rel.no.	%	rel.no.	%	rel.no.	%	rel.no.	%	rel.no.	%	rel.no.	%
Sugar Creek	42.8	105	18	405	68	-	-	42	7	-	-	-	-
L. Sugar Creek	4.9	-	-	123	20	24	3.8	352	57	5	0.8	-	-
W. Br. L. S.Ck.	1.0	268	7.4	246	6.8	746	20	1299	36	664	18	249	6.8
N. Fk. Sugar Ck.	5.4	2004	48	196	4.7	2	0.1	732	18	-	-	182	4.4
S.Red Belly Dace		994	24										
M. Fk. Sugar Ck.	12.3	156	4.4	220	6.2	1288	36	280	7.9	1090	31	108	3.1
Hogsucker		2	0.1										
Crabapple Creek	2.9	1660	29	1068	19	830	15	380	6.7	652	12	380	6.7
S.Red Belly Dace		4	0.1										
Elm Run	1.7	24	3.7	240	37	-	-	92	14	18	2.8	32	4.9
S. Fk. Sugar Ck.	21.1	32	6	219	39	74	13	178	32	-	-	-	-
E.Br. S. Fk. S.Ck.	5.5	48	15	162	50	32	9.8	38	12	-	-	-	-
Walnut Creek	7.9	114	4	1754	57	646	21	480	16	12	0.4	28	0.9
Goose Creek	0.3	40	12	122	37	60	18	110	33	-	-	-	-
Indian Trail Ck.	6.4	600	17	476	13	340	9.5	1006	28	96	2.7	804	22
S.Red Belly Dace		20	0.6										
Mudminnow		2	0.1										
Broad Run	2.8	8	0.6	178	13	102	7.5	574	42	210	15	2	0.2
Brandywine Ck.	0.2	90	17	208	39	2	0.4	54	10	-	-	6	1.1
Sculpin		20	3.8										

input was still considered likely. Habitat was more natural in appearance at RM 1.7 and better performance might have been predicted. This location was in Brewster. A sewage odor was noticed during the course of collecting the fish sample.

Brandywine Creek with mottled sculpin and blacknose dace failed to meet the biocriterion with fair performance at RM 0.2. Apparently, groundwater flow is continuous at this location but the fish community is unresponsive. The combination of agricultural and acid mine drainage are candidate causes for the source of the departure at this location.

Five 5.6 mi^2 locations registered poor performance. Flow was deemed a likely limiting factor at these sites. Additionally, habitat at all locations was a contributing limiting aspect. Further analysis of the fish communities at these locations is challenging recognizing the assemblages were so simple they failed to yield much information.

11 mi^2 subbasins

At eleven square miles, the influence of flow was pronounced. Locations within a geographic area which was composed of glacial morainal features all had fish communities which performed better than locations which were unglaciated. An ecoregional boundary overlies the morainal feature so, effectively, the sites in the Erie-Ontario Lake Plain achieved the biocriterion while those in the Western Allegheny Plateau did not.

From a habitat perspective, the EOLP sites generally had slightly better QHEI scores but this may also have been another reflection of flow dynamics. Pool formation, riffle development and other morphological features are affected by flow and these features are components of the QHEI.

Aside from these observations, all of the 11 mi^2 sites had poor to fair habitat attributes. All but one were flanked by intensive agricultural use. And, all would be predicted to fail to meet the biocriterion. The fact that fish communities in the EOLP continue to score adequately in the face of habitat obstacles suggests the WWH aquatic life use goal is a minimal expectation. In all likelihood, the EOLP streams draining the glacial moraine could attain the EWH status if habitat was improved.

Stated another way, the EWH aquatic life use standard, as defined by Ohio EPA policy, is a protection goal. Aquatic communities must demonstrate the ability to attain this goal in order to gain its assignment. While the streams in the Sugar Creek basin have been degraded for many years, it does illustrate the importance of correctly documenting aquatic life use before a cause of non-attainment prevents it.

22 mi^2 subbasins

The pattern of enhanced flow diluting the effects from polluted runoff in the EOLP continued downstream at 22 square miles. At this scale, fish communities are assessed with the wading IBI metrics and the MIwb. Good performance was recorded in the EOLP while very poor to fair communities existed in the WAP. As at better smaller size streams, the EOLP stations were downstream from point source discharges which further enhanced flow.

In the EOLP ecoregion, 18 and 19 species were collected at each site. In the WAP ecoregion, 10, 11 and 15 species were collected. This disparity was further reflected in MIwb scores which were 8.7 and 7.5 in the EOLP compared to 3.4, 5.3, and 5.7 in the WAP. Essentially, the fish were better distributed among species groups and from juveniles to adults in the EOLP. This aspect of community health was reflected by IBI metric scores as well.

Tolerant fish completely predominated the WAP assemblages. Simple lithophils were nearly absent, as were insectivores. The lack of both of these groups suggested the substrates were in poor condition at 22 mi^2 in the WAP. Furthermore, no darters or intolerant species were collected at these WAP locations. Taken as a whole, water quality in the WAP became more

polluted downstream as runoff constituents from headwaters were concentrated in larger sub basin reaches.

44 mi^2 subbasins
An evening of conditions occurred at 44 square miles in the Sugar Creek watershed. Performance in the EOLP declined while the South Fork of Sugar Creek at RM 13.3 exhibited a small improvement. Walnut Creek might also have been expected to show an improvement but a significant disparity was documented between two fish samples collected at RM 0.6.

In July, very poor results at RM 0.6 were interpreted to be the result of some type of sporadic or spurious event. This location was downstream from the confluence with Indian Trail Creek. Several entities discharge into Indian Trail. The probability that an unreported release occurred was considered likely especially in consideration of the chronic contamination emanating from Holmes ByProducts. By September, some recovery had occurred but performance was still poor to fair.

As mentioned with regard to the downstream concentration of pollutants at 22 mi^2 in the WAP this also seemed to be a basinwide condition at 44 mi^2. None of the fish communities at this scale achieved the biocriteria. Tolerant species predominated each location. No intolerant species were collected at any of the sites. Relative numbers of fish ranged from 48 to 386. Community traits were so simplified that further assessment was confounded. Conditions for fish were deplorable in the Sugar Creek watershed at 44 mi^2.

89 mi^2 subbasins
No improvement occurred with the next increase in basin size in the Sugar Creek watershed. Both 89 mi^2 sites were located in wetland influenced reaches thus assessment of the fish community performance at this scale must account for these habitat conditions. Both sites registered poor performance. Relative numbers of fish were 98 and 101. With this few fish the concept of community interaction is nebulous. Basically, upstream impacts combined with marginal habitat created conditions which were not conducive to fish inhabiting either location.

*178 and 356 mi^2 subbasin*s
Discussion of these drainages is effectively a discussion of the mainstem of Sugar Creek downstream from the Beach City Dam. This information is detailed in the dialog regarding fish community performance in Sugar Creek. Habitat exerted a greater role through this reach although the contaminated Dover Chemical area depressed performance.

Taken as a whole, fish community performance in the Sugar Creek watershed was almost unrivaled across Ohio for its diminished quality. Most streams in the basin originate in livestock pastures or within intensive rowcrop areas. Additionally, some streams flow from strip mine areas. As the tributaries confluenced, silt, nutrients and other pollutants were concentrated. This, in combination with severe habitat degradation, acted to make Sugar Creek an inhospitable

stream for fish. Downstream from the confluence with the South Fork and from the Beach City Dam, improved habitat resulted in some better community performance. This enhancement was longitudinally short as the contamination associated with Dover Chemical acted to retard further gains downstream. Sugar Creek is a source of excessive siltation and nutrient enrichment to the Tuscarawas River.

Area of Degradation Value Trend Assessment: 1998

The Area of Degradation Value (ADV) portrays the length and amount of departure from a biocriterion by an aquatic community. It reflects the distance that the biological index (IBI, MIWB, or ICI) moves longitudinally from the applicable biocriterion or from an upstream measurement of performance. A positive ADV is represented by the area above the biocriterion (or upstream level) when the results for each index are plotted against river mile (Figures. 17 upper plot and 18). Conversely, a negative ADV represents the more typical degradation (Figure 3). The results are also expressed as ADV/mile to normalize comparisons between segments and other streams and rivers. ADV statistics reported in Table 17 reflect positive and negative influences on the aquatic communities because a given reach can have segments which exceed and which do not attain biocriteria.

The attainment statistics imply that only seven percent (3.2 miles) of Sugar Creek fully met the WWH biocriteria in 1998. Twenty four miles (56.6%) were in partial attainment and 39.3% (17.7 miles) were in non-attainment of the biocriteria.

Table 17. Area of Degradation Values (ADV) statistics for Sugar Creek,1998. Values were calculated using Erie-Ontario Lake Plain and Western Allegheny Plateau ecoregion WWH biocriteria as the baseline for community performance.

Stream (Year)			Biological Index Values		ADV Statistics				Attainment Status		
	Reach				Positive		Negative		(miles)		
Index	Upper RM	Lower RM	Mini-mum	Maxi-mum	ADV	**ADV/ Mile**	ADV	**ADV/ Mile**	FULL	PARTIAL	**NON**
Sugar Creek (1998)											
IBI	45.0	0.0	13	42			2552	**56.7**	3.2	24.1	**17.7**
MIWB			3.8	8.1			2856	**63.4**			
ICI			26	44			32	**0.7**			

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Appendix Table A-1. Ohio EPA permitted discharges in the Sugar Creek watershed. List is from the SWIMS May 1999 database.

RM	Entity	Flow (MGD)	Discharge to
	Broadrun Cheese House		Broad Run
3.7	Kimble Clay & Limestone Co		Broad Run to Sugar Creek
	Belden Brick		unnamed Trib of Broad Run
	Alpine Hills Resort	0.005	unnamed Trib of Broad Run
	Kimble Clay & Limestone Co		unnamed Trib to Broad Run
0.95	Baltic WWTP	0.1	Brush Run
2.29	Allied-Baltic Rubber Inc	0.016	Brush Run Creek
	Buckeye Industrial Mine Inc		East Branch Creek
	Belden Brick		Ut to E Branch
	Holmes By Products		Ut to Indian Trail Creek
5.42/0.25	Troyer's Trail Bologna Inc	0.0045	Ut to Indian Trail Creek
4.84/.9	Holmco Industries	0.0015	Ut to Indian Trail Creek
3.2/1.4	Case Farms Inc	0.5	Ut to Indian Trail Creek
	Wilmot WTP	0.00225	Middle Fork
11.61/0.5	Canton Water Dept Sugarcreek Plant	0.078	Middle Fork-Sugar Creek
8.5	Alpine Cheese Factory Inc	0.025	Middle Fork-sugar Creek
	Wheeling Acquisition Corp	0.159	Middle Fork-sugar Creek
	Brewster Mechanical Faci		
12.48/2.2	Mt Hope WWTP	0.022	unnamed Trib to Middle Fork Sugar c
	Alpine Alpa Restaurant	0.015	unnamed Trib to Middle Fork Sugar c
6.11	Kidron Inc	0.006	N Fork Sugar Creek
5.85/0.8	Gerber's Poultry Inc	0.25	ut to North Fork-sugar Creek
2.48/1.	Mount Eaton Village	0.045	ut to North Fork-sugar Creek
	Sugarcreek Clay & Limestone		Pleasant Valley Creek
14.46/0.16	Belden Brick Co Plant No 3		S Frk Sugar Crk/Turkeyfoot Run
	Miller Mining Inc		South Fork Sugar Creek
14.1/0.48	Belden Brick Co Plant No 8		South Fork-sugar Creek
14.2	Sugarcreek STP	0.5	South Fork-sugar Creek
14.1/0.19	Ohio Whey Products Ltd Whey Drying Plant	0.065	South Fork-sugar Creek
15.83/1.4	Holmes Limestone Co		Trib to South Fork Sugarcreek
15.83/2.1	Holmes Limestone Co		Trib to South Fork Sugarcreek
	Belden Brick		Trib to South Fork Sugarcreek
	Holmes Limestone Co		Trib to South Fork Sugarcreek
	Belden Brick		Trib to South Fork Sugarcreek
	Belden Brick		Trib to South Fork Sugarcreek
	Holmes Limestone Co		Trib to South Fork Sugarcreek

RM	Entity	Flow (MGD)	Discharge to
	Belden brick		Trib to South Fork Sugarcreek
	Skyline Corp		Trib to South Fork Sugarcreek
	Miller Mining Inc Barrs Mill Tipple		trib to South Fork Sugarcreek
	Wayne Co Eastwood Subdivision STP	0.06	trib to South Fork Sugarcreek
	Kimble Clay & Limestone Co		Sugar Creek
7.45	Strasburg STP	0.225	Sugar Creek
	U.S. Silica Company-Dundee	0.01	Sugar Creek
19.04	Brewster STP	0.665	Sugar Creek
	Riceland Mobile Village		Sugar Creek
	Dover Chemical Subsidiary of ICC	1.45	Sugar Creek
19.05	Brewster Dairy Control Plant	0.3015	Sugar Creek
40.33	Smithville WWTP		Sugar Creek
	Beach City Lake - U.S. Army COE		Sugar Creek
13.8	Beach City Wilmot STP		
	Smithville Western Limited	0.09	Sugar Creek
20.8	Brewster PWS		Sugar Creek
31.85	Wayne Co Lake Harmony Subdivision STP	0.036	Sugar Crk
	Horizon Coal Corp		Sugar creek
	Smithville MHP		trib to Sugar Creek
	Sugarcreek WTP	0.021	trib to Sugar Creek
	Holmes Limestone Co		Troyer Valley Creek
1.47/0.12	Union Cheese Co		Troyer Valley Creek
2.08 to 2.58	Holmes Limestone Co		Troyer Valley Creek
	Red Malcuit Inc		
	Belden Brick		Turkey Foot Run
7.88	Walnut Hills Nursing & Reti		Walnut Creek
3.92/0.7	Miller Mining Co		Walnut Creek
	Holmes Cty Health Dept Walnut Crk WWTP	0.09	trib of Walnut Creek
	Der Dutchman Restaurant	0.06	trib of Walnut Creek

Appendix Table A-2. Results of chemical/physical sampling conducted in the Sugar Creek study area during July-September, 1998. Values proceeded by (<) indicate concentration below method detection limit. Italicized headings represent effluent samples and are arranged according to the outfall river mile location. Note: mainstem results precede tributaries and demand parameters follow nutrients and metals.

Sugar Creek (RM 42.8) Schellin Rd.

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.01	19.8	8.10	<2.0	21	709	1.96	<0.05	0.07	442	5
7/21	-	-	-	<2.0	<10	786	0.35	<0.05	<0.05	498	<5
8/11	5.70	20.5	7.70	4.1	33	557	2.85	0.41	1.4	373	14
8/27	6.20	18.5	7.80	<2.0	24	410	2.30	0.60	0.25	274	11
9/8	7.50	15.8	8.10	<2.0	<10	821	0.21	<0.05	0.25	502	<5
Mean	6.85	18.7	7.93	2.4	20	656	1.53	0.23	0.40	418	8

Smithville WWTP effluent (RM 40.33)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.66	19.3	7.51	2.1	12	1020	8.72	<0.05	1.42	584	<5
7/21	5.64	21.8	7.47	<2.0	16	1360	15.70	<0.05	2.09	764	<5
8/11	5.00	21.2	7.50	<2.0	<10	987	7.85	0.21	1.65	566	<5
8/27	6.80	20.0	7.60	4.7	21	785	6.67	0.46	0.70	462	7
9/8	Not sampled----------										
Mean	6.28	20.6	7.52	2.7	15	1038	9.73	0.19	1.47	594	5

Sugar Creek (RM 40.18) CR 502

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	9.36	20.1	7.92	<2.0	<10	603	6.59	<0.05	0.19	364	<5
7/21	7.07	22.5	7.87	<2.0	13	679	5.83	<0.05	0.26	404	5
8/11	6.90	21.0	7.80	5.0	27	510	3.58	0.18	1.17	346	17
8/27	7.50	19.0	8.00	<2.0	21	392	3.55	0.15	0.21	252	9
9/8	9.10	17.3	8.30	<2.0	15	703	5.91	<0.05	0.38	426	<5
Mean	7.99	20.0	7.98	2.6	17	577	5.09	0.10	0.44	358	8

Sugar Creek (RM 36.88) Orr Road

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	9.03	20.4	7.81	<2.0	<10	542	8.63	<0.05	0.10	322	6
7/21	6.58	23.0	7.84	<2.0	10	619	5.39	<0.05	0.11	366	<5
8/11	6.60	21.1	7.70	3.9	21	492	3.82	0.13	0.64	334	40
8/27	7.20	19.0	-	<2.0	15	382	7.62	0.14	0.49	242	22
9/8	8.40	17.2	8.20	<2.0	<10	632	5.73	<0.05	0.16	372	<5
Mean	7.56	20.1	7.89	2.4	13	533	6.24	0.08	0.30	327	16

Sugar Creek (RM 34.69) Kansas Road

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.06	21.2	7.84	<2.0	14	545	6.38	<0.05	0.11	328	16
7/21	5.94	23.7	7.86	<2.0	16	635	4.06	<0.05	0.14	372	12
8/11	6.20	21.2	7.80	4.4	18	558	3.15	0.12	0.47	352	67
8/27	7.40	19.1	-	<2.0	21	386	5.66	0.14	0.31	248	37
9/8	7.40	17.5	8.00	<2.0	12	621	4.29	<0.05	0.11	364	6
Mean	7.00	20.5	7.88	2.5	16	549	4.71	0.08	0.23	333	28

Sugar Creek (RM 26.7) West Lebanon Road

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.32	22.3	7.82	<2.0	15	657	5.52	<0.05	0.14	396	31
7/21	6.21	24.4	7.83	2.5	16	589	1.75	<0.05	0.14	361	18
8/11	5.50	22.6	8.00	4.6	<10	643	2.68	0.26	1.05	346	62
8/27	5.90	20.5	-	3.9	31	323	3.46	0.22	0.38	214	71
9/8	6.80	18.2	8.00	<2.0	12	580	3.12	0.05	0.21	338	17
Mean	6.55	21.6	7.91	3.0	16	558	3.31	0.13	0.38	331	40

Sugar Creek (RM 22.95) Alabama Road

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.98	21.7	7.79	<2.0	<10	536	4.19	0.06	0.18	328	40
7/21	6.40	24.0	7.90	2.4	18	580	1.81	0.05	0.20	360	32
8/11	4.80	22.6	7.90	2.2	<10	589	1.20	0.20	0.26	406	29
8/27	4.10	20.5	-	3.2	34	286	2.48	0.25	0.44	192	57
9/8	6.50	18.1	8.00	<2.0	15	578	2.16	0.11	0.12	334	30
Mean	5.96	21.3	7.89	2.3	17	513	2.36	0.13	0.24	324	37

Sugar Creek (RM 19.36) SR 93

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.81	22.6	7.80	2.0	<10	490	3.40	0.05	0.18	314	70
7/21	6.67	24.1	7.84	4.9	18	531	1.56	<0.05	0.17	346	37
8/11	6.30	23.0	7.80	2.9	<10	575	0.07	0.19	0.35	378	66
8/27	4.50	21.2	7.80	<2.0	31	258	2.33	0.22	0.37	174	23
9/8	6.90	18.7	7.90	<2.0	<10	544	1.53	0.07	0.20	316	34
Mean	6.43	21.9	7.82	2.8	15	479	1.77	0.11	0.25	305	46

Brewster Dairy effluent (RM 19.03)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	6.20	28.3	7.84	5.5	30	4260	1.15	0.20	10.8	2310	13
7/21	-	-	-	12	21	4330	12.9	0.37	9.4	2370	22
8/11	6.00	27.8	8.10	16	27	4270	0.75	0.54	11.6	2340	53
8/27	Not sampled----------										
9/8	Not sampled----------										
Mean	6.10	28.0	7.97	11.1	26	4286	4.93	0.37	10.6	2340	29

Brewster WWTP effluent (RM 19.04)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	6.00	21.1	7.34	4.4	30	1060	12.1	0.14	1.85	628	<5
7/21	6.56	21.9	7.42	8.1	21	1250	21.9	0.07	3.61	762	7
8/11	5.90	22.3	7.90	4.3	<10	1030	7.85	0.08	2.02	616	6
8/27	5.70	22.0	7.50	5.5	31	740	<0.1	1.86	0.75	422	<5
9/8	Not sampled----------										
Mean	6.04	21.8	7.54	5.5	23	1020	10.48	0.53	2.05	607	5

Sugar Creek (RM 18.55) U.S. 62

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.70	22.7	7.78	2.0	12	515	3.23	0.07	0.37	328	83
7/21	6.63	24.0	7.90	3.5	21	619	2.06	0.05	0.50	364	61
8/11	6.30	22.8	7.80	4.2	<10	553	1.20	0.23	0.50	345	88
8/27	4.60	22.2	7.40	2.0	34	251	2.56	0.29	0.36	170	27
9/8	6.80	18.8	8.00	<2.0	<10	634	3.75	0.27	2.06	378	33
Mean	6.40	22.1	7.77	2.7	17	514	2.56	0.18	0.75	317	58

Beach City WWTP effluent (RM 13.80)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	4.86	21.7	6.74	4.6	24	1140	7.5	0.13	4.00	670	7
7/21	6.93	22.5	6.96	6.9	36	1400	18.7	0.14	0.70	840	12
8/11	7.45	23.1	6.87	3.2	27	1290	18.1	0.15	4.20	768	8
8/25	5.73	22.5	7.42	2.1	32	1320	15.1	0.10	4.06	806	7
9/8	3.37	21.6	6.82	4.3	25	1390	11.2	0.16	4.15	808	8
Mean	5.66	22.2	6.96	4.2	28	1308	14.1	0.13	3.42	778	8

Sugar Creek (RM 13.70) Dst. Beach City WWTP

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	6.35	22.1	6.58	4.0	21	482	3.13	0.09	0.54	320	77
7/21	5.20	23.3	7.40	3.0	<10	595	2.86	0.11	<0.05	364	35
8/11	4.97	22.2	7.35	4.2	15	441	1.83	0.28	0.80	284	157
8/25	6.11	20.3	7.37	10.0	99	339	1.64	0.42	1.79	238	570
9/8	5.74	18.4	6.53	<2.0	<10	622	1.78	<0.05	0.66	358	32
Mean	5.67	21.2	7.04	4.6	31	495	2.24	0.19	0.76	312	174

Sugar Creek (RM 12.07) Dst. Beach City Reservoir

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	6.01	22.1	6.54	4.2	24	523	2.36	0.23	0.43	382	104
7/21	5.13	23.2	6.69	4.5	14	760	1.37	0.22	0.33	540	92
8/11	5.91	22.8	6.64	4.7	18	595	1.06	0.25	2.17	398	84
8/25	8.55	20.5	7.58	6.0	57	474	1.43	0.42	1.16	308	378
9/8	6.69	18.6	6.97	2.2	18	856	1.42	0.13	0.48	562	58
Mean	6.45	21.4	6.88	4.3	26	641	1.52	0.25	1.06	438	164

Strasburg WWTP effluent (RM 7.45)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	3.80	22.3	6.68	4.7	24	1340	16.9	<0.05	2.51	834	7
7/21	3.29	23.2	6.81	3.6	14	1570	17.5	0.39	2.91	932	8
8/11	3.14	23.2	6.81	<2.0	15	1600	16.3	0.09	3.71	953	<5
8/25	4.15	22.0	7.38	<2.0	16	1370	15.6	0.13	2.79	804	9
9/8	2.66	20.6	7.14	2.6	15	1560	19.7	0.37	2.72	922	6
Mean	3.40	22.2	6.96	2.9	16	1488	17.2	0.20	2.92	889	7

Sugar Creek (RM 7.28) SR 250

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	6.52	21.7	6.67	2.9	27	517	2.4	0.13	0.50	378	98
7/21	5.80	23.6	6.84	2.2	<10	783	1.6	0.08	0.77	543	48
8/11	5.38	22.5	6.80	4.4	15	472	1.5	0.18	1.57	302	199
8/25	8.35	20.3	6.78	10	99	346	1.2	0.42	2.85	257	136
9/8	6.97	17.9	7.40	2.0	25	818	1.8	<0.05	0.42	538	25
Mean	6.60	21.2	6.89	4.3	35	587	1.7	0.17	1.22	403	101

Sugar Creek (RM 3.64) CR 80

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	5.83	21.3	6.85	4.0	21	545	2.30	0.15	0.34	414	115
7/21	6.25	23.1	7.00	2.3	<10	870	1.62	0.06	0.28	600	39
8/11	6.63	22.4	7.03	4.2	15	566	1.20	0.15	0.55	362	82
8/25	7.90	20.3	7.63	9.9	19	409	1.26	0.55	1.79	292	156
9/8	7.09	17.3	7.64	<2.0	56	853	1.58	<0.05	0.29	578	15
Mean	6.74	20.8	7.23	4.4	24	648	1.59	0.19	0.65	449	81

Dover Chemical effluent (RM 2.10)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.73	20.6	7.48	<2.0	<10	772	1.40	<0.05	<0.05	507	<5
7/21	7.04	21.0	7.66	<2.0	<10	788	1.25	<0.05	0.05	536	<5
8/11	8.66	19.9	7.56	<2.0	<10	789	1.22	<0.05	0.59	512	<5
8/25	9.68	22.1	7.92	<2.0	19	785	1.20	<0.05	0.19	478	<5
9/8	6.65	21.2	7.72	<2.0	<10	804	1.27	<0.05	0.66	510	<5
Mean	8.15	20.9	7.66	<2.0	11	787	1.26	<0.05	0.30	508	<5

Sugar Creek (RM 1.83) SR 516 & 39

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.04	21.7	6.93	3.9	18	552	2.28	0.10	0.30	374	86
7/21	6.65	23.0	7.39	2.3	<10	889	1.64	<0.05	0.18	644	32
8/11	4.69	23.0	7.34	3.2	27	666	1.11	0.10	0.56	426	80
8/25	7.75	20.5	7.68	9.5	<10	425	1.17	0.50	1.33	296	625
9/8	7.20	18.1	7.35	<2.0	<10	849	1.58	<0.05	0.37	568	26
Mean	6.86	21.2	7.33	4.1	15	676	1.55	0.16	0.54	461	169

Sugar Creek (RM 0.63) SR 39

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	10.40	21.7	7.00	4.0	18	635	2.56	0.12	0.31	378	97
7/21	7.02	23.3	7.02	2.2	<10	888	1.54	<0.05	0.16	620	27
8/11	6.53	22.8	7.33	2.4	16	790	0.99	0.06	1.02	504	39
8/25	8.00	20.5	7.86	8.1	99	428	1.13	0.45	1.35	298	530
9/8	8.03	17.8	7.55	<2.0	<10	856	1.50	<0.05	0.55	578	14
Mean	7.99	21.2	7.35	3.7	30	719	1.54	0.14	0.67	475	141

Sugar Creek (RM 42.8) Schellin Rd.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	78	<10	<2	29	<40	<2	<10	314	253
7/21	3	<0.2	92	<10	<2	40	<40	<2	13	394	213
8/11	2	<0.2	56	<10	<2	19	<40	<2	16	218	981
8/27	4	<0.2	45	<10	<2	15	<40	<2	12	174	1040
9/8	3	<0.2	98	<10	<2	43	<40	<2	<10	422	199
Mean	2	<0.2	73	<10	<2	29	<40	<2	12	304	537

Smithville WWTP effluent (RM 40.33)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	63	<10	<2	19	<40	<2	44	236	<50
7/21	<2	<0.2	74	11	<2	25	<40	<2	34	288	<50
8/11	2	<0.2	64	<10	<2	18	<40	<2	32	234	<50
8/27	<2	<0.2	61	10	<2	17	<40	<2	22	222	133
9/8	Not sampled----------										
Mean	2	<0.2	65	10	<2	19	<40	<2	33	245	70

Sugar Creek (RM 40.18) CR 502

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	58	<10	<2	21	<40	<2	<10	231	98
7/21	<2	<0.2	65	<10	<2	26	<40	<2	<10	269	87
8/11	2	<0.2	46	<10	<2	15	<40	<2	13	177	1300
8/27	2	<0.2	37	<10	<2	12	<40	<2	<10	142	696
9/8	<2	<0.2	64	<10	<2	26	<40	<2	<10	267	68
Mean	2	<0.2	54	<10	<2	20	<40	<2	10	217	449

Sugar Creek (RM 36.88) Orr Road

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	54	<10	<2	19	<40	<2	10	213	257
7/21	<2	<0.2	60	<10	<2	22	<40	<2	<10	240	250
8/11	<2	<0.2	48	<10	4	16	<40	<2	24	186	1400
8/27	2	<0.2	41	<10	<2	65	<40	<2	14	156	1530
9/8	<2	<0.2	60	<10	<2	24	<40	<2	<10	249	242
Mean	<2	<0.2	52	<10	2	29	<40	<2	13	208	735

Sugar Creek (RM 34.69) Kansas Road

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	54	<10	<2	18	<40	<2	<10	209	498
7/21	<2	<0.2	61	<10	<2	22	<40	<2	<10	243	645
8/11	<2	<0.2	52	<10	3	17	<40	<2	14	200	1790
8/27	2	<0.2	39	<10	<2	13	<40	<2	12	151	1930
9/8	<2	<0.2	61	<10	<2	22	<40	<2	<10	243	402
Mean	2	<0.2	53	<10	2	18	<40	<2	11	209	1053

Sugar Creek (RM 26.7) West Lebanon Road

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	60	<10	<2	18	<40	<2	<10	224	843
7/21	<2	<0.2	61	<10	<2	20	<40	<2	<10	235	888
8/11	2	<0.2	49	<10	3	17	<40	<2	14	192	2590
8/27	3	<0.2	32	<10	2	10	<40	<2	16	121	2800
9/8	<2	<0.2	59	<10	<2	21	<40	<2	<10	234	966
Mean	2	<0.2	52	<10	2	17	<40	<2	12	201	1617

Sugar Creek (RM 22.95) Alabama Road

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	13	1	56	<10	12	17	<40	9	<10	210	940
7/21	2	<0.2	62	<10	<2	19	<40	<2	<10	233	1400
8/11	3	<0.2	64	<10	<2	21	<40	<2	<10	246	1430
8/27	3	<0.2	28	<10	2	9	<40	<2	17	107	2980
9/8	3	<0.2	61	<10	<2	20	<40	<2	<10	235	1450
Mean	4	0.3	54	<10	4	17	<40	3	11	206	1640

Sugar Creek (RM 19.36) SR 93

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	54	<10	<2	14	<40	<2	10	192	3410
7/21	2	<0.2	60	<10	<2	17	<40	<2	16	220	1840
8/11	4	<0.2	60	<10	3	19	<40	<2	16	228	3170
8/27	2	<0.2	26	<10	<2	7	<40	<2	<10	94	1970
9/8	2	<0.2	63	<10	<2	19	<40	<2	13	236	1770
Mean	2	<0.2	52	<10	2	15	<40	<2	13	194	2432

Brewster Dairy effluent (RM 19.03)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	5	<0.2	67	<10	<2	17	<40	<2	<10	237	60
7/21	4	<0.2	64	<10	<2	19	<40	<2	<10	238	83
8/11	4	<0.2	68	<10	<2	16	<40	<2	<10	236	137
8/27	Not sampled----------										
9/8	Not sampled----------										
Mean	4	<0.2	66	<10	<2	17	<40	<2	<10	237	93

Brewster WWTP effluent (RM 19.04)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	3	<0.2	72	<10	<2	17	<40	<2	31	250	52
7/21	<2	0.2	75	13	<2	19	<40	<2	29	266	127
8/11	4	<0.2	70	<10	<2	17	<40	<2	28	245	95
8/27	3	<0.2	61	<10	<2	13	<40	<2	15	206	<50
9/8	Not sampled----------										
Mean	3	0.2	69	10	<2	16	<40	<2	25	241	81

Sugar Creek (RM 18.55) U.S. 62

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	55	<10	2	15	<40	<2	11	199	2010
7/21	3	<0.2	60	<10	<2	16	<40	<2	<10	216	2470
8/11	4	<0.2	57	<10	3	17	<40	<2	20	212	3660
8/27	2	<0.2	24	<10	<2	7	<40	<2	11	89	2190
9/8	3	<0.2	63	<10	<2	19	<40	<2	<10	236	1580
Mean	2	<0.2	51	<10	2	14	<40	<2	12	190	2382

Beach City WWTP effluent (RM 13.80)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	79	<10	<2	22	<40	<2	46	288	<50
7/21	<2	0.2	84	10	<2	25	<40	<2	43	313	70
8/11	<2	0.2	82	<10	<2	25	<40	<2	51	308	75
8/25	<2	0.2	84	<10	<2	24	<40	<2	51	308	155
9/8	<2	0.2	92	<10	<2	27	<40	<2	52	341	66
Mean	<2	0.2	84	10	<2	24	<40	<2	48	311	83

Sugar Creek (RM 13.70) Dst. Beach City WWTP

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	3	<0.2	52	<10	2	14	<40	<2	26	187	1430
7/21	3	<0.2	57	<10	<2	16	<40	<2	<10	208	1620
8/11	2	<0.2	46	<10	5	12	<40	<2	30	164	7040
8/25	<4	<0.2	36	17	14	10	<40	<2	83	131	19500
9/8	3	<0.2	64	<10	<2	18	<40	<2	13	234	2070
Mean	3	<0.2	51	11	3	14	<40	<2	32	184	6332

Sugar Creek (RM 12.07) Dst. Beach City Reservoir

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	56	<10	3	21	<40	<2	17	226	2020
7/21	3	<0.2	81	<10	3	33	<40	<2	16	338	3650
8/11	4	<0.2	62	<10	5	23	<40	<2	45	250	8070
8/25	3	<0.2	49	13	9	18	<40	<2	69	196	12500
9/8	3	<0.2	92	<10	<2	38	<40	<2	11	386	2400
Mean	3	<0.2	68	10	4	26	<40	<2	31	279	5728

Strasburg WWTP effluent (RM 7.45)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	0.3	99	<10	<2	26	<40	<2	71	354	57
7/21	<2	0.4	104	<10	2	27	<40	<2	78	371	101
8/11	<2	0.4	108	<10	<2	28	<40	<2	84	385	<50
8/25	<2	0.3	95	<10	<2	25	<40	<2	63	340	150
9/8	<2	0.3	114	<10	<2	30	<40	<2	59	408	73
Mean	<2	0.3	104	<10	2	27	<40	<2	71	371	86

Sugar Creek (RM 7.28) SR 250

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	56	<10	3	20	<40	<2	17	222	2470
7/21	2	<0.2	82	<10	<2	33	<40	<2	<10	341	1780
8/11	3	<0.2	52	10	6	15	<40	<2	46	192	8100
8/25	4	0.3	40	20	16	12	<40	<2	111	149	26700
9/8	2	<0.2	89	<10	<2	35	<40	<2	10	366	1090
Mean	2	0.2	63	12	5	23	<40	<2	38	254	8028

Sugar Creek (RM 3.64) CR 80

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	3	<0.2	60	<10	3	22	<40	<2	29	240	2470
7/21	2	<0.2	96	<10	2	39	<40	<2	10	400	1490
8/11	3	<0.2	58	<10	2	19	<40	2	27	223	3790
8/25	3	0.3	46	20	16	16	42	<2	123	181	24100
9/8	<2	<0.2	96	<10	<2	37	<40	<2	16	392	752
Mean	2	0.2	71	12	5	26	40	2	41	287	6520

Dover Chemical Effluent (RM 2.10)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	0.4	95	<10	<2	27	<40	<2	14	348	69
7/21	<2	0.5	96	<10	<2	27	<40	<2	<10	351	73
8/11	<2	<0.2	98	<10	<2	28	<40	<2	<10	360	115
8/25	<2	5.0	98	<10	<2	27	<40	<2	21	356	<50
9/8	<2	0.4	97	<10	<2	29	<40	<2	<10	362	117
Mean	<2	1.3	96	<10	<2	27	<40	<2	13	355	84

Sugar Creek (RM 1.83) SR 516 & 39

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	61	<10	3	23	<40	<2	24	247	2190
7/21	<2	<0.2	95	<10	<2	39	<40	<2	<10	398	1050
8/11	3	<0.2	68	<10	2	23	<40	<2	23	264	3170
8/25	3	0.3	48	21	16	17	45	<2	126	190	23800
9/8	<2	<0.2	95	<10	<2	37	<40	<2	<10	390	506
Mean	2	0.2	73	12	5	27	41	<2	38	297	6143

Sugar Creek (RM 0.63) SR 39

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	3	<0.2	58	<10	3	22	<40	<2	29	235	2060
7/21	<2	<0.2	94	<10	<2	38	<40	<2	<10	391	747
8/11	2	<0.2	78	<10	<2	28	<40	<2	15	310	1580
8/25	3	0.3	48	19	16	17	46	<2	119	190	23800
9/8	<2	<0.2	98	<10	<2	36	<40	<2	11	393	552
Mean	2	0.2	75	11	5	28	41	<2	36	303	5747

Sugar Creek (RM 42.8) Schellin Rd.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	43	3	19	206	210	0.02	77	0.6
7/21	273	<30	29	3	20	252	233	<0.02	114	<0.2
8/11	610	<30	45	9	24	156	129	0.24	53	1.5
8/27	869	<30	38	6	12	125	117	0.06	44	1.4
9/8	<200	<30	23	4	24	273	265	<0.02	110	<0.2
Mean	430	<30	36	5	20	202	191	0.07	81	0.8

Smithville WWTP effluent (RM 40.33)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	20	7	96	156	148	0.05	64	1.2
7/21	<200	<30	12	10	150	170	143	0.08	60	1.0
8/11	<200	<30	209	8	99	147	140	0.07	58	1.2
8/27	<200	<30	38	17	64	164	139	0.22	49	1.6
9/8	-	-	-	-	-	-	-	-	-	-
Mean	<200	<30	70	11	102	159	143	0.11	58	1.3

Sugar Creek (RM 40.18) CR 502

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	20	4	23	152	129	<0.02	67	0.6
7/21	<200	<30	24	4	33	170	138	0.03	72	0.3
8/11	900	<30	50	9	27	121	103	0.11	51	1.2
8/27	567	<30	34	5	15	101	89	0.05	43	0.9
9/8	<200	<30	19	5	41	178	148	0.04	72	0.3
Mean	413	<30	29	5	28	144	121	0.05	61	0.7

Sugar Creek (RM 36.88) Orr Road

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	35	4	20	147	109	0.02	60	0.6
7/21	<200	<30	31	4	30	162	127	0.05	60	0.3
8/11	930	<30	79	8	22	125	104	0.07	51	1.4
8/27	1010	<30	65	6	13	121	78	0.04	43	0.8
9/8	<200	<30	25	5	35	180	137	0.03	66	0.4
Mean	508	<30	47	5	24	147	111	0.04	56	0.7

Sugar Creek (RM 34.69) Kansas Road

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	254	<30	96	5	22	168	117	0.04	55	0.8
7/21	383	<30	110	5	33	176	133	0.04	58	0.4
8/11	1000	<30	116	8	27	219	113	0.06	52	1.2
8/27	1350	<30	100	6	13	122	80	0.04	44	1.0
9/8	224	<30	43	5	31	170	145	0.03	64	0.4
Mean	642	<30	93	6	25	171	118	0.04	55	0.8

Sugar Creek (RM 26.7) West Lebanon Road

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	401	<30	120	6	34	360	117	0.06	52	1.0
7/21	556	<30	158	5	27	180	150	0.12	52	0.4
8/11	1530	<30	188	7	26	160	106	0.09	49	1.2
8/27	1850	<30	212	8	11	112	71	0.08	36	1.4
9/8	564	<30	154	6	28	190	149	0.03	60	0.4
Mean	980	<30	166	6	25	200	119	0.08	50	0.9

Sugar Creek (RM 22.95) Alabama Road

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	365	<30	187	5	22	169	130	0.05	51	0.8
7/21	776	<30	187	5	26	189	155	0.04	49	0.4
8/11	804	<30	200	6	33	188	155	0.13	58	0.9
8/27	2060	<30	169	9	10	101	66	0.11	29	1.5
9/8	713	<30	285	6	28	204	164	0.04	50	0.5
Mean	944	<30	206	6	24	170	134	0.07	47	0.8

Sugar Creek (RM 19.36) SR 93

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	1740	<30	230	5	16	154	123	0.05	51	0.9
7/21	943	<30	181	6	22	180	138	0.04	47	0.6
8/11	1750	<30	315	7	29	188	144	0.07	59	1.1
8/27	1280	<30	62	7	7	87	61	0.09	27	1.0
9/8	852	<30	267	6	23	207	165	0.03	60	0.5
Mean	1313	<30	211	6	19	163	126	0.06	49	0.8

Brewster Dairy effluent (RM 19.03)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	<10	43	949	112	595	0.32	26	2.4
7/21	<200	<30	<10	49	888	102	573	0.40	33	2.8
8/11	<200	<30	16	45	825	108	646	0.07	42	3.8
8/27	Not sampled----------									
9/8	Not sampled----------									
Mean	<200	<30	12	46	887	107	605	0.26	34	3.0

Brewster WWTP effluent (RM 19.04)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	31	35	89	179	174	0.52	66	1.4
7/21	<200	<30	23	19	129	167	160	0.03	67	1.6
8/11	<200	<30	14	43	91	178	182	<0.02	65	1.3
8/27	<200	<30	63	22	53	178	181	<0.02	61	2.8
9/8	Not sampled----------									
Mean	<200	<30	33	30	91	176	174	0.15	65	1.8

Sugar Creek (RM 18.55) U.S. 62

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	918	<30	255	6	23	159	126	0.05	50	0.9
7/21	1280	<30	200	8	40	178	144	0.05	48	0.9
8/11	1950	<30	283	8	24	175	132	0.08	61	1.2
8/27	1460	<30	62	8	8	84	57	0.09	25	1.1
9/8	729	<30	226	7	40	203	168	0.03	62	0.5
Mean	1267	<30	205	7	27	160	125	0.06	49	0.8

Beach City WWTP effluent (RM 13.80)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	<10	15	121	213	220	0.07	98	1.7
7/21	<200	<30	11	17	152	241	183	0.02	104	2.3
8/11	<200	<30	17	17	139	225	186	0.02	114	1.6
8/25	<200	<30	17	16	149	260	178	<0.02	96	1.8
9/8	<200	<30	11	16	154	251	241	0.08	95	1.9
Mean	<200	<30	13	16	143	238	202	0.04	101	1.9

Sugar Creek (RM 13.70) Dst. Beach City WWTP

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	574	<30	163	7	22	149	118	0.08	59	1.2
7/21	845	<30	126	7	37	170	131	0.05	61	0.8
8/11	3840	<30	250	9	19	144	92	0.09	64	1.3
8/25	10400	<30	748	11	15	122	72	0.17	40	4.0
9/8	1110	<30	189	7	38	187	169	0.33	60	0.5
Mean	3354	<30	295	8	26	154	116	0.14	57	1.6

Sugar Creek (RM 12.07) Dst. Beach City Reservoir

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	788	<30	911	7	14	198	85	0.12	123	1.3
7/21	1940	<30	1170	7	24	291	111	0.07	192	1.0
8/11	4350	<30	807	9	21	227	89	0.07	142	1.0
8/25	6950	<30	869	10	17	176	75	0.15	98	2.3
9/8	1300	<30	1360	7	33	323	146	0.05	207	0.7
Mean	3066	<30	1023	8	22	243	101	0.09	152	1.3

Strasburg WWTP effluent (RM 7.45)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	11	12	136	146	158	<0.02	150	1.2
7/21	<200	<30	37	13	166	147	161	0.26	161	1.6
8/11	<200	<30	12	14	171	142	149	0.02	171	1.2
8/25	<200	<30	33	11	151	132	127	0.10	138	1.2
9/8	<200	<30	25	14	154	145	162	0.39	174	2.0
Mean	<200	<30	24	13	156	142	151	0.16	159	1.4

Sugar Creek (RM 7.28) SR 250

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	1070	<30	716	7	14	194	86	0.11	123	0.8
7/21	940	<30	600	7	30	288	123	0.04	200	0.6
8/11	4250	<30	775	8	18	164	90	0.08	88	1.4
8/25	14300	<30	1480	11	14	126	74	0.19	58	2.8
9/8	660	<30	492	7	32	292	149	0.02	191	0.6
Mean	4244	<30	813	8	22	213	104	0.09	132	1.2

Sugar Creek (RM 3.64) CR 80

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	1230	<30	1030	7	14	201	85	0.11	152	1.3
7/21	963	<30	1060	6	32	319	125	0.04	242	0.6
8/11	2130	<30	905	7	26	184	109	0.05	98	0.9
8/25	12600	<30	2370	10	13	150	65	0.15	88	3.3
9/8	429	<30	908	6	28	298	146	0.02	226	0.3
Mean	3470	<30	1255	7	23	230	106	0.07	161	1.3

Dover Chemical Effluent (RM 2.10)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	87	3	28	175	147	0.02	152	0.3
7/21	<200	<30	99	3	27	175	151	<0.02	166	<0.2
8/11	<200	<30	53	3	28	179	146	<0.02	149	<0.2
8/25	<200	<30	55	3	29	180	158	0.02	152	<0.2
9/8	<200	<30	69	4	30	181	140	<0.02	157	0.2
Mean	<200	<30	73	3	28	178	148	0.02	155	0.2

Sugar Creek (RM 1.83) SR 516 & 39

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	1110	<30	1050	7	14	208	84	0.11	131	1.2
7/21	783	<30	1050	6	31	312	121	0.03	242	0.8
8/11	1740	<30	1050	7	32	216	127	0.04	120	0.8
8/25	12600	<30	2710	10	13	157	63	0.15	104	2.8
9/8	298	<30	724	6	31	289	142	<0.02	214	0.4
Mean	3306	<30	1317	7	24	236	107	0.07	162	1.2

Sugar Creek (RM 0.63) SR 39

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	1030	<30	1050	6	13	196	84	0.11	155	1.2
7/21	433	<30	907	6	32	317	124	0.03	180	0.4
8/11	946	<30	731	7	43	256	144	0.02	150	0.6
8/25	12400	<30	2960	10	14	164	63	0.15	95	3.4
9/8	294	<30	656	6	30	294	142	<0.02	214	0.4
Mean	3021	<30	1261	7	26	245	111	0.07	159	1.2

Little Sugar Creek (RM 4.2) Kansas Rd.

DATE	D.O mg/l	.Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/8	8.6	22.5	7.9	<2.0	19	463	2.43	<0.05	0.07	547	5
7/20	7.0	23.0	8.0	<2.0	<10	490	<0.1	<0.05	0.08	340	<5
8/10	5.3	23.2	7.9	2.9	31	620	0.16	0.45	0.33	340	15
8/24	-	-	-	-	-	-	-	-	-	-	-
9/9	8.4	15.4	8.2	<2.0	<10	458	0.25	<0.05	0.09	324	<5
Mean	7.3	21.0	8.0	2.2	18	508	0.74	0.15	0.14	388	8

Little Sugar Creek (RM 0.8) McQuaid Rd.

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/8	8.0	22.3	7.8	<2.0	19	692	1.93	0.08	0.06	514	7
7/20	8.9	24.0	8.2	2.2	18	490	0.39	0.11	0.09	366	11
8/10	5.2	24.0	-	3.1	28	1472	0.63	0.42	0.15	1110	27
8/24	6.1	22.0	7.5	4.0	72	6270	0.55	1.21	0.30	5660	90
9/9	8.6	15.8	8.0	<2	<10	820	0.63	0.11	0.08	1020	10
Mean	7.4	21.6	7.9	2.7	29	1949	0.83	0.39	0.14	1734	29

Little Sugar Creek trib. at RM 0.5 (RM 1.05) McQuaid Rd.

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/8	11.4	21.6	8.2	-	19	503	4.05	0.10	0.20	-	-
7/20	17.6	28.0	9.0	-	16	670	1.97	<0.05	0.08	438	5
8/10	7.0	23.5	7.9	2.3	14	617	0.44	0.15	0.14	376	11
8/24	7.2	20.5	7.9	4.5	31	718	1.28	0.20	0.39	468	25
9/9	12.6	17.8	8.4	<2.0	<10	595	1.87	0.14	0.17	384	10
Mean	11.2	22.3	8.3	2.9	18	621	1.92	0.13	0.20	417	17

North Fork Sugar Creek (RM 6.5) UST. Lehman Hardware

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/8	14.1	22.0	8.0	4.5	33	476	3.71	0.07	0.40	338	9
7/20	9.6	21.8	8.1	6.0	31	617	1.96	0.94	0.39	470	6
8/10	5.1	21.8	7.6	4.0	14	625	1.42	0.98	0.32	410	<5
8/24	3.8	19.6	7.7	14	50	448	2.30	0.80	0.05	300	75
9/9	8.1	15.3	8.5	2.1	<10	612	3.28	0.56	0.33	440	6
Mean	8.1	20.1	8.0	6.1	28	556	2.53	0.67	0.30	392	20

North Fork Sugar Creek (RM 5.53) Zuercher Road

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/8	-	-	-	4.8	22	-	10.2	0.05	2.76	524	<5.0
7/20	9.2	21.7	8.2	4.3	21	741	6.92	0.06	2.48	554	<5.0
8/10	7.6	22.1	7.8	6.5	31	1121	3.26	0.60	4.76	710	25
8/24	7.2	20.2	8.3	28	109	438	1.93	1.08	2.08	287	286
9/9	9.0	15.0	8.1	<2.0	20	886	5.23	0.11	3.49	648	<5.0
Mean	8.3	19.8	8.1	9.1	41	797	5.51	0.38	3.11	545	65

North Fork Sugar Creek (RM 1.35) West Lebanon Rd.

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/8	11.9	24.1	8.2	2.0	<10	440	2.73	<0.05	0.28	300	9
7/20	7.4	21.2	7.7	<2.0	<10	541	1.84	<0.05	0.32	410	16
8/10	6.8	22.0	8.0	3.3	14	470	0.72	0.24	0.65	323	51
8/24	6.4	21.2	7.5	2.1	25	610	0.32	0.20	0.44	394	18
9/9	8.4	15.5	8.0	<2.0	10	530	1.64	<0.05	0.53	394	<5
Mean	8.2	20.8	7.9	2.3	14	518	1.45	0.12	0.44	364	20

Middle Fork Sugar Creek (RM 12.0) From Twp. Rd. 656

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.5	24.9	7.47	<2.0	12	465	2.75	0.05	0.11	286	8
721	10	16.0	8.33	4.4	16	500	0.64	<0.05	0.21	286	83
8/11	9.3	24.4	7.6	<2.0	<10	522	0.72	0.14	0.48	296	7
8/27	7.5	22.1	7.59	<2.0	12	443	3.84	0.27	0.79	278	<5
9/9	12.5	16.9	8.1	<2.0	104	519	1.09	0.05	<0.05	308	<5
Mean	9.6	20.3	7.8	2.5	38	490	1.80	0.11	0.33	291	22

Middle Fork Sugar Creek (RM 10.25) Twp. Rd. 669

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.13	23.63	7.86	<2	<10	428	2.42	0.06	0.054	268	13
7/21	8.40	23.50	8.21	<2	23	464	1.03	<0.05	0.07	286	10
8/11	8.84	23.47	7.85	<2	<10	472	0.94	0.22	0.16	278	6
8/27	7.69	24.48	7.75	<2	<10	408	2.89	0.11	0.1	254	11
9/9	11.4	16.75	8.12	<2	29	465	0.88	<0.05	0.08	282	<5
Mean	8.89	22.37	7.95	<2	16	447	1.63	0.10	0.09	274	9

Alpine Valley effluent (RM 7.9)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.57	28.24	8.80	16	63	1580	<0.1	<0.05	22.3	950	52
7/21	8.10	27.00	8.93	13	36	1640	<0.1	<0.05	22.4	970	27
8/11	7.92	-	8.60	10	48	1700	<0.1	<0.05	21.8	1040	28
8/27	Not sampled----------										
9/9	Not sampled----------										
Mean	8.20	27.62	8.78	13	49	1640	<0.1	<0.05	22.2	987	36

Middle Fork Sugar Creek (RM 7.58) Twp. Rd. 606

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	9.11	22.27	8.0	<2	<10	482	2.49	0.06	0.07	306	60
7/21	8.4	24.5	8.25	<2	10	471	1.29	<0.05	0.16	302	10
8/11	8.94	22.78	8.11	<2	<10	489	1.28	0.21	0.29	286	13
8/27	8.25	22.66	7.75	<2	24	434	2.7	0.18	0.13	274	21
9/8	11.13	15.7	8.1	<2	13	482	1.33	<0.05	0.12	304	<5
Mean	9.17	21.58	8.04	<2	13	472	1.82	0.11	0.15	294	22

Middle Fork Sugar Creek (RM 1.66) Welty Rd.

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.93	21.86	7.77	<2	20	440	2.17	0.06	0.22	280	72
7/21	5.8	22.5	7.83	2.9	21	466	1.45	0.08	0.16	292	46
8/11	7.69	21.28	7.84	5.5	15	463	1.49	0.29	0.4	294	92
8/27	7.77	19.54	7.62	<2	24	397	2.29	0.28	0.18	260	113
9/8	9.34	15.34	7.82	<2	17	527	0.94	0.05	0.06	336	12
Mean	7.71	20.10	7.78	2.9	19	459	1.67	0.15	0.20	292	67

Middle Fork Sugar Creek trib. At RM 6.0 (RM 0.17) Twp. Rd. 659

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	12.06	20.26	8.06	<2	17	554	1.36	<0.05	0.11	344	5
7/21	9.8	-	8.33	<2	10	652	0.5	<0.05	<0.05	434	6
8/11	8.16	21.11	7.71	<2	<10	580	1.52	0.06	0.71	366	8
8/27	8.79	19.55	7.75	<2	-	481	-	-	-	310	7
9/9	10.7	15.07	7.94	<2	10	651	1.06	<0.05	<0.05	446	<5
Mean	9.90	19.00	7.92	<2	12	584	1.45	0.05	0.23	380	6

Middle Fork Sugar Creek trib. at RM 3.25 (RM 0.5) Twp. Rd. 314, Alabama Ave.

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.87	19.49	7.63	<2	<10	859	1.57	<0.05	<0.05	578	5
7/21	6.8	22.5	7.96	<2	13	1280	0.92	<0.05	0.07	968	28
8/11	8.65	20.14	7.74	<2	<10	766	1.38	0.07	0.54	520	11
8/27	8.94	18.12	7.66	<2	15	622	1.99	0.26	0.19	414	9
9/9	10.19	14.0	7.79	<2	<10	1130	1.59	<0.05	0.15	818	<5
Mean	8.69	18.85	7.76	<2	12	931	1.49	0.10	0.20	660	12

South Fork Sugar Creek (RM 21.1) CR 114

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	9.8	22	7.95	<2.0	12	402	1.74	0.07	0.13	282	11
7/21	13.2	23.5	8.10	3.1	14	431	1.22	0.11	0.16	310	14
8/11	7.7	21.8	7.58	2.7	<10	473	1.11	0.38	<0.05	330	13
8/25	7.4	19.9	7.40	6.9	49	434	1.56	0.61	0.56	286	99
9/8	9.6	18.0	8.04	2.1	32	478	0.99	0.17	0.17	298	58
Mean	9.5	21.0	7.81	3.4	23	444	1.32	0.27	0.21	301	39

South Fork Sugar Creek (RM 18.98) Twp. Rd. 173

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.45	23	7.72	<2.0	21	460	2.3	0.10	0.28	306	58
7/21	15.2	24	8.56	<2.0	<10	516	1.2	0.05	0.10	368	9
8/11	7.74	22.9	7.85	2.0	12	573	1.26	0.42	0.10	378	9
8/25	6.4	20	7.40	16	62	565	1.63	1.71	1.15	376	118
9/8	9.03	17.7	7.93	<2.0	<10	564	1.21	0.18	0.16	352	12
Mean	9.36	21.5	7.89	5	23	536	1.52	0.49	0.36	356	41

South Fork Sugar Creek (RM 15.26) CR 47

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.0	21.5	7.26	<2.0	18	732	3.2	0.21	0.26	500	24
7/21	14.1	24.6	8.00	<2.0	11	941	1.5	0.12	0.24	676	6
8/11	8.4	21.8	7.57	2.5	16	1200	0.81	0.44	0.22	872	6
8/25	5.2	19.9	7.38	12	72	670	2.17	0.92	1.76	494	202
9/8	9.5	16.7	7.48	2.7	20	1090	1.13	0.42	0.29	774	12
Mean	9.0	20.9	7.54	4.2	27	927	1.76	0.42	0.55	663	50

Sugarcreek WWTP effluent (RM 14.15)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.2	22.5	7.95	<2.0	18	1050	12.8	0.05	1.2	618	<5
7/21	11.6	25.0	7.63	<2.0	30	1170	16.8	0.05	2.84	696	<5
8/11	9.0	24.2	8.14	<2.0	18	1180	13.0	0.06	7.6	724	<5
8/25	7.3	22.8	7.73	<2.0	13	1110	10.5	0.14	4.84	664	<5
9/8	8.5	21.8	7.98	<2.0	15	1190	14.6	<0.05	2.5	708	<5
Mean	8.9	23.3	7.89	<2.0	19	1140	13.5	0.07	3.80	682	<5

South Fork Sugar Creek (RM 14.02) Twp. Rd. 355

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.1	21.9	7.47	<2.0	12	813	3.47	0.18	0.28	559	20
7/21	7.1	26.0	8.00	2.2	11	1020	2.18	0.14	0.49	704	7
8/11	9.8	24.1	7.95	2.2	15	1290	1.98	0.37	1.25	896	10
8/25	5.3	20.0	7.46	10	65	648	1.84	0.61	1.81	482	348
9/8	10.9	19.0	7.79	<2.0	18	1300	3.18	0.33	0.93	879	15
Mean	8.2	22.2	7.73	3.7	24	1014	2.53	0.33	0.95	704	80

South Fork Sugar Creek (RM 13.28) CR 73

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.4	22.0	7.33	2.2	<10	883	3.85	0.25	0.37	650	23
7/21	10.2	28.4	8.10	2.4	<10	1100	1.83	0.11	0.40	808	5
8/11	9.9	24.0	7.99	2.0	15	1430	1.55	0.55	0.62	1070	8
8/25	4.7	20.1	7.41	7.2	72	679	1.74	0.72	1.25	504	352
9/8	11.3	18.6	9.20	4.2	28	1250	2.25	0.53	0.48	892	19
Mean	8.7	22.6	8.01	3.6	27	1068	2.24	0.43	0.62	785	81

South Fork Sugar Creek (RM 7.42) SR 93

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	4.7	22.7	7.17	2.2	15	799	2.76	0.2	0.2	584	53
7/21	10.3	26.0	7.29	2.4	14	1110	1.27	0.23	0.2	860	59
8/11	4.5	22.6	7.83	2.0	15	1470	1.15	0.24	0.18	1140	16
8/25	4.8	19.9	7.62	7.2	47	625	1.69	1.17	1.27	482	208
9/8	7.3	17.4	7.81	4.2	53	1410	1.28	0.32	0.24	1030	52
Mean	6.3	21.7	7.54	3.6	29	1083	1.63	0.43	0.42	819	78

South Fork Sugar Creek (RM 6.43) CR 94

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	6.7	22.0	7.09	2.0	12	667	2.61	0.15	0.24	478	48
7/21	10.2	25.8	7.65	2.4	<10	964	1.48	0.18	0.16	730	35
8/11	4.6	22.3	7.69	3.4	30	1060	1.76	0.37	0.25	764	46
8/25	5.1	19.8	7.60	11	75	564	2.40	0.91	1.13	446	380
9/8	7.4	17.4	8.22	4.3	15	1320	1.02	0.22	0.20	968	47
Mean	8.1	21.5	7.65	4.6	28	915	1.85	0.37	0.40	677	111

South Fork Sugar Creek (RM 3.64) Twp. Rd. 62

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	5.9	22.9	7.15	2.4	18	617	2.33	0.15	0.24	438	56
7/21	7.8	25.0	7.25	4.1	14	922	1.52	0.47	0.18	708	59
8/11	5.2	23.5	7.06	4.5	21	1130	1.4	0.42	0.17	830	39
8/25	4.2	20.2	7.46	9.9	59	566	2.1	0.99	1.18	444	284
9/8	4.8	18.3	7.37	2.0	29	1150	0.88	0.20	0.15	828	45
Mean	5.6	22.0	7.26	4.6	28	877	1.65	0.45	0.38	650	97

South Fork Sugar Creek trib. at RM 14.1 (RM 0.28) CR 73

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.3	22.1	7.17	<2.0	<10	864	3.18	0.06	0.19	622	11
7/21	6.1	27.7	7.80	4.2	11	1050	1.13	0.47	0.10	760	6
8/11	6.9	24.8	7.96	4.1	21	1320	0.30	0.64	0.31	984	46
8/25	6.0	20.2	7.57	5.7	59	558	1.39	0.56	1.19	416	212
9/8	9.2	18.9	7.60	<2.0	25	772	0.37	0.64	0.26	520	106
Mean	7.3	22.7	7.62	3.6	25	913	1.27	0.47	0.41	660	76

Ohio Whey effluent (RM 0.19)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	4.6	25.1	8.12	15	81	1290	<0.1	1.16	37.3	814	14
7/21	7.2	26.9	8.26	15	69	1300	0.43	0.89	9.8	806	28
8/11	4.9	25.7	8.28	20	90	1430	1.02	1.54	11.9	890	26
8/25	2.8	23.4	8.09	-	82	1620	2.42	0.59	1.2	1020	30
9/8	6.3	20.5	8.76	18	88	1840	2.71	0.42	12.3	1140	26
Mean	5.2	24.3	8.3	17	82	1496	1.34	0.92	14.5	934	28

South Fork Sugar Creek trib. at RM 14.1 (RM 0.05) Dst. Ohio Whey

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.0	22.0	7.24	<2.0	12	759	3.28	0.10	0.34	518	9
7/21	6.1	27.4	8.06	3.5	14	1090	0.75	0.18	0.66	764	16
8/11	6.4	24.4	7.98	5.2	27	1360	0.44	1.03	1.62	952	38
8/25	5.6	20.1	7.51	2.7	82	559	1.29	0.58	1.27	404	290
9/8	9.0	19.6	8.46	6.7	37	1510	1.51	0.45	3.84	978	35
Mean	7.0	22.7	7.85	4.0	34	1056	1.45	0.47	1.55	723	78

South Fork Sugar Creek trib. at RM 1.0 (RM 0.68) Twp. Rd. 447

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.7	20.5	7.26	<2.0	<10	1060	2.0	<0.05	0.05	838	9
7/21	9.2	24.5	7.17	<2.0	14	1870	0.71	<0.05	<0.05	1640	<5
8/11	10.0	22.1	7.34	3.7	24	2430	0.54	<0.05	0.07	2100	<5
8/25	7.3	19.5	7.44	5.6	39	762	1.44	0.23	0.38	630	86
9/8	9.9	16.4	7.26	<2.0	13	2290	0.48	<0.05	0.05	2010	<5
Mean	9.0	20.6	7.29	3.1	20	1682	1.03	0.09	0.12	1444	38

East Branch of South Fork Sugar Creek (RM 5.47) CR 48 Ust. Ragersville

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.1	20.2	8.05	<2.0	<10	505	3.78	0.16	0.08	334	7
7/21	11.6	23.4	7.34	4.6	<10	609	1.82	0.45	0.07	464	9
8/11	8.5	20.4	7.83	<2.0	<10	734	0.9	0.13	0.08	547	10
8/25	6.9	19.7	7.27	5.5	33	470	2.97	0.32	0.52	368	86
9/8	8.9	15.6	7.56	4.3	25	597	1.78	0.22	0.42	402	42
Mean	8.8	19.9	7.61	3.7	18	583	2.25	0.26	0.23	423	31

East Branch of South Fork Sugar Creek (RM 5.04) CR 52 dst. Ragersville

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.8	20.2	7.42	<2.0	<10	599	3.62	0.21	0.08	420	6
7/21	5.8	22.9	7.33	4.5	<10	721	1.63	0.25	0.11	546	8
8/11	7.8	20.4	7.66	<2.0	<10	868	0.9	0.2	0.17	652	6
8/25	6.7	19.6	7.33	5.5	33	537	2.76	0.36	0.52	414	96
9/8	8.1	16.2	7.27	4.3	25	688	1.58	0.27	0.19	490	38
Mean	7.2	19.9	7.40	3.7	18	683	2.10	0.26	0.21	504	31

East Branch of South Fork Sugar Creek (RM 1.7) Twp. Rd. 348

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.0	20.9	7.31	4.2	21	963	4.11	0.65	0.13	714	18
7/21	12.1	24.4	7.35	2.0	<10	1240	1.51	0.21	0.08	999	8
8/11	7.1	21.7	7.51	5.1	21	1550	0.8	1.81	0.21	1270	8
8/25	5.4	20.0	7.30	8.9	95	832	1.98	0.77	0.75	647	185
9/8	9.2	17.7	7.58	7.3	31	1300	1.54	1.03	0.21	1020	23
Mean	8.2	20.9	7.41	5.5	36	1177	1.99	0.89	0.28	930	48

Crabapple Creek (RM 2.96) Twp. Rd. 357

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	15.7	24.1	8.29	2	21	549	1.67	<0.05	<0.05	330	9
7/21	12.9	26.0	8.53	7	16	577	1.5	0.1	0.15	362	135
8/11	11.1	24.9	7.87	<2	27	699	1.39	0.21	0.33	452	13
8/27	7.71	25.3	7.70	<2	12	593	2.44	0.14	0.06	394	10
9/9	12.4	17.7	8.12	2	20	639	1.76	0.19	0.07	412	10
Mean	12.0	23.6	8.10	3	19	611	8.76	0.14	0.13	390	35

Crabapple Creek (RM 0.31) Twp. Rd. 606

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	12.8	24.5	8.38	2.3	15	462	1.98	<0.05	<0.05	281	10
7/21	9.8	26.0	8.62	<2	<10	464	0.95	<0.05	0.06	300	10
8/11	7.7	24.8	7.97	2	15	519	1.47	0.27	0.46	332	20
8/27	7.3	24.8	7.72	<2	15	448	2.72	0.10	0.18	284	20
9/9	11.7	17.3	8.15	<2	32	494	1.68	<0.05	0.07	306	5
Mean	9.9	23.5	8.17	2.1	17	477	1.76	0.10	0.16	301	13

Misers Run (RM 0.22) Lane off Twp. Rd. 659

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	14.3	26.2	8.59	<2	<10	583	1.3	<0.05	<0.05	368	5
7/21	7.2	21.5	8.07	<2	13	694	0.89	<0.05	0.08	425	10
8/11	8.1	20.7	7.76	<2	12	616	1.4	0.10	0.47	388	12
8/27	8.0	24.1	7.68	<2	<10	540	2.67	0.09	0.44	346	5
9/9	10.9	14.3	8.00	<2	<10	672	1.15	<0.05	<0.05	446	<5
Mean	9.71	21.3	8.02	<2	11	621	1.48	0.07	0.22	395	7

Elm Run (RM 1.69) Harmon Ave.

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.7	19.8	7.69	<2	14	502	3.61	0.07	<0.05	322	16
7/21	5.3	22.0	7.97	2.2	<10	530	2.49	0.05	0.05	304	89
8/11	8.1	20.2	7.81	<2	15	468	1.17	0.15	0.42	294	44
8/27	8.9	18.1	7.67	<2	34	387	2.42	0.16	0.25	251	32
9/8	9.6	15.6	7.87	<2	<10	547	2.35	<0.05	0.13	332	7
Mean	8.1	19.1	7.80	2.0	17	487	2.41	0.10	0.18	301	38

Elm Run (RM 0.45) Kings Highway

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.6	20	7.36	4.2	32	492	2.60	0.1	0.15	320	64
7/21	5.0	22.5	7.55	6.6	26	520	1.70	0.1	0.20	302	67
8/11	7.2	20.8	7.85	5.6	33	398	1.06	0.26	0.45	270	144
8/27	7.0	19.4	8.04	8.4	53	338	1.04	0.29	0.48	224	74
9/8	8.6	16.4	8.34	2.8	21	534	1.46	0.06	0.19	320	40
Mean	7.1	19.8	7.83	5.5	33	456	1.57	0.16	0.29	287	78

Brush Run (RM 2.51) Shrock Rd.

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.4	20.0	8.32	<2.0	<10	959	1.13	0.06	0.18	716	6
7/21	9.0	23.2	7.16	4.4	<10	1200	0.85	0.37	0.09	922	<5
8/11	7.2	19.5	6.75	<2.0	<10	1440	0.66	0.05	0.07	1180	30
8/25	8.2	22.2	7.40	<2.0	13	691	0.96	0.89	0.14	480	68
9/8	7.4	15.5	7.16	4.8	10	1190	0.49	0.20	0.16	911	158
Mean	8.0	20.1	7.36	3.0	11	1096	0.82	0.31	0.13	842	53

Baltic WWTP effluent (RM 0.95)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	3.8	23.0	7.52	<2.0	18	1470	7.79	0.06	7.41	832	<5
7/21	4.6	22.2	7.18	3.9	19	1540	19.4	0.15	12.3	870	<5
8/11	1.3	21.8	7.25	7.1	32	1570	0.23	4.13	2.42	866	<5
8/25	5.5	22.0	7.50	<2.0	23	1250	0.41	0.06	3.64	678	<5
9/8	4.8	20.9	7.34	2.5	13	1760	14.4	<0.05	11.6	996	7
Mean	4.0	22.0	7.36	3.5	21	1518	8.45	0.89	7.47	848	5

Brush Run (RM 0.3) Twp. Rd. 171, dst. Baltic WWTP

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	10.2	22.0	7.44	<2.0	18	991	1.77	<0.05	0.45	716	8
7/21	14.6	24.0	8.12	<2.0	<10	1260	2.21	0.05	1.4	930	12
8/11	6.1	22.0	7.28	6.0	24	1460	0.32	1.22	0.93	1050	13
8/25	7.8	20.5	7.20	3.9	23	680	1.25	0.34	0.4	478	73
9/8	8.5	17.7	7.32	4.5	23	1250	0.85	0.16	0.52	948	26
Mean	9.4	21.3	7.47	3.7	20	1128	1.28	0.36	0.74	824	26

Pleasant Valley Creek (RM 0.24) From Twp. Rd. 339

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.7	20.6	7.28	<2.0	<10	876	5.73	<0.05	<0.05	668	13
7/21	7.0	24.8	7.36	<2.0	<10	1110	1.93	<0.05	<0.05	918	8
8/11	9.0	21.1	7.44	<2.0	<10	1390	1.27	0.13	0.07	1130	26
8/25	3.9	19.9	7.35	6.9	46	697	2.48	0.42	0.59	540	63
9/8	10.0	16.4	7.24	<2.0	12	1160	0.98	0.06	0.06	902	24
Mean	7.7	20.6	7.33	3.0	18	1047	2.48	0.14	0.16	832	27

Guggisburg Cheese effluent (RM 1.47)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	5.0	26.0	8.28	>95	475	3150	0.54	29	74.5	2030	312
7/21	7.0	24.0	8.15	160	72	3450	1.13	21.3	72.9	2090	356
8/11	No discharge----------										
8/25	No discharge----------										
9/8	No discharge----------										
Mean	6.0	25.0	8.20	128	274	3300	0.84	25.2	73.7	2060	334

Troyer Valley Creek (RM 1.08) SR 93

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.1	21.0	7.51	24	69	1040	3.68	3.1	6.4	682	45
7/21	9.7	23.5	7.95	29	78	1400	2.06	2.94	8.2	908	482
8/11	6.5	22.7	7.28	4.5	27	1330	1.48	1.2	0.32	1040	24
8/25	7.3	20.7	7.31	10	72	815	2.17	1.2	0.87	578	112
9/8	5.8	17.8	7.36	8.3	<10	1350	1.09	1.69	1.87	974	64
Mean	7.5	21.1	7.48	15.2	51	1187	2.10	2.03	3.53	836	145

Walnut Creek (RM 7.93) Old SR 39

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	9.4	23.0	7.87	<2.0	<10	495	2.63	0.05	0.11	332	14
7/21	14.4	25.4	8.00	<2.0	<10	633	1.00	0.06	0.16	428	12
8/11	8.0	23.6	7.75	<2.0	30	770	0.85	0.32	0.12	556	8
8/25	9.2	20.5	7.30	6.9	49	547	1.49	0.38	0.51	372	116
9/8	7.6	18.4	7.80	<2.0	20	815	0.79	0.17	0.18	532	28
Mean	9.7	22.2	7.74	3.0	24	652	1.35	0.20	0.22	444	36

Walnut Creek (RM 6.32) Twp. Rd. 444

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	9.0	23.0	8.27	<2.0	15	565	2.71	0.06	0.18	344	11
7/21	10.0	27.2	8.66	2.0	11	715	1.17	0.07	0.21	488	8
8/11	8.0	25.6	8.07	<2.0	21	843	1.18	0.04	0.37	578	13
8/25	6.8	20.5	7.40	6.1	49	550	1.67	0.46	0.56	362	164
9/8	9.4	19.1	8.01	2.4	13	846	1.00	0.30	0.41	526	27
Mean	8.6	23.1	8.08	2.9	22	704	1.55	0.19	0.35	460	45

Walnut Creek (RM 4.49) CR 172

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.4	25.0	7.98	<2.0	12	877	2.27	<0.05	0.1	629	27
7/21	5.8	27.0	7.90	2.3	14	1400	0.73	0.07	0.11	1120	23
8/11	7.9	24.2	7.85	<2.0	24	1360	1.1	0.35	0.3	1070	13
8/25	6.8	20.4	7.34	6.6	55	668	1.58	0.38	0.83	456	121
9/8	9.1	17.9	7.83	2.0	13	1610	1.08	0.18	0.31	1240	18
Mean	7.6	22.9	7.78	3.0	24	1183	1.35	0.21	0.33	903	40

Walnut Creek (RM 0.56) Lane from CR 94

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.0	22.0	8.17	2.0	27	559	2.68	0.12	0.29	402	90
7/21	10.5	25.0	7.48	<2.0	<10	905	1.56	0.12	0.21	688	24
8/11	7.4	23.5	7.73	2.3	21	844	3.3	0.32	0.37	648	24
8/25	7.3	20.0	7.16	7.2	163	586	2.35	0.61	0.93	386	290
9/8	7.9	16.7	7.75	4.3	13	1100	1.38	0.12	0.22	792	16
Mean	8.2	21.4	7.66	3.6	47	799	2.25	0.26	0.40	583	888

Goose Creek (RM 0.35) Twp. Rd. 419

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	10.4	24.0	8.31	2.3	12	662	1.82	0.07	0.16	446	17
7/21	7.6	27.2	8.32	5.5	14	1030	0.45	0.15	0.40	750	20
8/11	6.6	26.1	7.54	3.4	21	911	1.17	0.45	0.34	672	14
8/25	7.6	20.6	7.43	4.6	30	619	1.89	0.27	0.53	426	149
9/8	8.7	19.3	7.77	2.0	22	1250	0.56	0.15	0.16	912	18
Mean	8.2	23.4	7.87	3.6	20	894	1.18	0.22	0.32	641	44

Indian Trail Creek (RM 6.33) Twp. Rd. 414

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.4	22.0	8.24	<2.0	15	489	3.15	0.24	0.08	314	8
7/21	13.0	25.0	7.91	<2.0	<10	684	1.73	0.22	0.06	498	5
8/11	7.6	22.8	7.94	<2.0	14	857	6.15	1.45	0.08	626	<5
8/25	8.3	20.2	7.23	4.4	33	507	2.21	0.59	0.39	350	35
9/8	8.7	16.2	7.78	<2.0	13	910	0.98	0.08	0.22	642	<5
Mean	9.2	21.2	7.82	2.5	17	689	2.84	0.52	0.17	486	12

Indian Trail Creek (RM 5.4) SR 515

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.4	22.0	8.06	<2.0	18	476	3.58	0.23	0.08	306	10
7/21	8.8	26.2	7.51	<2.0	<10	622	2.58	0.06	<0.05	444	9
8/11	7.5	24.2	7.76	<2.0	60	743	4.69	0.45	0.07	536	5
8/25	8.0	20.7	7.20	4.8	33	536	5.28	2.53	0.47	352	39
9/8	9.4	18.0	7.84	<2.0	<10	799	2.86	0.12	0.08	548	6
Mean	8.4	22.2	7.67	2.6	26	635	3.80	0.68	0.15	437	14

Indian Trail Creek (RM 2.56) Twp. Rd. 66

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.2	21.0	8.29	<2.0	15	430	3.25	0.13	0.28	294	29
7/21	9.4	23.2	7.49	4.3	<10	581	2.19	0.69	0.46	400	37
8/11	6.8	21.8	7.90	2.9	21	652	6.97	0.30	1.4	440	27
8/25	7.8	19.9	7.50	9.6	56	467	3.97	1.18	0.98	336	224
9/8	7.0	16.2	7.79	<2.0	11	643	2.85	0.08	0.23	408	16
Mean	7.8	20.4	7.79	4.2	23	555	3.85	0.48	0.67	376	67

Indian Trail Creek tributary at RM 6.08 (RM 0.3) Twp. Rd. 413 (Holmes ByProducts West)

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.3	17.0	5.18	2	12	788	35.1	1.17	2.88	486	7
7/21	1.2	17.0	5.04	<2	13	680	32.2	0.41	<0.05	482	63
8/11	5.3	21.7	6.71	<2	<10	750	28.4	0.40	0.29	502	84
8/27	8.4	23.2	7.40	6.6	47	795	28.3	5.92	0.36	546	36
9/8	8.3	17.9	7.68	6.9	28	717	18.6	2.17	0.65	448	31
Mean	6.1	19.4	6.40	3.9	22	746	28.5	2.01	0.85	493	44

Broad Run (RM 2.8) Dst. Winfield @ CR 80

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	6.9	19.6	6.85	<2.0	15	801	2.22	0.15	0.1	588	20
7/21	6.9	22.0	6.84	2.9	<10	1100	0.62	0.43	0.08	802	14
8/11	9.0	21.1	6.89	<2.0	<10	1310	0.25	1.33	0.74	994	6
8/25	8.3	20.0	7.38	4.4	22	760	1.01	0.16	0.51	574	105
9/8	7.2	16.4	6.91	<2.0	13	1310	0.44	0.86	0.82	954	6
Mean	7.7	19.8	6.97	2.7	14	1056	0.91	0.59	0.45	782	30

Broad Run (RM 0.15) Twp. Rd. 425

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.3	20.0	6.66	<2.0	12	871	1.8	0.09	0.08	698	19
7/21	6.0	22.1	6.65	<2.0	<10	1230	0.67	0.14	0.05	956	29
8/11	6.9	21.1	6.86	<2.0	15	1480	0.6	0.37	0.57	1200	16
8/25	8.5	19.9	7.51	5.4	35	650	0.71	0.27	0.8	478	520
9/8	6.1	16.6	6.95	<2.0	15	1400	0.45	0.06	0.07	1110	18
Mean	7.0	19.9	6.93	2.7	17	1126	0.85	0.19	0.31	888	120

Cherry Run (RM 0.22) CR 78

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	7.6	19.3	5.54	<2.0	<10	1140	0.56	0.08	0.06	956	5
7/21	6.8	21.3	5.44	<2.0	11	1450	0.38	0.10	<0.05	1230	33
8/11	6.9	20.6	6.30	<2.0	15	1540	0.27	0.13	0.42	1340	<5
8/25	9.3	19.7	6.80	<2.0	32	1110	0.45	0.11	0.23	906	63
9/8	6.6	16.1	6.35	< 2.0	21	1720	0.27	0.09	1.55	1420	<5
Mean	7.4	19.4	6.09	<2.0	18	1392	0.39	0.10	0.46	1170	22

Turkeyfoot Run (RM 0.23) CR 78

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	6.9	20.0	6.41	<2.0	12	963	1.7	0.12	<0.05	798	6
7/21	8.29	22.7	5.80	2.2	18	1600	0.75	0.31	0.05	802	16
8/11	6.5	21.3	6.08	<2.0	24	2140	0.4	0.4	0.17	1890	<5
8/25	9.5	19.9	7.46	<2.0	54	779	0.4	0.19	0.96	588	185
9/8	7.6	16.3	6.31	<2.0	28	1930	0.57	0.17	0.13	1710	<5
Mean	7.76	20.0	7.69	2.0	27	1482	0.76	0.24	0.27	1158	43

Goettge Run (RM 0.25) Davis Street

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.2	19.6	6.63	<2.0	30	1060	0.64	0.09	<0.05	880	11
7/21	7.0	22.5	7.04	<2.0	14	1410	0.45	0.14	<0.05	1180	8
8/11	6.3	22.0	7.02	<2.0	18	1600	0.46	0.08	<0.05	1390	<5
8/25	9.3	19.8	7.57	<2.0	25	658	0.65	0.09	0.27	500	81
9/8	7.7	16.2	7.13	<2.0	18	1580	0.53	<0.05	<0.05	1330	<5
Mean	7.7	23.9	7.08	<2.0	21	1262	0.55	0.09	0.09	1056	22

Brandywine Creek (RM 2.02) Twp. Rd. 374

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	9.9	22.1	7.06	<2.0	<10	1130	1.21	<0.05	<0.05	788	9
7/21	8.3	22.7	6.94	<2.0	<10	1400	0.57	0.06	<0.05	1040	20
8/11	7.1	22.5	6.95	<2.0	12	1520	0.4	0.06	0.14	1110	6
8/25	8.7	20.6	7.50	2.1	51	960	1.0	0.23	0.49	656	206
9/8	8.8	16.9	7.32	<2.0	<10	1440	0.26	0.09	0.23	1120	40
Mean	8.6	21.0	7.15	2.0	19	1290	0.69	0.10	0.19	943	56

Brandywine Creek (RM 0.16) Twp. Rd. 211

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
7/9	8.2	20.7	6.99	<2.0	<10	1020	2.18	<0.05	0.05	708	<5
7/21	6.9	23.0	7.22	<2.0	<10	1330	0.87	0.28	0.09	968	6
8/11	5.6	21.2	7.01	<2.0	12	1440	0.66	0.15	0.35	1190	5
8/25	8.8	20.4	7.84	2.0	36	786	1.39	0.25	0.69	519	490
9/8	7.7	16.5	7.35	<2.0	<10	1380	0.05	0.38	0.22	1030	<5
Mean	7.4	20.4	7.28	2.0	16	1191	1.03	0.22	0.28	883	102

Little Sugar Creek (RM 4.2) Kansas Rd.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/8	3	<0.2	62	<10	<2	19	<40	<2	<10	233	270
7/20	3	<0.2	50	<10	<2	25	<40	<2	<10	228	355
8/10	9	<0.2	47	<10	<2	23	<40	<2	<10	212	628
8/24	----------										
9/9	3	<0.2	50	<10	<2	21	<40	<2	<10	211	243
Mean	5	<0.2	52	<10	<2	22	<40	<2	<10	221	374

Little Sugar Creek (RM 0.8) McQuaid Rd.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/8	<2	<0.2	76	<10	<2	20	<40	<2	<10	272	480
7/20	<2	<0.2	38	<10	<2	21	<40	<2	17	181	869
8/10	3	0.4	108	<10	<2	32	<40	<2	<10	401	880
8/24	4	2.4	568	<10	3	92	<40	5	24	1800	4600
9/9	<2	<0.2	68	<10	<2	23	<40	<2	17	264	851
Mean	3	0.7	172	<10	2	38	<40	3	16	584	1536

Little Sugar Creek trib. at RM 0.5 (RM 1.05) McQuaid Rd.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/8	<2	<0.2	50	<10	<2	14	<40	<2	<10	182	323
7/20	<2	<0.2	55	<10	<2	21	<40	<2	12	224	248
8/10	2	<0.2	65	<10	<2	22	<40	<2	<10	253	491
8/24	2	<0.2	65	<10	<2	22	<40	<2	16	253	1720
9/9	2	<0.2	54	<10	<2	20	<40	<2	14	217	501
Mean	2	<0.2	58	<10	<2	20	<40	<2	12	226	657

North Fork Sugar Creek (RM 6.5) Ust. Lehman Hardware

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/8	<2	<0.2	57	<10	<2	15	<40	<2	<10	204	295
7/20	<2	<0.2	67	<10	<2	21	<40	<2	<10	254	235
8/10	<2	<0.2	65	<10	<2	19	<40	<2	<10	240	236
8/24	<2	<0.2	40	10	3	12	<40	<2	25	149	2110
9/9	<2	<0.2	58	<10	<2	18	<40	<2	13	219	547
Mean	<2	<0.2	57	10	2	17	<40	<2	14	213	685

North Fork Sugar Creek (RM 5.53) Zuercher Road

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/8	<2	<0.2	65	<10	<2	18	<40	<2	<10	236	229
7/20	<2	<0.2	69	<10	4	19	<40	<2	10	250	176
8/10	4	<0.2	78	<10	<2	22	<40	<2	16	285	609
8/24	3	0.6	73	43	17	12	<40	<2	120	232	8330
9/9	4	<0.2	66	<10	<2	21	<40	<2	<10	251	162
Mean	3	0.4	70	17	5	18	<40	<2	33	251	1901

North Fork Sugar Creek (RM 1.35) West Lebanon Rd.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/8	<2	<0.2	57	<10	<2	13	<40	<2	<10	196	337
7/20	<2	<0.2	75	<10	<2	20	<40	<2	<10	270	788
8/10	3	<0.2	63	<10	<2	15	<40	<2	<10	219	910
8/24	4	<0.2	69	<10	<2	20	<40	<2	11	255	971
9/9	3	<0.2	64	<10	<2	19	<40	<2	<10	238	251
Mean	3	<0.2	66	<10	<2	17	<40	<2	10	236	651

Middle Fork Sugar Creek (RM 12.0) From Twp. Rd. 656

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	59	<10	<2	13	<40	<2	<10	201	377
7/21	<2	<0.2	63	<10	<2	15	<40	<2	<10	219	2140
8/11	3	<0.2	63	<10	<2	14	<40	<2	11	215	310
8/27	2	<0.2	59	<10	<2	12	<40	<2	<10	197	330
9/9	<2	<0.2	66	<10	<2	15	<40	<2	11	226	142
Mean	2	<0.2	62	<10	<2	14	<40	<2	10	212	660

Middle Fork Sugar Creek (RM 10.25) Twp. Rd. 669

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	56	<10	<2	13	<40	<2	<10	193	488
7/21	<2	<0.2	64	<10	<2	15	<40	<2	<10	222	1220
8/11	<2	<0.2	58	<10	<2	14	<40	<2	15	202	453
8/27	<2	<0.2	53	<10	<2	12	<40	<2	<10	182	689
9/9	<2	<0.2	58	<10	<2	16	<40	<2	<10	211	277
Mean	<2	<0.2	58	<10	<2	14	<40	<2	11	202	625

Alpine Valley effluent (RM 7.9)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	5	<0.2	20	<10	<2	11	<40	<2	<10	95.2	340
7/21	4	<0.2	19	<10	<2	12	<40	<2	<10	96.8	82
8/11	4	<0.2	19	<10	<2	12	<40	<2	<10	96.8	89
8/27	Not sampled----------										
9/9	Not sampled----------										
Mean	3	<0.2	19	<10	<2	12	<40	<2	<10	96.3	170

Middle Fork Sugar Creek (RM 7.58) Twp. Rd. 606

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	58	<10	<2	14	<40	<2	<10	202	370
7/21	<2	<0.2	61	<10	<2	15	<40	<2	<10	214	550
8/11	<2	<0.2	60	<10	<2	14	<40	<2	12	207	780
8/27	4	<0.2	56	<10	<2	13	<40	<2	<10	193	1050
9/9	<2	<0.2	58	<10	<2	16	<40	<2	<10	211	312
Mean	2	<0.2	59	<10	<2	14	<40	<2	10	205	612

Middle Fork Sugar Creek (RM 1.66) Welty Rd.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	2	<0.2	55	<10	2	13	<40	<2	<10	191	1360
7/21	<2	<0.2	57	<10	<2	14	<40	<2	<10	200	2250
8/11	2	<0.2	55	<10	4	13	<40	<2	28	191	4030
8/27	4	<0.2	53	<10	3	13	<40	<2	16	186	3410
9/9	<2	<0.2	70	<10	<2	17	<40	<2	<10	245	820
Mean	2	<0.2	58	<10	3	14	<40	<2	15	203	2374

Middle Fork Sugar Creek trib. at RM 6.0 (RM 0.17) Twp. Rd. 659

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	66	<10	<2	19	<40	<2	<10	243	142
7/21	<2	<0.2	83	<10	<2	23	<40	<2	<10	302	319
8/11	2	<0.2	73	<10	<2	21	<40	<2	13	269	333
8/27	<2	<0.2	62	<10	<2	17	<40	<2	<10	225	292
9/9	<2	<0.2	87	<10	<2	24	<40	<2	<10	316	133
Mean	<2	<0.2	74	<10	<2	21	<40	<2	11	271	244

Middle Fork Sugar Creek trib. at RM 3.25 (RM 0.5) Twp. Rd. 314, Alabama Ave.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	118	<10	<2	27	<40	<2	<10	406	204
7/21	<2	<0.2	187	<10	<2	48	<40	<2	<10	665	249
8/11	<2	<0.2	105	<10	<2	26	<40	<2	<10	369	612
8/27	<2	<0.2	90	<10	<2	20	<40	<2	10	307	544
9/9	<2	<0.2	160	<10	<2	42	<40	<2	<10	572	212
Mean	<2	<0.2	132	<10	<2	33	<40	<2	<10	464	364

South Fork Sugar Creek (RM 21.1) CR 114

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	40	<10	<2	15	<40	<2	<10	162	889
7/21	<2	<0.2	46	<10	<2	17	<40	<2	<10	185	972
8/11	<2	<0.2	48	<10	<2	18	<40	<2	<10	194	1040
8/25	<2	0.2	45	<10	4	13	<40	<2	29	166	5660
9/8	<2	<0.2	48	<10	<2	20	<40	<2	21	202	3100
Mean	<2	0.2	45	<10	2	17	<40	<2	16	182	2332

South Fork Sugar Creek (RM 18.98) Twp. Rd. 173

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	46	<10	4	16	<40	<2	<10	181	1160
7/21	<2	<0.2	56	<10	<2	20	<40	<2	<10	222	422
8/11	<2	<0.2	62	<10	<2	23	<40	<2	<10	250	543
8/25	2	<0.2	59	11	4	20	<40	<2	37	230	5660
9/8	<2	<0.2	57	<10	<2	23	<40	<2	<10	237	667
Mean	2	<0.2	56	10	3	20	<40	<2	15	224	1690

South Fork Sugar Creek (RM 15.26) CR 47

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	70	<10	<2	28	<40	<2	<10	290	1020
7/21	<2	<0.2	70	<10	<2	41	<40	<2	<10	411	312
8/11	<2	<0.2	122	<10	<2	53	<40	<4	<10	523	360
8/25	<2	0.2	73	14	6	28	<40	<2	65	298	12500
9/8	<2	<0.2	116	<10	<2	50	<40	<2	<10	496	651
Mean	<2	0.2	90	11	3	40	<40	<4	21	404	2969

Sugarcreek WWTP effluent (RM 14.15)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	41	<10	<2	12	<40	<2	49	152	82
7/21	<2	0.3	39	14	<2	12	<40	<2	57	147	<50
8/11	<2	0.7	34	12	<2	12	<40	<2	55	134	<50
8/25	<2	0.3	37	13	<2	12	<40	<2	62	142	<50
9/8	<2	0.3	39	13	<2	11	<40	<2	70	143	<50
Mean	<2	0.4	38	12	<2	12	<40	<2	59	144	56.4

South Fork Sugar Creek (RM 14.02) Twp. Rd. 355

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	79	<10	<2	28	<40	<2	<10	312	946
7/21	<2	<0.2	101	<10	<2	40	<40	<2	<10	417	309
8/11	<2	<0.2	117	<10	<2	46	<40	<2	14	482	532
8/25	<2	0.2	70	16	8	25	<40	<2	75	278	18000
9/8	<2	<0.2	122	<10	<2	48	<40	<2	15	502	702
Mean	<2	0.2	98	11	3	37	<40	<2	32	398	4098

South Fork Sugar Creek (RM 13.28) CR 73

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	92	<10	<2	36	<40	<2	14	378	865
7/21	<2	<0.2	121	<10	<2	50	<40	<2	<10	508	254
8/11	<2	<0.2	153	<10	<2	66	<40	<2	12	654	168
8/25	<2	<0.2	73	17	6	27	<40	<2	67	293	14800
9/8	<2	<0.2	128	<10	3	59	<40	<2	23	562	819
Mean	<2	<0.2	113	11	3	48	<40	<2	25	479	3381

South Fork Sugar Creek (RM 7.42) SR 93

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	82	<10	<2	36	<40	<2	10	353	1370
7/21	<2	<0.2	119	<10	<2	58	<40	<2	10	536	2280
8/11	<2	<0.2	158	<10	<2	81	<40	<2	<10	728	700
8/25	<2	<0.2	66	13	6	27	<40	<2	62	276	13400
9/8	<2	<0.2	155	<10	<2	80	<40	<2	18	716	2370
Mean	<2	<0.2	116	11	3	56	<40	<2	22	522	4024

South Fork Sugar Creek (RM 6.43) CR 94

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	69	<10	<2	29	<40	<2	18	292	2520
7/21	<2	<0.2	100	<10	<2	48	<40	<2	<10	447	1640
8/11	<2	<0.2	108	<10	<2	52	<40	<2	11	484	1850
8/25	<2	0.2	59	18	9	26	<40	<2	86	254	18500
9/8	<2	<0.2	146	<10	<2	80	<40	<2	14	694	2360
Mean	<2	0.2	96	12	3	47	<40	<2	28	434	5374

South Fork Sugar Creek (RM 3.64) Twp. Rd. 62

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	63	<10	<2	26	<40	<2	12	264	1990
7/21	<2	<0.2	96	<10	<2	45	<40	<2	10	425	2370
8/11	<2	<0.2	116	<10	<2	58	<40	<2	19	528	1630
8/25	<2	<0.2	59	17	7	24	<40	<2	62	246	13500
9/8	<2	<0.2	129	<10	<2	63	<40	<2	20	582	2380
Mean	<2	<0.2	93	11	3	43	<40	<2	25	409	4374

South Fork Sugar Creek trib. at RM 14.1 (RM 0.28) CR 73

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	99	<10	<2	36	<40	<2	<10	395	885
7/21	<2	<0.2	112	<10	<2	47	<40	<2	53	473	341
8/11	3	<0.2	140	<10	<2	62	<40	<2	13	605	2370
8/25	<2	<0.2	61	12	5	22	<40	<2	49	243	10400
9/8	<2	0.2	87	<10	4	35	<40	<2	315	361	3540
Mean	2	0.2	100	10	3	40	<40	<2	88	415	3507

Ohio Whey effluent (RM 0.19)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	30	<10	<2	12	<40	<2	<10	124	188
7/21	<2	<0.2	30	<10	<2	13	<40	<2	<10	128	210
8/11	<2	<0.2	27	<10	<2	12	<40	<2	<10	117	85
8/25	<2	<0.2	29	<10	<2	13	<40	<2	<10	126	743
9/8	<2	<0.2	29	<10	<2	12	<40	<2	<10	122	206
Mean	<2	<0.2	29	<10	<2	12	<40	<2	<10	123	286

South Fork Sugar Creek trib. at RM 14.1 (RM 0.05) Dst. Ohio Whey

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	78	<10	<2	29	<40	<2	<10	314	403
7/21	<2	<0.2	114	<10	<2	50	<40	<2	<10	490	457
8/11	3	<0.2	126	<10	<2	55	<40	<2	27	541	1300
8/25	<2	0.3	61	15	7	22	<40	<2	65	243	14200
9/8	<2	<0.2	114	<10	<2	47	<40	<2	22	478	1150
Mean	2	0.2	99	11	3	41	<40	<2	27	413	3502

South Fork Sugar Creek trib. at RM 1.0 (RM 0.68) Twp. Rd. 447

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	100	<10	<2	69	60	<2	19	534	247
7/21	<2	<0.2	181	<10	<2	159	124	<2	27	1110	203
8/11	<2	<0.2	291	<10	<2	266	<40	<2	78	1820	<50
8/25	<2	<0.2	75	<10	3	46	53	<4	37	377	5000
9/8	2	<0.2	259	<10	<2	237	193	<2	53	1620	196
Mean	2	<0.2	181	<10	2	155	94	<4	43	1092	1139

East Branch of South Fork Sugar Creek (RM 5.47) CR 48 Ust. Ragersville

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	48	16	<2	21	<40	<2	18	206	615
7/21	<2	<0.2	64	<10	<2	29	<40	<2	<10	279	593
8/11	<2	<0.2	76	<10	<2	36	<40	<2	<10	338	552
8/25	<2	<0.2	48	<10	2	20	<40	<2	19	202	5270
9/8	<2	<0.2	57	<10	<2	26	<40	<2	13	249	2830
Mean	<2	<0.2	59	11	2	26	<40	<2	14	255	1972

East Branch of South Fork Sugar Creek (RM 5.04) CR 52 Dst. Ragersville

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	59	<10	<2	26	<40	<2	<10	254	426
7/21	<2	<0.2	76	<10	<2	36	<40	<2	<10	338	569
8/11	<2	<0.2	91	<10	<2	45	<40	<2	10	412	410
8/25	<2	<0.2	56	<10	2	24	<40	<2	14	239	<50
9/8	<2	<0.2	70	<10	<2	33	<40	<2	16	311	2330
Mean	<2	<0.2	70	<10	2	33	<40	<2	12	311	757

East Branch of South Fork Sugar Creek (RM 1.7) Twp. Rd. 348

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	109	<10	<2	47	<40	<2	14	466	745
7/21	<2	<0.2	155	<10	<2	69	<40	<2	<10	671	370
8/11	<2	0.3	191	17	<2	87	<40	<2	27	835	321
8/25	<2	<0.2	98	14	3	41	<40	<2	48	414	7750
9/8	<2	<0.2	166	<10	<2	72	<40	<2	14	711	1430
Mean	<2	0.2	144	12	2	63	<40	<2	23	619	2123

Crabapple Creek (RM 2.96) Twp. Rd. 357

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	0.2	65	136	9	20	<40	<2	56	245	430
7/21	<2	<0.2	70	<10	<2	20	<40	<2	<10	257	961
8/11	4	<0.2	85	<10	<2	26	<40	<2	10	319	502
8/27	<2	<0.2	74	<10	<2	22	<40	<2	<10	275	541
9/9	<2	<0.2	81	<10	<2	25	<40	<2	10	305	535
Mean	2	<0.2	75	35	3	23	<40	<2	19	280	594

Crabapple Creek (RM 0.31) Twp. Rd. 606

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	57	<10	<2	15	<40	<2	<10	204	330
7/21	<2	<0.2	61	<10	<2	16	<40	<2	<10	218	605
8/11	2	<0.2	67	<10	<2	17	<40	<2	<10	237	662
8/27	<2	<0.2	62	<10	<2	15	<40	<2	<10	216	901
9/9	<2	<0.2	60	<10	<2	18	<40	<2	<10	224	348
Mean	<2	<0.2	61	<10	<2	16	<40	<2	<10	220	569

Misers Run (RM 0.22) Lane off Twp. Rd. 659

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	69	<10	<2	14	<40	<2	<10	230	350
7/21	<2	<0.2	81	<10	<2	17	<40	<2	<10	272	350
8/11	<2	<0.2	74	<10	<2	15	<40	<2	<10	246	463
8/27	2	<0.2	68	<10	<2	14	<40	<2	<10	227	376
9/9	<2	<0.2	82	<10	<2	17	<40	<2	11	275	229
Mean	<2	<0.2	75	<10	<2	15	<40	<2	<10	250	354

Elm Run (RM 1.69) Harmon Ave.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	57	<10	<2	15	<40	<2	<10	204	549
7/21	<2	<0.2	67	<10	<2	18	<40	<2	10	241	1090
8/11	2	<0.2	54	<10	2	14	<40	<2	17	192	2520
8/27	2	<0.2	46	<10	<2	12	<40	<2	16	164	1520
9/8	<2	<0.2	68	<10	<2	19	<40	<2	<10	248	524
Mean	2	<0.2	58	<10	<2	16	<40	<2	13	210	1241

Elm Run (RM 0.45) Kings Highway

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	3	<0.2	56	<10	4	15	<40	<2	12	202	2200
7/21	4	<0.2	64	<10	5	17	<40	<2	13	230	3000
8/11	3	<0.2	42	<10	7	11	<40	<2	31	150	6140
8/27	4	<0.2	37	<10	5	10	<40	<2	19	134	3320
9/8	3	<0.2	67	<10	4	18	<40	<2	21	241	2510
Mean	3	<0.2	53	<10	5	14	<40	<2	19	191	3434

Brush Run (RM 2.51) Shrock Rd.

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	104	<10	<2	52	<40	<2	<10	474	949
7/21	<2	<0.2	139	<10	<2	70	<40	<2	<10	635	312
8/11	<2	<0.2	179	<10	<2	91	<40	<2	14	818	532
8/25	<2	<0.2	75	<10	<2	38	<40	<2	30	344	3670
9/8	2	<0.2	146	<10	4	73	<40	<2	31	665	5930
Mean	2	<0.2	129	<10	2	65	<40	<2	19	587	2279

Baltic WWTP effluent (RM 0.95)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	54	<10	<2	14	<40	<2	44	192	<50
7/21	<2	0.3	53	<10	<2	16	<40	<2	49	198	54
8/11	<2	<0.2	51	<10	4	14	<40	<2	41	185	130
8/25	<2	0.3	48	<10	3	12	<40	<2	55	169	<50
9/8	<2	0.3	52	<10	<2	16	<40	<2	61	196	<50
Mean	<2	0.3	52	<10	3	14	<40	<2	50	188	67

Brush Run (RM 0.3) Twp. Rd. 171, dst. Baltic WWTP

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	100	<10	<2	42	<40	<2	<10	423	281
7/21	<2	<0.2	133	<10	<2	57	<40	<2	<10	567	276
8/11	<2	<0.2	136	<10	<2	61	<40	<2	24	591	678
8/25	<2	<0.2	74	<10	3	28	<40	<2	50	300	3720
9/8	<2	<0.2	139	<10	<2	70	<40	<2	18	635	1450
Mean	<2	<0.2	116	<10	2	52	<40	<2	22	503	1281

Pleasant Valley Creek (RM 0.24) From Twp. Rd. 339

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	97	<10	<2	41	<40	<2	<10	411	455
7/21	<2	<0.2	131	<10	<2	59	<40	<2	<10	570	354
8/11	<2	<0.2	171	<10	<2	77	<40	<2	<10	744	1000
8/25	<2	<0.2	77	<10	<2	31	<40	<4	25	320	3840
9/8	<2	<0.2	152	<10	<2	65	<40	<2	11	647	1070
Mean	<2	<0.2	126	<10	<2	55	<40	<4	13	538	1344

Guggisburg Cheese effluent (RM 1.47)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	3	<0.2	30	<10	<2	11	<40	<2	13	120	436
7/21	4	<0.2	39	<10	3	13	<40	<2	12	151	2800
8/11	Not discharging----------										
8/25	Not discharging----------										
9/8	Not discharging----------										
Mean	4	<0.2	35	<10	3	12	<40	<2	13	136	1618

Troyer Valley Creek (RM 1.08) SR 93

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	74	<10	<2	33	<40	<2	35	321	1240
7/21	<2	<0.2	98	<10	<2	45	45	<2	35	430	1690
8/11	<2	<0.2	143	<10	<2	68	<40	<2	16	637	1080
8/25	3	<0.2	87	13	4	37	40	<2	66	370	6220
9/8	<2	<0.2	131	<10	<2	66	47	<2	22	599	2420
Mean	2	<0.2	107	11	2	50	42	<2	35	471	2530

Walnut Creek (RM 7.93) Old SR 39

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	59	<10	<2	16	<40	<2	<10	213	366
7/21	<2	<0.2	74	<10	7	22	<40	<2	<10	275	580
8/11	<2	<0.2	89	<10	<2	28	<40	<2	<10	338	563
8/25	<2	<0.2	64	10	3	18	<40	<2	26	234	5540
9/8	<2	<0.2	94	<10	<2	32	<40	<2	<10	366	1240
Mean	<2	<0.2	76	10	3	23	<40	<2	13	285	1658

Walnut Creek (RM 6.32) Twp. Rd. 444

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	60	<10	<2	16	<40	<2	<10	216	336
7/21	<2	<0.2	75	<10	<2	22	<40	<2	<10	278	302
8/11	2	<0.2	84	<10	<2	26	<40	<2	<10	317	808
8/25	<2	<0.2	62	<10	4	18	<40	<2	35	229	6340
9/8	<2	<0.2	87	<10	<2	28	<40	<2	10	332	990
Mean	2	<0.2	74	<10	2	22	<40	<2	15	274	1755

Walnut Creek (RM 4.49) CR 172

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	97	<10	<2	47	<40	<2	<10	436	612
7/21	<2	<0.2	151	<10	<2	91	<40	<2	17	752	753
8/11	<2	<0.2	143	<10	<2	83	<40	<4	11	699	920
8/25	2	<0.2	73	12	6	30	<40	<2	51	306	11200
9/8	<2	<0.2	166	<10	<2	102	<40	<2	16	834	710
Mean	2	<0.2	126	10	3	71	<40	<4	21	605	2839

Walnut Creek (RM 0.56) Lane from CR 94

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	63	<10	<2	26	<40	<2	<10	264	1540
7/21	<2	<0.2	95	<10	<2	47	<40	<2	<10	431	1120
8/11	<2	<0.2	87	<10	<2	40	<40	<2	16	382	1190
8/25	2	0.2	63	14	7	28	<40	<2	62	273	11900
9/8	<2	<0.2	115	<10	<2	64	<40	<2	<10	551	825
Mean	2	0.2	85	11	3	41	<40	<2	22	380	3315

Goose Creek (RM 0.35) Twp. Rd. 419

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	76	<10	<2	30	<40	<2	<10	313	357
7/21	<2	<0.2	113	<10	<2	58	<40	<2	<10	521	702
8/11	<2	<0.2	99	<10	<2	48	<40	<2	<10	445	704
8/25	<2	0.3	72	<10	4	27	<40	<2	28	291	5990
9/8	<2	<0.2	136	<10	<2	80	<40	<2	<10	669	725
Mean	<2	0.2	99	<10	2	49	<40	<2	14	448	1696

Indian Trail Creek (RM 6.33) Twp. Rd. 414

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	61	<10	<2	15	<40	<2	12	214	831
7/21	<2	<0.2	85	<10	<2	24	<40	<2	<10	311	616
8/11	<2	<0.2	101	<10	<2	30	<40	<2	17	376	626
8/25	<2	<0.2	58	<10	<2	15	<40	<2	22	206	1970
9/8	<2	<0.2	119	<10	<2	36	<40	<2	<10	445	583
Mean	<2	<0.2	85	<10	<2	24	<40	<2	14	310	925

Indian Trail Creek (RM 5.4) SR 515

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	79	532	<2	26	222	<2	549	304	5770
7/21	<2	<0.2	76	<10	<2	21	<40	<2	<10	276	524
8/11	<2	<0.2	88	<10	<2	25	<40	<2	21	323	538
8/25	<2	<0.2	56	<10	<2	16	<40	<2	22	206	1900
9/8	<2	<0.2	100	<10	<2	29	<40	<2	<10	369	225
Mean	<2	<0.2	80	114	<2	23	76	<2	122	296	1791

Indian Trail Creek (RM 2.56) Twp. Rd. 66

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	48	<10	<2	13	<40	<2	10	173	785
7/21	<2	<0.2	64	<10	<2	18	<40	<2	<10	234	1900
8/11	<2	<0.2	67	<10	<2	19	<40	<2	18	246	1850
8/25	2	<0.2	51	14	6	17	<40	<2	63	197	10900
9/8	<2	<0.2	73	<10	<2	21	<40	<2	10	269	866
Mean	2	<0.2	61	11	3	18	<40	<2	22	224	3260

Indian Trail Creek tributary at RM 6.08 (RM 0.3) Twp. Rd. 413 (Holmes ByProducts West)

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	2.3	48	<10	<2	24	202	<2	325	219	142
7/21	<2	1.5	57	<10	<2	24	129	<2	214	241	1410
8/11	<2	1.4	63	<10	<2	27	<40	<2	222	268	764
8/25	<2	0.2	64	<10	<2	24	<40	<2	30	259	1900
9/8	<2	<0.2	70	<10	2	22	<40	<2	42	265	172
Mean	<2	1.1	60	<10	<2	24	90	<2	167	250	878

Broad Run (RM 2.8) Dst. Winfield @ CR 80

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	98	<10	<2	38	<40	<2	14	401	444
7/21	<2	<0.2	134	<10	<2	55	<40	<2	<10	561	474
8/11	<2	<0.2	165	<10	<2	66	<40	<2	<10	684	361
8/25	<2	<0.2	90	<10	3	38	<40	<2	36	381	5780
9/8	<2	<0.2	162	<10	<2	63	<40	<2	14	664	358
Mean	<2	<0.2	130	<10	2	52	<40	<2	17	538	1483

Broad Run (RM 0.15) Twp. Rd. 425

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	0.2	95	<10	<2	49	78	<2	79	439	454
7/21	<2	0.3	136	<10	<2	73	90	<2	79	640	856
8/11	<2	0.3	163	<10	<2	88	119	<2	110	769	476
8/25	2	0.4	70	22	10	34	84	<2	145	315	17700
9/8	<2	0.2	167	<10	<2	84	98	<2	96	763	633
Mean	2	0.3	126	12	4	66	94	<2	102	585	4024

Cherry Run (RM 0.22) CR 78

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	0.5	117	<10	<2	77	167	<2	182	609	839
7/21	<2	0.5	151	<10	<2	103	184	<2	186	801	1880
8/11	<2	0.5	166	<10	<2	136	184	<2	197	974	493
8/25	<2	0.5	111	<10	<2	75	150	<2	166	586	4060
9/8	<2	0.5	205	<10	<2	142	189	<2	199	1100	885
Mean	<2	0.5	150	<10	<2	107	175	<2	186	814	1631

Turkeyfoot Run (RM 0.23) CR 78

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	0.4	96	<10	<2	61	132	<2	135	491	396
7/21	<2	0.5	158	<10	2	107	181	2	199	835	527
8/11	<2	0.7	243	<10	<2	161	244	2	246	1270	110
8/25	<2	0.6	79	18	3	44	158	<2	202	378	6690
9/8	<2	0.7	201	<10	<2	152	247	<2	282	1130	210
Mean	<2	0.6	155	12	2	105	192	2	213	821	1587

Goettge Run (RM 0.25) Davis Street

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	0.5	110	<10	<2	66	173	<2	140	546	460
7/21	<2	0.2	150	<10	<2	91	198	<2	117	749	371
8/11	<2	0.2	178	<10	<2	130	168	<2	98	980	78
8/25	<2	<0.2	65	<10	<2	35	80	<2	60	306	3800
9/8	<2	<0.2	181	<10	<2	125	153	<2	90	967	110
Mean	<2	0.3	137	<10	<2	89	154	<2	101	710	964

Brandywine Creek (RM 2.02) Twp. Rd. 374

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	138	<10	<2	39	<40	<2	<10	505	1000
7/21	<2	<0.2	176	<10	<2	50	<40	<2	<10	645	1660
8/11	<2	<0.2	224	<10	<2	51	<40	<2	<10	769	1390
8/25	<2	<0.2	109	10	4	30	<40	2	31	396	7560
9/8	<2	<0.2	195	<10	<2	49	<40	<2	14	689	3470
Mean	<2	<0.2	168	10	2	44	<40	2	15	601	3016

Brandywine Creek (RM 0.16) Twp. Rd. 211

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
7/9	<2	<0.2	125	<10	<2	34	<40	<2	<10	452	290
7/21	<2	<0.2	165	<10	<2	42	<40	<2	<10	585	201
8/11	<2	<0.2	197	<10	<2	45	<40	<2	<10	677	272
8/25	<2	<0.2	89	17	8	23	<40	2	63	317	17000
9/8	<2	<0.2	189	<10	<2	46	<40	<4	<10	661	297
Mean	<2	<0.2	153	11	3	38	<40	2	21	538	3612

Little Sugar Creek (RM 4.2) Kansas Rd.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/8	246	<30	28	7	20	178	154	0.09	50	0.7
7/20	<200	<30	50	10	36	187	154	<0.02	38	0.7
8/10	203	<30	131	11	50	166	155	0.02	34	1.3
8/24	----------									
9/9	<200	<30	22	8	35	170	174	0.03	47	0.3
Mean	212	<30	58	9	35	175	159	0.04	42	0.4

Little Sugar Creek (RM 0.8) McQuaid Rd.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/8	288	<30	84	8	68	1040	118	0.07	51	0.9
7/20	439	<30	105	8	45	254	98	0.03	59	0.8
8/10	568	<30	332	15	231	2250	122	0.04	60	1.5
8/24	2580	<30	1250	42	968	17300	128	0.06	34	2.4
9/9	407	<30	127	10	91	1090	132	0.05	55	1.0
Mean	856	<30	380	17	281	4387	120	0.05	52	1.3

Little Sugar Creek trib. at RM 0.5 (RM 1.05) McQuaid Rd.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/8	210	<30	28	6	46	151	-	-	-	1.1
7/20	<200	<30	19	6	66	197	115	0.03	49	0.7
8/10	<200	<30	85	6	48	161	169	0.13	41	0.9
8/24	691	<30	122	8	71	168	176	0.04	43	1.1
9/9	200	<30	44	6	53	162	156	0.03	43	0.9
Mean	300	<30	60	6	57	168	154	0.06	44	0.9

North Fork Sugar Creek (RM 6.5) UST. Lehman Hardware

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/8	<200	<30	116	8	30	192	140	0.18	46	0.8
7/20	<200	<30	145	7	58	203	157	0.22	53	1.9
8/10	<200	<30	222	9	57	187	151	0.29	46	1.5
8/24	1170	<30	393	12	31	115	104	0.18	42	2.3
9/9	258	<30	124	6	70	196	153	0.16	47	0.8
Mean	406	<30	200	8	49	179	141	0.21	47	1.5

North Fork Sugar Creek (RM 5.53) Zuercher Road

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/8	<200	<30	38	14	88	246	139	0.24	59	1.2
7/20	<200	<30	37	13	98	288	155	0.26	54	1.5
8/10	208	<30	200	19	154	308	168	0.27	61	2.1
8/24	3820	<30	655	13	39	216	85	0.15	37	3.9
9/9	<200	<30	26	15	134	279	180	0.22	57	1.1
Mean	926	<30	191	15	103	267	145	0.23	54	2.0

North Fork Sugar Creek (RM 1.35) West Lebanon Rd.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/8	<200	<30	76	6	23	185	138	0.05	46	0.8
7/20	411	<30	135	7	42	278	177	0.05	48	0.3
8/10	435	<30	190	8	31	217	149	0.08	46	0.8
8/24	489	<30	220	7	55	285	213	0.03	36	0.7
9/9	<200	<30	85	7	48	260	191	0.05	46	<0.2
Mean	347	<30	141	7	40	245	174	0.05	44	0.6

Middle Fork Sugar Creek (RM 12.0) From Twp. Rd. 656

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	162	6	13	154	142	0.03	46	0.7
7/21	879	<30	276	7	18	186	159	0.02	37	0.7
8/11	<200	<30	126	7	19	200	168	0.05	36	0.6
8/27	<200	<30	72	7	13	149	129	0.06	46	0.6
9/9	<200	<30	82	5	21	201	179	0.02	40	<0.2
Mean	336	<30	144	6	17	178	155	0.04	41	0.6

Middle Fork Sugar Creek (RM 10.25) Twp. Rd. 669

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	77	6	9	150	131	0.03	37	0.6
7/21	247	<30	88	6	12	191	150	0.03	38	0.4
8/11	215	<30	92	7	13	188	149	0.09	36	0.9
8/27	326	<30	94	6	9	149	125	0.04	47	0.5
9/9	<200	<30	112	5	14	206	170	0.03	41	<0.2
Mean	238	<30	93	6	11	177	145	0.04	40	0.5

Alpine Valley WWTP effluent (RM 7.9)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	28	26	365	98	579	<0.02	40	3.7
7/21	<200	<30	11	26	402	89	600	0.02	48	2.5
8/11	<200	<30	12	27	391	88	638	0.02	57	2.6
8/27	Not sampled----------									
9/9	Not sampled----------									
Mean	<200	<30	17	26	386	92	606	0.02	48	2.9

Middle Fork Sugar Creek (RM 7.58) Twp. Rd. 606

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	37	5	13	167	125	0.03	49	0.7
7/21	237	<30	98	6	12	178	141	0.05	48	0.4
8/11	371	<30	116	7	14	180	139	0.09	52	0.8
8/27	521	<30	112	6	13	147	121	0.05	51	0.6
9/9	<200	<30	90	5	14	191	160	0.04	50	0.2
Mean	306	<30	91	6	13	173	137	0.05	50	0.5

Middle Fork Sugar Creek (RM 1.66) Welty Rd.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	599	<30	151	6	10	153	119	0.04	57	1.2
7/21	1120	<30	159	8	13	174	117	0.06	58	0.8
8/11	2180	<30	209	9	13	176	104	0.11	62	1.3
8/27	1810	<30	273	6	9	142	110	0.05	53	1.0
9/9	315	<30	126	5	14	205	159	0.03	73	<0.2
Mean	1205	<30	184	7	12	170	122	0.06	61	0.9

Middle Fork Sugar Creek trib. at RM 6.0 (RM 0.17) Twp. Rd. 659

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	43	5	12	228	105	<0.02	109	0.6
7/21	<200	<30	76	5	15	287	125	<0.02	123	<0.2
8/11	<200	<30	71	6	12	248	116	0.02	104	0.4
8/27	<200	<30	46	5	10	198	108	<0.02	87	-
9/9	<200	<30	64	5	15	305	149	0.02	124	<0.2
Mean	<200	<30	60	5	13	253	121	0.02	109	0.3

Middle Fork Sugar Creek trib. at RM 3.25 (RM 0.5) Twp. Rd. 314, Alabama Ave.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	230	5	16	314	133	<0.02	231	0.6
7/21	<200	<30	330	8	26	520	155	0.02	271	0.3
8/11	334	<30	287	7	15	290	112	0.02	190	0.6
8/27	288	<30	221	5	12	229	112	0.02	141	0.4
9/9	<200	<30	244	7	25	447	164	0.03	347	<0.2
Mean	244	<30	262	6	19	360	135	0.02	236	0.4

South Fork Sugar Creek (RM 21.1) CR 114

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	330	<30	179	5	10	172	83	0.07	73	0.9
7/21	372	<30	365	6	12	198	89	0.10	67	0.8
8/11	384	<30	373	8	13	208	98	0.16	77	1.0
8/25	3040	<30	674	17	14	201	77	0.16	57	2.4
9/8	1590	<30	424	8	15	230	106	0.09	84	0.5
Mean	1143	<30	403	9	13	202	91	0.12	72	1.1

South Fork Sugar Creek (RM 18.98) Twp. Rd. 173

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	551	<30	151	5	12	177	86	0.08	100	1.0
7/21	<200	<30	211	7	14	218	96	0.11	105	0.6
8/11	276	<30	444	9	16	246	111	0.20	118	0.9
8/25	3060	<30	1850	20	16	216	87	0.16	126	4.0
9/8	467	<30	390	9	17	246	119	0.11	115	0.3
Mean	911	<30	609	10	15	221	100	0.13	113	1.4

South Fork Sugar Creek (RM 15.26) CR 47

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	407	<30	1060	7	24	304	86	0.11	230	1.0
7/21	<200	<30	1590	9	33	427	97	0.11	364	0.7
8/11	236	<30	2750	11	45	543	113	0.12	440	1.0
8/25	6200	<30	3740	17	19	288	67	0.14	201	3.3
9/8	388	<30	2620	10	46	517	114	0.11	397	0.9
Mean	1486	<30	2352	11	33	416	95	0.12	326	1.4

Sugarcreek WWTP effluent (RM 14.15)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	<10	12	145	165	164	0.03	118	1.4
7/21	<200	<30	<10	16	178	168	178	0.04	141	1.1
8/11	<200	<30	12	19	183	158	190	0.02	130	1.3
8/25	<200	<30	20	17	177	173	187	0.06	130	1.4
9/8	<200	<30	11	16	188	167	203	0.02	119	1.4
Mean	<200	<30	13	16	174	166	184	0.03	128	1.3

South Fork Sugar Creek (RM 14.02) Twp. Rd. 355

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	272	<30	890	7	34	342	96	0.10	238	1.0
7/21	<200	<30	1050	10	48	453	112	0.09	264	1.0
8/11	310	<30	1820	12	72	543	133	0.10	377	1.0
8/25	7500	<30	3080	15	23	297	68	0.14	173	2.7
9/8	446	<30	1970	14	87	544	157	0.12	438	1.2
Mean	1746	<30	1762	12	53	436	113	0.11	298	1.4

South Fork Sugar Creek (RM 13.28) CR 73

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	413	<30	713	7	25	354	89	0.10	263	1.1
7/21	<200	<30	1050	8	34	476	102	0.08	347	0.6
8/11	<200	<30	2520	10	45	606	119	0.18	<5	1.2
8/25	6800	<30	3040	15	20	303	67	0.13	199	3.2
9/8	531	<30	2540	14	57	562	126	0.12	450	1.6
Mean	1629	<30	1973	11	36	460	101	0.12	253	1.5

South Fork Sugar Creek (RM 7.42) SR 93

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	494	<30	1310	7	18	307	82	0.10	272	1.1
7/21	1030	<30	1610	9	27	487	98	0.06	368	0.9
8/11	302	<30	2550	10	40	661	116	0.07	602	0.9
8/25	6460	<30	3320	14	13	253	53	0.17	198	4.1
9/8	1240	<30	2680	12	54	697	130	0.08	542	0.5
Mean	1905	<30	2294	10	30	481	96	0.10	396	1.5

South Fork Sugar Creek (RM 6.43) CR 94

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	1250	<30	1180	6	14	<30	84	0.08	214	1.0
7/21	746	<30	1480	8	23	397	99	0.06	312	0.6
8/11	946	<30	2060	10	26	435	100	0.11	426	1.2
8/25	9670	<30	2720	14	13	224	58	0.17	173	3.3
9/8	1190	<30	2620	11	41	628	129	0.07	539	0.6
Mean	2760	<30	2012	10	23	343	94	0.10	333	1.3

South Fork Sugar Creek (RM 3.64) Twp. Rd. 62

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	984	<30	1220	6	13	230	79	0.09	168	1.1
7/21	1160	<30	1800	9	20	378	97	0.10	309	1.1
8/11	795	<30	2320	10	25	469	90	0.11	436	1.2
8/25	7230	<30	2750	14	13	230	59	0.17	169	3.3
9/8	1020	<30	2480	8	31	496	130	0.06	452	0.6
Mean	2238	<30	2114	9	20	361	91	0.11	307	1.5

South Fork Sugar Creek trib. at RM 14.1 (RM 0.28) CR 73

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	203	<30	618	5	19	394	90	0.05	312	0.6
7/21	209	<30	418	6	39	540	120	0.09	317	1.0
8/11	768	<30	723	9	48	729	165	0.08	511	1.6
8/25	5710	<30	1070	13	16	263	63	0.15	169	2.4
9/8	2520	<30	551	6	22	412	91	0.09	275	1.5
Mean	1882	<30	676	8	29	468	106	0.09	317	1.6

Ohio Whey effluent (RM 0.19)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	54	50	249	119	477	0.02	45	6.5
7/21	<200	<30	29	53	234	108	463	0.23	42	6.2
8/11	<200	<30	37	57	256	95	505	0.35	60	6.4
8/25	312	<30	102	67	287	91	595	0.52	82	5.9
9/8	<200	<30	23	67	388	75	703	0.23	71	6.1
Mean	222	<30	49	59	283	98	549	0.27	60	6.2

South Fork Sugar Creek trib. at RM 14.1 (RM 0.05) Dst. Ohio Whey

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	260	6	24	329	108	0.05	232	0.9
7/21	<200	<30	442	11	45	551	153	0.09	326	1.0
8/11	521	<30	821	16	75	656	208	0.14	453	2.2
8/25	7380	<30	1160	14	19	264	70	0.16	157	3.3
9/8	664	<30	493	30	149	494	354	0.18	365	2.5
Mean	1793	<30	635	15	62	459	179	0.12	307	2.0

South Fork Sugar Creek trib. at RM 1.0 (RM 0.68) Twp. Rd. 447

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	3980	5	10	328	50	0.02	461	0.5
7/21	<200	<30	9820	7	16	639	38	<0.02	996	<0.2
8/11	<200	<30	17600	9	20	806	26	<0.02	1520	0.4
8/25	2750	<30	3160	10	9	244	42	0.06	312	1.8
9/8	<200	32	13700	8	22	887	27	<0.02	1320	0.3
Mean	710	30	9652	8	15	581	37	0.03	922	0.6

East Branch of South Fork Sugar Creek (RM 5.47) CR 48 uST. Ragersville

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	233	<30	219	4	11	175	69	0.11	140	0.8
7/21	<200	<30	309	5	12	219	84	0.11	181	1.2
8/11	238	<30	386	5	15	256	94	0.04	249	0.5
8/25	3110	<30	549	12	11	169	62	0.13	126	2.1
9/8	1610	<30	419	11	15	207	93	0.11	142	1.0
Mean	1078	<30	376	7	13	205	80	0.10	167	1.1

East Branch of South Fork Sugar Creek (RM 5.04) CR 52 dst. Ragersville

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	170	4	14	199	77	0.11	185	1.1
7/21	<200	<30	36	5	14	257	93	0.09	216	0.8
8/11	214	<30	385	5	18	304	106	0.04	299	0.6
8/25	2930	<30	575	11	12	193	66	0.11	153	1.7
9/8	1230	<30	404	10	14	246	103	0.11	198	1.1
Mean	955	<30	314	7	14	240	89	0.09	210	1.1

East Branch of South Fork Sugar Creek (RM 1.7) Twp. Rd. 348

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	436	<30	1290	6	16	382	84	0.10	444	1.5
7/21	<200	<30	2560	6	16	552	90	0.07	558	0.6
8/11	<200	<30	3990	10	22	693	107	0.10	701	2.7
8/25	4540	<30	3120	14	13	363	57	0.12	324	2.6
9/8	834	<30	3740	12	20	564	99	0.12	526	2.3
Mean	1242	<30	2940	10	17	511	87	0.10	511	1.9

Crabapple Creek (RM 2.96) Twp. Rd. 357

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	214	<30	68	14	16	208	120	0.02	84	0.8
7/21	390	<30	124	5	16	211	133	0.04	78	0.7
8/11	280	<30	107	8	16	273	150	0.06	125	0.8
8/27	305	<30	82	6	15	227	133	0.03	115	0.6
9/9	277	<30	107	5	15	249	161	0.04	107	<0.2
Mean	293	<30	98	8	16	234	139	0.04	102	0.6

Crabapple Creek (RM 0.31) Twp. Rd. 606

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	70	5	10	161	118	0.02	63	1.0
7/21	252	<30	78	4	10	162	130	0.03	54	0.6
8/11	254	<30	146	7	10	182	139	0.08	73	1.2
8/27	439	<30	96	6	9	157	120	0.03	64	0.7
9/9	<200	<30	76	4	11	178	150	0.04	62	<0.2
Mean	269	<30	93	5	10	168	131	0.04	63	0.7

Misers Run (RM 0.22) Lane off Twp. Rd. 659

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	107	8	20	184	121	0.03	99	0.5
7/21	<200	<30	107	11	29	219	136	<0.02	108	0.4
8/11	<200	<30	130	10	26	205	124	0.02	101	0.6
8/27	<200	<30	81	9	21	180	117	0.02	95	0.3
9/9	<200	<30	101	10	27	211	141	0.02	123	<0.2
Mean	<200	<30	105	10	25	200	128	0.02	105	0.4

Elm Run (RM 1.69) Harmon Ave.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	241	<30	92	3	14	150	128	0.05	59	0.8
7/21	567	<30	127	3	14	171	142	0.04	61	0.4
8/11	1330	<30	194	5	18	138	110	0.06	50	0.9
8/27	894	<30	140	4	13	118	98	0.03	47	0.6
9/8	248	<30	75	3	17	174	164	0.03	60	0.2
Mean	656	<30	126	4	15	150	128	0.04	55	0.6

Elm Run (RM 0.45) Kings Highway

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	868	<30	320	4	17	149	122	0.06	54	1.5
721	1360	<30	383	4	15	167	137	0.06	55	1.4
8/11	3460	<30	374	6	19	115	79	0.11	48	1.9
8/27	2020	<30	306	5	16	96	75	0.04	49	2.2
9/8	1120	<30	307	4	17	178	159	0.04	63	0.9
Mean	1766	<30	338	5	17	141	114	0.06	54	1.6

Brush Run (RM 2.51) Shrock Rd.

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	327	<30	2160	5	15	390	79	0.03	371	0.9
7/21	<200	<30	2210	5	24	525	93	0.02	568	0.5
8/11	217	<30	1570	5	21	658	98	<0.02	1300	0.4
8/25	2060	<30	1500	7	11	273	38	0.07	330	1.5
9/8	2430	<30	3820	6	22	547	101	0.04	519	0.6
Mean	1047	<30	2252	6	19	479	82	0.04	618	0.8

Baltic WWTP effluent (RM 0.95)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	11	22	226	307	232	<0.02	49	1.6
7/21	<200	<30	15	25	220	329	208	0.14	67	1.6
8/11	<200	<30	80	19	287	391	291	0.06	41	6.1
8/25	<200	<30	20	18	198	324	225	<0.02	40	1.3
9/8	<200	<30	<10	27	311	346	255	<0.02	50	2.2
Mean	<200	<30	27	22	248	339	242	0.05	49	2.6

Brush Run (RM 0.3) Twp. Rd. 171, dst. Baltic WWTP

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	226	<30	1640	6	34	394	96	0.04	345	0.6
7/21	<200	<30	1560	9	56	549	98	0.04	474	0.5
8/11	272	<30	3870	11	91	592	135	0.15	542	2.6
8/25	2200	<30	2030	9	30	351	63	0.08	220	1.1
9/8	867	<30	3120	10	39	636	82	0.08	533	1.0
Mean	753	<30	2444	9	50	504	95	0.08	423	1.2

Pleasant Valley Creek (RM 0.24) From Twp. Rd. 339

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	325	<30	1460	5	14	298	68	0.07	336	0.7
7/21	209	<30	1490	6	16	412	71	0.05	521	0.3
8/11	650	<30	1140	7	20	523	77	0.09	714	0.6
8/25	2320	<30	1440	15	14	253	67	0.13	204	2.1
9/8	770	<30	1100	7	19	467	99	0.03	462	0.4
Mean	855	<30	1326	8	17	391	76	0.07	447	0.8

Guggisburg Cheese effluent (RM 1.47)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	78	112	593	49	1120	0.17	114	74.3
7/21	1200	<30	405	126	682	72	1130	0.36	94	63.5
8/11	Not discharging----------									
8/25	Not discharging----------									
9/8	Not discharging----------									
Mean	700	<30	242	119	638	61	1125	0.27	104	68.9

Troyer Valley Creek (RM 1.08) SR 93

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	971	<30	4250	17	81	256	176	0.19	254	7.7
7/21	1180	<30	6700	23	129	332	210	0.42	365	8.2
8/11	637	<30	15000	11	27	516	93	0.25	656	1.6
8/25	3910	<30	4410	23	18	302	62	0.19	289	3.7
9/8	1390	<30	11700	15	58	508	147	0.19	472	3.0
Mean	1618	<30	8412	18	63	383	138	0.25	407	4.2

Walnut Creek (RM 7.93) Old SR 39

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	101	5	13	200	104	0.05	94	0.9
7/21	315	<30	163	7	19	261	118	0.08	119	1.2
8/11	307	<30	211	10	25	328	124	0.17	200	0.8
8/25	3200	<30	326	14	17	237	91	0.15	134	2.2
9/8	826	<30	267	10	28	355	149	0.10	227	0.3
Mean	970	<30	214	9	20	276	117	0.11	155	1.1

Walnut Creek (RM 6.32) Twp. Rd. 444

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	82	5	24	210	110	0.05	93	0.8
7/21	<200	<30	129	7	35	276	127	0.09	153	0.6
8/11	477	<30	214	11	44	324	131	0.15	164	1.1
8/25	3630	<30	390	14	20	224	90	0.15	125	2.1
9/8	746	<30	234	11	41	335	163	0.13	171	0.7
Mean	1051	<30	210	10	33	274	124	0.11	141	1.1

Walnut Creek (RM 4.49) CR 172

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	302	<30	1140	6	17	392	104	0.04	283	0.6
7/21	627	<30	2480	8	28	689	114	0.06	596	0.6
8/11	599	<30	1780	11	30	663	108	0.12	507	0.9
8/25	5800	<30	1400	14	19	305	86	0.13	182	2.5
9/8	585	<30	2090	10	49	798	135	0.09	688	0.4
Mean	1583	<30	1778	10	29	569	109	0.09	451	1.0

Walnut Creek (RM 0.56) Lane from CR 94

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	560	<30	1070	5	12	224	89	0.07	182	1.0
7/21	467	<30	1600	8	21	364	107	0.07	276	0.6
8/11	500	<30	1480	10	21	350	95	0.15	270	1.0
8/25	6380	<30	1780	11	13	228	59	0.14	176	2.7
9/8	296	<30	1880	8	28	480	129	0.07	415	<0.2
Mean	1641	<30	1562	8	19	329	96	0.10	264	1.1

Goose Creek (RM 0.35) Twp. Rd. 419

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	832	6	14	305	109	0.04	193	0.8
7/21	377	<30	1320	9	21	541	127	0.06	327	0.9
8/11	417	<30	1310	11	19	461	118	0.14	337	1.1
8/25	3370	<30	1070	12	17	303	87	0.12	169	1.6
9/8	545	<30	2030	10	28	690	147	0.07	512	0.2
Mean	982	<30	1312	10	20	460	118	0.09	308	0.9

Indian Trail Creek (RM 6.33) Twp. Rd. 414

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	229	<30	469	5	11	186	99	0.04	100	1.2
7/21	218	<30	986	6	15	286	102	0.06	180	0.5
8/11	<200	<30	1660	8	22	356	96	0.17	276	2.1
8/25	989	<30	501	11	16	187	86	0.13	109	1.9
9/8	<200	<30	1540	6	19	424	102	0.02	331	<0.2
Mean	367	<30	1031	7	17	288	97	0.08	199	1.2

Indian Trail Creek (RM 5.4) SR 515

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	2330	214	858	16	33	720	93	0.13	100	1.0
7/21	236	<30	321	6	15	244	102	0.07	151	0.4
8/11	200	<30	482	7	19	292	99	0.32	215	1.1
8/25	990	<30	758	16	21	179	81	0.27	96	4.5
9/8	<200	<30	356	6	20	341	108	0.15	251	<0.2
Mean	791	67	555	10	22	355	97	0.19	163	1.4

Indian Trail Creek (RM 2.56) Twp. Rd. 66

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	320	<30	182	5	11	151	84	0.10	90	0.9
7/21	799	<30	270	10	20	211	109	0.20	107	1.4
8/11	734	<30	286	12	26	232	97	0.22	108	1.3
8/25	5760	<30	680	11	15	168	68	0.21	97	3.3
9/8	342	<30	238	8	22	248	124	0.22	138	<0.2
Mean	1591	<30	331	9	19	202	96	0.19	108	1.4

Indian Trail Creek tributary at RM 6.08 (RM 0.3) Twp. Rd. 413 (Holmes ByProducts West)

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	9910	<30	8800	7	25	213	<5	<0.02	146	1.8
7/21	7750	<30	6500	6	19	218	<5	0.03	108	0.9
8/11	6230	<30	4990	6	20	235	12	0.05	133	0.8
8/25	826	<30	2390	12	34	232	80	0.9	82	9.2
9/8	787	<30	1260	9	29	240	106	2.1	82	3.4
Mean	5101	<30	4788	8	25	228	42	0.6	110	3.2

Broad Run (RM 2.8) Dst. Winfield @ CR 80

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	261	<30	767	4	16	327	106	0.03	240	0.8
7/21	216	<30	645	6	24	474	132	0.06	567	0.7
8/11	<200	<30	905	9	37	609	164	0.10	587	1.4
8/25	3280	<30	1370	8	14	314	60	0.05	280	1.4
9/8	<200	<30	553	9	41	580	178	0.10	457	0.6
Mean	831	<30	848	7	26	461	128	0.07	426	1.0

Broad Run (RM 0.15) Twp. Rd. 425

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	641	<30	5960	4	13	343	57	0.02	402	0.5
7/21	1080	<30	8400	6	23	519	64	0.03	821	0.4
8/11	1080	<30	11000	7	41	669	69	0.04	716	0.5
8/25	9220	<30	4220	9	13	259	31	0.08	244	2.2
9/8	1050	<30	9240	6	29	611	88	<0.02	653	0.4
Mean	2614	<30	7764	6	24	480	62	0.04	567	0.8

Cherry Run (RM 0.22) CR 78

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l	Acid. mg/l
7/9	2030	<30	13200	4	10	438	<5	<0.02	621	<0.2	105
7/21	2540	<30	15200	5	13	600	<5	<0.02	754	<0.2	42
8/11	1830	<30	20900	6	15	675	<5	<0.02	900	0.2	51
8/25	3050	<30	11800	5	11	451	<5	<0.02	569	0.5	69
9/8	1880	<30	19900	5	17	754	7	<0.02	920	<0.2	-
Mean	2266	<30	16200	5	13	584	5	<0.02	753	0.3	67

Turkeyfoot Run (RM 0.23) CR 78

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l	Acid. mg/l
7/9	330	<30	10900	5	12	372	10	<0.02	510	0.5	-
7/21	1910	<30	16400	6	39	674	<5	<0.02	453	0.8	42
8/11	2440	<30	20800	9	78	1000	<5	<0.02	1200	0.6	65
8/25	4400	<30	7270	7	11	300	<5	0.02	328	1.0	44
9/8	3080	<30	23100	6	36	873	6	<0.02	1070	0.4	-
Mean	2432	<30	15694	7	35	644	6	0.02	712	0.7	30

Goettge Run (RM 0.25) Davis Street

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	912	<30	13200	4	14	393	11	<0.02	622	0.4
7/21	348	<30	16000	5	21	562	8	<0.02	907	0.3
8/11	218	<30	18700	7	26	685	8	<0.02	902	0.2
8/25	2390	<30	5970	6	10	240	13	0.02	298	0.8
9/8	<200	<30	14300	6	29	693	13	<0.02	822	<0.2
Mean	814	<30	13634	6	20	515	11	0.02	710	0.4

Brandywine Creek (RM 2.02) Twp. Rd. 374

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	1280	4	39	784	122	<0.02	237	0.4
7/21	<200	<30	1370	5	56	998	138	<0.02	415	0.2
8/11	<200	<30	1040	5	61	1160	161	<0.02	488	0.4
8/25	4210	<30	1590	8	45	949	67	0.08	240	1.1
9/8	583	<30	1340	5	47	922	172	<0.02	452	0.4
Mean	1079	<30	1324	5	50	963	132	0.03	366	0.5

Brandywine Creek (RM 0.16) Twp. Rd. 211

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
7/9	<200	<30	574	5	40	735	120	0.06	264	0.4
7/21	<200	<30	255	5	58	986	135	0.04	389	0.4
8/11	<200	<30	181	5	57	1200	156	0.04	469	0.4
8/25	9430	<30	1090	9	37	767	64	0.08	166	1.7
9/8	<200	<30	295	6	49	990	171	0.05	475	0.6
Mean	2046	<30	479	6	48	936	129	0.05	353	0.7

Appendix Table A-3. Results of chemical/physical sampling conducted in the Sugar Creek study area targeted to evaluate the potential for mining influences during July-September, 1998. Values proceeded by (<) indicate concentration below method detection limit. Note: Demand parameters follow nutrients and metals.

unnamed trib. to South Fork of Sugar Creek @ RM 18.45 (RM 0.01) at SR 93

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/3	7.12	19.19	7.35	4.9	28	1700	1.31	0.90	0.31	1450	92
8/26	6.97	21.14	6.85	4.5	49	1250	1.88	0.74	0.35	1060	309
Mean	7.05	20.17	7.10	4.7	39	1475	1.60	0.82	0.33	1255	201

unnamed trib. to South Fork of Sugar Creek at RM 15.83 (RM 0.63) at CR 71

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/3	8.70	21.5	7.37	2.5	22	1620	0.52	0.46	0.10	1290	20
8/26	7.54	18.5	6.40	<2	10	879	2.3	0.38	0.52	662	41
Mean	8.12	20.0	6.89	2.3	16	1250	1.41	0.42	0.31	1952	31

unnamed trib. to South Fork of Sugar Creek at RM 11.3 (RM 0.23) at Twp. Rd. 354

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/3	9.40	18.80	7.59	4.9	<10	3280	0.55	0.18	0.07	3300	7
8/26	7.63	19.44	6.78	4.0	30	817	1.03	0.28	0.77	648	32
Mean	8.52	19.12	7.19	4.5	20	2049	0.79	0.23	0.42	1974	20

unnamed trib. to Brush Run at RM 1.54 (RM 0.1) from park at SR 93

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/3	8.27	19.02	3.01	<2	25	3130	-	0.71	0.32	2750	6
8/26	7.62	21.85	3.23	<2	26	1190	0.19	0.33	0.16	906	49
Mean	7.95	20.44	3.12	<2	26	2160	0.19	0.52	0.24	1828	28

unnamed trib. to East Branch at RM 3.95 (RM 0.1) at Twp. Rd. 336

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/3	2.5	28.4	7.97	35	253	1160	<0.1	12.8	1.98	722	20
8/26	1.15	23.3	7.39	27	105	1000	<0.1	3.79	1.27	724	48
Mean	1.83	25.9	7.68	31	179	1080	<0.1	8.30	1.63	723	34

unnamed trib. to East Branch at RM 3.6 (RM 0.5) driveway from Twp. Rd. 336

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/3	9.2	21.6	8.26	<2	<10	2470	0.22	0.13	0.08	2230	<5
8/26	8.3	18.7	7.10	<2	<10	1670	0.98	0.14	0.09	1440	8
Mean	8.8	20.2	7.7	<2	<10	2070	0.60	0.14	0.09	1835	7

unnamed trib. to East Branch at RM 2.07 (RM 0.14) at CR 46

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/3	8.30	22.7	7.44	<2	<10	1830	0.47	0.28	0.13	1620	33
8/26	7.78	19.9	6.91	2.3	10	1250	1.05	0.30	0.19	1060	37
Mean	8.04	21.3	7.18	2.2	10	1540	0.76	0.29	0.15	1340	35

unnamed trib. to Walnut Creek at RM 3.92 (RM 1.28) at CR 168

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/3	7.75	18.70	3.98	<2	31	2480	0.77	<0.05	0.07	2370	<5
8/26	7.79	19.44	4.47	-	36	1208	1.31	0.05	0.05	-	-
Mean	7.77	19.07	4.23	<2	34	1844	1.04	0.05	0.06	2370	<5

Hershberger Trib (RM 0.57) to Holmes ByProducts Trib (RM 6.08) at Mouth

DATE	D.O. mg/l	Temp. °C	pH SU	BOD_5 mg/l	COD mg/l	Cond. umhos/cm	NO_3-NO_2 mg/l	NH_3-N mg/l	TP mg/l	TDS mg/l	TSS mg/l
8/27	8.83	19.44	6.99	6.5	37	1180	127	4.22	0.24	1530	70
9/8	9.10	16.49	7.52	10	69	1200	95.3	9.03	0.26	1200	56
Mean	8.96	17.96	7.25	8.3	53	1190	111.1	6.62	0.25	1365	63

unnamed trib. to South Fork of Sugar Creek at RM 18.45 (RM 0.01) SR 93

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
8/3	<2	<0.2	190	<10	<2	116	61	<2	27	952	1940
8/26	3	0.2	139	<10	5	15900	83	<2	72	676	7530
Mean	3	0.2	165	<10	4	8019	72	<2	63	814	5705

unnamed trib. to South Fork of Sugar Creek at RM 15.83 (RM 0.63) CR 71

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
8/3	<2	<0.2	194	<10	<2	83	<40	<2	<10	826	3700
8/26	<2	<0.2	100	<10	<2	40	<40	5	17	414	4920
Mean	<2	<0.2	147	<10	<2	62	<40	4	14	620	4310

unnamed trib. to South Fork of Sugar Creek at RM 11.3 (RM 0.23) Twp. Rd. 354

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
8/3	<2	0.2	422	<10	<2	368	69	<2	12	2570	399
8/26	<2	<0.2	116	<10	<2	77	<40	<2	20	607	3110
Mean	<2	0.2	269	<10	<2	223	55	<2	16	1589	1755

unnamed trib. to Brush Run at RM 1.54 (RM 0.1) from park area off SR 93

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
8/3	<2	1.8	375	37	3	156	686	<2	1630	1580	75200
8/26	<2	0.9	112	18	2	43	178	<2	557	457	12200
Mean	<2	1.4	244	28	3	100	432	<2	1094	1019	43700

unnamed trib. to East Branch at RM 3.95 (RM 0.1) Twp. Rd. 336

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
8/3	4	<0.2	91	13	6	56	<40	<2	19	458	1310
8/26	6	<0.2	84	18	<2	55	<40	<2	14	436	3820
Mean	5	<0.2	88	16	4	56	<40	<2	17	447	2565

unnamed trib. to East Branch at RM 3.6 (RM 0.5) driveway from Twp. Rd. 336

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
8/3	<2	<0.2	417	<10	<2	189	<40	<2	<10	1820	450
8/26	<2	<0.2	251	<10	<2	107	<40	<2	<10	1070	867
Mean	<2	<0.2	334	<10	<2	148	<40	<2	<10	1445	659

unnamed trib. to East Branch at RM 2.07 (RM 0.14) CR 46

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
8/3	<2	0.4	304	14	<2	115	92	<2	66	1230	1460
8/26	<2	0.4	170	<10	<2	69	80	<2	71	709	2200
Mean	<2	0.4	237	12	<2	92	86	<2	69	970	1830

~~**unnamed trib. to Walnut Creek at RM 3.92** (RM 1.28) CR 168~~

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
~~8/3~~	~~<2~~	~~3.3~~	~~278~~	~~18~~	~~<2~~	~~206~~	~~589~~	~~<2~~	~~697~~	~~1540~~	~~1290~~
8/26	<2	1.8	147	<10	<2	119	295	<2	364	857	1410
Mean	<2	2.6	213	14	<2	163	442	<2	531	1199	1350

Hershberger Trib (RM 0.57) to Holmes ByProducts Trib (RM 6.08) at Mouth

DATE	T-As ug/l	T-Cd ug/l	T-Ca mg/l	T-Cu ug/l	T-Pb ug/l	T-Mg mg/l	T-Ni ug/l	T-Se ug/l	T-Zn ug/l	Hard. mg/l	T-Fe ug/l
8/27	<2	1.6	158	<10	3	66	135	<2	156	666	1920
9/8	<2	0.9	129	<10	2	60	98	<2	73	569	1860
Mean	<2	1.3	143	<10	2.5	63	116	<2	114	617	1890

unnamed trib. to the South Fork Sugar Creek at RM 18.45 (RM 0.01) SR 93

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/3	1690	48	21700	6	18	629	39.3	0.05	929	1.2
8/26	5450	<30	15900	10	12	436	39	0.06	580	1.9
Mean	3570	39	18800	8	15	533	39.2	0.06	755	1.6

unnamed trib. to the South Fork Sugar Creek at RM 15.83 (RM 0.63) CR 71

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/3	391	<30	2260	9	63	1070	81.5	0.06	668	0.6
8/26	914	<30	1700	10	23	488	71.0	0.05	324	0.9
Mean	653	<30	1980	10	43	779	76.3	0.06	496	0.8

unnamed trib. to the South Fork Sugar Creek trib. at RM 11.3 (RM 0.23) Twp. Rd. 354

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/3	223	77	11100	10	22	1790	62.2	0.03	2030	<0.2
8/26	1200	<30	3690	7	14	499	50.0	0.03	324	0.8
Mean	712	54	7395	9	18	1145	56.1	0.03	1177	0.5

unnamed trib. to Brush Run at RM 1.54 (RM 0.1) from park area off SR 93

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/3	29100	52	51400	6	28	1740	<5	0.02	1610	0.4
8/26	7840	<30	14000	7	10	607	<5	<0.02	510	0.5
Mean	18470	41	32700	7	19	1174	<5	0.02	1060	0.5

unnamed trib. to East Branch at RM 3.95 (RM 0.1) Twp. Rd. 336

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/3	<200	<30	588	48	31	327	209	0.03	243	16.9
8/26	1550	<30	945	45	21	316	165	0.07	283	8.4
Mean	875	<30	767	47	26	322	187	0.05	263	12.7

unnamed trib. to East Branch at RM 3.6 (RM 0.5) driveway from Twp. Rd. 336

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/3	<200	39	6060	7	25	1760	228	<0.02	1280	<0.2
8/26	247	<30	3520	8	18	1090	155	0.02	764	0.5
Mean	224	35	4790	8	22	1425	192	0.02	1022	0.4

unnamed trib. to East Branch at RM 2.07 (RM 0.14) CR 46

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/3	991	<30	6970	5	19	864	43.7	<0.02	996	0.4
8/26	1030	<30	6240	8	14	556	29	0.03	602	0.7
Mean	1011	<30	6605	7	17	710	36.4	0.03	799	0.6

unnamed trib. to Walnut Creek at RM 3.92 (RM 1.28) CR 168

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/3	25000	79	68500	6	14	630	<5	<0.02	1410	<0.2
8/26	8890	<30	37100	6	11	389	-	-	-	0.2
Mean	16945	55	52800	6	13	510	<5	<0.02	1410	0.2

Hershberger Trib (RM 0.57) to Holmes ByProducts Trib (RM 6.08) at Mouth

DATE	Al. ug/l	Cr. ug/l	Mn. ug/l	K mg/l	Na mg/l	Sr ug/l	Alk. mg/l	NO_2 mg/l	SO_4 mg/l	TKN mg/l
8/27	1340	<30	10500	19	66	620	31	0.67	127	5.2
9/8	1240	<30	8210	17	54	515	44	2.39	95.3	8.0
Mean	1290	<30	9355	18	60	567	37	1.53	111	6.6

Appendix Table A-4. Results of fecal coliform sampling conducted in the Sugar Creek study area during July-September, 1998. Values are in number of organisms/100ml.

Stream RM/ Landmark		1st sample	2nd sample	3rd sample	4th sample
Sugar Creek					
42.8	Schellin Rd	900	400	>6700	5800
40.33	Smithville WWTP effluent	5000	380	--	--
40.18	CR 502	1000	700	>6700	5400
36.88	Orr Rd	700	300	>4000	3700
34.69	Kansas Rd	2400	310	30,000	8000
26.7	West Lebanon Rd	1400	2300	14,000	18,000
22.95	Alabama Ave	2300	800	7900	7500
19.36	SR 93	4600	330	2700	3900
19.03	Brewster Dairy effluent	--	150	250	--
19.04	Brewster WWTP effluent	21,000	11,000	4000	300
18.55	US 62	7600	1900	1200	2200
13.80	Beach City WWTP effluent	290	120	2600	--
13.7	At park, Dst. WWTP	330	540	2000	--
12.07	Dst. Beach City Reservoir	200	450	350	--
7.45	Strasburg WWTP effluent	1080	7500	2000	--
7.28	US 250	200	200	400	--
3.64	Ohio Ave, CR 80	130	260	410	--
2.10	Dover Chemical effluent	30	<10	<10	--
1.83	SR 516 & 39	160	240	280	--
0.63	SR 39	280	340	340	--
Little Sugar Creek					
4.2	Kansas Rd, lower	5700	530	3300	--
0.8	McQuaid Rd	4600	6400	26,000	3500
Little Sugar Creek Tributary at RM 0.5					
1.05	McQuaid Rd	28,000	4200	27,000	65,000
North Fork Sugar Creek					
6.5	Ust Lehman Hardware	13,000	3000	21,000	92,000
5.53	Zuercher Rd	60,000	11,000	75,000	310,000
1.35	West Lebanon Rd.	29,000	7200	--	10,000
Middle Fork Sugar Creek					
12.0	From T-656	28,000	21,000	200	--
10.25	T-669	9300	22,000	700	--
7.9	Alpine Valley effluent	90	100	--	--
7.58	T-606, Dst Alpine Valley	8000	18,000	670	--
1.66	Welty Rd	3100	<100	700	–

Stream RM/ Landmark		1st sample	2nd sample	3rd sample	4th sample
Middle Fork Sugar Creek Tributary at RM 6.0					
0.17	T-659	830	10,000	500	--
.**Middle Fork Sugar Creek Tributary at RM 3.25**					
0.5	T-314	2400	20,000	400	--
South Fork Sugar Creek					
21.1	CR-114	5750	20,000	7500	--
18.98	T-173	2800	520	5800	--
15.26	CR-47	4300	660	10,000	--
14.15	Sugar Creek WWTP effluent	2900	30	140	--
14.02	T-355	4000	830	27,000	--
13.28	CR-73	791	2200	21,000	--
7.42	SR-93	490	700	6900	--
6.43	CR-94	645	600	4600	--
3.64	T-62	170	80	490	--
South Fork Sugar Creek Tributary at RM 14.1 (17-424)					
0.28	CR-73	7180	4800	20,000	--
0.19	Ohio Whey effluent	3400	130	2100	--
0.05	Dst. Ohio Whey	5000	4400	9600	--
South Fork Sugar Creek Tributary at RM 1.0					
0.68	T-447	2000	2300	4200	--
East Branch South Fork Sugar Creek					
5.47	CR-48 Ust Ragersville	770	2000	>60,000	--
5.04	CR-52, Dst Ragersville	6500	5000	>60,000	--
1.7	T-348	250	3600	5200	--
Crabapple Creek					
2.96	T-357	150,000	13,000	<330	--
0.31	T-606	3300	32,000	200	--
Misers Run					
0.22	From T-659	2800	18,000	1000	--
Elm Run					
1.69	Harmon St	2600	19,000	200	--
0.45	Kings Highway	2500	15,000	500	--
Brush Run					
2.51	Shrock Rd	590	2700	2300	--
0.95	Baltic WWTP	60	--	20	--
0.3	TR-171	57,000	36,000	44,000	--
Pleasant Valley Creek					
0.24	From T-339	3600	2300	5500	--
Troyer Valley Creek					
1.47	Guggisburg Cheese effluent	--	--	>60,000	--

Stream RM/ Landmark	1st sample	2nd sample	3rd sample	4th sample
1.08 SR-93	4500	2300	590	--
Walnut Creek				
7.93 Old Rt. 39	3900	700	5200	--
6.32 T-444	2500	490	4600	--
4.49 T-172	6000	3900	5900	--
0.56 Lane from CR 94	1030	2200	12,000	--
Goose Creek				
0.35 T-419	2600	2000	5000	--
Indian Trail Creek				
6.33 T-414	790	580	2000	--
5.4 SR 515	3600	590	1100	--
2.56 T-66	2500	3100	2500	--
Indian Trail Creek Tributary at RM 6.08				
0.3 T-413	<100	<10	3600	--
Hershberger tributary to Holmes ByProducts trib. at RM 6.08				
0.57 at mouth	1400	--	--	--
Broad Run				
2.8 CR-80	4200	3000	>60,000	--
0.15 T-425	350	350	370	--
Cherry Run				
0.22 CR-78	40	60	130	--
Turkeyfoot Run				
0.23 CR-78	175	200	100	--
Goettge Run				
0.25 Davis St.	340	500	740	--
Brandywine Creek				
2.02 T-374	350	370	910	--
0.16 T-211	2500	2700	4500	--

Appendix Table A-5 Summary of Ohio EPA database water column chemistry statistics based on samples from regional reference sites in the Erie Ontario Lake Plain and in the Western Allegheny Plateau. 50th percentile to 75th percentile value ranges for "headwater" and "wadeable" watersheds (up to 200 sq. mi. drainage). From Ohio EPA Technical Bulletin MAS/1999-1-1, January 7, 1999.

Parameter (units)	EOLP Ecoregion	WAP Ecoregion
Temperature (ºC)	18--22	20--24
T-Arsenic (ug/l)	1--2	1--1
T-Barium (ug/l)	no data	100--100
T-Cadmium (ug/l)	0.1--0.25	0.1--0.25
T-Chromium (ug/l)	15--15	15--15
T-Copper (ug/l)	5--5	5--5
T-Iron (ug/l)	570--1350	300--940
T-Lead (ug/l)	2--3	1--2
T-Manganese (ug/l)	140--248	40--252
T-Nickel (ug/l)	20--20	20--20
T-Zinc (ug/l)	5-15	5-15
dissolved oxygen (mg/l)	6.6--8.1	7.0--8.4
BOD_5 (mg/l)	1.1--2.5	0.5--1.6
Fecal Coliform (#/100 ml)	295--1500	375--1220
Fecal Strep (#/100 ml)	410--6977	no data
T-Phenolics (ug/l)	9--10	9--10
COD (mg/l)	10--22	10--13
Field pH (su)	7.8--8.2	7.9--8.2
Lab pH (su)	7.6--7.9	7.9--8.1
T-Alkalinity-$CaCO_3$ (mg/l)	105--195	113--164
Total Solids (mg/l)	no data	269--556
TSS (mg/l)	9--25	2.5--16
Flow (cfs)	0.8--42	0.6--20
Ammonia-N (mg/l)	0.025--0.070	0.025--0.025
Nitrite (mg/l)	0.01--0.03	0.01--0.01
TKN (mg/l)	0.4--0.7	0.2--0.4
Nitrate (mg/l)	0.4--1.1	0.2--0.5
T-Phosphorus (mg/l)	0.05--0.110	0.025--0.060
TOC (mg/l)	6.2--9.6	3.2--5.6
TDS (mg/l)	350--443	288--478
T-Cyanide (ug/l)	0.003--0.005	no data
$cBOD_5$ (mg/l)	1.0--1.7	1.0--1.3
Hardness (mg/l)	251--302	194--255
T-Calcium (mg/l)	64--80	53--74
T-Magnesium (mg/l)	19--25	13--18

Parameter (units)	EOLP Ecoregion	WAP Ecoregion
T-Sodium (mg/l)	15--24	10--88
T-Potassium (mg/l)	3--4	6--8
Field Conductivity (umhos/cm)	409--642	375--573
Chlorides (mg/l)	26--42	14--30
Sulfates (mg/l)	35--101	70--156
Lab Conductivity (umhos/cm)	501--649	404--639

Appendix Table A-6 Summary of Ohio EPA database sediment chemistry statistics from samples collected at statewide reference sites. All values expressed as mg/kg.

Parameter	(n)	Mean	Mini-mum	25th %tile	50th %tile	75th %tile	90th %tile	95th %tile	Maxi-mum	Inter-Quatile	Std. Dev.
Aluminum	80	10409	2210	4540	6855	11700	15650	19350	170000	7160	18701
Arsenic	154	7.96	0.61	4.54	6.84	10.2	13.8	16.1	57.9	5.66	6.379
Barium	66	74.0	1.11	36.0	68.0	95.0	142	175	202	59.0	45.564
Cadmium	153	0.330	0.038	0.143	0.280	0.430	0.563	0.804	2.140	0.287	0.286
Chromium	164	13.2	0.98	8.0	11.1	16.8	24.6	27.2	43.8	8.8	7.844
Copper	163	16.4	2.69	9.36	13.2	18.7	23.7	27.0	306	9.34	23.973
Iron	147	20459	4380	13700	18300	24600	33900	40700	56600	10900	9819
Lead	165	21.1	2.41	12.0	16.9	27.3	38.1	44.5	66.8	15.3	12.812
Manganese	90	904	96.6	309	704	1170	1970	2560	6030	861	878
Nickel	162	20.5	4.0	11.0	17.3	24.6	39.8	47.0	151	13.6	15.894
Zinc	162	71.2	13.5	46.5	65.6	86.6	112	140	247	40.1	35.346

Appendix Table A-7 Comparison of Ohio EPA database sediment chemistry statistics (Table A-6) with values reported for use in Illinois (Kelly and Hite 1984) and Ontario (Persaud *et al.* 1994). Ohio elevation catagories based on median value plus 1, 2, 4 and 8 inter-quartile range values. All values expressed as mg/kg.

Parameter	State	Non-Elevated	Slightly Elevated	Elevated	Highly Elevated	Extremely Elevated
Arsenic	Ohio	<12.5	12.5-18.2	18.3-29.5	29.6-52.1	>52.1
	Illinois	<8.0	8.0-10.9	11.0-16.9	17.0-28.0	>28.0
	Ontario	<6.0				>33.0
Cadmium	Ohio	<0.567	0.567-0.854	0.855-1.428	1.429-2.576	>2.576
	Illinois	<0.500	0.500-1.000	1.001-2.000	2.001-20.00	>20.00
	Ontario	<0.600				>10.00
Chromium	Ohio	<19.9	19.9-28.8	28.9-46.5	46.6-81.9	>81.9
	Illinois	<16.0	16.0-23.0	23.1-38.0	38.1-60.0	>60.0
	Ontario	<26.0				>110
Copper	Ohio	<22.5	22.5-31.9	32.0-50.6	50.7-87.9	>87.9
	Illinois	<38.0	38.0-60.0	60.1-100	101-200	>200
	Ontario	<16.0				>110
Iron	Ohio	<29200	29200-40100	40101-61900	61901-105500	>105500
	Illinois	<18000	18000-23000	23001-32000	32001-50000	>50000
	Ontario	<20000				>40000
Lead	Ohio	<32.2	32.2-47.5	47.6-78.1	78.2-139	>139
	Illinois	<28.0	28.0-38.0	38.1-60.0	60.1-100	>100
	Ontario	<31.0				>250
Manganese	Ohio	<1565	1565-2426	2427-4148	4149-7592	>7592
	Illinois	<1300	1300-1800	1801-2800	2801-5000	>5000
	Ontario	<460				>1100
Nickel	Ohio	<30.9	30.9-44.5	44.6-71.7	71.8-126	>126
	Illinois	N/A				N/A
	Ontario	<16.0				>75.0
Zinc	Ohio	<106	106-146	147-226	227-386	>386
	Illinois	<80.0	80.0-100	101-170	171-300	>300
	Ontario	<120				

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/14/1998 17-400 Sugar Creek RM: 42.80

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
04686	*Placobdella papillifera*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	
13400	*Stenacron sp*	
13570	*Stenonema terminatum*	
13590	*Stenonema vicarium*	
22001	*Coenagrionidae*	
22300	*Argia sp*	
23909	*Boyeria vinosa*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52440	*Ceratopsyche slossonae*	
52530	*Hydropsyche depravata group*	
53501	*Hydroptilidae*	
58505	*Helicopsyche borealis*	
60800	*Haliplus sp*	
60900	*Peltodytes sp*	
68075	*Psephenus herricki*	
68707	*Dubiraphia quadrinotata*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
71900	*Tipula sp*	
74501	*Ceratopogonidae*	
77800	*Helopelopia sp*	
84480	*Polypedilum (P.) laetum group*	
84750	*Stictochironomus sp*	
87540	*Hemerodromia sp*	
93900	*Elimia sp*	
96002	*Helisoma anceps anceps*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	32
No. Qualitative Taxa:	32	ICI:	
Number of Organisms:	0	Qual EPT:	10

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/14/1998 17-400 Sugar Creek RM: 40.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
04935	*Erpobdella punctata punctata*	
06201	*Hyalella azteca*	+
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11130	*Baetis intercalaris*	
13400	*Stenacron sp*	
13521	*Stenonema femoratum*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
21200	*Calopteryx sp*	
23600	*Aeshna sp*	
23909	*Boyeria vinosa*	
50301	*Chimarra aterrima*	
52530	*Hydropsyche depravata group*	
59300	*Mystacides sp*	
60900	*Peltodytes sp*	
65800	*Berosus sp*	
67800	*Tropisternus sp*	
68075	*Psephenus herricki*	
68707	*Dubiraphia quadrinotata*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
81650	*Parametriocnemus sp*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83840	*Microtendipes pedellus group*	
84155	*Paralauterborniella nigrohalteralis*	
84300	*Phaenopsectra obediens group*	
84480	*Polypedilum (P.) laetum group*	
84750	*Stictochironomus sp*	
85625	*Rheotanytarsus exiguus group*	
93900	*Elimia sp*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	39
No. Qualitative Taxa:	39	ICI:	
Number of Organisms:	0	Qual EPT:	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/14/1998 17-400 Sugar Creek RM: 36.90

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	+
04901	*Erpobdellidae*	
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
13400	*Stenacron sp*	
13521	*Stenonema femoratum*	
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	
23909	*Boyeria vinosa*	
45100	*Palmacorixa sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
59310	*Mystacides sepulchralis*	
65800	*Berosus sp*	
68708	*Dubiraphia vittata group*	
71900	*Tipula sp*	
74100	*Simulium sp*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
78450	*Nilotanypus fimbriatus*	
80430	*Cricotopus (C.) tremulus group*	
82141	*Thienemanniella xena*	
83040	*Dicrotendipes neomodestus*	
84210	*Paratendipes albimanus or P. duplicatus*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84700	*Stenochironomus sp*	
85501	*Paratanytarsus n.sp 1*	
85625	*Rheotanytarsus exiguus group*	
85800	*Tanytarsus sp*	
85818	*Tanytarsus glabrescens group sp 4*	
94400	*Fossaria sp*	
95100	*Physella sp*	
99240	*Lasmigona complanata*	
99440	*Fusconaia flava*	
99860	*Lampsilis radiata luteola*	

No. Quantitative Taxa:	0	Total Taxa:	41
No. Qualitative Taxa:	41	ICI:	
Number of Organisms:	0	Qual EPT:	6

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 08/31/1998 17-400 Sugar Creek RM: 34.70

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	72
03600	*Oligochaeta*	105
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	1 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
08601	*Hydracarina*	8
11120	*Baetis flavistriga*	37
11130	*Baetis intercalaris*	113
11430	*Diphetor hageni*	
13400	*Stenacron sp*	9
13521	*Stenonema femoratum*	1
13590	*Stenonema vicarium*	16
17200	*Caenis sp*	27
21200	*Calopteryx sp*	10
22001	*Coenagrionidae*	
22300	*Argia sp*	2
52200	*Cheumatopsyche sp*	712
52430	*Ceratopsyche morosa group*	22
52530	*Hydropsyche depravata group*	26
53800	*Hydroptila sp*	
65800	*Berosus sp*	1
68075	*Psephenus herricki*	
68601	*Ancyronyx variegata*	12
68708	*Dubiraphia vittata group*	39
68901	*Macronychus glabratus*	27
69400	*Stenelmis sp*	160
71500	*Ormosia sp*	1
74100	*Simulium sp*	1
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	194
77750	*Hayesomyia senata or Thienemannimyia norena*	22
77800	*Helopelopia sp*	22
78450	*Nilotanypus fimbriatus*	80
80204	*Brillia flavifrons group*	22
80351	*Corynoneura n.sp 1*	4
80370	*Corynoneura lobata*	64
80430	*Cricotopus (C.) tremulus group*	22
81650	*Parametriocnemus sp*	43
82121	*Thienemanniella lobapodema*	16
82141	*Thienemanniella xena*	16
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	430
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	22
83840	*Microtendipes pedellus group*	
84210	*Paratendipes albimanus or P. duplicatus*	65
84450	*Polypedilum (P.) flavum*	108
84460	*Polypedilum (P.) fallax group*	43
84540	*Polypedilum (Tripodura) scalaenum group*	581
84750	*Stictochironomus sp*	
85230	*Cladotanytarsus mancus group*	84
85261	*Cladotanytarsus vanderwulpi group Type 1*	43
85500	*Paratanytarsus sp*	86
85625	*Rheotanytarsus exiguus group*	129
85800	*Tanytarsus sp*	43
85802	*Tanytarsus curticornis group*	
85821	*Tanytarsus glabrescens group sp 7*	409
85840	*Tanytarsus guerlus group*	43
87540	*Hemerodromia sp*	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 08/31/1998 17-400 Sugar Creek RM: 34.70

Taxa Code	Taxa	Quant/Qual
95100	*Physella sp*	1
96120	*Menetus (Micromenetus) dilatatus*	1
96900	*Ferrissia sp*	10
98600	*Sphaerium sp*	

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	50	Total Taxa:	62
No. Qualitative Taxa:	40	ICI:	**44**
Number of Organisms:	4013	Qual EPT:	11

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 08/31/1998 17-400 Sugar Creek RM: 26.70

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	
00653	*Eunapius fragilis*	
01801	*Turbellaria*	
03360	*Plumatella sp*	+
03600	*Oligochaeta*	
05800	*Caecidotea sp*	
06201	*Hyalella azteca*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	
45100	*Palmacorixa sp*	
49200	*Climacia sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
52570	*Hydropsyche simulans*	
53800	*Hydroptila sp*	
65800	*Berosus sp*	
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
77800	*Helopelopia sp*	
78401	*Natarsia species A (sensu Roback, 1978)*	
78655	*Procladius (Holotanypus) sp*	
81200	*Nanocladius sp*	
82220	*Tvetenia discoloripes group*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83300	*Glyptotendipes (G.) sp*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84450	*Polypedilum (P.) flavum*	
84700	*Stenochironomus sp*	
84888	*Xenochironomus xenolabis*	
85625	*Rheotanytarsus exiguus group*	
85814	*Tanytarsus glabrescens group*	
98600	*Sphaerium sp*	
99240	*Lasmigona complanata*	
99280	*Lasmigona costata*	
99420	*Amblema plicata plicata*	
99440	*Fusconaia flava*	
99860	*Lampsilis radiata luteola*	

No. Quantitative Taxa:	0	Total Taxa:	49
No. Qualitative Taxa:	49	ICI:	
Number of Organisms:	0	Qual EPT:	10

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 08/31/1998 17-400 Sugar Creek RM: 22.90

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	20
01801	*Turbellaria*	4
03360	*Plumatella sp*	
03451	*Urnatella gracilis*	1
03600	*Oligochaeta*	56
04935	*Erpobdella punctata punctata*	
05800	*Caecidotea sp*	1
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	1
11130	*Baetis intercalaris*	25
11200	*Callibaetis sp*	
13400	*Stenacron sp*	5
13510	*Stenonema exiguum*	14
13521	*Stenonema femoratum*	
16700	*Tricorythodes sp*	2
17200	*Caenis sp*	51
21200	*Calopteryx sp*	1
22001	*Coenagrionidae*	1
22300	*Argia sp*	17
42700	*Belostoma sp*	
45100	*Palmacorixa sp*	
45400	*Trichocorixa sp*	
47600	*Sialis sp*	2
52200	*Cheumatopsyche sp*	361
52430	*Ceratopsyche morosa group*	8
52570	*Hydropsyche simulans*	2
53800	*Hydroptila sp*	
63300	*Hydroporus sp*	
65800	*Berosus sp*	1
68601	*Ancyronyx variegata*	8
68708	*Dubiraphia vittata group*	20
68901	*Macronychus glabratus*	13
69400	*Stenelmis sp*	4
72700	*Anopheles sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	4
77120	*Ablabesmyia mallochi*	20
77500	*Conchapelopia sp*	41
77740	*Hayesomyia senata*	123
77800	*Helopelopia sp*	20
78655	*Procladius (Holotanypus) sp*	
80370	*Corynoneura lobata*	24
80420	*Cricotopus (C.) bicinctus*	
81229	*Nanocladius (N.) crassicornus*	225
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
82880	*Cryptotendipes sp*	
83040	*Dicrotendipes neomodestus*	491
83050	*Dicrotendipes lucifer*	41
83300	*Glyptotendipes (G.) sp*	61
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	20
84020	*Parachironomus carinatus*	
84450	*Polypedilum (P.) flavum*	143
84460	*Polypedilum (P.) fallax group*	
84470	*Polypedilum (P.) illinoense*	20
84540	*Polypedilum (Tripodura) scalaenum group*	143
84790	*Tribelos fuscicorne*	102
85230	*Cladotanytarsus mancus group*	20
85261	*Cladotanytarsus vanderwulpi group Type 1*	143

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 08/31/1998 17-400 Sugar Creek RM: 22.90

Taxa Code	Taxa	Quant/Qual
85500	*Paratanytarsus sp*	41
85501	*Paratanytarsus n.sp 1*	20
85625	*Rheotanytarsus exiguus group*	286
85800	*Tanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	388
85840	*Tanytarsus guerlus group*	41
87400	*Stratiomys sp*	
87540	*Hemerodromia sp*	4
96900	*Ferrissia sp*	8

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	47	Total Taxa:	68
No. Qualitative Taxa:	39	ICI:	**38**
Number of Organisms:	3047	Qual EPT:	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/01/1998 17-400 Sugar Creek RM: 19.30

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	66
01801	*Turbellaria*	13
03360	*Plumatella sp*	
03600	*Oligochaeta*	38
05800	*Caecidotea sp*	1
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	5
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
08601	*Hydracarina*	4
11130	*Baetis intercalaris*	332
11150	*Pseudocloeon propinquus*	
12200	*Isonychia sp*	4
13000	*Leucrocuta sp*	1
13400	*Stenacron sp*	37
13510	*Stenonema exiguum*	123
13561	*Stenonema pulchellum*	62
17200	*Caenis sp*	4
21200	*Calopteryx sp*	
22300	*Argia sp*	2
23909	*Boyeria vinosa*	
24900	*Gomphus sp*	
45100	*Palmacorixa sp*	
45400	*Trichocorixa sp*	
52200	*Cheumatopsyche sp*	248
52430	*Ceratopsyche morosa group*	1
52530	*Hydropsyche depravata group*	1
52570	*Hydropsyche simulans*	5
57900	*Pycnopsyche sp*	1
60300	*Dineutus sp*	
63300	*Hydroporus sp*	
68601	*Ancyronyx variegata*	1
68700	*Dubiraphia sp*	8
68901	*Macronychus glabratus*	45
69400	*Stenelmis sp*	2
72700	*Anopheles sp*	
77120	*Ablabesmyia mallochi*	9
77500	*Conchapelopia sp*	9
77750	*Hayesomyia senata or Thienemannimyia norena*	
78450	*Nilotanypus fimbriatus*	8
80370	*Corynoneura lobata*	80
80410	*Cricotopus (C.) sp*	9
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	36
81825	*Rheocricotopus (Psilocricotopus) robacki*	9
82730	*Chironomus (C.) decorus group*	9
83040	*Dicrotendipes neomodestus*	
84450	*Polypedilum (P.) flavum*	9
84460	*Polypedilum (P.) fallax group*	63
84470	*Polypedilum (P.) illinoense*	9
84540	*Polypedilum (Tripodura) scalaenum group*	27
85615	*Rheotanytarsus distinctissimus group*	99
85625	*Rheotanytarsus exiguus group*	494
85800	*Tanytarsus sp*	9
85814	*Tanytarsus glabrescens group*	9
87540	*Hemerodromia sp*	25
95907	*Gyraulus (Torquis) parvus*	1
96900	*Ferrissia sp*	1

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/01/1998 17-400 Sugar Creek RM: 19.30

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	42	Total Taxa:	56
No. Qualitative Taxa:	29	ICI:	**44**
Number of Organisms:	1919	Qual EPT:	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/01/1998 17-400 Sugar Creek RM: 18.60

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	4
01801	*Turbellaria*	8
03360	*Plumatella sp*	
03600	*Oligochaeta*	322
05800	*Caecidotea sp*	1
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	
11130	*Baetis intercalaris*	95
12200	*Isonychia sp*	1
13400	*Stenacron sp*	
13510	*Stenonema exiguum*	5
13561	*Stenonema pulchellum*	1
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	
24900	*Gomphus sp*	
44501	*Corixidae*	
52200	*Cheumatopsyche sp*	281
52430	*Ceratopsyche morosa group*	5
52570	*Hydropsyche simulans*	8
60300	*Dineutus sp*	
68130	*Helichus sp*	
68601	*Ancyronyx variegata*	
68708	*Dubiraphia vittata group*	13
68901	*Macronychus glabratus*	16
69400	*Stenelmis sp*	25
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	3
77740	*Hayesomyia senata*	15
77800	*Helopelopia sp*	2
78650	*Procladius sp*	
80370	*Corynoneura lobata*	20
81825	*Rheocricotopus (Psilocricotopus) robacki*	58
82141	*Thienemanniella xena*	4
82730	*Chironomus (C.) decorus group*	
82800	*Cladopelma sp*	
82820	*Cryptochironomus sp*	3
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	2
83840	*Microtendipes pedellus group*	3
84155	*Paralauterborniella nigrohalteralis*	
84450	*Polypedilum (P.) flavum*	7
84460	*Polypedilum (P.) fallax group*	16
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	484
85615	*Rheotanytarsus distinctissimus group*	
85625	*Rheotanytarsus exiguus group*	2
85821	*Tanytarsus glabrescens group sp 7*	16
85840	*Tanytarsus guerlus group*	2
86100	*Chrysops sp*	
87540	*Hemerodromia sp*	3

No. Quantitative Taxa:	30	Total Taxa:	52
No. Qualitative Taxa:	36	ICI:	**26**
Number of Organisms:	1425	Qual EPT:	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/01/1998 17-400 Sugar Creek RM: 13.70

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	12
01801	*Turbellaria*	25
03360	*Plumatella sp*	
03600	*Oligochaeta*	1
05800	*Caecidotea sp*	1
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
08601	*Hydracarina*	4
11130	*Baetis intercalaris*	122
13400	*Stenacron sp*	159
13510	*Stenonema exiguum*	69
17200	*Caenis sp*	1
21200	*Calopteryx sp*	
22300	*Argia sp*	6
45100	*Palmacorixa sp*	
47600	*Sialis sp*	2
52200	*Cheumatopsyche sp*	635
52430	*Ceratopsyche morosa group*	34
52530	*Hydropsyche depravata group*	
52570	*Hydropsyche simulans*	42
53501	*Hydroptilidae*	
57900	*Pycnopsyche sp*	
68601	*Ancyronyx variegata*	16
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	31
69400	*Stenelmis sp*	1
72700	*Anopheles sp*	
77120	*Ablabesmyia mallochi*	
77750	*Hayesomyia senata or Thienemannimyia norena*	34
78401	*Natarsia species A (sensu Roback, 1978)*	
78450	*Nilotanypus fimbriatus*	16
80370	*Corynoneura lobata*	12
81825	*Rheocricotopus (Psilocricotopus) robacki*	20
82730	*Chironomus (C.) decorus group*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84450	*Polypedilum (P.) flavum*	14
84460	*Polypedilum (P.) fallax group*	14
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	7
85500	*Paratanytarsus sp*	14
85625	*Rheotanytarsus exiguus group*	500
85821	*Tanytarsus glabrescens group sp 7*	41
87540	*Hemerodromia sp*	9
95100	*Physella sp*	
96900	*Ferrissia sp*	4
97601	*Corbicula fluminea*	8

No. Quantitative Taxa:	30	Total Taxa:	47
No. Qualitative Taxa:	37	ICI:	**40**
Number of Organisms:	1854	Qual EPT:	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/01/1998 17-400 Sugar Creek RM: 12.00

Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	1
01320	*Hydra sp*	22
03360	*Plumatella sp*	6
03600	*Oligochaeta*	36
05800	*Caecidotea sp*	
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
08601	*Hydracarina*	6
11130	*Baetis intercalaris*	143
11200	*Callibaetis sp*	
13400	*Stenacron sp*	125
13510	*Stenonema exiguum*	11
13561	*Stenonema pulchellum*	29
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	1
23704	*Anax junius*	
28955	*Libellula lydia*	
42700	*Belostoma sp*	
44501	*Corixidae*	4
45100	*Palmacorixa sp*	
45400	*Trichocorixa sp*	
45900	*Notonecta sp*	
47600	*Sialis sp*	
48410	*Corydalus cornutus*	1
51206	*Cyrnellus fraternus*	24
51300	*Neureclipsis sp*	4
52200	*Cheumatopsyche sp*	2774
52560	*Hydropsyche orris*	1711
52570	*Hydropsyche simulans*	59
53800	*Hydroptila sp*	4
63900	*Laccophilus sp*	
65700	*Anacaena sp*	
67800	*Tropisternus sp*	
68601	*Ancyronyx variegata*	5
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	19
69400	*Stenelmis sp*	
72700	*Anopheles sp*	
74100	*Simulium sp*	4
74501	*Ceratopogonidae*	
77120	*Ablabesmyia mallochi*	
77750	*Hayesomyia senata or Thienemannimyia norena*	71
78450	*Nilotanypus fimbriatus*	24
80370	*Corynoneura lobata*	35
81825	*Rheocricotopus (Psilocricotopus) robacki*	24
82730	*Chironomus (C.) decorus group*	
83051	*Dicrotendipes simpsoni*	
83300	*Glyptotendipes (G.) sp*	24
84450	*Polypedilum (P.) flavum*	427
84460	*Polypedilum (P.) fallax group*	12
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	616
87540	*Hemerodromia sp*	31
95100	*Physella sp*	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/01/1998 17-400 Sugar Creek RM: 12.00

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
97601	*Corbicula fluminea*	2			
98600	*Sphaerium sp*				

No. Quantitative Taxa:	31	Total Taxa:	61
No. Qualitative Taxa:	45	ICI:	**38**
Number of Organisms:	6255	Qual EPT:	9

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/03/1998 17-400 Sugar Creek RM: 7.30

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	1
01801	*Turbellaria*	16
03600	*Oligochaeta*	20
05800	*Caecidotea sp*	+
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
08601	*Hydracarina*	24
11130	*Baetis intercalaris*	191
12200	*Isonychia sp*	2
13400	*Stenacron sp*	58
13510	*Stenonema exiguum*	5
13570	*Stenonema terminatum*	15
16700	*Tricorythodes sp*	4
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	1
24900	*Gomphus sp*	
34700	*Agnetina capitata complex*	11
42700	*Belostoma sp*	
45400	*Trichocorixa sp*	
48410	*Corydalus cornutus*	2
50315	*Chimarra obscura*	1
52200	*Cheumatopsyche sp*	1244
52430	*Ceratopsyche morosa group*	259
52521	*Hydropsyche bidens or H. orris*	19
52540	*Hydropsyche dicantha*	19
52570	*Hydropsyche simulans*	7
52801	*Potamyia flava*	
53501	*Hydroptilidae*	1
59410	*Nectopsyche diarina*	
59500	*Oecetis sp*	8
63900	*Laccophilus sp*	
67700	*Paracymus sp*	
68601	*Ancyronyx variegata*	9
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	22
69400	*Stenelmis sp*	8
74100	*Simulium sp*	12
74501	*Ceratopogonidae*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
78450	*Nilotanypus fimbriatus*	16
81825	*Rheocricotopus (Psilocricotopus) robacki*	167
82730	*Chironomus (C.) decorus group*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	167
84470	*Polypedilum (P.) illinoense*	
84480	*Polypedilum (P.) laetum group*	
84540	*Polypedilum (Tripodura) scalaenum group*	15
85615	*Rheotanytarsus distinctissimus group*	15
85625	*Rheotanytarsus exiguus group*	972
85800	*Tanytarsus sp*	
85814	*Tanytarsus glabrescens group*	
87540	*Hemerodromia sp*	14
89501	*Ephydridae*	
93900	*Elimia sp*	
95100	*Physella sp*	
96900	*Ferrissia sp*	10

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/03/1998 17-400 Sugar Creek RM: 7.30

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
97601	*Corbicula fluminea*	1			

No. Quantitative Taxa:	34	Total Taxa:	61	
No. Qualitative Taxa:	48	ICI:	**42**	+
Number of Organisms:	3336	Qual EPT:	11	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/03/1998 17-400 Sugar Creek RM: 3.60

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	4
03451	*Urnatella gracilis*	1
03600	*Oligochaeta*	12
05800	*Caecidotea sp*	
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	4
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
08601	*Hydracarina*	8
11130	*Baetis intercalaris*	33
12200	*Isonychia sp*	
13000	*Leucrocuta sp*	
13400	*Stenacron sp*	104
13510	*Stenonema exiguum*	5
13561	*Stenonema pulchellum*	2
13570	*Stenonema terminatum*	8
16700	*Tricorythodes sp*	33
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	4
34700	*Agnetina capitata complex*	13
42700	*Belostoma sp*	
45100	*Palmacorixa sp*	
45400	*Trichocorixa sp*	
45900	*Notonecta sp*	
52200	*Cheumatopsyche sp*	342
52430	*Ceratopsyche morosa group*	139
52530	*Hydropsyche depravata group*	
52540	*Hydropsyche dicantha*	45
60300	*Dineutus sp*	
63900	*Laccophilus sp*	
66500	*Enochrus sp*	
67800	*Tropisternus sp*	
68601	*Ancyronyx variegata*	1
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	9
69400	*Stenelmis sp*	2
74100	*Simulium sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	24
77800	*Helopelopia sp*	24
78450	*Nilotanypus fimbriatus*	194
80370	*Corynoneura lobata*	69
81650	*Parametriocnemus sp*	48
81825	*Rheocricotopus (Psilocricotopus) robacki*	167
82730	*Chironomus (C.) decorus group*	
83300	*Glyptotendipes (G.) sp*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	24
84450	*Polypedilum (P.) flavum*	120
84470	*Polypedilum (P.) illinoense*	
84520	*Polypedilum (Tripodura) halterale group*	24
84540	*Polypedilum (Tripodura) scalaenum group*	24
85615	*Rheotanytarsus distinctissimus group*	24
85625	*Rheotanytarsus exiguus group*	1747
87540	*Hemerodromia sp*	21
93900	*Elimia sp*	
96900	*Ferrissia sp*	4
97601	*Corbicula fluminea*	1
98600	*Sphaerium sp*	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/03/1998 17-400 Sugar Creek RM: 3.60

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	34	Total Taxa:	58	
No. Qualitative Taxa:	44	ICI:	**42**	
Number of Organisms:	3284	Qual EPT:	12	+

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/03/1998 17-400 Sugar Creek RM: 1.80

Taxa Code	Taxa	Quant/Qual
03121	*Paludicella articulata*	1
03360	*Plumatella sp*	1
03600	*Oligochaeta*	88
05800	*Caecidotea sp*	1
06700	*Crangonyx sp*	
11130	*Baetis intercalaris*	43
12200	*Isonychia sp*	2
13400	*Stenacron sp*	24
13561	*Stenonema pulchellum*	10
13570	*Stenonema terminatum*	2
16700	*Tricorythodes sp*	38
21200	*Calopteryx sp*	3
22001	*Coenagrionidae*	
23600	*Aeshna sp*	
24900	*Gomphus sp*	
34700	*Agnetina capitata complex*	
45400	*Trichocorixa sp*	
47600	*Sialis sp*	3
52200	*Cheumatopsyche sp*	11
52430	*Ceratopsyche morosa group*	23
52540	*Hydropsyche dicantha*	1
60300	*Dineutus sp*	
67700	*Paracymus sp*	
68601	*Ancyronyx variegata*	5
68707	*Dubiraphia quadrinotata*	2
68901	*Macronychus glabratus*	8
69400	*Stenelmis sp*	2
71900	*Tipula sp*	
74100	*Simulium sp*	126
74501	*Ceratopogonidae*	
77120	*Ablabesmyia mallochi*	
77750	*Hayesomyia senata or Thienemannimyia norena*	48
77800	*Helopelopia sp*	24
78450	*Nilotanypus fimbriatus*	24
80410	*Cricotopus (C.) sp*	24
80430	*Cricotopus (C.) tremulus group*	24
81825	*Rheocricotopus (Psilocricotopus) robacki*	429
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	24
83300	*Glyptotendipes (G.) sp*	
83410	*Harnischia curtilamellata*	
84300	*Phaenopsectra obediens group*	24
84450	*Polypedilum (P.) flavum*	72
84460	*Polypedilum (P.) fallax group*	143
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	95
85615	*Rheotanytarsus distinctissimus group*	24
85625	*Rheotanytarsus exiguus group*	1287
85821	*Tanytarsus glabrescens group sp 7*	119
86100	*Chrysops sp*	
87540	*Hemerodromia sp*	109
93900	*Elimia sp*	
94400	*Fossaria sp*	
96900	*Ferrissia sp*	8
97601	*Corbicula fluminea*	
98600	*Sphaerium sp*	1
99180	*Strophitus undulatus undulatus*	
99240	*Lasmigona complanata*	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/03/1998 17-400 Sugar Creek RM: 1.80

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
99680	*Leptodea fragilis*				

No. Quantitative Taxa:	37	Total Taxa:	60	
No. Qualitative Taxa:	44	ICI:	**36**	+
Number of Organisms:	2873	Qual EPT:	8	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/03/1998 17-400 Sugar Creek RM: 0.60

Taxa Code	Taxa	Quant/Qual
00653	*Eunapius fragilis*	
01801	*Turbellaria*	1
03121	*Paludicella articulata*	1
03600	*Oligochaeta*	11 +
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	1
07860	*Cambarus (Puncticambarus) robustus*	
08601	*Hydracarina*	4
11130	*Baetis intercalaris*	8
11200	*Callibaetis sp*	
13400	*Stenacron sp*	4
16700	*Tricorythodes sp*	15
17200	*Caenis sp*	1
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	6
23909	*Boyeria vinosa*	
24900	*Gomphus sp*	
44501	*Corixidae*	
47600	*Sialis sp*	
48410	*Corydalus cornutus*	
52200	*Cheumatopsyche sp*	11
52430	*Ceratopsyche morosa group*	6
53501	*Hydroptilidae*	1
55300	*Ptilostomis sp*	
68601	*Ancyronyx variegata*	4
68708	*Dubiraphia vittata group*	6
68901	*Macronychus glabratus*	8
69400	*Stenelmis sp*	15
71300	*Limonia sp*	
71900	*Tipula sp*	
74100	*Simulium sp*	6
74501	*Ceratopogonidae*	8
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	53
77750	*Hayesomyia senata or Thienemannimyia norena*	211
78450	*Nilotanypus fimbriatus*	21
80420	*Cricotopus (C.) bicinctus*	
81825	*Rheocricotopus (Psilocricotopus) robacki*	132
82141	*Thienemanniella xena*	16
82730	*Chironomus (C.) decorus group*	
83300	*Glyptotendipes (G.) sp*	26
84300	*Phaenopsectra obediens group*	26
84450	*Polypedilum (P.) flavum*	53
84460	*Polypedilum (P.) fallax group*	53
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	290
84750	*Stictochironomus sp*	26
85500	*Paratanytarsus sp*	26
85625	*Rheotanytarsus exiguus group*	1241
85800	*Tanytarsus sp*	106
85821	*Tanytarsus glabrescens group sp 7*	158
87540	*Hemerodromia sp*	31
93200	*Hydrobiidae*	
94400	*Fossaria sp*	
95100	*Physella sp*	
96900	*Ferrissia sp*	2
98600	*Sphaerium sp*	
99180	*Strophitus undulatus undulatus*	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date	09/03/1998	17-400	Sugar Creek	RM:	0.60

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
99240	*Lasmigona complanata*				
99680	*Leptodea fragilis*				

No. Quantitative Taxa:	36	Total Taxa:	61	+
No. Qualitative Taxa:	48	ICI:	**38**	
Number of Organisms:	2588	Qual EPT:	7	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/29/1998 17-401 Brandywine Creek RM: 0.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	+
22700	*Ischnura sp*	
24900	*Gomphus sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53501	*Hydroptilidae*	
60900	*Peltodytes sp*	
63300	*Hydroporus sp*	
63600	*Hygrotus sp*	
65700	*Anacaena sp*	
65800	*Berosus sp*	
67700	*Paracymus sp*	
68707	*Dubiraphia quadrinotata*	
68708	*Dubiraphia vittata group*	
71910	*Tipula abdominalis*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
78655	*Procladius (Holotanypus) sp*	
80410	*Cricotopus (C.) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82730	*Chironomus (C.) decorus group*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84470	*Polypedilum (P.) illinoense*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85821	*Tanytarsus glabrescens group sp 7*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	33
No. Qualitative Taxa:	33	ICI:	
Number of Organisms:	0	Qual EPT:	3

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/30/1998 17-402 Broad Run RM: 2.80

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03040	*Fredericella sp*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	+
04601	*Glossiphoniidae*	
11120	*Baetis flavistriga*	
17200	*Caenis sp*	
22600	*Enallagma sp*	
22700	*Ischnura sp*	
23909	*Boyeria vinosa*	
43570	*Neoplea sp*	
45400	*Trichocorixa sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
60900	*Peltodytes sp*	
65700	*Anacaena sp*	
65800	*Berosus sp*	
66500	*Enochrus sp*	
67700	*Paracymus sp*	
67800	*Tropisternus sp*	
68707	*Dubiraphia quadrinotata*	
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	
69400	*Stenelmis sp*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82101	*Thienemanniella taurocapita*	
82730	*Chironomus (C.) decorus group*	
82770	*Chironomus (C.) riparius group*	
82820	*Cryptochironomus sp*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84460	*Polypedilum (P.) fallax group*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85500	*Paratanytarsus sp*	
86501	*Stratiomyidae*	
89700	*Limnophora sp*	
99180	*Strophitus undulatus undulatus*	

No. Quantitative Taxa:	0	Total Taxa:	44
No. Qualitative Taxa:	44	ICI:	
Number of Organisms:	0	Qual EPT:	5

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/30/1998 17-402 Broad Run RM: 0.20

Taxa Code	Taxa	Quant/Qual
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
22001	*Coenagrionidae*	+
23600	*Aeshna sp*	
23909	*Boyeria vinosa*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
60300	*Dineutus sp*	
68708	*Dubiraphia vittata group*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
78655	*Procladius (Holotanypus) sp*	
84470	*Polypedilum (P.) illinoense*	
95100	*Physella sp*	

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	0	Total Taxa:	14
No. Qualitative Taxa:	14	ICI:	
Number of Organisms:	0	Qual EPT:	1

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/23/1998 17-403 Turkeyfoot Run RM: 0.20

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	
23618	*Aeshna umbrosa*	
42700	*Belostoma sp*	
45400	*Trichocorixa sp*	+
47600	*Sialis sp*	
52315	*Diplectrona modesta*	
52530	*Hydropsyche depravata group*	
63300	*Hydroporus sp*	
63900	*Laccophilus sp*	
81040	*Limnophyes sp*	

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	0	Total Taxa:	10
No. Qualitative Taxa:	10	ICI:	
Number of Organisms:	0	Qual EPT:	2

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/17/1998 17-405 Elm Run RM: 1.70

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	
06201	*Hyalella azteca*	
08255	*Orconectes rusticus x sanbornii*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11125	*Pseudocloeon frondalis*	
13400	*Stenacron sp*	
23909	*Boyeria vinosa*	
45400	*Trichocorixa sp*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
59730	*Triaenodes melaca*	
60900	*Peltodytes sp*	
61400	*Agabus sp*	
63300	*Hydroporus sp*	
67500	*Laccobius sp*	
68707	*Dubiraphia quadrinotata*	
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	
69400	*Stenelmis sp*	
71910	*Tipula abdominalis*	
77800	*Helopelopia sp*	
78450	*Nilotanypus fimbriatus*	
80410	*Cricotopus (C.) sp*	
80850	*Heterotrissocladius marcidus*	
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	
81650	*Parametriocnemus sp*	
82200	*Tvetenia bavarica group*	
82820	*Cryptochironomus sp*	
82885	*Cryptotendipes pseudotener*	
84440	*Polypedilum (P.) aviceps*	
84700	*Stenochironomus sp*	
85261	*Cladotanytarsus vanderwulpi group Type 1*	
86100	*Chrysops sp*	
87540	*Hemerodromia sp*	
95100	*Physella sp*	
96900	*Ferrissia sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	38
No. Qualitative Taxa:	38	ICI:	
Number of Organisms:	0	Qual EPT:	5

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/17/1998 17-406 Middle Fork Sugar Creek RM: 12.10

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
06201	*Hyalella azteca*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11150	*Pseudocloeon propinquus*	
11200	*Callibaetis sp*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
44501	*Corixidae*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52440	*Ceratopsyche slossonae*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
65800	*Berosus sp*	
67500	*Laccobius sp*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
80420	*Cricotopus (C.) bicinctus*	
81650	*Parametriocnemus sp*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84315	*Phaenopsectra flavipes*	
84450	*Polypedilum (P.) flavum*	
84460	*Polypedilum (P.) fallax group*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	40
No. Qualitative Taxa:	40	ICI:	
Number of Organisms:	0	Qual EPT:	12

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/17/1998 17-406 Middle Fork Sugar Creek RM: 10.30

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
06201	*Hyalella azteca*	
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
60400	*Gyrinus sp*	
60900	*Peltodytes sp*	
63300	*Hydroporus sp*	
65800	*Berosus sp*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
80430	*Cricotopus (C.) tremulus group*	
81270	*Nanocladius (N.) spiniplenus*	
81650	*Parametriocnemus sp*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
85625	*Rheotanytarsus exiguus group*	
85821	*Tanytarsus glabrescens group sp 7*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	36
No. Qualitative Taxa:	36	ICI:	
Number of Organisms:	0	Qual EPT:	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/17/1998 17-406 Middle Fork Sugar Creek RM: 7.60

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
06201	*Hyalella azteca*	+
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11150	*Pseudocloeon propinquus*	
11430	*Diphetor hageni*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
21300	*Hetaerina sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
53501	*Hydroptilidae*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
80430	*Cricotopus (C.) tremulus group*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85821	*Tanytarsus glabrescens group sp 7*	
95100	*Physella sp*	
96900	*Ferrissia sp*	

No. Quantitative Taxa:	0	Total Taxa:	40
No. Qualitative Taxa:	40	ICI:	
Number of Organisms:	0	Qual EPT:	11

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 08/31/1998 17-406 Middle Fork Sugar Creek RM: 1.70

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	21
01801	*Turbellaria*	1
03600	*Oligochaeta*	4
06201	*Hyalella azteca*	4
07701	*Cambaridae*	1
08601	*Hydracarina*	
11130	*Baetis intercalaris*	63
11150	*Pseudocloeon propinquus*	
12200	*Isonychia sp*	1
13000	*Leucrocuta sp*	4
13400	*Stenacron sp*	15
13510	*Stenonema exiguum*	104
13590	*Stenonema vicarium*	
16200	*Eurylophella sp*	4
16700	*Tricorythodes sp*	23
17200	*Caenis sp*	5
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	21
45100	*Palmacorixa sp*	
45300	*Sigara sp*	
51600	*Polycentropus sp*	4
52200	*Cheumatopsyche sp*	309
52430	*Ceratopsyche morosa group*	12
52570	*Hydropsyche simulans*	1
59410	*Nectopsyche diarina*	
59500	*Oecetis sp*	4
60300	*Dineutus sp*	1
63300	*Hydroporus sp*	
68601	*Ancyronyx variegata*	4
68708	*Dubiraphia vittata group*	8
68901	*Macronychus glabratus*	55
69400	*Stenelmis sp*	1
77750	*Hayesomyia senata or Thienemannimyia norena*	78
77800	*Helopelopia sp*	67
78200	*Larsia sp*	11
78450	*Nilotanypus fimbriatus*	12
80370	*Corynoneura lobata*	28
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	33
82141	*Thienemanniella xena*	4
83040	*Dicrotendipes neomodestus*	22
84300	*Phaenopsectra obediens group*	11
84460	*Polypedilum (P.) fallax group*	33
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	78
85230	*Cladotanytarsus mancus group*	11
85500	*Paratanytarsus sp*	45
85625	*Rheotanytarsus exiguus group*	490
85821	*Tanytarsus glabrescens group sp 7*	111
87540	*Hemerodromia sp*	12
95100	*Physella sp*	4
96900	*Ferrissia sp*	12

No. Quantitative Taxa:	42	Total Taxa:	52
No. Qualitative Taxa:	25	ICI:	**50**
Number of Organisms:	1732	Qual EPT:	11

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/16/1998 17-408 Crabapple Creek RM: 3.00

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
04664	*Helobdella stagnalis*	
04935	*Erpobdella punctata punctata*	
06201	*Hyalella azteca*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
08601	*Hydracarina*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11150	*Pseudocloeon propinquus*	
13400	*Stenacron sp*	
13510	*Stenonema exiguum*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
45300	*Sigara sp*	
45400	*Trichocorixa sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
60900	*Peltodytes sp*	
65800	*Berosus sp*	
67300	*Hydrochus sp*	
68708	*Dubiraphia vittata group*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	
81650	*Parametriocnemus sp*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
84750	*Stictochironomus sp*	

No. Quantitative Taxa:	0	Total Taxa:	38
No. Qualitative Taxa:	38	ICI:	
Number of Organisms:	0	Qual EPT:	10

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/16/1998 17-408 Crabapple Creek RM: 0.30

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
04935	*Erpobdella punctata punctata*	
06201	*Hyalella azteca*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52440	*Ceratopsyche slossonae*	
52530	*Hydropsyche depravata group*	
60900	*Peltodytes sp*	
65800	*Berosus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
80420	*Cricotopus (C.) bicinctus*	
81650	*Parametriocnemus sp*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
85500	*Paratanytarsus sp*	
87540	*Hemerodromia sp*	
89001	*Sciomyzidae*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	40
No. Qualitative Taxa:	40	ICI:	
Number of Organisms:	0	Qual EPT:	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/13/1998 17-409 North Fork Sugar Creek RM: 5.40

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*				
03360	*Plumatella sp*				
03600	*Oligochaeta*				
04664	*Helobdella stagnalis*				
04935	*Erpobdella punctata punctata*				
06700	*Crangonyx sp*				
11120	*Baetis flavistriga*				
11130	*Baetis intercalaris*				
22001	*Coenagrionidae*				
23600	*Aeshna sp*				
52200	*Cheumatopsyche sp*				
52530	*Hydropsyche depravata group*				
53800	*Hydroptila sp*				
74100	*Simulium sp*				
77500	*Conchapelopia sp*				
80420	*Cricotopus (C.) bicinctus*				
80430	*Cricotopus (C.) tremulus group*				
82820	*Cryptochironomus sp*				
84300	*Phaenopsectra obediens group*				
84450	*Polypedilum (P.) flavum*				
85400	*Micropsectra sp*				
85500	*Paratanytarsus sp*				
85625	*Rheotanytarsus exiguus group*				
87540	*Hemerodromia sp*				
95100	*Physella sp*				

No. Quantitative Taxa:	0	Total Taxa:	25
No. Qualitative Taxa:	25	ICI:	
Number of Organisms:	0	Qual EPT:	5

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/13/1998 17-409 North Fork Sugar Creek RM: 3.10

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	
04664	*Helobdella stagnalis*	
04935	*Erpobdella punctata punctata*	
06201	*Hyalella azteca*	+
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
21300	*Hetaerina sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
42700	*Belostoma sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
63300	*Hydroporus sp*	
65800	*Berosus sp*	
69400	*Stenelmis sp*	
71900	*Tipula sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
81650	*Parametriocnemus sp*	
82141	*Thienemanniella xena*	
82820	*Cryptochironomus sp*	
83300	*Glyptotendipes (G.) sp*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84750	*Stictochironomus sp*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85821	*Tanytarsus glabrescens group sp 7*	
87540	*Hemerodromia sp*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	44
No. Qualitative Taxa:	44	ICI:	
Number of Organisms:	0	Qual EPT:	9

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/13/1998 17-409 North Fork Sugar Creek RM: 1.30

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	
04660	*Helobdella sp*	
05900	*Lirceus sp*	
06201	*Hyalella azteca*	+
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
21300	*Hetaerina sp*	
23909	*Boyeria vinosa*	
24900	*Gomphus sp*	
45100	*Palmacorixa sp*	
45300	*Sigara sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
65800	*Berosus sp*	
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	
69400	*Stenelmis sp*	
71100	*Hexatoma sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
80410	*Cricotopus (C.) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
81650	*Parametriocnemus sp*	
82820	*Cryptochironomus sp*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84750	*Stictochironomus sp*	
84960	*Pseudochironomus sp*	
85261	*Cladotanytarsus vanderwulpi group Type 1*	
85500	*Paratanytarsus sp*	
85800	*Tanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	
87540	*Hemerodromia sp*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	43
No. Qualitative Taxa:	43	ICI:	
Number of Organisms:	0	Qual EPT:	7

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/29/1998 17-410 South Fork Sugar Creek RM: 21.10

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
04664	*Helobdella stagnalis*	
04935	*Erpobdella punctata punctata*	
07880	*Cambarus (Tubericambarus) thomai*	
11120	*Baetis flavistriga*	
13400	*Stenacron sp*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23600	*Aeshna sp*	
23909	*Boyeria vinosa*	
28955	*Libellula lydia*	
45300	*Sigara sp*	
45400	*Trichocorixa sp*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
60900	*Peltodytes sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
66500	*Enochrus sp*	
67000	*Helophorus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
78655	*Procladius (Holotanypus) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
96002	*Helisoma anceps anceps*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	44
No. Qualitative Taxa:	44	ICI:	
Number of Organisms:	0	Qual EPT:	7

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/29/1998 17-410 South Fork Sugar Creek RM: 19.00

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
04664	*Helobdella stagnalis*	
04935	*Erpobdella punctata punctata*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11200	*Callibaetis sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
45300	*Sigara sp*	
45400	*Trichocorixa sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
60900	*Peltodytes sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
71900	*Tipula sp*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77355	*Clinotanypus pinguis*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
78655	*Procladius (Holotanypus) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85230	*Cladotanytarsus mancus group*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85821	*Tanytarsus glabrescens group sp 7*	
86100	*Chrysops sp*	
95100	*Physella sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	41
No. Qualitative Taxa:	41	ICI:	
Number of Organisms:	0	Qual EPT:	6

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/29/1998 17-410 South Fork Sugar Creek RM: 15.30

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
04666	*Helobdella triserialis*	
04685	*Placobdella ornata*	+
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11200	*Callibaetis sp*	
13550	*Stenonema mexicanum integrum*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
42700	*Belostoma sp*	
45300	*Sigara sp*	
45400	*Trichocorixa sp*	
45700	*Buenoa sp*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
59570	*Oecetis nocturna*	
60900	*Peltodytes sp*	
63300	*Hydroporus sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
66500	*Enochrus sp*	
67000	*Helophorus sp*	
67700	*Paracymus sp*	
67800	*Tropisternus sp*	
68601	*Ancyronyx variegata*	
68708	*Dubiraphia vittata group*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77740	*Hayesomyia senata*	
78655	*Procladius (Holotanypus) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83300	*Glyptotendipes (G.) sp*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
85230	*Cladotanytarsus mancus group*	
85800	*Tanytarsus sp*	
95100	*Physella sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	49
No. Qualitative Taxa:	49	ICI:	
Number of Organisms:	0	Qual EPT:	9

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/29/1998 17-410 South Fork Sugar Creek RM: 13.90

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
04666	*Helobdella triserialis*	
06201	*Hyalella azteca*	
11150	*Pseudocloeon propinquus*	
11200	*Callibaetis sp*	
11590	*Paracloeodes sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
42700	*Belostoma sp*	
45100	*Palmacorixa sp*	
45300	*Sigara sp*	
45400	*Trichocorixa sp*	
52200	*Cheumatopsyche sp*	
60800	*Haliplus sp*	
60900	*Peltodytes sp*	
62200	*Copelatus sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
67800	*Tropisternus sp*	
68300	*Cyphon sp*	
68708	*Dubiraphia vittata group*	
72900	*Culex sp*	
74100	*Simulium sp*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
78655	*Procladius (Holotanypus) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
81240	*Nanocladius (N.) distinctus*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83300	*Glyptotendipes (G.) sp*	
83330	*Glyptotendipes (G.) barbipes*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85821	*Tanytarsus glabrescens group sp 7*	
85840	*Tanytarsus guerlus group*	
95100	*Physella sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	43
No. Qualitative Taxa:	43	ICI:	
Number of Organisms:	0	Qual EPT:	4

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/02/1998 17-410 South Fork Sugar Creek RM: 13.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	119
03360	*Plumatella sp*	
03600	*Oligochaeta*	19
04664	*Helobdella stagnalis*	
04666	*Helobdella triserialis*	1
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	
11200	*Callibaetis sp*	
16700	*Tricorythodes sp*	2
17200	*Caenis sp*	1
22001	*Coenagrionidae*	
22300	*Argia sp*	
28955	*Libellula lydia*	
42700	*Belostoma sp*	
45100	*Palmacorixa sp*	
45400	*Trichocorixa sp*	
52200	*Cheumatopsyche sp*	26
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	17
59410	*Nectopsyche diarina*	
59570	*Oecetis nocturna*	
60900	*Peltodytes sp*	
63300	*Hydroporus sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	14
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	5
71900	*Tipula sp*	1
72700	*Anopheles sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	8
77120	*Ablabesmyia mallochi*	4
77355	*Clinotanypus pinguis*	
77500	*Conchapelopia sp*	14
77750	*Hayesomyia senata or Thienemannimyia norena*	25
78200	*Larsia sp*	2
78655	*Procladius (Holotanypus) sp*	
80420	*Cricotopus (C.) bicinctus*	5
80430	*Cricotopus (C.) tremulus group*	2
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	6
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	4
83040	*Dicrotendipes neomodestus*	9
83300	*Glyptotendipes (G.) sp*	2
84300	*Phaenopsectra obediens group*	2
84450	*Polypedilum (P.) flavum*	9
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	11
85230	*Cladotanytarsus mancus group*	5
85500	*Paratanytarsus sp*	5
85821	*Tanytarsus glabrescens group sp 7*	16
85840	*Tanytarsus guerlus group*	30
87400	*Stratiomys sp*	
87501	*Empididae*	1
95100	*Physella sp*	
98600	*Sphaerium sp*	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/02/1998 17-410 South Fork Sugar Creek RM: 13.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	29	Total Taxa:	56	
No. Qualitative Taxa:	44	ICI:	**28**	
Number of Organisms:	365	Qual EPT:	8	+

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/02/1998 17-410 South Fork Sugar Creek RM: 7.40

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	88
05800	*Caecidotea sp*	
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	+
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11130	*Baetis intercalaris*	
12200	*Isonychia sp*	
13590	*Stenonema vicarium*	2
17200	*Caenis sp*	1
21200	*Calopteryx sp*	
22300	*Argia sp*	1
28500	*Libellula sp*	
44501	*Corixidae*	8
45100	*Palmacorixa sp*	
45400	*Trichocorixa sp*	
47600	*Sialis sp*	1
52200	*Cheumatopsyche sp*	184
52530	*Hydropsyche depravata group*	
52570	*Hydropsyche simulans*	11
68708	*Dubiraphia vittata group*	4
74100	*Simulium sp*	
74501	*Ceratopogonidae*	40
77120	*Ablabesmyia mallochi*	15
77500	*Conchapelopia sp*	
77740	*Hayesomyia senata*	279
78655	*Procladius (Holotanypus) sp*	31
80370	*Corynoneura lobata*	4
80420	*Cricotopus (C.) bicinctus*	15
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	31
82101	*Thienemanniella taurocapita*	4
82200	*Tvetenia bavarica group*	15
82730	*Chironomus (C.) decorus group*	46
83040	*Dicrotendipes neomodestus*	62
83051	*Dicrotendipes simpsoni*	
83410	*Harnischia curtilamellata*	
84450	*Polypedilum (P.) flavum*	
84460	*Polypedilum (P.) fallax group*	46
84470	*Polypedilum (P.) illinoense*	15
84540	*Polypedilum (Tripodura) scalaenum group*	77
84700	*Stenochironomus sp*	
85230	*Cladotanytarsus mancus group*	15
85500	*Paratanytarsus sp*	139
85625	*Rheotanytarsus exiguus group*	31
85800	*Tanytarsus sp*	15
85818	*Tanytarsus glabrescens group sp 4*	15
85821	*Tanytarsus glabrescens group sp 7*	387
85840	*Tanytarsus guerlus group*	217
87540	*Hemerodromia sp*	16

No. Quantitative Taxa:	31	Total Taxa:	48
No. Qualitative Taxa:	33	ICI:	**34**
Number of Organisms:	1815	Qual EPT:	5

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/02/1998 17-410 South Fork Sugar Creek RM: 6.40

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	24
05800	*Caecidotea sp*	
06201	*Hyalella azteca*	4
06700	*Crangonyx sp*	1 +
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11130	*Baetis intercalaris*	16
13400	*Stenacron sp*	
13510	*Stenonema exiguum*	1
16700	*Tricorythodes sp*	
17200	*Caenis sp*	4
21200	*Calopteryx sp*	1
22001	*Coenagrionidae*	
45100	*Palmacorixa sp*	
47600	*Sialis sp*	1
52200	*Cheumatopsyche sp*	197
52570	*Hydropsyche simulans*	1
68708	*Dubiraphia vittata group*	16
69400	*Stenelmis sp*	12
74100	*Simulium sp*	
74501	*Ceratopogonidae*	16
77120	*Ablabesmyia mallochi*	32
77740	*Hayesomyia senata*	276
78401	*Natarsia species A (sensu Roback, 1978)*	
78450	*Nilotanypus fimbriatus*	16
80370	*Corynoneura lobata*	8
80420	*Cricotopus (C.) bicinctus*	16
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	32
81825	*Rheocricotopus (Psilocricotopus) robacki*	65
83040	*Dicrotendipes neomodestus*	146
84155	*Paralauterborniella nigrohalteralis*	
84460	*Polypedilum (P.) fallax group*	49
84470	*Polypedilum (P.) illinoense*	16
84540	*Polypedilum (Tripodura) scalaenum group*	113
84790	*Tribelos fuscicorne*	
85500	*Paratanytarsus sp*	178
85625	*Rheotanytarsus exiguus group*	194
85821	*Tanytarsus glabrescens group sp 7*	681
85840	*Tanytarsus guerlus group*	65
86100	*Chrysops sp*	
87540	*Hemerodromia sp*	17

No. Quantitative Taxa:	29	Total Taxa:	40
No. Qualitative Taxa:	26	ICI:	**34**
Number of Organisms:	2198	Qual EPT:	5

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/02/1998 17-410 South Fork Sugar Creek RM: 3.60

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	8
01801	*Turbellaria*	20
03600	*Oligochaeta*	260
04664	*Helobdella stagnalis*	3
04666	*Helobdella triserialis*	1
05800	*Caecidotea sp*	6
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	30
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	4
28208	*Erythemis simplicicollis*	
44300	*Pelocoris sp*	
44501	*Corixidae*	
60400	*Gyrinus sp*	
68708	*Dubiraphia vittata group*	
77120	*Ablabesmyia mallochi*	7
77140	*Ablabesmyia peleensis*	10
80370	*Corynoneura lobata*	4
82730	*Chironomus (C.) decorus group*	10
83040	*Dicrotendipes neomodestus*	3
83051	*Dicrotendipes simpsoni*	54
83158	*Endochironomus nigricans*	54
83300	*Glyptotendipes (G.) sp*	31
84460	*Polypedilum (P.) fallax group*	7
84540	*Polypedilum (Tripodura) scalaenum group*	20
84790	*Tribelos fuscicorne*	156
84800	*Tribelos jucundum*	7
85500	*Paratanytarsus sp*	31
85625	*Rheotanytarsus exiguus group*	3
85800	*Tanytarsus sp*	3
95100	*Physella sp*	1
96900	*Ferrissia sp*	1

No. Quantitative Taxa:	25	Total Taxa:	33
No. Qualitative Taxa:	19	ICI:	**10**
Number of Organisms:	734	Qual EPT:	0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/28/1998 17-411 Walnut Creek RM: 7.90

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
04666	*Helobdella triserialis*	
04935	*Erpobdella punctata punctata*	
05800	*Caecidotea sp*	
06201	*Hyalella azteca*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11200	*Callibaetis sp*	
13400	*Stenacron sp*	
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	
23909	*Boyeria vinosa*	
45300	*Sigara sp*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
60900	*Peltodytes sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
71900	*Tipula sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
77800	*Helopelopia sp*	
78650	*Procladius sp*	
80410	*Cricotopus (C.) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	
81250	*Nanocladius (N.) minimus*	
81270	*Nanocladius (N.) spiniplenus*	
81632	*Parakiefferiella n.sp 2*	
82141	*Thienemanniella xena*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83003	*Dicrotendipes fumidus*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
84960	*Pseudochironomus sp*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85800	*Tanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	
89001	*Sciomyzidae*	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/28/1998 17-411 Walnut Creek RM: 7.90

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
95100	*Physella sp*				
96900	*Ferrissia sp*				
98600	*Sphaerium sp*				
		+			

No. Quantitative Taxa:	0	Total Taxa:	61
No. Qualitative Taxa:	61	ICI:	
Number of Organisms:	0	Qual EPT:	8

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/28/1998 17-411 Walnut Creek RM: 6.30

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
04666	*Helobdella triserialis*	
04935	*Erpobdella punctata punctata*	
06201	*Hyalella azteca*	
08601	*Hydracarina*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
13400	*Stenacron sp*	
13561	*Stenonema pulchellum*	
13570	*Stenonema terminatum*	
13590	*Stenonema vicarium*	
16700	*Tricorythodes sp*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
28955	*Libellula lydia*	
45300	*Sigara sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53501	*Hydroptilidae*	
60900	*Peltodytes sp*	
62200	*Copelatus sp*	
63900	*Laccophilus sp*	
65700	*Anacaena sp*	
65800	*Berosus sp*	
66500	*Enochrus sp*	
67000	*Helophorus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
77800	*Helopelopia sp*	
78650	*Procladius sp*	
80410	*Cricotopus (C.) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84469	*Polypedilum (P.) illinoense group*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85800	*Tanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	
94400	*Fossaria sp*	
95100	*Physella sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	53
No. Qualitative Taxa:	53	ICI:	
Number of Organisms:	0	Qual EPT:	11

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/28/1998 17-411 Walnut Creek RM: 4.50

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
04935	*Erpobdella punctata punctata*	
05800	*Caecidotea sp*	+
06201	*Hyalella azteca*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11200	*Callibaetis sp*	
13590	*Stenonema vicarium*	
14900	*Leptophlebia sp*	
16700	*Tricorythodes sp*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23600	*Aeshna sp*	
23909	*Boyeria vinosa*	
45300	*Sigara sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
53501	*Hydroptilidae*	
60900	*Peltodytes sp*	
65800	*Berosus sp*	
67700	*Paracymus sp*	
67800	*Tropisternus sp*	
68130	*Helichus sp*	
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
77800	*Helopelopia sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83000	*Dicrotendipes sp*	
84470	*Polypedilum (P.) illinoense*	
85500	*Paratanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	
87501	*Empididae*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	45
No. Qualitative Taxa:	45	ICI:	
Number of Organisms:	0	Qual EPT:	11

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/02/1998 17-411 Walnut Creek RM: 0.60

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	
05800	*Caecidotea sp*	
06201	*Hyalella azteca*	
06700	*Crangonyx sp*	+
11130	*Baetis intercalaris*	
11200	*Callibaetis sp*	
13400	*Stenacron sp*	
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	
42700	*Belostoma sp*	
44300	*Pelocoris sp*	
45100	*Palmacorixa sp*	
45300	*Sigara sp*	
45900	*Notonecta sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53501	*Hydroptilidae*	
63900	*Laccophilus sp*	
65010	*Hydrocanthus sp*	
65800	*Berosus sp*	
67300	*Hydrochus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
83040	*Dicrotendipes neomodestus*	
84470	*Polypedilum (P.) illinoense*	
85625	*Rheotanytarsus exiguus group*	
85802	*Tanytarsus curticornis group*	
85821	*Tanytarsus glabrescens group sp 7*	
87501	*Empididae*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	37
No. Qualitative Taxa:	37	ICI:	
Number of Organisms:	0	Qual EPT:	7

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/10/1998 17-412 Indian Trail Creek RM: 6.40

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
04935	*Erpobdella punctata punctata*	
05800	*Caecidotea sp*	+
06201	*Hyalella azteca*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11200	*Callibaetis sp*	
11250	*Centroptilum sp (w/o hindwing pads)*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	
23909	*Boyeria vinosa*	
24900	*Gomphus sp*	
28955	*Libellula lydia*	
42700	*Belostoma sp*	
47600	*Sialis sp*	
50301	*Chimarra aterrima*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52440	*Ceratopsyche slossonae*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
55300	*Ptilostomis sp*	
60900	*Peltodytes sp*	
60910	*Peltodytes edentulus*	
63300	*Hydroporus sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
67500	*Laccobius sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
71100	*Hexatoma sp*	
71700	*Pilaria sp*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
77800	*Helopelopia sp*	
78350	*Meropelopia sp*	
80420	*Cricotopus (C.) bicinctus*	
81460	*Orthocladius (O.) sp*	
81650	*Parametriocnemus sp*	
81825	*Rheocricotopus (Psilocricotopus) robacki*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84440	*Polypedilum (P.) aviceps*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84750	*Stictochironomus sp*	
85500	*Paratanytarsus sp*	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/10/1998 17-412 Indian Trail Creek RM: 6.40

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
85625	*Rheotanytarsus exiguus group*				
85800	*Tanytarsus sp*				
86100	*Chrysops sp*				
87540	*Hemerodromia sp*	+			

No. Quantitative Taxa:	0	Total Taxa:	62
No. Qualitative Taxa:	62	ICI:	
Number of Organisms:	0	Qual EPT:	14

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/28/1998 17-412 Indian Trail Creek RM: 5.40

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
04935	*Erpobdella punctata punctata*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	+
11125	*Pseudocloeon frondalis*	
11130	*Baetis intercalaris*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
33001	*Leuctridae*	
45300	*Sigara sp*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52315	*Diplectrona modesta*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
59500	*Oecetis sp*	
60900	*Peltodytes sp*	
63300	*Hydroporus sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
67500	*Laccobius sp*	
67700	*Paracymus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
80370	*Corynoneura lobata*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
81632	*Parakiefferiella n.sp 2*	
82141	*Thienemanniella xena*	
83840	*Microtendipes pedellus group*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84315	*Phaenopsectra flavipes*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85800	*Tanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	
87540	*Hemerodromia sp*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	49
No. Qualitative Taxa:	49	ICI:	
Number of Organisms:	0	Qual EPT:	12

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/28/1998 17-412 Indian Trail Creek RM: 2.60

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	
06201	*Hyalella azteca*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	+
11125	*Pseudocloeon frondalis*	
11130	*Baetis intercalaris*	
11250	*Centroptilum sp (w/o hindwing pads)*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
21001	*Calopterygidae*	
23600	*Aeshna sp*	
23909	*Boyeria vinosa*	
45300	*Sigara sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52440	*Ceratopsyche slossonae*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
60900	*Peltodytes sp*	
63300	*Hydroporus sp*	
65800	*Berosus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
69225	*Optioservus fastiditus*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
77120	*Ablabesmyia mallochi*	
77500	*Conchapelopia sp*	
78350	*Meropelopia sp*	
78401	*Natarsia species A (sensu Roback, 1978)*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
80440	*Cricotopus (C.) trifascia group*	
81632	*Parakiefferiella n.sp 2*	
82141	*Thienemanniella xena*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
85261	*Cladotanytarsus vanderwulpi group Type 1*	
85500	*Paratanytarsus sp*	
85615	*Rheotanytarsus distinctissimus group*	
85800	*Tanytarsus sp*	
86100	*Chrysops sp*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	49
No. Qualitative Taxa:	49	ICI:	
Number of Organisms:	0	Qual EPT:	12

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/28/1998 17-413 Goose Creek RM: 0.40

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
04666	*Helobdella triserialis*	
04686	*Placobdella papillifera*	
04935	*Erpobdella punctata punctata*	
06201	*Hyalella azteca*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23600	*Aeshna sp*	
23909	*Boyeria vinosa*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
60900	*Peltodytes sp*	
63300	*Hydroporus sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
67000	*Helophorus sp*	
67800	*Tropisternus sp*	
68708	*Dubiraphia vittata group*	
69275	*Optioservus trivittatus*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
77800	*Helopelopia sp*	
80410	*Cricotopus (C.) sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82102	*Thienemanniella boltoni*	
82141	*Thienemanniella xena*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84210	*Paratendipes albimanus or P. duplicatus*	
84450	*Polypedilum (P.) flavum*	
84469	*Polypedilum (P.) illinoense group*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85800	*Tanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	
85840	*Tanytarsus guerlus group*	
86100	*Chrysops sp*	
95100	*Physella sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	53
No. Qualitative Taxa:	53	ICI:	
Number of Organisms:	0	Qual EPT:	9

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/24/1998 17-414 East Branch South Fork Sugar Creek RM: 5.50

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	
03600	*Oligochaeta*	
06700	*Crangonyx sp*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
13400	*Stenacron sp*	
13590	*Stenonema vicarium*	
14950	*Leptophlebia sp or Paraleptophlebia sp*	
17200	*Caenis sp*	
23909	*Boyeria vinosa*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
57900	*Pycnopsyche sp*	
67700	*Paracymus sp*	
69400	*Stenelmis sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
81270	*Nanocladius (N.) spiniplenus*	
81650	*Parametriocnemus sp*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
82885	*Cryptotendipes pseudotener*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85400	*Micropsectra sp*	
86100	*Chrysops sp*	
87501	*Empididae*	
95100	*Physella sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	34
No. Qualitative Taxa:	34	ICI:	
Number of Organisms:	0	Qual EPT:	9

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/24/1998 17-414 East Branch South Fork Sugar Creek RM: 5.00

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	
06700	*Crangonyx sp*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	+
13400	*Stenacron sp*	
17200	*Caenis sp*	
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	
23909	*Boyeria vinosa*	
24900	*Gomphus sp*	
45300	*Sigara sp*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53501	*Hydroptilidae*	
61400	*Agabus sp*	
68201	*Scirtidae*	
69400	*Stenelmis sp*	
71900	*Tipula sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
81825	*Rheocricotopus (Psilocricotopus) robacki*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85625	*Rheotanytarsus exiguus group*	
86100	*Chrysops sp*	
95100	*Physella sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	36
No. Qualitative Taxa:	36	ICI:	
Number of Organisms:	0	Qual EPT:	7

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/27/1998 17-414 East Branch South Fork Sugar Creek RM: 1.70

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03360	*Plumatella sp*	
03600	*Oligochaeta*	
22001	*Coenagrionidae*	+
23600	*Aeshna sp*	
23909	*Boyeria vinosa*	
42700	*Belostoma sp*	
43570	*Neoplea sp*	
45300	*Sigara sp*	
52530	*Hydropsyche depravata group*	
60400	*Gyrinus sp*	
60900	*Peltodytes sp*	
63300	*Hydroporus sp*	
65800	*Berosus sp*	
67000	*Helophorus sp*	
67800	*Tropisternus sp*	
68130	*Helichus sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
80440	*Cricotopus (C.) trifascia group*	
81650	*Parametriocnemus sp*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83158	*Endochironomus nigricans*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84315	*Phaenopsectra flavipes*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
85800	*Tanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	34
No. Qualitative Taxa:	34	ICI:	
Number of Organisms:	0	Qual EPT:	1

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/24/1998 17-415 Pleasant Valley Creek RM: 0.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11125	*Pseudocloeon frondalis*	
22001	*Coenagrionidae*	
23600	*Aeshna sp*	
23909	*Boyeria vinosa*	
42700	*Belostoma sp*	
45300	*Sigara sp*	
45400	*Trichocorixa sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
64050	*Liodessus sp*	
65800	*Berosus sp*	
67500	*Laccobius sp*	
67700	*Paracymus sp*	
67800	*Tropisternus sp*	
68707	*Dubiraphia quadrinotata*	
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	
69400	*Stenelmis sp*	
71900	*Tipula sp*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
78650	*Procladius sp*	
80410	*Cricotopus (C.) sp*	
80420	*Cricotopus (C.) bicinctus*	
81825	*Rheocricotopus (Psilocricotopus) robacki*	
82141	*Thienemanniella xena*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
82885	*Cryptotendipes pseudotener*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84210	*Paratendipes albimanus or P. duplicatus*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84469	*Polypedilum (P.) illinoense group*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85821	*Tanytarsus glabrescens group sp 7*	
86100	*Chrysops sp*	
95100	*Physella sp*	
98200	*Pisidium sp*	

No. Quantitative Taxa:	0	Total Taxa:	46
No. Qualitative Taxa:	46	ICI:	
Number of Organisms:	0	Qual EPT:	4

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/27/1998 17-416 Troyer Valley Creek RM: 1.10

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	
03600	*Oligochaeta*	
04664	*Helobdella stagnalis*	
04666	*Helobdella triserialis*	
06700	*Crangonyx sp*	
11200	*Callibaetis sp*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23600	*Aeshna sp*	
28955	*Libellula lydia*	
42700	*Belostoma sp*	
45300	*Sigara sp*	
45400	*Trichocorixa sp*	
47600	*Sialis sp*	
60900	*Peltodytes sp*	
63900	*Laccophilus sp*	
65800	*Berosus sp*	
67800	*Tropisternus sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
78350	*Meropelopia sp*	
78401	*Natarsia species A (sensu Roback, 1978)*	
78700	*Psectrotanypus sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82730	*Chironomus (C.) decorus group*	
82770	*Chironomus (C.) riparius group*	
82820	*Cryptochironomus sp*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	31
No. Qualitative Taxa:	31	ICI:	
Number of Organisms:	0	Qual EPT:	2

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/27/1998 17-417 Brush Run RM: 2.50

Taxa Code	Taxa	Quant/Qual
06201	*Hyalella azteca*	
11200	*Callibaetis sp*	
21200	*Calopteryx sp*	
23600	*Aeshna sp*	+
23909	*Boyeria vinosa*	
26100	*Cordulegaster sp*	
27600	*Epitheca (Tetragoneuria) sp*	
28500	*Libellula sp*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52315	*Diplectrona modesta*	
52530	*Hydropsyche depravata group*	
65700	*Anacaena sp*	
66500	*Enochrus sp*	
67000	*Helophorus sp*	
67300	*Hydrochus sp*	
67700	*Paracymus sp*	
71910	*Tipula abdominalis*	
72700	*Anopheles sp*	
74100	*Simulium sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
78702	*Psectrotanypus dyari*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
82200	*Tvetenia bavarica group*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
82885	*Cryptotendipes pseudotener*	
84440	*Polypedilum (P.) aviceps*	
84470	*Polypedilum (P.) illinoense*	
89704	*Limnophora aequifrons*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	33
No. Qualitative Taxa:	33	ICI:	
Number of Organisms:	0	Qual EPT:	4

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/27/1998 17-417 Brush Run RM: 0.80

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
08250	*Orconectes (Procericambarus) rusticus*	
11200	*Callibaetis sp*	+
22600	*Enallagma sp*	
22700	*Ischnura sp*	
23909	*Boyeria vinosa*	
45300	*Sigara sp*	
47600	*Sialis sp*	
60900	*Peltodytes sp*	
62200	*Copelatus sp*	
63300	*Hydroporus sp*	
65800	*Berosus sp*	
67800	*Tropisternus sp*	
68707	*Dubiraphia quadrinotata*	
72700	*Anopheles sp*	
77500	*Conchapelopia sp*	
78655	*Procladius (Holotanypus) sp*	
78702	*Psectrotanypus dyari*	
82730	*Chironomus (C.) decorus group*	
82770	*Chironomus (C.) riparius group*	
82820	*Cryptochironomus sp*	
84470	*Polypedilum (P.) illinoense*	
84520	*Polypedilum (Tripodura) halterale group*	
84540	*Polypedilum (Tripodura) scalaenum group*	
86100	*Chrysops sp*	
86501	*Stratiomyidae*	

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	0	Total Taxa:	27
No. Qualitative Taxa:	27	ICI:	
Number of Organisms:	0	Qual EPT:	1

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 08/31/1998 17-418 Little Sugar Creek RM: 4.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	13
03600	*Oligochaeta*	83
04935	*Erpobdella punctata punctata*	1
06201	*Hyalella azteca*	+
06700	*Crangonyx sp*	3
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	11
11130	*Baetis intercalaris*	
11200	*Callibaetis sp*	
13400	*Stenacron sp*	162
13521	*Stenonema femoratum*	17
17200	*Caenis sp*	8
21200	*Calopteryx sp*	
22001	*Coenagrionidae*	2
22300	*Argia sp*	
28208	*Erythemis simplicicollis*	
28500	*Libellula sp*	
28955	*Libellula lydia*	
42700	*Belostoma sp*	
45300	*Sigara sp*	
47600	*Sialis sp*	1
50315	*Chimarra obscura*	15
52200	*Cheumatopsyche sp*	18
52530	*Hydropsyche depravata group*	9
53800	*Hydroptila sp*	
58505	*Helicopsyche borealis*	
60900	*Peltodytes sp*	
63900	*Laccophilus sp*	
65700	*Anacaena sp*	
65800	*Berosus sp*	
67700	*Paracymus sp*	
68708	*Dubiraphia vittata group*	
68901	*Macronychus glabratus*	2
69400	*Stenelmis sp*	18
71900	*Tipula sp*	
77120	*Ablabesmyia mallochi*	4
77500	*Conchapelopia sp*	62
78450	*Nilotanypus fimbriatus*	6
80370	*Corynoneura lobata*	40
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	4
81650	*Parametriocnemus sp*	4
82141	*Thienemanniella xena*	6
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	36
83051	*Dicrotendipes simpsoni*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	29
84210	*Paratendipes albimanus or P. duplicatus*	73
84450	*Polypedilum (P.) flavum*	25
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	65
85500	*Paratanytarsus sp*	18
85625	*Rheotanytarsus exiguus group*	11
85802	*Tanytarsus curticornis group*	4
85821	*Tanytarsus glabrescens group sp 7*	65
87540	*Hemerodromia sp*	14
92516	*Campeloma decisum*	
96900	*Ferrissia sp*	9
98200	*Pisidium sp*	1

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 08/31/1998 17-418 Little Sugar Creek RM: 4.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
98600	*Sphaerium sp*	1			

No. Quantitative Taxa:	35	Total Taxa:	59	
No. Qualitative Taxa:	47	ICI:	**44**	+
Number of Organisms:	840	Qual EPT:	10	

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/14/1998 17-418 Little Sugar Creek RM: 0.80

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
04685	*Placobdella ornata*	
06201	*Hyalella azteca*	+
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	
11130	*Baetis intercalaris*	
11200	*Callibaetis sp*	
11250	*Centroptilum sp (w/o hindwing pads)*	
13400	*Stenacron sp*	
13521	*Stenonema femoratum*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
23600	*Aeshna sp*	
23704	*Anax junius*	
23909	*Boyeria vinosa*	
24900	*Gomphus sp*	
45300	*Sigara sp*	
47600	*Sialis sp*	
52200	*Cheumatopsyche sp*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
58505	*Helicopsyche borealis*	
65800	*Berosus sp*	
68075	*Psephenus herricki*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
71900	*Tipula sp*	
74501	*Ceratopogonidae*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
80430	*Cricotopus (C.) tremulus group*	
82141	*Thienemanniella xena*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83840	*Microtendipes pedellus group*	
84450	*Polypedilum (P.) flavum*	
84750	*Stictochironomus sp*	
85500	*Paratanytarsus sp*	
85625	*Rheotanytarsus exiguus group*	
85821	*Tanytarsus glabrescens group sp 7*	
95100	*Physella sp*	
96900	*Ferrissia sp*	
98200	*Pisidium sp*	
98600	*Sphaerium sp*	

No. Quantitative Taxa:	0	Total Taxa:	46
No. Qualitative Taxa:	46	ICI:	
Number of Organisms:	0	Qual EPT:	11

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/30/1998 | 17-422 | Goettge Run | RM: 0.30

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
13400	*Stenacron sp*	
22001	*Coenagrionidae*	+
23600	*Aeshna sp*	
24900	*Gomphus sp*	
47600	*Sialis sp*	
52530	*Hydropsyche depravata group*	
63300	*Hydroporus sp*	
68707	*Dubiraphia quadrinotata*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
77500	*Conchapelopia sp*	
77800	*Helopelopia sp*	
78350	*Meropelopia sp*	
80410	*Cricotopus (C.) sp*	
80430	*Cricotopus (C.) tremulus group*	
80740	*Eukiefferiella claripennis group*	
82730	*Chironomus (C.) decorus group*	
84315	*Phaenopsectra flavipes*	
84469	*Polypedilum (P.) illinoense group*	
87540	*Hemerodromia sp*	

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	0	Total Taxa:	22
No. Qualitative Taxa:	22	ICI:	
Number of Organisms:	0	Qual EPT:	2

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 07/16/1998 17-428 Trib. to M. Fk. Sugar Creek (RM RM: 0.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	
03600	*Oligochaeta*	
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	
11120	*Baetis flavistriga*	+
11125	*Pseudocloeon frondalis*	
11130	*Baetis intercalaris*	
12501	*Heptageniidae*	
17200	*Caenis sp*	
22001	*Coenagrionidae*	
22300	*Argia sp*	
23600	*Aeshna sp*	
24600	*Arigomphus sp*	
24900	*Gomphus sp*	
45300	*Sigara sp*	
52200	*Cheumatopsyche sp*	
52430	*Ceratopsyche morosa group*	
52530	*Hydropsyche depravata group*	
53800	*Hydroptila sp*	
65800	*Berosus sp*	
67300	*Hydrochus sp*	
67500	*Laccobius sp*	
67800	*Tropisternus sp*	
68130	*Helichus sp*	
68708	*Dubiraphia vittata group*	
69400	*Stenelmis sp*	
71100	*Hexatoma sp*	
77500	*Conchapelopia sp*	
77750	*Hayesomyia senata or Thienemannimyia norena*	
77800	*Helopelopia sp*	
79400	*Zavrelimyia sp*	
80370	*Corynoneura lobata*	
80410	*Cricotopus (C.) sp*	
81270	*Nanocladius (N.) spiniplenus*	
81650	*Parametriocnemus sp*	
82141	*Thienemanniella xena*	
82730	*Chironomus (C.) decorus group*	
82820	*Cryptochironomus sp*	
83040	*Dicrotendipes neomodestus*	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	
84300	*Phaenopsectra obediens group*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
84540	*Polypedilum (Tripodura) scalaenum group*	
85625	*Rheotanytarsus exiguus group*	
85800	*Tanytarsus sp*	
85821	*Tanytarsus glabrescens group sp 7*	
86100	*Chrysops sp*	
87400	*Stratiomys sp*	

No. Quantitative Taxa:	0	Total Taxa:	48
No. Qualitative Taxa:	48	ICI:	
Number of Organisms:	0	Qual EPT:	9

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date 09/10/1998 17-433 Trib. to Indian Trail Creek (RM 6.08) RM: 0.30

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	
11200	*Callibaetis sp*	
22001	*Coenagrionidae*	
23710	*Anax longipes*	+
28955	*Libellula lydia*	
42700	*Belostoma sp*	
44300	*Pelocoris sp*	
44700	*Corisella sp*	
45300	*Sigara sp*	
45900	*Notonecta sp*	
47600	*Sialis sp*	
52315	*Diplectrona modesta*	
63700	*Ilybius sp*	
63900	*Laccophilus sp*	
66200	*Cymbiodyta sp*	
66500	*Enochrus sp*	
67100	*Hydrobius sp*	
67500	*Laccobius sp*	
67700	*Paracymus sp*	
67800	*Tropisternus sp*	
69400	*Stenelmis sp*	
72700	*Anopheles sp*	
72900	*Culex sp*	
74100	*Simulium sp*	
77500	*Conchapelopia sp*	
78350	*Meropelopia sp*	
78401	*Natarsia species A (sensu Roback, 1978)*	
78702	*Psectrotanypus dyari*	
79400	*Zavrelimyia sp*	
80420	*Cricotopus (C.) bicinctus*	
80430	*Cricotopus (C.) tremulus group*	
81650	*Parametriocnemus sp*	
82730	*Chironomus (C.) decorus group*	
82770	*Chironomus (C.) riparius group*	
83300	*Glyptotendipes (G.) sp*	
83380	*Goeldichironomus holoprasinus*	
84210	*Paratendipes albimanus or P. duplicatus*	
84450	*Polypedilum (P.) flavum*	
84470	*Polypedilum (P.) illinoense*	
95100	*Physella sp*	

No. Quantitative Taxa:	0	Total Taxa:	40
No. Qualitative Taxa:	40	ICI:	
Number of Organisms:	0	Qual EPT:	2

ICI Metrics Table for the Sugar Creek Basin, 1998

River Mile	Drainage Area (sq mi)	Number of Total Taxa	Number of Mayfly Taxa	Number of Caddisfly Taxa	Number of Dipteran Taxa	Percent: Mayflies	Percent: Caddis-flies	Percent: Tany-tarsini	Percent: Other Dipt/NI	Percent: Tolerant Organisms	Qual. EPT	Eco-region	ICI
Sugar Creek (17-400)													
Year: 1998													
34.70	46.0	50(6)	6(4)	3(4)	27(6)	5.1(2)	18.9(6)	20.9(4)	48.9(2)	4.0(6)	11(4)	3	44
22.90	93.0	47(6)	5(2)	3(4)	23(6)	3.2(2)	12.2(4)	30.8(4)	51.6(2)	2.8(6)	8(2)	3	38
19.30	145.0	42(6)	7(4)	5(6)	17(4)	29.3(4)	13.3(4)	31.8(4)	22.5(6)	6.3(4)	8(2)	3	44
18.60	152.0	30(4)	4(2)	3(4)	16(4)	7.2(2)	20.6(6)	1.4(2)	67.0(0)	23.7(0)	8(2)	3	26
13.70	161.0	30(4)	4(2)	3(4)	11(2)	18.9(4)	38.4(6)	29.9(4)	9.8(6)	1.0(6)	8(2)	3	40
12.00	300.0	31(4)	4(2)	6(6)	10(2)	4.9(2)	73.2(6)	9.8(2)	11.6(6)	0.8(6)	9(2)	3	38
7.30	311.0	34(4)	6(4)	8(6)	8(2)	8.2(2)	46.7(6)	29.6(4)	13.9(6)	0.9(6)	11(2)	4	42
3.60	340.0	34(4)	6(4)	3(4)	13(4)	5.6(2)	16.0(4)	53.9(6)	23.5(4)	0.5(6)	12(4)	4	42
1.80	350.0	37(6)	6(4)	3(4)	16(6)	4.1(2)	1.2(2)	49.8(6)	44.1(2)	8.3(2)	8(2)	4	36
0.60	356.0	36(6)	4(2)	3(4)	18(6)	1.1(2)	0.7(2)	59.2(6)	37.6(2)	2.6(6)	7(2)	4	38
Middle Fork Sugar Creek (17-406)													
Year: 1998													
1.70	63.0	42(6)	8(4)	5(6)	16(4)	12.6(2)	19.1(6)	37.9(6)	25.2(6)	3.1(6)	11(4)	3	50
South Fork Sugar Creek (17-410)													
Year: 1998													
13.20	63.3	29(4)	2(0)	2(4)	20(6)	0.8(2)	11.8(4)	15.3(2)	66.8(0)	6.6(4)	8(2)	4	28
7.40	75.0	31(4)	2(0)	2(4)	22(6)	0.2(2)	10.7(4)	45.1(6)	43.2(4)	11.6(2)	5(2)	4	34
6.40	124.0	29(4)	3(2)	2(2)	17(4)	1.0(2)	9.0(2)	50.9(6)	37.8(4)	4.8(6)	5(2)	4	34
3.60	131.0	25(4)	0(0)	0(0)	15(4)	0.0(0)	0.0(0)	5.0(2)	94.4(0)	45.4(0)	0(0)	4	10
Little Sugar Creek (17-418)													
Year: 1998													
4.20	9.0	35(4)	4(2)	3(6)	17(4)	23.6(6)	5.0(6)	11.7(4)	57.0(2)	11.0(4)	10(6)	3	44

Species List

River Code: **17-400** River Mile: **42.80**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 1281 sec Drain Area: 5.9 sq mi Dist Fished: 0.10 km No of Passes: 1	Sample Date: **1998** Date Range: 08/11/1998 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	8	24.00	7.02	0.96	20.98	40.00
Blacknose Dace	N	G	S	T	10	30.00	8.77	0.09	1.97	3.00
Creek Chub	N	G	N	T	61	183.00	53.51	2.64	57.70	14.43
Common Shiner	N	I	S		1	3.00	0.88	0.01	0.20	3.00
Bluntnose Minnow	N	O	C	T	1	3.00	0.88	0.01	0.13	2.00
Rock Bass	S	C	C		14	42.00	12.28	0.80	17.57	19.14
Largemouth Bass	F	C	C		1	3.00	0.88	0.01	0.26	4.00
Johnny Darter	D	I	C		18	54.00	15.79	0.05	1.18	1.00
Mile Total					114	342.00		4.58		
Number of Species					8					
Number of Hybrids					0					

Species List

River Code: **17-400** River Mile: **40.20**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 1574 sec Drain Area: 14.4 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/11/1998 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
Northern Hog Sucker	R	I	S	M	9	18.00	0.73	0.84	7.50	46.67
White Sucker	W	O	S	T	106	212.00	8.58	0.50	4.43	2.34
Hornyhead Chub	N	I	N	I	5	10.00	0.40	0.14	1.21	13.60
Blacknose Dace	N	G	S	T	103	206.00	8.33	0.55	4.92	2.67
Creek Chub	N	G	N	T	121	242.00	9.79	1.51	13.45	6.23
South. Redbelly Dace	N	H	S		4	8.00	0.32	0.02	0.18	2.50
Common Shiner	N	I	S		384	768.00	31.07	4.16	37.08	5.41
Sand Shiner	N	I	M	M	85	170.00	6.88	0.32	2.85	1.88
Silverjaw Minnow	N	I	M		112	224.00	9.06	0.52	4.64	2.32
Bluntnose Minnow	N	O	C	T	145	290.00	11.73	0.61	5.43	2.10
Central Stoneroller	N	H	N		140	280.00	11.33	1.90	16.94	6.78
Rock Bass	S	C	C		4	8.00	0.32	0.10	0.89	12.50
Johnny Darter	D	I	C		16	32.00	1.29	0.05	0.45	1.56
Fantail Darter	D	I	C		2	4.00	0.16	0.01	0.05	1.50
Mile Total					1,236	2,472.00		11.21		
Number of Species					14					
Number of Hybrids					0					

Species List

River Code: **17-400** River Mile: **38.10**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 1578 sec Drain Area: 21.9 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/10/1998 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
Northern Hog Sucker	R	I	S	M	1	2.00	0.15	0.04	0.25	20.00
White Sucker	W	O	S	T	68	136.00	10.49	7.80	48.10	57.35
Common Carp	G	O	M	T	1	2.00	0.15	0.35	2.16	175.00
Blacknose Dace	N	G	S	T	3	6.00	0.46	0.02	0.10	2.67
Creek Chub	N	G	N	T	56	112.00	8.64	1.87	11.55	16.72
Common Shiner	N	I	S		322	644.00	49.69	4.20	25.90	6.52
Sand Shiner	N	I	M	M	45	90.00	6.94	0.15	0.93	1.67
Silverjaw Minnow	N	I	M		6	12.00	0.93	0.03	0.19	2.50
Bluntnose Minnow	N	O	C	T	91	182.00	14.04	0.30	1.85	1.65
Central Stoneroller	N	H	N		20	40.00	3.09	0.33	2.04	8.25
Yellow Bullhead		I	C	T	1	2.00	0.15	0.01	0.05	4.00
Brown Bullhead		I	C	T	2	4.00	0.31	0.17	1.04	42.00
Trout-perch		I	M		2	4.00	0.31	0.05	0.31	12.50
Black Crappie	S	I	C		4	8.00	0.62	0.22	1.36	27.50
Largemouth Bass	F	C	C		2	4.00	0.31	0.06	0.37	15.00
Green Sunfish	S	I	C	T	15	30.00	2.31	0.48	2.96	16.00
Bluegill Sunfish	S	I	C	P	4	8.00	0.62	0.12	0.74	15.00
Johnny Darter	D	I	C		4	8.00	0.62	0.02	0.10	2.00
Brook Stickleback		I	C		1	2.00	0.15	0.00	0.02	2.00
	Mile Total				648	1,296.00		16.22		
	Number of Species				19					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **34.90**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 1012 sec Drain Area: 28.2 sq mi Dist Fished: 0.20 km No of Passes: 1	Sample Date: **1998** Date Range: 07/15/1998 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	15	22.50	7.73	1.06	17.78	47.00
Common Carp	G	O	M	T	2	3.00	1.03	2.10	35.30	700.00
Creek Chub	N	G	N	T	53	79.50	27.32	1.29	21.68	16.23
Common Shiner	N	I	S		51	76.50	26.29	0.74	12.47	9.70
Sand Shiner	N	I	M	M	23	34.50	11.86	0.08	1.36	2.35
Silverjaw Minnow	N	I	M		6	9.00	3.09	0.02	0.39	2.50
Bluntnose Minnow	N	O	C	T	10	15.00	5.15	0.02	0.39	1.50
Yellow Bullhead		I	C	T	3	4.50	1.55	0.16	2.71	35.67
Trout-perch		I	M		3	4.50	1.55	0.04	0.59	7.67
Black Crappie	S	I	C		1	1.50	0.52	0.05	0.76	30.00
Largemouth Bass	F	C	C		3	4.50	1.55	0.14	2.40	31.67
Green Sunfish	S	I	C	T	23	34.50	11.86	0.24	4.08	7.05
Greenside Darter	D	I	S	M	1	1.50	0.52	0.01	0.13	5.00
	Mile Total				194	291.00		5.95		
	Number of Species				13					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **34.60**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 3422 sec Drain Area: 46.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/15/1998 Thru: 08/30/1998 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
Northern Hog Sucker	R	I	S	M	5	3.75	0.97	0.59	5.14	158.00
White Sucker	W	O	S	T	52	39.00	10.12	3.26	28.32	83.65
Common Carp	G	O	M	T	12	9.00	2.33	3.34	28.97	370.83
Blacknose Dace	N	G	S	T	4	3.00	0.78	0.02	0.13	5.00
Creek Chub	N	G	N	T	110	82.50	21.40	1.75	15.16	21.16
Common Shiner	N	I	S		71	53.25	13.81	0.48	4.20	9.08
Sand Shiner	N	I	M	M	59	44.25	11.48	0.11	0.93	2.42
Silverjaw Minnow	N	I	M		2	1.50	0.39	0.00	0.04	3.00
Bluntnose Minnow	N	O	C	T	50	37.50	9.73	0.11	0.93	2.87
Central Stoneroller	N	H	N		4	3.00	0.78	0.04	0.33	12.50
Yellow Bullhead		I	C	T	25	18.75	4.86	0.77	6.68	41.00
Stonecat Madtom		I	C	I	1	0.75	0.19	0.06	0.52	80.00
Black Crappie	S	I	C		6	4.50	1.17	0.20	1.69	43.33
Largemouth Bass	F	C	C		3	2.25	0.58	0.08	0.68	34.67
Warmouth Sunfish	S	C	C		1	0.75	0.19	0.02	0.20	30.00
Green Sunfish	S	I	C	T	64	48.00	12.45	0.38	3.32	7.97
Bluegill Sunfish	S	I	C	P	10	7.50	1.95	0.16	1.35	20.70
Pumpkinseed Sunfish	S	I	C	P	1	0.75	0.19	0.04	0.39	59.00
Johnny Darter	D	I	C		7	5.25	1.36	0.01	0.08	1.71
Greenside Darter	D	I	S	M	19	14.25	3.70	0.09	0.79	6.42
Fantail Darter	D	I	C		8	6.00	1.56	0.02	0.16	3.00
	Mile Total				514	385.50		11.52		
	Number of Species				21					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **26.80**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 2503 sec Drain Area: 68.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/15/1998 Thru: 08/31/1998 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
Northern Hog Sucker	R	I	S	M	1	0.75	0.28	0.01	0.10	8.00
White Sucker	W	O	S	T	3	2.25	0.85	0.18	2.98	77.67
Common Carp	G	O	M	T	8	6.00	2.25	4.35	74.22	725.25
Blacknose Dace	N	G	S	T	2	1.50	0.56	0.00	0.05	2.00
Creek Chub	N	G	N	T	51	38.25	14.37	0.60	10.23	15.69
Common Shiner	N	I	S		18	13.50	5.07	0.12	1.97	8.56
Sand Shiner	N	I	M	M	130	97.50	36.62	0.18	3.11	1.87
Silverjaw Minnow	N	I	M		8	6.00	2.25	0.01	0.25	2.44
Bluntnose Minnow	N	O	C	T	78	58.50	21.97	0.10	1.75	1.75
Central Stoneroller	N	H	N		3	2.25	0.85	0.01	0.18	4.67
Yellow Bullhead		I	C	T	4	3.00	1.13	0.05	0.87	17.00
Largemouth Bass	F	C	C		8	6.00	2.25	0.08	1.37	13.38
Green Sunfish	S	I	C	T	16	12.00	4.51	0.11	1.84	9.00
Bluegill Sunfish	S	I	C	P	4	3.00	1.13	0.03	0.45	8.75
Johnny Darter	D	I	C		5	3.75	1.41	0.01	0.12	1.80
Greenside Darter	D	I	S	M	11	8.25	3.10	0.02	0.33	2.36
Fantail Darter	D	I	C		5	3.75	1.41	0.01	0.20	3.00
	Mile Total				355	266.25		5.86		
	Number of Species				17					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **23.00**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 3145 sec Drain Area: 93.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/15/1998 Thru: 08/13/1998 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		2	1.50	1.53	0.08	0.16	52.50
Northern Pike	F	P	M		1	0.75	0.76	0.94	1.93	1,250.00
Golden Redhorse	R	I	S	M	1	0.75	0.76	0.18	0.37	240.00
White Sucker	W	O	S	T	9	6.75	6.87	1.37	2.82	203.00
Common Carp	G	O	M	T	37	27.75	28.24	44.19	90.98	1,592.32
Golden Shiner	N	I	M	T	1	0.75	0.76	0.00	0.01	3.00
Common Shiner	N	I	S		18	13.50	13.74	0.17	0.35	12.56
Bluntnose Minnow	N	O	C	T	8	6.00	6.11	0.01	0.02	1.50
Yellow Bullhead		I	C	T	5	3.75	3.82	0.68	1.40	181.80
Brown Bullhead		I	C	T	4	3.00	3.05	0.22	0.46	73.75
White Crappie	S	I	C		2	1.50	1.53	0.10	0.21	67.00
Black Crappie	S	I	C		2	1.50	1.53	0.15	0.31	100.00
Largemouth Bass	F	C	C		12	9.00	9.16	0.19	0.38	20.58
Warmouth Sunfish	S	C	C		1	0.75	0.76	0.02	0.03	22.00
Green Sunfish	S	I	C	T	18	13.50	13.74	0.16	0.33	11.85
Bluegill Sunfish	S	I	C	P	5	3.75	3.82	0.07	0.14	18.40
Pumpkinseed Sunfish	S	I	C	P	4	3.00	3.05	0.04	0.09	13.75
Greenside Darter	D	I	S	M	1	0.75	0.76	0.01	0.02	13.00
	Mile Total				131	98.25		48.57		
	Number of Species				18					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **19.30**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 3762 sec Drain Area: 145.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/15/1998 Thru: 08/31/1998 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		1	0.75	2.38	0.02	0.14	30.00
Northern Pike	F	P	M		1	0.75	2.38	1.65	10.49	2,200.00
Golden Redhorse	R	I	S	M	1	0.75	2.38	0.29	1.81	380.00
White Sucker	W	O	S	T	2	1.50	4.76	0.15	0.96	101.00
Common Carp	G	O	M	T	11	8.25	26.19	12.99	82.54	1,574.24
Sand Shiner	N	I	M	M	2	1.50	4.76	0.00	0.02	1.50
Bluntnose Minnow	N	O	C	T	7	5.25	16.67	0.01	0.05	1.43
Yellow Bullhead		I	C	T	4	3.00	9.52	0.40	2.53	132.50
Brown Bullhead		I	C	T	2	1.50	4.76	0.13	0.81	85.00
Black Crappie	S	I	C		2	1.50	4.76	0.04	0.28	29.00
Green Sunfish	S	I	C	T	5	3.75	11.90	0.04	0.24	10.00
Pumpkinseed Sunfish	S	I	C	P	4	3.00	9.52	0.02	0.14	7.50
	Mile Total				42	31.50		15.74		
	Number of Species				12					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **17.60**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 3002 sec Drain Area: 153.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 08/31/1998 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
Silver Redhorse	R	I	S	M	2	1.50	3.45	1.14	5.09	762.50
Golden Redhorse	R	I	S	M	1	0.75	1.72	0.64	2.84	850.00
Northern Hog Sucker	R	I	S	M	2	1.50	3.45	0.58	2.57	385.00
White Sucker	W	O	S	T	2	1.50	3.45	0.23	1.01	152.00
Common Carp	G	O	M	T	27	20.25	46.55	19.28	85.76	951.85
Common Shiner	N	I	S		1	0.75	1.72	0.00	0.01	2.00
Bluntnose Minnow	N	O	C	T	1	0.75	1.72	0.00	0.01	3.00
Yellow Bullhead		I	C	T	2	1.50	3.45	0.23	1.03	155.00
Brown Bullhead		I	C	T	3	2.25	5.17	0.24	1.09	108.33
Black Crappie	S	I	C		2	1.50	3.45	0.03	0.13	20.00
Warmouth Sunfish	S	C	C		2	1.50	3.45	0.01	0.05	8.00
Green Sunfish	S	I	C	T	5	3.75	8.62	0.02	0.07	4.00
Bluegill Sunfish	S	I	C	P	2	1.50	3.45	0.04	0.17	26.00
Pumpkinseed Sunfish	S	I	C	P	5	3.75	8.62	0.04	0.16	9.40
Greenside Darter	D	I	S	M	1	0.75	1.72	0.00	0.01	3.00
	Mile Total				58	43.50		22.48		
	Number of Species				15					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **13.70**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 3507 sec Drain Area: 161.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/01/1998 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		1	0.75	1.75	0.14	0.80	190.00
Silver Redhorse	R	I	S	M	1	0.75	1.75	0.98	5.47	1,300.00
Northern Hog Sucker	R	I	S	M	5	3.75	8.77	1.27	7.10	337.60
White Sucker	W	O	S	T	1	0.75	1.75	0.20	1.14	270.00
Common Carp	G	O	M	T	23	17.25	40.35	14.74	82.71	854.35
Bluntnose Minnow	N	O	C	T	1	0.75	1.75	0.00	0.01	2.00
Yellow Bullhead		I	C	T	4	3.00	7.02	0.26	1.48	87.75
Brown Bullhead		I	C	T	4	3.00	7.02	0.13	0.74	43.75
White Crappie	S	I	C		1	0.75	1.75	0.01	0.06	14.00
Black Crappie	S	I	C		1	0.75	1.75	0.01	0.05	12.00
Smallmouth Bass	F	C	C	M	1	0.75	1.75	0.01	0.05	12.00
Largemouth Bass	F	C	C		3	2.25	5.26	0.02	0.09	6.67
Warmouth Sunfish	S	C	C		1	0.75	1.75	0.00	0.02	5.00
Green Sunfish	S	I	C	T	7	5.25	12.28	0.04	0.23	7.71
Bluegill Sunfish	S	I	C	P	1	0.75	1.75	0.01	0.03	8.00
Pumpkinseed Sunfish	S	I	C	P	1	0.75	1.75	0.00	0.02	5.00
Rainbow Darter	D	I	S	M	1	0.75	1.75	0.00	0.01	2.00
	Mile Total				57	42.75		17.82		
	Number of Species				17					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **12.00**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 2377 sec Drain Area: 300.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/02/1998 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
Bowfin		P	C		1	0.75	0.40	0.98	6.07	1,300.00
Gizzard Shad		O	M		15	11.25	6.00	0.62	3.88	55.33
Silver Redhorse	R	I	S	M	2	1.50	0.80	1.88	11.68	1,250.00
Golden Redhorse	R	I	S	M	1	0.75	0.40	0.68	4.20	900.00
White Sucker	W	O	S	T	1	0.75	0.40	0.02	0.11	24.00
Common Carp	G	O	M	T	18	13.50	7.20	4.96	30.88	367.22
Spotfin Shiner	N	I	M		13	9.75	5.20	0.02	0.14	2.31
Bluntnose Minnow	N	O	C	T	26	19.50	10.40	0.04	0.25	2.04
Yellow Bullhead		I	C	T	1	0.75	0.40	0.09	0.56	120.00
Brown Bullhead		I	C	T	4	3.00	1.60	0.27	1.68	90.00
White Crappie	S	I	C		8	6.00	3.20	0.21	1.33	35.50
Black Crappie	S	I	C		4	3.00	1.60	0.18	1.12	60.00
Largemouth Bass	F	C	C		27	20.25	10.80	3.75	23.37	185.30
Warmouth Sunfish	S	C	C		13	9.75	5.20	0.58	3.63	59.85
Green Sunfish	S	I	C	T	22	16.50	8.80	0.20	1.21	11.81
Bluegill Sunfish	S	I	C	P	45	33.75	18.00	0.88	5.46	25.98
Redear Sunfish	E	I	C		1	0.75	0.40	0.03	0.19	40.00
Pumpkinseed Sunfish	S	I	C	P	42	31.50	16.80	0.31	1.92	9.76
Blackside Darter	D	I	S		1	0.75	0.40	0.00	0.02	3.00
Johnny Darter	D	I	C		1	0.75	0.40	0.00	0.01	2.00
Banded Darter	D	I	S	I	1	0.75	0.40	0.00	0.01	2.00
Sauger X Walleye	E	P			3	2.25	1.20	0.37	2.29	163.33
	Mile Total				250	187.50		16.06		
	Number of Species				21					
	Number of Hybrids				1					

Species List

River Code: **17-400** River Mile: **7.20**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 4082 sec Drain Area: 311.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/02/1998 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		11	8.25	3.26	0.20	0.83	23.64
Silver Redhorse	R	I	S	M	4	3.00	1.19	4.20	17.79	1,400.00
Golden Redhorse	R	I	S	M	6	4.50	1.78	3.75	15.89	833.33
Shorthead Redhorse	R	I	S	M	3	2.25	0.89	1.04	4.38	460.00
Northern Hog Sucker	R	I	S	M	34	25.50	10.09	6.03	25.53	236.29
White Sucker	W	O	S	T	3	2.25	0.89	0.47	2.01	210.33
Common Carp	G	O	M	T	7	5.25	2.08	5.36	22.69	1,020.00
River Chub	N	I	N	I	12	9.00	3.56	0.26	1.12	29.25
Gravel Chub	N	I	S	M	14	10.50	4.15	0.06	0.23	5.21
Striped Shiner	N	I	S		1	0.75	0.30	0.00	0.01	2.00
Spotfin Shiner	N	I	M		4	3.00	1.19	0.01	0.04	3.00
Sand Shiner	N	I	M	M	51	38.25	15.13	0.08	0.35	2.16
Bluntnose Minnow	N	O	C	T	67	50.25	19.88	0.13	0.53	2.49
Central Stoneroller	N	H	N		1	0.75	0.30	0.00	0.01	4.00
Channel Catfish	F		C		1	0.75	0.30	0.98	4.13	1,300.00
Yellow Bullhead		I	C	T	1	0.75	0.30	0.01	0.04	12.00
Stonecat Madtom		I	C	I	1	0.75	0.30	0.02	0.06	20.00
Rock Bass	S	C	C		2	1.50	0.59	0.15	0.62	97.50
Green Sunfish	S	I	C	T	1	0.75	0.30	0.01	0.04	12.00
Bluegill Sunfish	S	I	C	P	3	2.25	0.89	0.01	0.04	4.33
Walleye	F	P	S		1	0.75	0.30	0.34	1.43	450.00
Logperch	D	I	S	M	1	0.75	0.30	0.01	0.04	12.00
Johnny Darter	D	I	C		6	4.50	1.78	0.01	0.03	1.67
Greenside Darter	D	I	S	M	8	6.00	2.37	0.04	0.15	6.08
Banded Darter	D	I	S	I	45	33.75	13.35	0.05	0.21	1.49
Sauger X Walleye	E	P			2	1.50	0.59	0.21	0.89	140.00
Mottled Sculpin		I	C		47	35.25	13.95	0.22	0.92	6.17
	Mile Total				337	252.75		23.61		
	Number of Species				26					
	Number of Hybrids				1					

Species List

River Code: **17-400** River Mile: **3.70**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 5132 sec Drain Area: 340.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/22/1998 Thru: 09/02/1998 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		1	0.75	0.33	0.21	0.51	280.00
Silver Redhorse	R	I	S	M	4	3.00	1.34	3.19	7.74	1,063.75
Golden Redhorse	R	I	S	M	3	2.25	1.00	1.33	3.23	591.67
Shorthead Redhorse	R	I	S	M	3	2.25	1.00	1.26	3.05	558.33
Northern Hog Sucker	R	I	S	M	26	19.50	8.70	3.13	7.58	160.23
Common Carp	G	O	M	T	25	18.75	8.36	23.49	56.96	1,253.00
Golden Shiner	N	I	M	T	1	0.75	0.33	0.00	0.00	2.00
River Chub	N	I	N	I	6	4.50	2.01	0.03	0.08	7.00
Gravel Chub	N	I	S	M	4	3.00	1.34	0.02	0.05	6.50
Creek Chub	N	G	N	T	3	2.25	1.00	0.01	0.02	3.33
Suckermouth Minnow	N	I	S		3	2.25	1.00	0.02	0.04	7.33
Emerald Shiner	N	I	S		2	1.50	0.67	0.01	0.02	5.00
Spotfin Shiner	N	I	M		65	48.75	21.74	0.15	0.36	3.00
Sand Shiner	N	I	M	M	30	22.50	10.03	0.05	0.12	2.29
Bluntnose Minnow	N	O	C	T	18	13.50	6.02	0.03	0.08	2.50
Central Stoneroller	N	H	N		1	0.75	0.33	0.00	0.01	3.00
Channel Catfish	F		C		4	3.00	1.34	4.26	10.32	1,419.25
Brown Bullhead		I	C	T	1	0.75	0.33	0.11	0.27	150.00
Rock Bass	S	C	C		6	4.50	2.01	0.07	0.16	14.50
Smallmouth Bass	F	C	C	M	3	2.25	1.00	0.49	1.19	218.33
Largemouth Bass	F	C	C		2	1.50	0.67	0.15	0.36	97.50
Warmouth Sunfish	S	C	C		1	0.75	0.33	0.02	0.05	30.00
Green Sunfish	S	I	C	T	7	5.25	2.34	0.06	0.16	12.14
Bluegill Sunfish	S	I	C	P	17	12.75	5.69	0.33	0.80	25.76
Pumpkinseed Sunfish	S	I	C	P	1	0.75	0.33	0.02	0.05	25.00
Green Sf X Bluegill Sf					3	2.25	1.00	0.07	0.16	30.00
Walleye	F	P	S		1	0.75	0.33	0.14	0.33	180.00
Johnny Darter	D	I	C		4	3.00	1.34	0.00	0.01	1.50
Greenside Darter	D	I	S	M	5	3.75	1.67	0.01	0.03	3.00
Banded Darter	D	I	S	I	9	6.75	3.01	0.01	0.02	1.11
Sauger X Walleye	E	P			1	0.75	0.33	0.27	0.65	360.00
Freshwater Drum			M	P	1	0.75	0.33	2.21	5.36	2,950.00
Mottled Sculpin		I	C		38	28.50	12.71	0.11	0.26	3.76
	Mile Total				299	224.25		41.25		
	Number of Species				31					
	Number of Hybrids				2					

Species List

River Code: **17-400** River Mile: **1.80**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 1812 sec Drain Area: 350.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/02/1998 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		15	11.25	7.18	0.42	5.25	37.33
Golden Redhorse	R	I	S	M	2	1.50	0.96	0.31	3.84	204.50
Northern Hog Sucker	R	I	S	M	8	6.00	3.83	0.27	3.34	44.50
Common Carp	G	O	M	T	5	3.75	2.39	5.44	67.95	1,450.00
River Chub	N	I	N	I	1	0.75	0.48	0.00	0.06	6.00
Gravel Chub	N	I	S	M	12	9.00	5.74	0.05	0.56	5.00
Emerald Shiner	N	I	S		3	2.25	1.44	0.01	0.09	3.00
Spotfin Shiner	N	I	M		9	6.75	4.31	0.02	0.24	2.78
Sand Shiner	N	I	M	M	96	72.00	45.93	0.13	1.59	1.77
Bluntnose Minnow	N	O	C	T	11	8.25	5.26	0.02	0.28	2.73
Channel Catfish	F		C		1	0.75	0.48	0.75	9.37	1,000.00
Rock Bass	S	C	C		1	0.75	0.48	0.07	0.84	90.00
Smallmouth Bass	F	C	C	M	2	1.50	0.96	0.19	2.34	125.00
Spotted Bass	F	C	C		4	3.00	1.91	0.02	0.26	7.00
Largemouth Bass	F	C	C		2	1.50	0.96	0.03	0.42	22.50
Green Sunfish	S	I	C	T	9	6.75	4.31	0.04	0.49	5.78
Bluegill Sunfish	S	I	C	P	10	7.50	4.78	0.17	2.09	22.30
Green Sf X Bluegill Sf					1	0.75	0.48	0.02	0.28	30.00
Yellow Perch			M		1	0.75	0.48	0.01	0.14	15.00
Johnny Darter	D	I	C		2	1.50	0.96	0.00	0.04	2.00
Greenside Darter	D	I	S	M	2	1.50	0.96	0.01	0.09	5.00
Banded Darter	D	I	S	I	3	2.25	1.44	0.00	0.05	1.67
Mottled Sculpin		I	C		9	6.75	4.31	0.03	0.39	4.67
	Mile Total				209	156.75		8.00		
	Number of Species				22					
	Number of Hybrids				1					

Species List

River Code: **17-400** River Mile: **0.60**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 1735 sec Drain Area: 356.0 sq mi Dist Fished: 0.20 km No of Passes: 1	Sample Date: **1998** Date Range: 07/22/1998 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
Longnose Gar		P	M		1	1.50	1.96	0.03	0.71	20.00
Northern Hog Sucker	R	I	S	M	2	3.00	3.92	0.39	9.24	131.00
Common Carp	G	O	M	T	5	7.50	9.80	2.58	60.66	344.00
Golden Shiner	N	I	M	T	3	4.50	5.88	0.01	0.21	2.00
Gravel Chub	N	I	S	M	5	7.50	9.80	0.06	1.41	8.00
Spotfin Shiner	N	I	M		2	3.00	3.92	0.01	0.14	2.00
Sand Shiner	N	I	M	M	15	22.50	29.41	0.04	0.82	1.53
Bluntnose Minnow	N	O	C	T	3	4.50	5.88	0.01	0.33	3.00
Rock Bass	S	C	C		3	4.50	5.88	0.38	9.01	85.00
Largemouth Bass	F	C	C		1	1.50	1.96	0.00	0.07	2.00
Warmouth Sunfish	S	C	C		1	1.50	1.96	0.04	0.82	23.00
Bluegill Sunfish	S	I	C	P	3	4.50	5.88	0.01	0.19	1.67
Walleye	F	P	S		1	1.50	1.96	0.66	15.52	440.00
Yellow Perch			M		1	1.50	1.96	0.01	0.12	3.00
Greenside Darter	D	I	S	M	2	3.00	3.92	0.01	0.19	2.50
Mottled Sculpin		I	C		3	4.50	5.88	0.03	0.63	6.00
	Mile Total				51	76.50		4.25		
	Number of Species				16					
	Number of Hybrids				0					

Species List

River Code: **17-400** River Mile: **0.40**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 2520 sec Drain Area: 356.0 sq mi Dist Fished: 0.20 km No of Passes: 1	Sample Date: **1998** Date Range: 09/02/1998 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		29	43.50	16.29	3.08	15.35	70.69
Quillback Carpsucker	C	O	M		1	1.50	0.56	1.13	5.62	750.00
Silver Redhorse	R	I	S	M	2	3.00	1.12	3.75	18.72	1,250.00
Shorthead Redhorse	R	I	S	M	1	1.50	0.56	0.01	0.02	3.00
Northern Hog Sucker	R	I	S	M	7	10.50	3.93	0.24	1.20	22.86
White Sucker	W	O	S	T	1	1.50	0.56	0.09	0.46	62.00
Common Carp	G	O	M	T	8	12.00	4.49	8.36	41.75	696.88
Gravel Chub	N	I	S	M	9	13.50	5.06	0.08	0.37	5.56
Creek Chub	N	G	N	T	1	1.50	0.56	0.01	0.02	3.00
Suckermouth Minnow	N	I	S		1	1.50	0.56	0.01	0.02	3.00
Emerald Shiner	N	I	S		1	1.50	0.56	0.01	0.03	4.00
Spotfin Shiner	N	I	M		6	9.00	3.37	0.03	0.13	2.83
Sand Shiner	N	I	M	M	61	91.50	34.27	0.15	0.75	1.64
Silverjaw Minnow	N	I	M		1	1.50	0.56	0.00	0.01	2.00
Bluntnose Minnow	N	O	C	T	11	16.50	6.18	0.03	0.16	2.00
Central Stoneroller	N	H	N		3	4.50	1.69	0.02	0.07	3.33
White Crappie	S	I	C		3	4.50	1.69	0.15	0.75	33.33
Rock Bass	S	C	C		1	1.50	0.56	0.11	0.52	70.00
Largemouth Bass	F	C	C		2	3.00	1.12	0.17	0.82	55.00
Green Sunfish	S	I	C	T	1	1.50	0.56	0.00	0.01	2.00
Bluegill Sunfish	S	I	C	P	7	10.50	3.93	0.17	0.84	16.00
Green Sf X Bluegill Sf					1	1.50	0.56	0.03	0.15	20.00
Yellow Perch			M		1	1.50	0.56	0.05	0.22	30.00
Johnny Darter	D	I	C		6	9.00	3.37	0.02	0.07	1.67
Greenside Darter	D	I	S	M	2	3.00	1.12	0.01	0.03	2.00
Banded Darter	D	I	S	I	3	4.50	1.69	0.01	0.04	1.67
Sauger X Walleye	E	P			2	3.00	1.12	1.43	7.11	475.00
Freshwater Drum			M	P	1	1.50	0.56	0.90	4.49	600.00
Mottled Sculpin		I	C		5	7.50	2.81	0.05	0.22	6.00
	Mile Total				178	267.00		20.03		
	Number of Species				27					
	Number of Hybrids				2					

River Code: **17-400** Mile Range: **0.40** Thru: **42.80**	Stream: **Sugar Creek** Basin: Muskingum River Time Fished: 42444 sec Dist Fished: 5.00 km No of Passes: 26	River Segment Totals Date Range: 07/15/1998 Thru: 09/02/1998 Sampler Type: D 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
Longnose Gar		P	M		1	0.06	0.02	0.00	0.01	20.00
Bowfin		P	C		1	0.06	0.02	0.08	0.40	1,300.00
Gizzard Shad		O	M		75	4.33	1.39	0.25	1.33	57.40
Northern Pike	F	P	M		2	0.12	0.04	0.20	1.07	1,725.00
Quillback Carpsucker	C	O	M		1	0.06	0.02	0.04	0.23	750.00
Silver Redhorse	R	I	S	M	15	0.87	0.28	1.02	5.48	1,178.67
Golden Redhorse	R	I	S	M	15	0.87	0.28	0.55	2.96	636.93
Shorthead Redhorse	R	I	S	M	7	0.40	0.13	0.18	0.95	436.86
Northern Hog Sucker	R	I	S	M	100	5.96	1.91	0.97	5.21	166.74
White Sucker	W	O	S	T	271	19.44	6.22	0.85	4.58	48.25
Common Carp	G	O	M	T	189	10.92	3.50	11.14	59.84	1,021.32
Golden Shiner	N	I	M	T	5	0.29	0.09	0.00	0.00	2.20
Hornyhead Chub	N	I	N	I	5	0.38	0.12	0.01	0.03	13.60
River Chub	N	I	N	I	19	1.10	0.35	0.02	0.12	21.00
Gravel Chub	N	I	S	M	44	2.54	0.81	0.01	0.08	5.66
Blacknose Dace	N	G	S	T	122	9.65	3.09	0.03	0.14	2.76
Creek Chub	N	G	N	T	456	33.23	10.64	0.46	2.48	14.41
Suckermouth Minnow	N	I	S		4	0.23	0.07	0.00	0.01	6.25
South. Redbelly Dace	N	H	S		4	0.31	0.10	0.00	0.00	2.50
Emerald Shiner	N	I	S		6	0.35	0.11	0.00	0.01	3.83
Striped Shiner	N	I	S		1	0.06	0.02	0.00	0.00	2.00
Common Shiner	N	I	S		866	63.60	20.36	0.41	2.20	6.58
Spotfin Shiner	N	I	M		99	5.71	1.83	0.02	0.09	2.86
Sand Shiner	N	I	M	M	597	36.94	11.83	0.07	0.38	1.92
Silverjaw Minnow	N	I	M		135	10.06	3.22	0.02	0.13	2.35
Bluntnose Minnow	N	O	C	T	528	35.06	11.22	0.07	0.39	2.09
Central Stoneroller	N	H	N		172	13.00	4.16	0.09	0.49	6.95
Channel Catfish	F		C		6	0.35	0.11	0.46	2.47	1,329.50
Yellow Bullhead		I	C	T	50	2.90	0.93	0.20	1.07	68.72
Brown Bullhead		I	C	T	20	1.19	0.38	0.09	0.49	77.95
Stonecat Madtom		I	C	I	2	0.12	0.04	0.01	0.03	50.00
Trout-perch		I	M		5	0.33	0.10	0.00	0.02	9.60
White Crappie	S	I	C		14	0.81	0.26	0.03	0.16	38.00
Black Crappie	S	I	C		22	1.35	0.43	0.06	0.31	43.18
Rock Bass	S	C	C		31	2.67	0.86	0.08	0.40	32.74
Smallmouth Bass	F	C	C	M	6	0.35	0.11	0.05	0.28	152.83
Spotted Bass	F	C	C		4	0.23	0.07	0.00	0.01	7.00
Largemouth Bass	F	C	C		66	3.90	1.25	0.34	1.85	90.33
Warmouth Sunfish	S	C	C		20	1.15	0.37	0.05	0.28	45.20
Green Sunfish	S	I	C	T	193	11.42	3.66	0.11	0.58	9.35
Bluegill Sunfish	S	I	C	P	111	6.48	2.07	0.14	0.75	21.75
Redear Sunfish	E	I	C		1	0.06	0.02	0.00	0.01	40.00
Pumpkinseed Sunfish	S	I	C	P	58	3.35	1.07	0.04	0.20	10.88
Green Sf X Bluegill Sf					5	0.29	0.09	0.01	0.04	28.00

River: 17-400 Sugar Creek

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Walleye	F	P	S		3	0.17	0.06	0.06	0.33	356.67
Yellow Perch			M		3	0.17	0.06	0.00	0.02	16.00
Blackside Darter	D	I	S		1	0.06	0.02	0.00	0.00	3.00
Logperch	D	I	S	M	1	0.06	0.02	0.00	0.00	12.00
Johnny Darter	D	I	C		69	5.40	1.73	0.01	0.04	1.51
Greenside Darter	D	I	S	M	52	3.00	0.96	0.01	0.08	4.84
Banded Darter	D	I	S	I	61	3.52	1.13	0.01	0.03	1.46
Rainbow Darter	D	I	S	M	1	0.06	0.02	0.00	0.00	2.00
Fantail Darter	D	I	C		15	0.90	0.29	0.00	0.01	2.80
Sauger X Walleye	E	P			8	0.46	0.15	0.12	0.64	260.00
Freshwater Drum			M	P	2	0.12	0.04	0.20	1.10	1,775.00
Mottled Sculpin		I	C		102	5.88	1.88	0.03	0.16	5.13
Brook Stickleback		I	C		1	0.08	0.02	0.00	0.00	2.00
	Stream Total				4,673	312.40		18.62		
	Number of Species				55					
	Number of Hybrids				2					

Species List

River Code: **17-406** River Mile: **12.30**	Stream: **Middle Fork Sugar Creek** Basin: Muskingum River Time Fished: 1482 sec Drain Area: 8.0 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/12/1998 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
Quillback Carpsucker	C	O	M		4	8.00	0.23	0.08	0.78	10.50
Northern Hog Sucker	R	I	S	M	1	2.00	0.06	0.02	0.15	8.00
White Sucker	W	O	S	T	8	16.00	0.45	0.09	0.83	5.63
Blacknose Dace	N	G	S	T	78	156.00	4.40	0.34	3.14	2.18
Creek Chub	N	G	N	T	110	220.00	6.21	2.55	23.54	11.59
Common Shiner	N	I	S		545	1,090.00	30.77	3.14	29.01	2.88
Sand Shiner	N	I	M	M	182	364.00	10.28	0.59	5.45	1.62
Silverjaw Minnow	N	I	M		644	1,288.00	36.36	2.56	23.63	1.99
Bluntnose Minnow	N	O	C	T	140	280.00	7.91	0.70	6.46	2.50
Central Stoneroller	N	H	N		54	108.00	3.05	0.52	4.84	4.85
Yellow Bullhead		I	C	T	3	6.00	0.17	0.14	1.29	23.33
Largemouth Bass	F	C	C		1	2.00	0.06	0.02	0.15	8.00
Green Sunfish	S	I	C	T	1	2.00	0.06	0.08	0.74	40.00
	Mile Total				1,771	3,542.00		10.83		
	Number of Species				13					
	Number of Hybrids				0					

Species List

River Code: **17-401** River Mile: **2.00**	Stream: **Brandywine Creek** Basin: Muskingum River Time Fished: 1342 sec Drain Area: 3.5 sq mi Dist Fished: 0.13 km No of Passes: 1	Sample Date: **1998** Date Range: 09/04/1998 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
Blacknose Dace	N	G	S	T	310	715.39	35.59			
Creek Chub	N	G	N	T	245	565.39	28.13			
Silverjaw Minnow	N	I	M		135	311.54	15.50			
Bluntnose Minnow	N	O	C	T	4	9.23	0.46			
Central Stoneroller	N	H	N		53	122.31	6.08			
Largemouth Bass	F	C	C		2	4.62	0.23			
Green Sunfish	S	I	C	T	1	2.31	0.11			
Bluegill Sunfish	S	I	C	P	1	2.31	0.11			
Green Sf X Bluegill Sf					1	2.31	0.11			
Johnny Darter	D	I	C		119	274.62	13.66			
	Mile Total				871	2,010.00				
	Number of Species				9					
	Number of Hybrids				1					

Species List

River Code: **17-401** River Mile: **0.20**	Stream: **Brandywine Creek** Basin: Muskingum River Time Fished: 931 sec Drain Area: 5.5 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 09/04/1998 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	8	16.00	2.99			
Common Carp	G	O	M	T	1	2.00	0.37			
Blacknose Dace	N	G	S	T	45	90.00	16.79			
Creek Chub	N	G	N	T	104	208.00	38.81			
Silverjaw Minnow	N	I	M		1	2.00	0.37			
Bluntnose Minnow	N	O	C	T	27	54.00	10.07			
Central Stoneroller	N	H	N		3	6.00	1.12			
Yellow Bullhead		I	C	T	7	14.00	2.61			
Green Sunfish	S	I	C	T	4	8.00	1.49			
Bluegill Sunfish	S	I	C	P	4	8.00	1.49			
Johnny Darter	D	I	C		54	108.00	20.15			
Mottled Sculpin		I	C		10	20.00	3.73			
	Mile Total				268	536.00				
	Number of Species				12					
	Number of Hybrids				0					

Species List

River Code: **17-401** Mile Range: **0.20** Thru: **2.00**	Stream: **Brandywine Creek** Basin: Muskingum River Time Fished: 2273 sec Dist Fished: 0.28 km No of Passes: 2	River Segment Totals Date Range: 09/04/1998 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	8	8.00	0.63			
Common Carp	G	O	M	T	1	1.00	0.08			
Blacknose Dace	N	G	S	T	355	402.69	31.63			
Creek Chub	N	G	N	T	349	386.69	30.38			
Silverjaw Minnow	N	I	M		136	156.77	12.31			
Bluntnose Minnow	N	O	C	T	31	31.62	2.48			
Central Stoneroller	N	H	N		56	64.15	5.04			
Yellow Bullhead		I	C	T	7	7.00	0.55			
Largemouth Bass	F	C	C		2	2.31	0.18			
Green Sunfish	S	I	C	T	5	5.15	0.40			
Bluegill Sunfish	S	I	C	P	5	5.15	0.40			
Green Sf X Bluegill Sf					1	1.15	0.09			
Johnny Darter	D	I	C		173	191.31	15.03			
Mottled Sculpin		I	C		10	10.00	0.79			
	Stream Total				1,139	1,273.00				
	Number of Species				13					
	Number of Hybrids				1					

Species List

River Code: **17-402** River Mile: **2.80**	Stream: **Broad Run** Basin: Muskingum River Time Fished: 1695 sec Drain Area: 8.2 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/20/1998 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
Gizzard Shad		O	M		5	10.00	0.73			
White Sucker	W	O	S	T	8	16.00	1.17			
Common Carp	G	O	M	T	7	14.00	1.02			
Blacknose Dace	N	G	S	T	4	8.00	0.59			
Creek Chub	N	G	N	T	89	178.00	13.03			
Common Shiner	N	I	S		105	210.00	15.37			
Sand Shiner	N	I	M	M	26	52.00	3.81			
Silverjaw Minnow	N	I	M		51	102.00	7.47			
Bluntnose Minnow	N	O	C	T	287	574.00	42.02			
Central Stoneroller	N	H	N		1	2.00	0.15			
Yellow Bullhead		I	C	T	7	14.00	1.02			
Rock Bass	S	C	C		1	2.00	0.15			
Largemouth Bass	F	C	C		11	22.00	1.61			
Green Sunfish	S	I	C	T	8	16.00	1.17			
Bluegill Sunfish	S	I	C	P	43	86.00	6.30			
Green Sf X Bluegill Sf					1	2.00	0.15			
Johnny Darter	D	I	C		29	58.00	4.25			
	Mile Total				683	1,366.00				
	Number of Species				16					
	Number of Hybrids				1					

Species List

River Code: **17-402** River Mile: **0.20**	Stream: **Broad Run** Basin: Muskingum River Time Fished: 1552 sec Drain Area: 20.0 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/20/1998 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
Gizzard Shad		O	M		7	14.00	7.61	0.30	3.72	21.43
White Sucker	W	O	S	T	2	4.00	2.17	1.03	12.74	257.00
Common Carp	G	O	M	T	1	2.00	1.09	4.90	60.75	2,450.00
Creek Chub	N	G	N	T	5	10.00	5.43	0.04	0.50	4.00
Common Shiner	N	I	S		1	2.00	1.09	0.01	0.07	3.00
Sand Shiner	N	I	M	M	16	32.00	17.39	0.06	0.79	2.00
Bluntnose Minnow	N	O	C	T	17	34.00	18.48	0.08	0.94	2.24
Central Stoneroller	N	H	N		3	6.00	3.26	0.14	1.74	23.33
Yellow Bullhead		I	C	T	3	6.00	3.26	0.57	7.07	95.00
Rock Bass	S	C	C		1	2.00	1.09	0.25	3.10	125.00
Largemouth Bass	F	C	C		2	4.00	2.17	0.04	0.45	9.00
Bluegill Sunfish	S	I	C	P	13	26.00	14.13	0.43	5.31	16.46
Johnny Darter	D	I	C		6	12.00	6.52	0.04	0.45	3.00
Greenside Darter	D	I	S	M	3	6.00	3.26	0.04	0.50	6.67
Mottled Sculpin		I	C		12	24.00	13.04	0.15	1.88	6.33
	Mile Total				92	184.00		8.07		
	Number of Species				15					
	Number of Hybrids				0					

Species List

River Code: **17-402** Mile Range: **0.20** Thru: **2.80**	Stream: **Broad Run** Basin: Muskingum River Time Fished: 3247 sec Dist Fished: 0.30 km No of Passes: 2	River Segment Totals Date Range: 08/20/1998 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
Gizzard Shad		O	M		12	12.00	1.55	0.30	3.72	21.43
White Sucker	W	O	S	T	10	10.00	1.29	1.03	12.74	257.00
Common Carp	G	O	M	T	8	8.00	1.03	4.90	60.75	2,450.00
Blacknose Dace	N	G	S	T	4	4.00	0.52			
Creek Chub	N	G	N	T	94	94.00	12.13	0.04	0.50	4.00
Common Shiner	N	I	S		106	106.00	13.68	0.01	0.07	3.00
Sand Shiner	N	I	M	M	42	42.00	5.42	0.06	0.79	2.00
Silverjaw Minnow	N	I	M		51	51.00	6.58			
Bluntnose Minnow	N	O	C	T	304	304.00	39.23	0.08	0.94	2.24
Central Stoneroller	N	H	N		4	4.00	0.52	0.14	1.74	23.33
Yellow Bullhead		I	C	T	10	10.00	1.29	0.57	7.07	95.00
Rock Bass	S	C	C		2	2.00	0.26	0.25	3.10	125.00
Largemouth Bass	F	C	C		13	13.00	1.68	0.04	0.45	9.00
Green Sunfish	S	I	C	T	8	8.00	1.03			
Bluegill Sunfish	S	I	C	P	56	56.00	7.23	0.43	5.31	16.46
Green Sf X Bluegill Sf					1	1.00	0.13			
Johnny Darter	D	I	C		35	35.00	4.52	0.04	0.45	3.00
Greenside Darter	D	I	S	M	3	3.00	0.39	0.04	0.50	6.67
Mottled Sculpin		I	C		12	12.00	1.55	0.15	1.88	6.33
	Stream Total				775	775.00		8.07		
	Number of Species				18					
	Number of Hybrids				1					

Species List

River Code: **17-403** River Mile: **0.20**	Stream: **Turkeyfoot Run** Basin: Muskingum River Time Fished: 782 sec Drain Area: 4.2 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/20/1998 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
Creek Chub	N	G	N	T	3	6.00	100.00			
	Mile Total				3	6.00				
	Number of Species				1					
	Number of Hybrids				0					

River Code: **17-403** Mile Range: **0.20**	Stream: **Turkeyfoot Run** Basin: Muskingum River Time Fished: 782 sec Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 08/20/1998 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
Creek Chub	N	G	N	T	3	6.00	100.00			
	Stream Total				3	6.00				
	Number of Species				1					
	Number of Hybrids				0					

Species List

River Code: **17-405** River Mile: **1.70**	Stream: **Elm Run** Basin: Muskingum River Time Fished: 1256 sec Drain Area: 5.5 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/13/1998 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	61	122.00	18.83	3.62	50.14	29.69
Blacknose Dace	N	G	S	T	12	24.00	3.70	0.04	0.55	1.67
Creek Chub	N	G	N	T	120	240.00	37.04	2.54	35.11	10.57
Common Shiner	N	I	S		9	18.00	2.78	0.14	1.88	7.56
Bluntnose Minnow	N	O	C	T	46	92.00	14.20	0.29	3.96	3.11
Central Stoneroller	N	H	N		16	32.00	4.94	0.18	2.49	5.63
Yellow Bullhead		I	C	T	3	6.00	0.93	0.09	1.22	14.67
Black Crappie	S	I	C		1	2.00	0.31	0.02	0.33	12.00
Largemouth Bass	F	C	C		1	2.00	0.31	0.01	0.17	6.00
Green Sunfish	S	I	C	T	7	14.00	2.16	0.09	1.29	6.67
Pumpkinseed Sunfish	S	I	C	P	7	14.00	2.16	0.10	1.44	7.43
Johnny Darter	D	I	C		39	78.00	12.04	0.09	1.27	1.18
Fantail Darter	D	I	C		2	4.00	0.62	0.01	0.14	2.50
	Mile Total				324	648.00		7.22		
	Number of Species				13					
	Number of Hybrids				0					

Species List

River Code: **17-405** River Mile: **0.40**	Stream: **Elm Run** Basin: Muskingum River Time Fished: 1008 sec Drain Area: 6.6 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/13/1998 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	2	4.00	1.00			
Common Carp	G	O	M	T	5	10.00	2.50			
Creek Chub	N	G	N	T	27	54.00	13.50			
Bluntnose Minnow	N	O	C	T	29	58.00	14.50			
Brown Bullhead		I	C	T	26	52.00	13.00			
Black Crappie	S	I	C		21	42.00	10.50			
Largemouth Bass	F	C	C		33	66.00	16.50			
Warmouth Sunfish	S	C	C		1	2.00	0.50			
Green Sunfish	S	I	C	T	6	12.00	3.00			
Bluegill Sunfish	S	I	C	P	16	32.00	8.00			
Pumpkinseed Sunfish	S	I	C	P	33	66.00	16.50			
Yellow Perch			M		1	2.00	0.50			
	Mile Total				200	400.00				
	Number of Species				12					
	Number of Hybrids				0					

Species List

River Code: **17-405** Mile Range: **0.40** Thru: **1.70**	Stream: **Elm Run** Basin: Muskingum River Time Fished: 2264 sec Dist Fished: 0.30 km No of Passes: 2	River Segment Totals Date Range: 08/13/1998 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	63	63.00	12.02	3.62	50.14	29.69
Common Carp	G	O	M	T	5	5.00	0.95			
Blacknose Dace	N	G	S	T	12	12.00	2.29	0.04	0.55	1.67
Creek Chub	N	G	N	T	147	147.00	28.05	2.54	35.11	10.57
Common Shiner	N	I	S		9	9.00	1.72	0.14	1.88	7.56
Bluntnose Minnow	N	O	C	T	75	75.00	14.31	0.29	3.96	3.11
Central Stoneroller	N	H	N		16	16.00	3.05	0.18	2.49	5.63
Yellow Bullhead		I	C	T	3	3.00	0.57	0.09	1.22	14.67
Brown Bullhead		I	C	T	26	26.00	4.96			
Black Crappie	S	I	C		22	22.00	4.20	0.02	0.33	12.00
Largemouth Bass	F	C	C		34	34.00	6.49	0.01	0.17	6.00
Warmouth Sunfish	S	C	C		1	1.00	0.19			
Green Sunfish	S	I	C	T	13	13.00	2.48	0.09	1.29	6.67
Bluegill Sunfish	S	I	C	P	16	16.00	3.05			
Pumpkinseed Sunfish	S	I	C	P	40	40.00	7.63	0.10	1.44	7.43
Yellow Perch			M		1	1.00	0.19			
Johnny Darter	D	I	C		39	39.00	7.44	0.09	1.27	1.18
Fantail Darter	D	I	C		2	2.00	0.38	0.01	0.14	2.50
	Stream Total				524	524.00		7.22		
	Number of Species				18					
	Number of Hybrids				0					

Species List

River Code: **17-407** River Mile: **0.20**	Stream: **Misers Run** Basin: Muskingum River Time Fished: 1267 sec Drain Area: 2.1 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/13/1998 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	30	60.00	4.67	0.15	1.75	2.48
Blacknose Dace	N	G	S	T	183	366.00	28.50	0.72	8.45	1.97
Creek Chub	N	G	N	T	259	518.00	40.34	6.15	72.16	11.88
South. Redbelly Dace	N	H	S		10	20.00	1.56	0.04	0.47	2.00
Common Shiner	N	I	S		106	212.00	16.51	1.20	14.07	5.66
Silverjaw Minnow	N	I	M		22	44.00	3.43	0.12	1.41	2.73
Bluntnose Minnow	N	O	C	T	25	50.00	3.89	0.10	1.17	2.00
Central Stoneroller	N	H	N		1	2.00	0.16	0.00	0.05	2.00
Green Sunfish	S	I	C	T	1	2.00	0.16	0.01	0.14	6.00
Green Sf X Pumpkinseed					1	2.00	0.16	0.02	0.19	8.00
Brook Stickleback		I	C		4	8.00	0.62	0.01	0.14	1.50
	Mile Total				642	1,284.00		8.52		
	Number of Species				10					
	Number of Hybrids				1					

Species List

River Code: **17-407** Mile Range: **0.20**	Stream: **Misers Run** Basin: Muskingum River Time Fished: 1267 sec Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 08/13/1998 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	30	60.00	4.67	0.15	1.75	2.48
Blacknose Dace	N	G	S	T	183	366.00	28.50	0.72	8.45	1.97
Creek Chub	N	G	N	T	259	518.00	40.34	6.15	72.16	11.88
South. Redbelly Dace	N	H	S		10	20.00	1.56	0.04	0.47	2.00
Common Shiner	N	I	S		106	212.00	16.51	1.20	14.07	5.66
Silverjaw Minnow	N	I	M		22	44.00	3.43	0.12	1.41	2.73
Bluntnose Minnow	N	O	C	T	25	50.00	3.89	0.10	1.17	2.00
Central Stoneroller	N	H	N		1	2.00	0.16	0.00	0.05	2.00
Green Sunfish	S	I	C	T	1	2.00	0.16	0.01	0.14	6.00
Green Sf X Pumpkinseed					1	2.00	0.16	0.02	0.19	8.00
Brook Stickleback		I	C		4	8.00	0.62	0.01	0.14	1.50
	Stream Total				642	1,284.00		8.52		
	Number of Species				10					
	Number of Hybrids				1					

Species List

River Code: **17-408** River Mile: **2.90**	Stream: **Crabapple Creek** Basin: Muskingum River Time Fished: 1920 sec Drain Area: 5.1 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/12/1998 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
Quillback Carpsucker	C	O	M		20	40.00	0.71	0.28	1.12	6.90
White Sucker	W	O	S	T	227	454.00	8.06	1.70	6.90	3.75
Blacknose Dace	N	G	S	T	830	1,660.00	29.45	3.65	14.80	2.20
Creek Chub	N	G	N	T	534	1,068.00	18.95	8.93	36.17	8.36
South. Redbelly Dace	N	H	S		2	4.00	0.07	0.01	0.03	2.00
Common Shiner	N	I	S		326	652.00	11.57	3.20	12.97	4.91
Sand Shiner	N	I	M	M	51	102.00	1.81	0.28	1.12	2.71
Silverjaw Minnow	N	I	M		415	830.00	14.73	2.57	10.42	3.10
Bluntnose Minnow	N	O	C	T	190	380.00	6.74	1.35	5.48	3.56
Central Stoneroller	N	H	N		190	380.00	6.74	1.97	7.98	5.18
Yellow Bullhead		I	C	T	9	18.00	0.32	0.33	1.34	18.33
Largemouth Bass	F	C	C		10	20.00	0.35	0.14	0.57	7.00
Green Sunfish	S	I	C	T	5	10.00	0.18	0.20	0.81	20.00
Bluegill Sunfish	S	I	C	P	1	2.00	0.04	0.02	0.08	10.00
Johnny Darter	D	I	C		8	16.00	0.28	0.06	0.23	3.50
	Mile Total				2,818	5,636.00		24.68		
	Number of Species				15					
	Number of Hybrids				0					

Species List

River Code: **17-408** River Mile: **0.30**	Stream: **Crabapple Creek** Basin: Muskingum River Time Fished: 1494 sec Drain Area: 10.8 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/12/1998 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
Quillback Carpsucker	C	O	M		4	8.00	0.51	0.10	0.98	12.50
Northern Hog Sucker	R	I	S	M	1	2.00	0.13	0.01	0.08	4.00
White Sucker	W	O	S	T	33	66.00	4.21	0.46	4.49	6.97
Blacknose Dace	N	G	S	T	124	248.00	15.82	0.65	6.38	2.63
Creek Chub	N	G	N	T	243	486.00	30.99	5.00	48.85	10.29
South. Redbelly Dace	N	H	S		1	2.00	0.13	0.00	0.04	2.00
Common Shiner	N	I	S		203	406.00	25.89	2.46	23.98	6.05
Sand Shiner	N	I	M	M	5	10.00	0.64	0.02	0.23	2.40
Silverjaw Minnow	N	I	M		81	162.00	10.33	0.39	3.79	2.40
Bluntnose Minnow	N	O	C	T	38	76.00	4.85	0.32	3.12	4.21
Central Stoneroller	N	H	N		35	70.00	4.46	0.58	5.66	8.29
Largemouth Bass	F	C	C		5	10.00	0.64	0.20	1.95	20.00
Johnny Darter	D	I	C		9	18.00	1.15	0.03	0.29	1.67
Greenside Darter	D	I	S	M	1	2.00	0.13	0.01	0.12	6.00
Fantail Darter	D	I	C		1	2.00	0.13	0.00	0.04	2.00
	Mile Total				784	1,568.00		10.24		
	Number of Species				15					
	Number of Hybrids				0					

River Code: **17-408** Mile Range: **0.30** Thru: **2.90**	Stream: **Crabapple Creek** Basin: Muskingum River Time Fished: 3414 sec Dist Fished: 0.30 km No of Passes: 2	River Segment Totals Date Range: 08/12/1998 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
Quillback Carpsucker	C	O	M		24	24.00	0.67	0.19	1.08	7.83
Northern Hog Sucker	R	I	S	M	1	1.00	0.03	0.00	0.02	4.00
White Sucker	W	O	S	T	260	260.00	7.22	1.08	6.19	4.16
Blacknose Dace	N	G	S	T	954	954.00	26.49	2.15	12.33	2.26
Creek Chub	N	G	N	T	777	777.00	21.57	6.97	39.89	8.96
South. Redbelly Dace	N	H	S		3	3.00	0.08	0.01	0.03	2.00
Common Shiner	N	I	S		529	529.00	14.69	2.83	16.20	5.35
Sand Shiner	N	I	M	M	56	56.00	1.55	0.15	0.86	2.68
Silverjaw Minnow	N	I	M		496	496.00	13.77	1.48	8.48	2.99
Bluntnose Minnow	N	O	C	T	228	228.00	6.33	0.84	4.79	3.67
Central Stoneroller	N	H	N		225	225.00	6.25	1.27	7.30	5.66
Yellow Bullhead		I	C	T	9	9.00	0.25	0.17	0.94	18.33
Largemouth Bass	F	C	C		15	15.00	0.42	0.17	0.97	11.33
Green Sunfish	S	I	C	T	5	5.00	0.14	0.10	0.57	20.00
Bluegill Sunfish	S	I	C	P	1	1.00	0.03	0.01	0.06	10.00
Johnny Darter	D	I	C		17	17.00	0.47	0.04	0.25	2.53
Greenside Darter	D	I	S	M	1	1.00	0.03	0.01	0.03	6.00
Fantail Darter	D	I	C		1	1.00	0.03	0.00	0.01	2.00
Stream Total					3,602	3,602.00		17.46		
Number of Species					18					
Number of Hybrids					0					

Species List

River Code: **17-406** River Mile: **10.30**	Stream: **Middle Fork Sugar Creek** Basin: Muskingum River Time Fished: 1533 sec Drain Area: 10.3 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/12/1998 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	9	18.00	1.14	1.24	10.63	68.67
Blacknose Dace	N	G	S	T	112	224.00	14.18	0.45	3.85	2.00
Creek Chub	N	G	N	T	60	120.00	7.59	1.71	14.74	14.29
Common Shiner	N	I	S		158	316.00	20.00	3.29	28.31	10.42
Sand Shiner	N	I	M	M	59	118.00	7.47	0.25	2.15	2.12
Silverjaw Minnow	N	I	M		163	326.00	20.63	0.80	6.90	2.46
Bluntnose Minnow	N	O	C	T	114	228.00	14.43	0.53	4.57	2.33
Central Stoneroller	N	H	N		93	186.00	11.77	1.37	11.80	7.38
Yellow Bullhead		I	C	T	9	18.00	1.14	1.70	14.58	94.22
Green Sunfish	S	I	C	T	1	2.00	0.13	0.04	0.34	20.00
Pumpkinseed Sunfish	S	I	C	P	1	2.00	0.13	0.18	1.55	90.00
Green Sf X Pumpkinseed					1	2.00	0.13	0.02	0.17	10.00
Johnny Darter	D	I	C		5	10.00	0.63	0.02	0.14	1.60
Greenside Darter	D	I	S	M	1	2.00	0.13	0.01	0.10	6.00
Fantail Darter	D	I	C		4	8.00	0.51	0.02	0.17	2.50
	Mile Total				790	1,580.00		11.63		
	Number of Species				14					
	Number of Hybrids				1					

Species List

River Code: **17-406** River Mile: **7.90**	Stream: **Middle Fork Sugar Creek** Basin: Muskingum River Time Fished: 1680 sec Drain Area: 29.7 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/13/1998 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
Quillback Carpsucker	C	O	M		1	2.00	0.11	0.02	0.11	12.00
Northern Hog Sucker	R	I	S	M	11	22.00	1.21	5.29	24.58	240.36
White Sucker	W	O	S	T	8	16.00	0.88	2.30	10.69	143.75
Blacknose Dace	N	G	S	T	16	32.00	1.76	0.09	0.41	2.75
Creek Chub	N	G	N	T	87	174.00	9.58	2.56	11.92	14.74
Common Shiner	N	I	S		408	816.00	44.93	6.96	32.36	8.53
Sand Shiner	N	I	M	M	108	216.00	11.89	0.50	2.34	2.33
Silverjaw Minnow	N	I	M		17	34.00	1.87	0.08	0.37	2.35
Bluntnose Minnow	N	O	C	T	84	168.00	9.25	0.47	2.17	2.77
Central Stoneroller	N	H	N		105	210.00	11.56	2.46	11.43	11.71
Yellow Bullhead		I	C	T	1	2.00	0.11	0.04	0.17	18.00
Smallmouth Bass	F	C	C	M	3	6.00	0.33	0.24	1.12	40.00
Largemouth Bass	F	C	C		1	2.00	0.11	0.01	0.04	4.00
Johnny Darter	D	I	C		4	8.00	0.44	0.01	0.06	1.50
Greenside Darter	D	I	S	M	41	82.00	4.52	0.44	2.06	5.41
Banded Darter	D	I	S	I	9	18.00	0.99	0.02	0.11	1.33
Rainbow Darter	D	I	S	M	2	4.00	0.22	0.01	0.04	2.00
Fantail Darter	D	I	C		2	4.00	0.22	0.01	0.03	1.50
	Mile Total				908	1,816.00		21.52		
	Number of Species				18					
	Number of Hybrids				0					

Species List

River Code: **17-406** River Mile: **1.70**	Stream: **Middle Fork Sugar Creek** Basin: Muskingum River Time Fished: 4850 sec Drain Area: 63.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/15/1998 Thru: 08/30/1998 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
Quillback Carpsucker	C	O	M		1	0.75	0.45	0.01	0.08	12.00
Golden Redhorse	R	I	S	M	4	3.00	1.79	1.14	9.80	381.25
Northern Hog Sucker	R	I	S	M	7	5.25	3.13	0.80	6.86	152.57
White Sucker	W	O	S	T	11	8.25	4.91	1.07	9.12	129.09
Common Carp	G	O	M	T	8	6.00	3.57	6.88	58.92	1,146.88
Creek Chub	N	G	N	T	14	10.50	6.25	0.25	2.14	23.79
Common Shiner	N	I	S		64	48.00	28.57	0.55	4.69	11.41
Sand Shiner	N	I	M	M	20	15.00	8.93	0.02	0.15	1.20
Silverjaw Minnow	N	I	M		3	2.25	1.34	0.00	0.04	2.00
Bluntnose Minnow	N	O	C	T	34	25.50	15.18	0.05	0.40	1.82
Yellow Bullhead		I	C	T	9	6.75	4.02	0.57	4.87	84.22
Black Crappie	S	I	C		1	0.75	0.45	0.01	0.08	12.00
Smallmouth Bass	F	C	C	M	1	0.75	0.45	0.01	0.08	12.00
Largemouth Bass	F	C	C		7	5.25	3.13	0.03	0.24	5.43
Green Sunfish	S	I	C	T	38	28.50	16.96	0.29	2.47	10.13
Pumpkinseed Sunfish	S	I	C	P	1	0.75	0.45	0.01	0.06	10.00
Johnny Darter	D	I	C		1	0.75	0.45	0.00	0.01	2.00
	Mile Total				224	168.00		11.68		
	Number of Species				17					
	Number of Hybrids				0					

Species List

River Code: **17-406**	Stream: **Middle Fork Sugar Creek**	River Segment Totals
Mile Range: **1.70**	Basin: Muskingum River	Date Range: 07/15/1998
Thru: **12.30**	Time Fished: 9545 sec	Thru: 08/30/1998
	Dist Fished: 0.85 km No of Passes: 5	Sampler Type: D 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
Quillback Carpsucker	C	O	M		6	2.30	0.16	0.03	0.19	11.00
Golden Redhorse	R	I	S	M	4	1.20	0.08	0.46	3.40	381.25
Northern Hog Sucker	R	I	S	M	19	6.90	0.47	1.38	10.26	195.79
White Sucker	W	O	S	T	36	13.30	0.91	1.15	8.55	89.81
Common Carp	G	O	M	T	8	2.40	0.16	2.75	20.44	1,146.88
Blacknose Dace	N	G	S	T	206	82.40	5.66	0.18	1.30	2.13
Creek Chub	N	G	N	T	271	107.00	7.35	1.47	10.88	13.83
Common Shiner	N	I	S		1,175	463.60	31.87	2.90	21.52	6.32
Sand Shiner	N	I	M	M	369	145.60	10.01	0.28	2.05	1.89
Silverjaw Minnow	N	I	M		827	330.50	22.72	0.69	5.12	2.09
Bluntnose Minnow	N	O	C	T	372	145.40	9.99	0.36	2.66	2.45
Central Stoneroller	N	H	N		252	100.80	6.93	0.87	6.47	8.64
Yellow Bullhead		I	C	T	22	7.90	0.54	0.60	4.47	77.00
Black Crappie	S	I	C		1	0.30	0.02	0.00	0.03	12.00
Smallmouth Bass	F	C	C	M	4	1.50	0.10	0.05	0.38	33.00
Largemouth Bass	F	C	C		9	2.90	0.20	0.02	0.12	5.56
Green Sunfish	S	I	C	T	40	12.20	0.84	0.14	1.04	11.13
Pumpkinseed Sunfish	S	I	C	P	2	0.70	0.05	0.04	0.29	50.00
Green Sf X Pumpkinseed					1	0.40	0.03	0.00	0.03	10.00
Johnny Darter	D	I	C		10	3.90	0.27	0.01	0.05	1.60
Greenside Darter	D	I	S	M	42	16.80	1.15	0.09	0.68	5.43
Banded Darter	D	I	S	I	9	3.60	0.25	0.00	0.04	1.33
Rainbow Darter	D	I	S	M	2	0.80	0.05	0.00	0.01	2.00
Fantail Darter	D	I	C		6	2.40	0.16	0.01	0.04	2.17
	Stream Total				3,693	1,454.80		13.47		
	Number of Species				23					
	Number of Hybrids				1					

Species List

River Code: **17-409** River Mile: **5.40**	Stream: **North Fork Sugar Creek** Basin: Muskingum River Time Fished: 1273 sec Drain Area: 5.5 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/05/1998 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	10	20.00	0.48	0.11	1.18	5.50
Blacknose Dace	N	G	S	T	1,002	2,004.00	48.13	4.61	49.58	2.30
Creek Chub	N	G	N	T	98	196.00	4.71	0.79	8.51	4.04
South. Redbelly Dace	N	H	S		497	994.00	23.87	0.88	9.47	0.88
Silverjaw Minnow	N	I	M		1	2.00	0.05	0.00	0.04	2.00
Bluntnose Minnow	N	O	C	T	366	732.00	17.58	1.39	14.96	1.90
Central Stoneroller	N	H	N		91	182.00	4.37	0.57	6.14	3.14
Green Sunfish	S	I	C	T	12	24.00	0.58	0.49	5.27	20.42
Bluegill Sunfish	S	I	C	P	3	6.00	0.14	0.36	3.87	60.00
Pumpkinseed Sunfish	S	I	C	P	2	4.00	0.10	0.09	0.97	22.50
	Mile Total				2,082	4,164.00		9.30		
	Number of Species				10					
	Number of Hybrids				0					

Species List

River Code: **17-409** River Mile: **3.10**	Stream: **North Fork Sugar Creek** Basin: Muskingum River Time Fished: 1500 sec Drain Area: 10.5 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/06/1998 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
Quillback Carpsucker	C	O	M		28	56.00	1.03	0.28	1.31	5.00
White Sucker	W	O	S	T	55	110.00	2.02	0.42	1.97	3.82
Blacknose Dace	N	G	S	T	793	1,586.00	29.09	2.55	11.95	1.61
Creek Chub	N	G	N	T	420	840.00	15.41	7.45	34.88	8.87
South. Redbelly Dace	N	H	S		6	12.00	0.22	0.07	0.32	5.75
Common Shiner	N	I	S		391	782.00	14.34	3.50	16.40	4.48
Sand Shiner	N	I	M	M	38	76.00	1.39	0.20	0.92	2.58
Silverjaw Minnow	N	I	M		454	908.00	16.65	1.67	7.82	1.84
Bluntnose Minnow	N	O	C	T	195	390.00	7.15	1.28	6.00	3.28
Central Stoneroller	N	H	N		335	670.00	12.29	3.52	16.47	5.25
Yellow Bullhead		I	C	T	8	16.00	0.29	0.34	1.59	21.25
Largemouth Bass	F	C	C		1	2.00	0.04	0.02	0.09	10.00
Bluegill Sunfish	S	I	C	P	1	2.00	0.04	0.06	0.26	28.00
Brook Stickleback		I	C		1	2.00	0.04	0.00	0.02	2.00
Mile Total					2,726	5,452.00		21.36		
Number of Species					14					
Number of Hybrids					0					

Species List

River Code: **17-409** River Mile: **1.30**	Stream: **North Fork Sugar Creek** Basin: Muskingum River Time Fished: 1477 sec Drain Area: 16.5 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/06/1998 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
Central Mudminnow		I	C	T	1	2.00	0.15	0.01	0.08	3.00
Quillback Carpsucker	C	O	M		1	2.00	0.15	0.01	0.08	3.00
White Sucker	W	O	S	T	26	52.00	4.00	0.76	10.54	14.54
Blacknose Dace	N	G	S	T	152	304.00	23.38	0.78	10.84	2.56
Creek Chub	N	G	N	T	154	308.00	23.69	2.68	37.39	8.71
Common Shiner	N	I	S		119	238.00	18.31	1.32	18.43	5.56
Sand Shiner	N	I	M	M	8	16.00	1.23	0.04	0.50	2.25
Silverjaw Minnow	N	I	M		92	184.00	14.15	0.43	6.05	2.36
Bluntnose Minnow	N	O	C	T	62	124.00	9.54	0.32	4.46	2.58
Central Stoneroller	N	H	N		25	50.00	3.85	0.70	9.76	14.00
Yellow Bullhead		I	C	T	2	4.00	0.31	0.06	0.84	15.00
Largemouth Bass	F	C	C		2	4.00	0.31	0.01	0.14	2.50
Green Sunfish	S	I	C	T	2	4.00	0.31	0.06	0.84	15.00
Brook Stickleback		I	C		4	8.00	0.62	0.00	0.06	0.50
	Mile Total				650	1,300.00		7.18		
	Number of Species				14					
	Number of Hybrids				0					

Species List

River Code: **17-409** Mile Range: **1.30** Thru: **5.40**	Stream: **North Fork Sugar Creek** Basin: Muskingum River Time Fished: 4250 sec Dist Fished: 0.45 km No of Passes: 3	River Segment Totals Date Range: 08/05/1998 Thru: 08/06/1998 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
Central Mudminnow		I	C	T	1	0.67	0.02	0.00	0.02	3.00
Quillback Carpsucker	C	O	M		29	19.33	0.53	0.10	0.76	4.93
White Sucker	W	O	S	T	91	60.67	1.67	0.43	3.40	7.07
Blacknose Dace	N	G	S	T	1,947	1,298.00	35.67	2.65	20.99	2.04
Creek Chub	N	G	N	T	672	448.00	12.31	3.64	28.88	8.13
South. Redbelly Dace	N	H	S		503	335.33	9.22	0.32	2.51	0.94
Common Shiner	N	I	S		510	340.00	9.34	1.61	12.76	4.73
Sand Shiner	N	I	M	M	46	30.67	0.84	0.08	0.61	2.52
Silverjaw Minnow	N	I	M		547	364.67	10.02	0.70	5.57	1.93
Bluntnose Minnow	N	O	C	T	623	415.33	11.41	1.00	7.91	2.40
Central Stoneroller	N	H	N		451	300.67	8.26	1.60	12.66	5.31
Yellow Bullhead		I	C	T	10	6.67	0.18	0.13	1.06	20.00
Largemouth Bass	F	C	C		3	2.00	0.05	0.01	0.08	5.00
Green Sunfish	S	I	C	T	14	9.33	0.26	0.18	1.45	19.64
Bluegill Sunfish	S	I	C	P	4	2.67	0.07	0.14	1.10	52.00
Pumpkinseed Sunfish	S	I	C	P	2	1.33	0.04	0.03	0.24	22.50
Brook Stickleback		I	C		5	3.33	0.09	0.00	0.02	0.80
	Stream Total				5,458	3,638.67		12.61		
	Number of Species				17					
	Number of Hybrids				0					

River Code: **17-410** River Mile: **21.10**	Stream: **South Fork Sugar Creek** Basin: Muskingum River Time Fished: 1020 sec Drain Area: 7.3 sq mi Dist Fished: 0.13 km No of Passes: 1	Sample Date: **1998** Date Range: 08/24/1998 Sampler Type: F

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	1	2.31	0.41			
Blacknose Dace	N	G	S	T	14	32.31	5.81			
Creek Chub	N	G	N	T	95	219.23	39.42			
Silverjaw Minnow	N	I	M		32	73.85	13.28			
Bluntnose Minnow	N	O	C	T	77	177.69	31.95			
Yellow Bullhead		I	C	T	1	2.31	0.41			
Largemouth Bass	F	C	C		10	23.08	4.15			
Green Sunfish	S	I	C	T	9	20.77	3.73			
Bluegill Sunfish	S	I	C	P	2	4.62	0.83			
	Mile Total				241	556.15				
	Number of Species				9					
	Number of Hybrids				0					

Species List

River Code: **17-410** River Mile: **19.00**	Stream: **South Fork Sugar Creek** Basin: Muskingum River Time Fished: 900 sec Drain Area: 12.6 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 09/03/1998 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	11	22.00	9.91			
Creek Chub	N	G	N	T	59	118.00	53.15			
Silverjaw Minnow	N	I	M		1	2.00	0.90			
Bluntnose Minnow	N	O	C	T	38	76.00	34.23			
Green Sunfish	S	I	C	T	2	4.00	1.80			
	Mile Total				111	222.00				
	Number of Species				5					
	Number of Hybrids				0					

Species List

River Code: **17-410** River Mile: **15.30**	Stream: **South Fork Sugar Creek** Basin: Muskingum River Time Fished: 746 sec Drain Area: 30.0 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/14/1998 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	1	2.00	0.08	0.04	0.59	20.00
Golden Shiner	N	I	M	T	1	2.00	0.08	0.01	0.09	3.00
Blacknose Dace	N	G	S	T	100	200.00	8.45	0.24	3.57	1.20
Creek Chub	N	G	N	T	635	1,270.00	53.68	2.28	33.95	1.80
Common Shiner	N	I	S		1	2.00	0.08	0.00	0.06	2.00
Silverjaw Minnow	N	I	M		75	150.00	6.34	0.24	3.57	1.60
Fathead Minnow	N	O	C	T	6	12.00	0.51	0.02	0.36	2.00
Bluntnose Minnow	N	O	C	T	310	620.00	26.20	1.25	18.57	2.01
Yellow Bullhead		I	C	T	37	74.00	3.13	2.34	34.80	31.62
Largemouth Bass	F	C	C		4	8.00	0.34	0.08	1.19	10.00
Green Sunfish	S	I	C	T	13	26.00	1.10	0.22	3.27	8.46
	Mile Total				1,183	2,366.00		6.73		
	Number of Species				11					
	Number of Hybrids				0					

Species List

River Code: **17-410** River Mile: **13.90**	Stream: **South Fork Sugar Creek** Basin: Muskingum River Time Fished: 958 sec Drain Area: 35.0 sq mi Dist Fished: 0.13 km No of Passes: 1	Sample Date: **1998** Date Range: 08/14/1998 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
Quillback Carpsucker	C	O	M		21	48.46	2.45	0.72	3.62	14.76
White Sucker	W	O	S	T	3	6.92	0.35	0.04	0.19	5.33
Common Carp	G	O	M	T	42	96.92	4.91	4.50	22.78	46.43
Golden Shiner	N	I	M	T	1	2.31	0.12	0.01	0.05	4.00
Creek Chub	N	G	N	T	344	793.85	40.19	4.74	23.97	5.97
Fathead Minnow	N	O	C	T	1	2.31	0.12	0.01	0.04	3.00
Bluntnose Minnow	N	O	C	T	275	634.62	32.13	1.88	9.52	2.96
Yellow Bullhead		I	C	T	1	2.31	0.12	2.08	10.51	900.00
Brown Bullhead		I	C	T	21	48.46	2.45	0.07	0.35	1.43
White Crappie	S	I	C		1	2.31	0.12	0.19	0.94	80.00
Largemouth Bass	F	C	C		17	39.23	1.99	0.30	1.52	7.65
Green Sunfish	S	I	C	T	47	108.46	5.49	0.55	2.80	5.11
Bluegill Sunfish	S	I	C	P	78	180.00	9.11	4.35	22.02	24.17
Pumpkinseed Sunfish	S	I	C	P	1	2.31	0.12	0.15	0.76	65.00
Green Sf X Bluegill Sf					1	2.31	0.12	0.07	0.35	30.00
Green Sf X Pumpkinseed					2	4.62	0.23	0.12	0.58	25.00
	Mile Total				856	1,975.39		19.76		
	Number of Species				14					
	Number of Hybrids				2					

Species List

River Code: **17-410** River Mile: **13.30**	Stream: **South Fork Sugar Creek** Basin: Muskingum River Time Fished: 2494 sec Drain Area: 63.3 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/01/1998 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
Common Carp	G	O	M	T	28	21.00	7.71	1.46	21.56	69.64
Golden Shiner	N	I	M	T	1	0.75	0.28	0.00	0.02	2.00
Blacknose Dace	N	G	S	T	1	0.75	0.28	0.00	0.02	2.00
Creek Chub	N	G	N	T	36	27.00	9.92	0.50	7.41	18.61
Silverjaw Minnow	N	I	M		1	0.75	0.28	0.00	0.01	1.00
Bluntnose Minnow	N	O	C	T	55	41.25	15.15	0.12	1.70	2.78
Yellow Bullhead		I	C	T	77	57.75	21.21	2.65	39.02	45.84
Brown Bullhead		I	C	T	8	6.00	2.20	0.64	9.40	106.25
Black Bullhead		I	C	P	5	3.75	1.38	0.33	4.79	86.60
Largemouth Bass	F	C	C		11	8.25	3.03	0.06	0.92	7.55
Warmouth Sunfish	S	C	C		1	0.75	0.28	0.04	0.57	52.00
Green Sunfish	S	I	C	T	78	58.50	21.49	0.54	7.94	9.21
Bluegill Sunfish	S	I	C	P	57	42.75	15.70	0.40	5.84	9.26
Pumpkinseed Sunfish	S	I	C	P	2	1.50	0.55	0.03	0.46	21.00
Green Sf X Bluegill Sf					2	1.50	0.55	0.02	0.35	16.00
	Mile Total				363	272.25		6.78		
	Number of Species				14					
	Number of Hybrids				1					

River Code: **17-410** River Mile: **7.50**	Stream: **South Fork Sugar Creek** Basin: Muskingum River Time Fished: 2982 sec Drain Area: 75.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/01/1998 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		2	1.50	1.49	0.21	0.87	140.00
White Sucker	W	O	S	T	9	6.75	6.72	1.30	5.36	192.67
Common Carp	G	O	M	T	31	23.25	23.13	18.68	77.02	803.23
Yellow Bullhead		I	C	T	29	21.75	21.64	1.98	8.15	90.86
Brown Bullhead		I	C	T	12	9.00	8.96	0.81	3.35	90.33
White Crappie	S	I	C		8	6.00	5.97	0.30	1.25	50.50
Black Crappie	S	I	C		2	1.50	1.49	0.09	0.38	61.50
Warmouth Sunfish	S	C	C		3	2.25	2.24	0.09	0.36	38.33
Green Sunfish	S	I	C	T	25	18.75	18.66	0.21	0.86	11.18
Bluegill Sunfish	S	I	C	P	4	3.00	2.99	0.07	0.31	24.50
Pumpkinseed Sunfish	S	I	C	P	7	5.25	5.22	0.06	0.24	11.00
Walleye	F	P	S		1	0.75	0.75	0.08	0.34	110.00
Sauger X Walleye	E	P			1	0.75	0.75	0.37	1.52	490.00
	Mile Total				134	100.50		24.25		
	Number of Species				12					
	Number of Hybrids				1					

River Code: **17-410** River Mile: **6.40**	Stream: **South Fork Sugar Creek** Basin: Muskingum River Time Fished: 2395 sec Drain Area: 124.0 sq mi Dist Fished: 0.40 km No of Passes: 1	Sample Date: **1998** Date Range: 09/23/1998 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	2.50	1.54	0.53	0.46	210.00
Grass Pickerel		P	M	P	3	7.50	4.62	0.08	0.07	10.00
White Sucker	W	O	S	T	7	17.50	10.77	4.65	4.07	265.71
Common Carp	G	O	M	T	42	105.00	64.62	106.48	93.28	1,014.10
Yellow Bullhead		I	C	T	1	2.50	1.54	0.25	0.22	100.00
Brown Bullhead		I	C	T	5	12.50	7.69	1.80	1.58	144.00
Black Crappie	S	I	C		1	2.50	1.54	0.20	0.18	80.00
Warmouth Sunfish	S	C	C		1	2.50	1.54	0.05	0.04	20.00
Green Sunfish	S	I	C	T	4	10.00	6.15	0.13	0.11	12.50
	Mile Total				65	162.50		114.16		
	Number of Species				9					
	Number of Hybrids				0					

River Code: **17-410** River Mile: **3.60**	Stream: **South Fork Sugar Creek** Basin: Muskingum River Time Fished: 3496 sec Drain Area: 131.0 sq mi Dist Fished: 0.80 km No of Passes: 2	Sample Date: **1998** Date Range: 07/23/1998 Thru: 09/02/1998 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	3.75	3.00	0.83	1.67	220.00
Grass Pickerel		P	M	P	1	1.25	1.00	0.01	0.03	10.00
White Sucker	W	O	S	T	4	5.00	4.00	1.07	2.16	214.00
Common Carp	G	O	M	T	43	53.75	43.00	42.70	86.23	794.48
Brown Bullhead		I	C	T	20	25.00	20.00	3.19	6.44	127.50
White Crappie	S	I	C		4	5.00	4.00	0.22	0.44	43.75
Black Crappie	S	I	C		3	3.75	3.00	0.41	0.82	108.33
Largemouth Bass	F	C	C		1	1.25	1.00	0.11	0.22	85.00
Warmouth Sunfish	S	C	C		9	11.25	9.00	0.46	0.93	41.11
Green Sunfish	S	I	C	T	3	3.75	3.00	0.09	0.17	22.67
Bluegill Sunfish	S	I	C	P	3	3.75	3.00	0.25	0.50	66.67
Pumpkinseed Sunfish	S	I	C	P	6	7.50	6.00	0.19	0.39	25.83
	Mile Total				100	125.00		49.52		
	Number of Species				12					
	Number of Hybrids				0					

Species List

River Code: **17-410**	Stream: **South Fork Sugar Creek**	River Segment Totals
Mile Range: **3.60**	Basin: Muskingum River	Date Range: 07/21/1998
Thru: **21.10**	Time Fished: 14991 sec	Thru: 09/23/1998
	Dist Fished: 2.56 km No of Passes: 11	Sampler Type: A D F

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		6	1.18	0.21	0.29	0.86	191.67
Grass Pickerel		P	M	P	4	0.91	0.16	0.01	0.03	10.00
Quillback Carpsucker	C	O	M		21	4.41	0.77	0.08	0.24	14.76
White Sucker	W	O	S	T	25	4.75	0.83	1.05	3.14	186.92
Common Carp	G	O	M	T	186	36.17	6.34	26.30	78.43	567.50
Golden Shiner	N	I	M	T	3	0.53	0.09	0.00	0.01	3.00
Blacknose Dace	N	G	S	T	126	23.26	4.07	0.03	0.08	1.21
Creek Chub	N	G	N	T	1,169	223.19	39.11	0.89	2.66	3.81
Common Shiner	N	I	S		1	0.18	0.03	0.00	0.00	2.00
Silverjaw Minnow	N	I	M		109	20.67	3.62	0.03	0.08	1.59
Fathead Minnow	N	O	C	T	7	1.30	0.23	0.00	0.01	2.14
Bluntnose Minnow	N	O	C	T	755	144.62	25.34	0.37	1.11	2.49
Yellow Bullhead		I	C	T	146	21.83	3.83	1.55	4.61	57.48
Brown Bullhead		I	C	T	66	12.81	2.25	1.24	3.69	79.30
Black Bullhead		I	C	P	5	0.68	0.12	0.07	0.22	86.60
White Crappie	S	I	C		13	2.21	0.39	0.14	0.41	50.69
Black Crappie	S	I	C		6	1.18	0.21	0.13	0.40	88.00
Largemouth Bass	F	C	C		43	8.12	1.42	0.08	0.24	10.24
Warmouth Sunfish	S	C	C		14	2.82	0.49	0.14	0.41	39.79
Green Sunfish	S	I	C	T	181	30.11	5.28	0.29	0.85	8.62
Bluegill Sunfish	S	I	C	P	144	25.78	4.52	0.64	1.92	19.09
Pumpkinseed Sunfish	S	I	C	P	16	2.80	0.49	0.08	0.24	21.19
Green Sf X Bluegill Sf					3	0.48	0.08	0.01	0.04	20.67
Green Sf X Pumpkinseed					2	0.42	0.07	0.01	0.04	25.00
Walleye	F	P	S		1	0.14	0.02	0.02	0.05	110.00
Sauger X Walleye	E	P			1	0.14	0.02	0.08	0.24	490.00
	Stream Total				3,053	570.69		33.53		
	Number of Species				23					
	Number of Hybrids				3					

Species List

River Code: **17-411** River Mile: **7.90**	Stream: **Walnut Creek** Basin: Muskingum River Time Fished: 1332 sec Drain Area: 9.1 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/19/1998 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
Quillback Carpsucker	C	O	M		3	6.00	0.19			
White Sucker	W	O	S	T	2	4.00	0.13			
Blacknose Dace	N	G	S	T	57	114.00	3.70			
Creek Chub	N	G	N	T	877	1,754.00	56.95			
Common Shiner	N	I	S		6	12.00	0.39			
Silverjaw Minnow	N	I	M		323	646.00	20.97			
Fathead Minnow	N	O	C	T	1	2.00	0.06			
Bluntnose Minnow	N	O	C	T	240	480.00	15.58			
Central Stoneroller	N	H	N		14	28.00	0.91			
Yellow Bullhead		I	C	T	2	4.00	0.13			
Largemouth Bass	F	C	C		14	28.00	0.91			
Green Sunfish	S	I	C	T	1	2.00	0.06			
	Mile Total				1,540	3,080.00				
	Number of Species				12					
	Number of Hybrids				0					

River Code: **17-411** River Mile: **6.40**	Stream: **Walnut Creek** Basin: Muskingum River Time Fished: 1244 sec Drain Area: 10.6 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/19/1998 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
Quillback Carpsucker	C	O	M		3	6.00	0.78			
Blacknose Dace	N	G	S	T	5	10.00	1.29			
Creek Chub	N	G	N	T	331	662.00	85.53			
Silverjaw Minnow	N	I	M		6	12.00	1.55			
Bluntnose Minnow	N	O	C	T	28	56.00	7.24			
Yellow Bullhead		I	C	T	11	22.00	2.84			
Largemouth Bass	F	C	C		3	6.00	0.78			
	Mile Total				387	774.00				
	Number of Species				7					
	Number of Hybrids				0					

Species List

River Code: **17-411** River Mile: **4.50**	Stream: **Walnut Creek** Basin: Muskingum River Time Fished: 1560 sec Drain Area: 22.0 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/19/1998 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
Quillback Carpsucker	C	O	M		3	6.00	0.67	0.04	0.25	7.33
White Sucker	W	O	S	T	30	60.00	6.67	5.65	32.36	94.13
Common Carp	G	O	M	T	4	8.00	0.89	1.36	7.79	170.00
Blacknose Dace	N	G	S	T	47	94.00	10.44	0.33	1.89	3.51
Creek Chub	N	G	N	T	247	494.00	54.89	7.60	43.54	15.38
South. Redbelly Dace	N	H	S		1	2.00	0.22	0.01	0.03	3.00
Common Shiner	N	I	S		15	30.00	3.33	0.48	2.75	16.00
Silverjaw Minnow	N	I	M		27	54.00	6.00	0.12	0.71	2.30
Bluntnose Minnow	N	O	C	T	23	46.00	5.11	0.18	1.05	4.00
Central Stoneroller	N	H	N		10	20.00	2.22	0.23	1.34	11.70
Yellow Bullhead		I	C	T	20	40.00	4.44	0.98	5.64	24.60
Black Crappie	S	I	C		1	2.00	0.22	0.04	0.23	20.00
Largemouth Bass	F	C	C		6	12.00	1.33	0.16	0.94	13.67
Green Sunfish	S	I	C	T	15	30.00	3.33	0.20	1.15	6.67
Bluegill Sunfish	S	I	C	P	1	2.00	0.22	0.06	0.33	29.00
	Mile Total				450	900.00		17.46		
	Number of Species				15					
	Number of Hybrids				0					

River Code: **17-411** River Mile: **0.60**	Stream: **Walnut Creek** Basin: Muskingum River Time Fished: 1849 sec Drain Area: 48.0 sq mi Dist Fished: 0.35 km No of Passes: 2	Sample Date: **1998** Date Range: 07/21/1998 Thru: 09/01/1998 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	1	0.75	1.58	0.09	2.50	115.00
Common Carp	G	O	M	T	3	2.25	4.74	2.78	80.32	1,233.33
Golden Shiner	N	I	M	T	1	1.00	2.11	0.00	0.09	3.00
Creek Chub	N	G	N	T	1	0.75	1.58	0.00	0.07	3.00
Silverjaw Minnow	N	I	M		1	1.00	2.11	0.00	0.03	1.00
Bluntnose Minnow	N	O	C	T	2	1.50	3.16	0.00	0.09	2.00
Yellow Bullhead		I	C	T	5	4.25	8.95	0.39	11.20	91.40
White Crappie	S	I	C		1	1.00	2.11	0.02	0.58	20.00
Largemouth Bass	F	C	C		1	1.00	2.11	0.01	0.14	5.00
Warmouth Sunfish	S	C	C		1	1.00	2.11	0.01	0.14	5.00
Green Sunfish	S	I	C	T	30	29.50	62.11	0.14	3.97	4.87
Bluegill Sunfish	S	I	C	P	3	2.50	5.26	0.03	0.74	11.00
Pumpkinseed Sunfish	S	I	C	P	1	1.00	2.11	0.01	0.14	5.00
	Mile Total				51	47.50		3.46		
	Number of Species				13					
	Number of Hybrids				0					

River Code: **17-411** Mile Range: **0.60** Thru: **7.90**	Stream: **Walnut Creek** Basin: Muskingum River Time Fished: 5985 sec Dist Fished: 0.80 km No of Passes: 5	River Segment Totals Date Range: 07/21/1998 Thru: 09/01/1998 Sampler Type: D 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
Quillback Carpsucker	C	O	M		9	3.60	0.37	0.01	0.18	7.33
White Sucker	W	O	S	T	33	13.10	1.35	1.94	23.89	94.81
Common Carp	G	O	M	T	7	2.50	0.26	2.30	28.36	625.71
Golden Shiner	N	I	M	T	1	0.40	0.04	0.00	0.02	3.00
Blacknose Dace	N	G	S	T	109	43.60	4.50	0.11	1.35	3.51
Creek Chub	N	G	N	T	1,456	582.30	60.04	2.54	31.21	15.33
South. Redbelly Dace	N	H	S		1	0.40	0.04	0.00	0.02	3.00
Common Shiner	N	I	S		21	8.40	0.87	0.16	1.97	16.00
Silverjaw Minnow	N	I	M		357	142.80	14.72	0.04	0.52	2.25
Fathead Minnow	N	O	C	T	1	0.40	0.04			
Bluntnose Minnow	N	O	C	T	293	117.00	12.06	0.06	0.78	3.84
Central Stoneroller	N	H	N		24	9.60	0.99	0.08	0.96	11.70
Yellow Bullhead		I	C	T	38	14.90	1.54	0.59	7.21	37.96
White Crappie	S	I	C		1	0.40	0.04	0.01	0.16	20.00
Black Crappie	S	I	C		1	0.40	0.04	0.01	0.16	20.00
Largemouth Bass	F	C	C		24	9.60	0.99	0.06	0.71	12.43
Warmouth Sunfish	S	C	C		1	0.40	0.04	0.00	0.04	5.00
Green Sunfish	S	I	C	T	46	18.20	1.88	0.16	1.95	5.47
Bluegill Sunfish	S	I	C	P	4	1.40	0.14	0.04	0.45	15.50
Pumpkinseed Sunfish	S	I	C	P	1	0.40	0.04	0.00	0.04	5.00
	Stream Total				2,428	969.80		8.12		
	Number of Species				20					
	Number of Hybrids				0					

Species List

River Code: **17-418** River Mile: **4.90**	Stream: **Little Sugar Creek** Basin: Muskingum River Time Fished: 2964 sec Drain Area: 8.1 sq mi Dist Fished: 0.35 km No of Passes: 2	Sample Date: **1998** Date Range: 07/15/1998 Thru: 09/01/1998 Sampler Type: E F

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	14	11.25	1.81	0.22	4.63	36.67
Common Carp	G	O	M	T	21	20.00	3.22	0.62	13.06	18.24
Creek Chub	N	G	N	T	133	122.50	19.74	1.04	21.90	5.71
Common Shiner	N	I	S		6	5.00	0.81	0.02	0.42	5.00
Silverjaw Minnow	N	I	M		26	23.75	3.83	0.05	1.05	1.47
Bluntnose Minnow	N	O	C	T	372	352.00	56.73	0.83	17.41	1.42
Yellow Bullhead		I	C	T	53	48.75	7.86	1.59	33.52	22.11
Green Sunfish	S	I	C	T	41	37.25	6.00	0.38	8.00	7.31
	Mile Total				666	620.50		4.75		
	Number of Species				8					
	Number of Hybrids				0					

Species List

River Code: **17-418** River Mile: **0.80**	Stream: **Little Sugar Creek** Basin: Muskingum River Time Fished: 1557 sec Drain Area: 13.3 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/12/1998 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
Quillback Carpsucker	C	O	M		3	6.00	0.24	0.04	0.30	6.00
White Sucker	W	O	S	T	4	8.00	0.32	0.54	4.45	67.50
Common Carp	G	O	M	T	2	4.00	0.16	0.90	7.41	225.00
Blacknose Dace	N	G	S	T	46	92.00	3.67	0.12	0.99	1.30
Creek Chub	N	G	N	T	169	338.00	13.47	3.02	24.82	8.92
Common Shiner	N	I	S		162	324.00	12.91	3.31	27.26	10.22
Sand Shiner	N	I	M	M	252	504.00	20.08	0.72	5.93	1.43
Silverjaw Minnow	N	I	M		139	278.00	11.08	0.47	3.89	1.70
Bluntnose Minnow	N	O	C	T	417	834.00	33.23	1.30	10.71	1.56
Central Stoneroller	N	H	N		23	46.00	1.83	0.27	2.22	5.87
Yellow Bullhead		I	C	T	7	14.00	0.56	0.64	5.27	45.71
Brown Bullhead		I	C	T	1	2.00	0.08	0.11	0.91	55.00
Largemouth Bass	F	C	C		9	18.00	0.72	0.13	1.07	7.22
Green Sunfish	S	I	C	T	14	28.00	1.12	0.56	4.61	20.00
Johnny Darter	D	I	C		1	2.00	0.08	0.00	0.03	2.00
Greenside Darter	D	I	S	M	2	4.00	0.16	0.01	0.05	1.50
Fantail Darter	D	I	C		4	8.00	0.32	0.01	0.10	1.50
	Mile Total				1,255	2,510.00		12.15		
	Number of Species				17					
	Number of Hybrids				0					

Species List

River Code: **17-418**	Stream: **Little Sugar Creek**	River Segment Totals
Mile Range: **0.80**	Basin: Muskingum River	Date Range: 07/15/1998
Thru: **4.90**	Time Fished: 4521 sec	Thru: 09/01/1998
	Dist Fished: 0.50 km No of Passes: 3	Sampler Type: E F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Quillback Carpsucker	C	O	M		3	2.00	0.16	0.02	0.21	6.00
White Sucker	W	O	S	T	18	10.17	0.81	0.38	4.50	54.29
Common Carp	G	O	M	T	23	14.67	1.17	0.76	9.00	40.00
Blacknose Dace	N	G	S	T	46	30.67	2.45	0.06	0.71	1.30
Creek Chub	N	G	N	T	302	194.33	15.54	2.03	24.00	7.80
Common Shiner	N	I	S		168	111.33	8.90	1.67	19.72	10.16
Sand Shiner	N	I	M	M	252	168.00	13.44	0.36	4.26	1.43
Silverjaw Minnow	N	I	M		165	108.50	8.68	0.26	3.09	1.67
Bluntnose Minnow	N	O	C	T	789	512.67	41.00	1.06	12.59	1.50
Central Stoneroller	N	H	N		23	15.33	1.23	0.14	1.60	5.87
Yellow Bullhead		I	C	T	60	37.17	2.97	1.12	13.21	25.95
Brown Bullhead		I	C	T	1	0.67	0.05	0.06	0.65	55.00
Largemouth Bass	F	C	C		9	6.00	0.48	0.07	0.77	7.22
Green Sunfish	S	I	C	T	55	34.17	2.73	0.47	5.56	11.75
Johnny Darter	D	I	C		1	0.67	0.05	0.00	0.02	2.00
Greenside Darter	D	I	S	M	2	1.33	0.11	0.00	0.04	1.50
Fantail Darter	D	I	C		4	2.67	0.21	0.01	0.07	1.50
	Stream Total				1,921	1,250.33		8.45		
	Number of Species				17					
	Number of Hybrids				0					

Species List

River Code: **17-419** River Mile: **0.20**	Stream: **Cherry Run** Basin: Muskingum River Time Fished: 633 sec Drain Area: 3.5 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/20/1998 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
Creek Chub	N	G	N	T	5	10.00	100.00			
	Mile Total				5	10.00				
	Number of Species				1					
	Number of Hybrids				0					

Species List

River Code: **17-419** Mile Range: **0.20**	Stream: **Cherry Run** Basin: Muskingum River Time Fished: 633 sec Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 08/20/1998 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
Creek Chub	N	G	N	T	5	10.00	100.00			
	Stream Total				5	10.00				
	Number of Species				1					
	Number of Hybrids				0					

Species List

River Code: **17-422** River Mile: **0.30**	Stream: **Goettge Run** Basin: Muskingum River Time Fished: 1003 sec Drain Area: 4.6 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 09/03/1998 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	10	20.00	21.28			
Creek Chub	N	G	N	T	27	54.00	57.45			
Largemouth Bass	F	C	C		3	6.00	6.38			
Green Sunfish	S	I	C	T	6	12.00	12.77			
Mottled Sculpin		I	C		1	2.00	2.13			
	Mile Total				47	94.00				
	Number of Species				5					
	Number of Hybrids				0					

River Code: **17-422** Mile Range: **0.30**	Stream: **Goettge Run** Basin: Muskingum River Time Fished: 1003 sec Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 09/03/1998 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	10	20.00	21.28			
Creek Chub	N	G	N	T	27	54.00	57.45			
Largemouth Bass	F	C	C		3	6.00	6.38			
Green Sunfish	S	I	C	T	6	12.00	12.77			
Mottled Sculpin		I	C		1	2.00	2.13			
	Stream Total				47	94.00				
	Number of Species				5					
	Number of Hybrids				0					

Species List

River Code: **17-424** River Mile: **0.20**	Stream: **Trib. to S. Fk. Sugar Creek (RM 14.14)** Basin: Muskingum River Time Fished: 1200 sec Drain Area: 3.2 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/19/1998 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
Creek Chub	N	G	N	T	1	2.00	2.27			
Bluntnose Minnow	N	O	C	T	11	22.00	25.00			
Yellow Bullhead		I	C	T	15	30.00	34.09			
Green Sunfish	S	I	C	T	16	32.00	36.36			
Bluegill Sunfish	S	I	C	P	1	2.00	2.27			
	Mile Total				44	88.00				
	Number of Species				5					
	Number of Hybrids				0					

Species List

River Code: **17-424** River Mile: **0.10**	Stream: **Trib. to S. Fk. Sugar Creek (RM 14.14)** Basin: Muskingum River Time Fished: 1543 sec Drain Area: 3.2 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/19/1998 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
Golden Shiner	N	I	M	T	9	18.00	2.62			
Blacknose Dace	N	G	S	T	4	8.00	1.16			
Creek Chub	N	G	N	T	170	340.00	49.42			
Fathead Minnow	N	O	C	T	5	10.00	1.45			
Bluntnose Minnow	N	O	C	T	68	136.00	19.77			
Yellow Bullhead		I	C	T	26	52.00	7.56			
Brown Bullhead		I	C	T	1	2.00	0.29			
Largemouth Bass	F	C	C		6	12.00	1.74			
Green Sunfish	S	I	C	T	32	64.00	9.30			
Bluegill Sunfish	S	I	C	P	20	40.00	5.81			
Pumpkinseed Sunfish	S	I	C	P	2	4.00	0.58			
Green Sf X Bluegill Sf					1	2.00	0.29			
	Mile Total				344	688.00				
	Number of Species				11					
	Number of Hybrids				1					

Species List

River Code: **17-424** Mile Range: **0.10** Thru: **0.20**	Stream: **Trib. to S. Fk. Sugar Creek (RM 14.14)** Basin: Muskingum River Time Fished: 2743 sec Dist Fished: 0.30 km No of Passes: 2	River Segment Totals Date Range: 08/19/1998 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
Golden Shiner	N	I	M	T	9	9.00	2.32			
Blacknose Dace	N	G	S	T	4	4.00	1.03			
Creek Chub	N	G	N	T	171	171.00	44.07			
Fathead Minnow	N	O	C	T	5	5.00	1.29			
Bluntnose Minnow	N	O	C	T	79	79.00	20.36			
Yellow Bullhead		I	C	T	41	41.00	10.57			
Brown Bullhead		I	C	T	1	1.00	0.26			
Largemouth Bass	F	C	C		6	6.00	1.55			
Green Sunfish	S	I	C	T	48	48.00	12.37			
Bluegill Sunfish	S	I	C	P	21	21.00	5.41			
Pumpkinseed Sunfish	S	I	C	P	2	2.00	0.52			
Green Sf X Bluegill Sf					1	1.00	0.26			
	Stream Total				388	388.00				
	Number of Species				11					
	Number of Hybrids				1					

Species List

River Code: **17-427** River Mile: **0.50**	Stream: **Trib. to M. Fk. Sugar Creek (RM 3.25)** Basin: Muskingum River Time Fished: 1737 sec Drain Area: 2.9 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/13/1998 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	3	6.00	1.00	0.02	0.42	2.67
Blacknose Dace	N	G	S	T	85	170.00	28.43	0.37	9.79	2.17
Creek Chub	N	G	N	T	119	238.00	39.80	2.75	72.81	11.57
South. Redbelly Dace	N	H	S		7	14.00	2.34	0.04	1.06	2.86
Common Shiner	N	I	S		30	60.00	10.03	0.23	6.08	3.83
Silverjaw Minnow	N	I	M		13	26.00	4.35	0.07	1.90	2.77
Bluntnose Minnow	N	O	C	T	9	18.00	3.01	0.05	1.27	2.67
Central Stoneroller	N	H	N		1	2.00	0.33	0.01	0.16	3.00
Largemouth Bass	F	C	C		1	2.00	0.33	0.01	0.21	4.00
Green Sunfish	S	I	C	T	6	12.00	2.01	0.16	4.23	13.33
Johnny Darter	D	I	C		22	44.00	7.36	0.07	1.85	1.59
Brook Stickleback		I	C		3	6.00	1.00	0.01	0.21	1.33
	Mile Total				299	598.00		3.78		
	Number of Species				12					
	Number of Hybrids				0					

River Code: **17-427** Mile Range: **0.50**	Stream: **Trib. to M. Fk. Sugar Creek (RM 3.25)** Basin: Muskingum River Time Fished: 1737 sec Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 08/13/1998 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	3	6.00	1.00	0.02	0.42	2.67
Blacknose Dace	N	G	S	T	85	170.00	28.43	0.37	9.79	2.17
Creek Chub	N	G	N	T	119	238.00	39.80	2.75	72.81	11.57
South. Redbelly Dace	N	H	S		7	14.00	2.34	0.04	1.06	2.86
Common Shiner	N	I	S		30	60.00	10.03	0.23	6.08	3.83
Silverjaw Minnow	N	I	M		13	26.00	4.35	0.07	1.90	2.77
Bluntnose Minnow	N	O	C	T	9	18.00	3.01	0.05	1.27	2.67
Central Stoneroller	N	H	N		1	2.00	0.33	0.01	0.16	3.00
Largemouth Bass	F	C	C		1	2.00	0.33	0.01	0.21	4.00
Green Sunfish	S	I	C	T	6	12.00	2.01	0.16	4.23	13.33
Johnny Darter	D	I	C		22	44.00	7.36	0.07	1.85	1.59
Brook Stickleback		I	C		3	6.00	1.00	0.01	0.21	1.33
Stream Total					299	598.00		3.78		
Number of Species					12					
Number of Hybrids					0					

Species List

River Code: **17-428** River Mile: **0.20**	Stream: **Trib. to M. Fk. Sugar Creek (RM 6.00)** Basin: Muskingum River Time Fished: 1560 sec Drain Area: 2.3 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1998** Date Range: 08/13/1998 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	39	78.00	3.24	0.18	3.74	2.26
Blacknose Dace	N	G	S	T	539	1,078.00	44.73	1.52	32.30	1.41
Creek Chub	N	G	N	T	412	824.00	34.19	1.85	39.29	2.24
South. Redbelly Dace	N	H	S		3	6.00	0.25	0.02	0.34	2.67
Common Shiner	N	I	S		28	56.00	2.32	0.20	4.33	3.64
Silverjaw Minnow	N	I	M		36	72.00	2.99	0.14	3.06	2.00
Bluntnose Minnow	N	O	C	T	21	42.00	1.74	0.08	1.78	2.00
Central Stoneroller	N	H	N		123	246.00	10.21	0.44	9.43	1.81
Yellow Bullhead		I	C	T	1	2.00	0.08	0.26	5.52	130.00
Johnny Darter	D	I	C		3	6.00	0.25	0.01	0.19	1.50
	Mile Total				1,205	2,410.00		4.71		
	Number of Species				10					
	Number of Hybrids				0					

Species List

River Code: **17-428** Mile Range: **0.20**	Stream: **Trib. to M. Fk. Sugar Creek (RM 6.00)** Basin: Muskingum River Time Fished: 1560 sec Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 08/13/1998 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	39	78.00	3.24	0.18	3.74	2.26
Blacknose Dace	N	G	S	T	539	1,078.00	44.73	1.52	32.30	1.41
Creek Chub	N	G	N	T	412	824.00	34.19	1.85	39.29	2.24
South. Redbelly Dace	N	H	S		3	6.00	0.25	0.02	0.34	2.67
Common Shiner	N	I	S		28	56.00	2.32	0.20	4.33	3.64
Silverjaw Minnow	N	I	M		36	72.00	2.99	0.14	3.06	2.00
Bluntnose Minnow	N	O	C	T	21	42.00	1.74	0.08	1.78	2.00
Central Stoneroller	N	H	N		123	246.00	10.21	0.44	9.43	1.81
Yellow Bullhead		I	C	T	1	2.00	0.08	0.26	5.52	130.00
Johnny Darter	D	I	C		3	6.00	0.25	0.01	0.19	1.50
	Stream Total				1,205	2,410.00		4.71		
	Number of Species				10					
	Number of Hybrids				0					

Species List

River Code: **17-429** Mile Range: **0.70**	Stream: **Trib. to S. Fk. Sugar Creek (RM 1.00)** Basin: Muskingum River Time Fished: 1692 sec Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 08/13/1998 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	28	56.00	7.07	5.50	45.36	98.21
Blacknose Dace	N	G	S	T	52	104.00	13.13	0.34	2.80	3.27
Creek Chub	N	G	N	T	307	614.00	77.53	6.08	50.12	9.90
Bluntnose Minnow	N	O	C	T	1	2.00	0.25	0.00	0.03	2.00
Central Stoneroller	N	H	N		4	8.00	1.01	0.17	1.40	21.25
Yellow Bullhead		I	C	T	1	2.00	0.25	0.02	0.16	10.00
Johnny Darter	D	I	C		3	6.00	0.76	0.01	0.12	2.33
	Stream Total				396	792.00		12.13		
	Number of Species				7					
	Number of Hybrids				0					

Species List

River Code: **17-430** Mile Range: **0.20**	Stream: **Trib. to S. Fk. Sugar Creek (RM 11.30)** Basin: Muskingum River Time Fished: 1106 sec Dist Fished: 0.12 km No of Passes: 1	River Segment Totals Date Range: 09/01/1998 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	3	7.50	9.68			
Creek Chub	N	G	N	T	26	65.00	83.87			
Largemouth Bass	F	C	C		1	2.50	3.23			
Green Sunfish	S	I	C	T	1	2.50	3.23			
	Stream Total				31	77.50				
	Number of Species				4					
	Number of Hybrids				0					

Species List

River Code: **17-431** Mile Range: **1.10**	Stream: **Trib. to S. Fk. Sugar Creek (RM 15.83)** Basin: Muskingum River Time Fished: Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 08/19/1998 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
Blacknose Dace	N	G	S	T	17	34.00	8.10			
Creek Chub	N	G	N	T	189	378.00	90.00			
Bluntnose Minnow	N	O	C	T	1	2.00	0.48			
Green Sunfish	S	I	C	T	3	6.00	1.43			
	Stream Total				210	420.00				
	Number of Species				4					
	Number of Hybrids				0					

Species List

River Code: **17-432** Mile Range: **0.40**	Stream: **Trib. to Walnut Creek (RM 3.95)** Basin: Muskingum River Time Fished: 1065 sec Dist Fished: 0.12 km No of Passes: 1	River Segment Totals Date Range: 08/19/1998 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	2	5.00	1.10			
Blacknose Dace	N	G	S	T	11	27.50	6.08			
Creek Chub	N	G	N	T	155	387.50	85.64			
South. Redbelly Dace	N	H	S		10	25.00	5.52			
Bluntnose Minnow	N	O	C	T	1	2.50	0.55			
Largemouth Bass	F	C	C		2	5.00	1.10			
	Stream Total				181	452.50				
	Number of Species				6					
	Number of Hybrids				0					

River Code: **17-433** Mile Range: **0.40**	Stream: **Trib. to Indian Trail Creek (RM 6.08)** Basin: Muskingum River Time Fished: 648 sec Dist Fished: 0.15 km No of Passes: 1	River Segment Totals Date Range: 08/17/1998 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
No Fish					0	0.00	0			
	Stream Total				0					
	Number of Species				0					
	Number of Hybrids				0					

Species List

River Code: **17-434** Mile Range: **0.70**	Stream: **Trib to E Br S Fk Sugar Creek (RM 2.07)** Basin: Muskingum River Time Fished: 986 sec Dist Fished: 0.12 km No of Passes: 1	River Segment Totals Date Range: 09/01/1998 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	2	5.00	6.25			
Creek Chub	N	G	N	T	26	65.00	81.25			
Green Sunfish	S	I	C	T	4	10.00	12.50			
	Stream Total				32	80.00				
	Number of Species				3					
	Number of Hybrids				0					

Species List

River Code: **17-435** Mile Range: **0.70**	Stream: **Trib to E Br S Fk Sugar Creek (RM 3.60)** Basin: Muskingum River Time Fished: 1080 sec Dist Fished: 0.12 km No of Passes: 1	River Segment Totals Date Range: 09/04/1998 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Blacknose Dace	N	G	S	T	94	235.00	62.67			
Creek Chub	N	G	N	T	44	110.00	29.33			
Green Sunfish	S	I	C	T	12	30.00	8.00			
	Stream Total				150	375.00				
	Number of Species				3					
	Number of Hybrids				0					

Species List

River Code: **17-436** Mile Range: **0.10**	Stream: **Trib. to Brush Run (RM 1.54)** Basin: Muskingum River Time Fished: 900 sec Dist Fished: 0.12 km No of Passes: 1	River Segment Totals Date Range: 09/03/1998 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
No Fish					0	0.00	0			
	Stream Total				0					
	Number of Species				0					
	Number of Hybrids				0					

Species List

River Code: **17-437** Mile Range: **1.00**	Stream: **Trib. to L. Sugar Creek (RM 0.50)** Basin: Muskingum River Time Fished: 1496 sec Dist Fished: 0.14 km No of Passes: 1	River Segment Totals Date Range: 08/06/1998 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	55	117.86	3.24	0.45	3.77	3.82
Blacknose Dace	N	G	S	T	125	267.86	7.36	0.39	3.23	1.44
Creek Chub	N	G	N	T	115	246.43	6.77	1.22	10.24	4.96
Common Shiner	N	I	S		310	664.29	18.25	3.87	32.42	5.82
Sand Shiner	N	I	M	M	1	2.14	0.06	0.36	3.05	170.00
Silverjaw Minnow	N	I	M		348	745.71	20.48	1.02	8.52	1.36
Bluntnose Minnow	N	O	C	T	606	1,298.57	35.67	2.21	18.48	1.70
Central Stoneroller	N	H	N		116	248.57	6.83	1.69	14.16	6.80
Yellow Bullhead		I	C	T	11	23.57	0.65	0.50	4.22	21.36
Largemouth Bass	F	C	C		2	4.29	0.12	0.06	0.54	15.00
Green Sunfish	S	I	C	T	10	21.43	0.59	0.16	1.35	7.50
	Stream Total				1,699	3,640.71		11.93		
	Number of Species				11					
	Number of Hybrids				0					

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Sugar Creek - (17-400)																
Year: 1998																
42.80	E	08/11/1998	5.9	8(3)	4(3)	1(1)	0(1)	1(1)	3(3)	70(1)	8(5)	70(1)	17(1)	0.0(5)	102(1)	26
40.20	D	08/11/1998	14.4	14(3)	9(5)	3(3)	3(3)	2(1)	5(3)	38(3)	20(3)	32(3)	50(5)	0.0(5)	1522(5)	42

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Number of: Sunfish species	Number of: Sucker species	Number of: Intolerant species	Number of: Darter species	Percent of Individuals: Simple Lithophils	Percent of Individuals: Tolerant fishes	Percent of Individuals: Omni-vores	Percent of Individuals: Top carnivores	Percent of Individuals: Insect-ivores	Percent of Individuals: DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb
Sugar Creek - (17400)																	
Year: 1998																	
38.10	D	08/10/1998	21	18(5)	3(3)	2(3)	0(1)	1(1)	61(5)	37(3)	25(3)	0.3(1)	63(5)	0.0(5)	822(5)	40	7.5
34.90	D	07/15/1998	28	12(3)	2(3)	1(1)	0(1)	1(1)	35(3)	55(1)	14(5)	1.6(3)	57(5)	0.0(5)	132(1)	32	6.2
34.60	D	07/15/1998	46	17(3)	3(3)	2(3)	0(1)	3(3)	27(3)	63(1)	19(3)	0.4(1)	56(5)	0.0(5)	144(1)	32	6.7
34.60	D	08/30/1998	46	19(3)	5(5)	2(3)	1(1)	3(3)	32(3)	60(1)	25(3)	1.2(3)	52(3)	0.0(5)	152(1)	34	7.4
26.80	D	07/15/1998	68	15(3)	2(3)	1(1)	0(1)	3(3)	10(1)	50(1)	26(3)	1.1(3)	55(5)	0.0(5)	131(1)	30	6.4
26.80	D	08/31/1998	68	15(3)	2(3)	2(3)	0(1)	3(3)	9(1)	41(3)	24(3)	3.3(3)	58(5)	0.0(5)	159(1)	34	5.2
23.00	D	07/15/1998	93	14(3)	5(5)	2(3)	0(1)	1(1)	27(3)	58(1)	41(1)	4.7(3)	54(3)	0.0(5)	54(1) *	30	4.9
23.00	D	08/13/1998	93	11(1)	3(3)	1(1)	0(1)	0(1)	13(1)	72(1)	46(1)	21.7(5)	33(3)	4.7(1)	20(1) *	20	4.4
19.30	D	07/15/1998	145	8(1)	3(3)	1(1)	0(1)	0(1)	7(1)	77(1)	40(1)	0.0(1)	60(1)	6.7(1)	11(1) * *	14	3.6
19.30	D	08/31/1998	145	5(1)	1(1)	1(1)	0(1)	0(1)	8(1)	67(1)	75(1)	8.3(1)	17(1)	0.0(1)	6(1) * *	12	3.9
17.60	D	07/21/1998	153	11(1)	3(3)	3(3)	0(1)	1(1)	16(1)	70(1)	54(1)	0.0(1)	46(3)	0.0(5)	17(1) *	22	4.6
17.60	D	08/31/1998	153	7(1)	4(5)	2(1)	0(1)	0(1)	14(1)	67(1)	48(1)	9.5(1)	43(1)	0.0(1)	11(1) * *	16	3.5
13.70	D	09/01/1998	161	6(1)	1(1)	3(3)	0(1)	0(1)	23(1)	73(1)	68(1)	4.6(1)	27(1)	0.0(1)	9(1) * *	14	3.7
13.70	D	07/21/1998	161	13(3)	5(5)	1(1)	0(1)	1(1)	9(1)	69(1)	31(3)	11.4(5)	57(5)	0.0(5)	17(1) *	32	4.4
12.00	D	07/21/1998	300	13(3)	5(5)	1(1)	0(1)	1(1)	1(1)	26(3)	20(3)	19.5(5)	60(5)	0.8(5)	143(1) *	34	7.4
12.00	D	09/02/1998	300	16(3)	6(5)	2(1)	1(1)	2(1)	4(1)	32(1)	28(3)	15.6(5)	57(5)	0.8(3)	125(1) *	30	8.1
7.20	D	09/02/1998	311	19(3)	1(1)	3(3)	3(3)	4(3)	38(5)	23(3)	29(3)	1.1(3)	69(5)	0.6(3)	212(3)	38	8.1
7.20	D	07/21/1998	311	18(3)	3(3)	5(5)	2(1)	3(3)	32(3)	25(3)	23(3)	1.9(3)	75(5)	0.7(3)	176(1)	36	8.2
3.70	D	07/22/1998	340	20(3)	4(5)	4(3)	2(1)	2(1)	18(3)	20(3)	16(5)	6.6(5)	77(5)	0.0(5)	147(1) *	40	7.1
3.70	D	09/02/1998	340	26(5)	4(5)	4(3)	2(1)	3(1)	21(3)	18(3)	14(5)	3.4(3)	76(5)	0.0(5)	219(3)	42	8.5
1.80	D	07/21/1998	350	11(1)	2(3)	1(1)	0(1)	1(1)	4(1)	14(5)	10(5)	2.8(3)	86(5)	0.0(5)	92(1) *	32	4.6
1.80	D	09/02/1998	350	18(3)	2(3)	2(1)	2(1)	2(1)	20(3)	11(5)	17(5)	5.1(5)	76(5)	0.0(5)	185(1)	38	7.0
0.60	D	07/22/1998	356	15(3)	3(3)	1(1)	0(1)	1(1)	20(3)	22(3)	16(5)	13.7(5)	69(5)	0.0(5)	60(1) *	36	6.0

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of					Percent of Individuals								
River Mile	Type	Date	Drainage area (sq mi)	Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb
0.40	D	09/02/1998	356	26(5)	4(5)	5(3)	1(1)	3(1)	15(1)	12(5)	28(3)	2.8(3)	65(5)	1.1(3)	234(3)	38	7.9

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
M. Fk. Sugar Creek - (17-406)																
Year: 1998																
12.30	E	08/12/1998	8.0	13(3)	7(5)	1(1)	2(1)	0(1)	4(3)	19(5)	9(5)	51(3)	78(5)	0.0(5)	2862(5)	42
10.30	E	08/12/1998	10.3	14(3)	7(5)	2(3)	2(1)	3(3)	4(3)	39(3)	16(5)	43(3)	51(5)	0.0(5)	970(5)	44
N. Fk. Sugar Creek - (17-409)																
Year: 1998																
5.40	E	08/05/1998	5.5	10(3)	6(5)	2(3)	0(1)	0(1)	3(3)	71(1)	18(3)	23(5)	1(1)	0.0(5)	1188(5)	36
3.10	E	08/06/1998	10.5	14(3)	8(5)	3(3)	1(1)	0(1)	4(3)	54(3)	10(5)	39(3)	33(3)	0.0(5)	2510(5)	40
1.30	E	08/06/1998	16.5	14(3)	7(5)	2(3)	1(1)	0(1)	3(1)	61(1)	14(5)	48(3)	35(3)	0.0(5)	502(3)	34

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of					Percent of Individuals									
River Mile	Type	Date	Drainage area (sq mi)	Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)		IBI	Modified Iwb
M. Fk. Sugar Creek - (17406)																		
Year: 1998																		
7.90	E	08/13/1998	29	18(3)	0(1)	3(3)	1(1)	5(5)	55(5)	22(5)	10(5)	0.4(1)	66(5)	0.0(5)	1424(5)		44	8.7
1.70	D	07/15/1998	63	14(3)	2(3)	3(3)	0(1)	1(1)	38(5)	44(1)	25(3)	4.5(3)	66(5)	0.6(5)	131(1)		34	6.1
1.70	D	08/30/1998	63	13(3)	2(3)	4(5)	0(1)	0(1)	38(5)	66(1)	22(3)	1.5(3)	66(5)	0.0(5)	35(1)	*	36	6.3

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
S. Fk. Sugar Creek - (17-410)																
Year: 1998																
21.10	F	08/24/1998	7.3	9(3)	4(3)	1(1)	0(1)	0(1)	2(1)	82(1)	32(1)	88(1)	18(1)	0.0(5)	102(1)	20
19.00	F	09/03/1998	12.6	5(1)	4(3)	1(1)	0(1)	0(1)	1(1)	99(1)	34(1)	90(1)	3(1)	0.0(5)	2(1)	18
Walnut Creek - (17-411)																
Year: 1998																
7.90	E	08/19/1998	9.1	12(3)	7(5)	1(1)	0(1)	0(1)	3(3)	77(1)	16(3)	94(1)	22(3)	0.0(5)	720(3)	30
6.40	E	08/19/1998	10.6	7(1)	4(3)	1(1)	0(1)	0(1)	1(1)	97(1)	8(5)	94(1)	4(1)	0.0(5)	24(1)	22
E Br S Fk Sugar Cr. - (17-414)																
Year: 1998																
5.50	E	09/04/1998	10.0	9(3)	4(3)	1(1)	0(1)	0(1)	2(1)	81(1)	13(5)	74(1)	21(1)	0.0(5)	62(1)	24
5.00	E	09/04/1998	10.8	8(3)	4(3)	1(1)	0(1)	0(1)	2(1)	93(1)	9(5)	58(1)	8(1)	0.0(5)	68(1)	24
3.30	E	09/04/1998	17.2	8(1)	4(3)	1(1)	0(1)	0(1)	2(1)	87(1)	13(5)	86(1)	11(1)	0.0(5)	138(1)	22

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of					Percent of Individuals								
River Mile	Type	Date	Drainage area (sq mi)	Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb
S. Fk. Sugar Creek - (17410)																	
Year: 1998																	
15.30	D	08/14/1998	30	11(3)	1(1)	1(1)	0(1)	0(1)	9(1)	93(1)	27(3)	0.3(1)	11(1)	0.0(5)	160(1)	20	5.3
13.90	D	08/14/1998	35	13(3)	4(5)	2(3)	0(1)	0(1)	0(1)	86(1)	40(1)	2.0(3)	18(1)	0.0(5)	279(3)	28	7.1
13.30	D	07/21/1998	63	11(3)	4(5)	0(1)	0(1)	0(1)	1(1)	75(1)	26(3)	1.2(3)	66(5)	0.0(5)	65(1)	30	5.6
13.30	D	09/01/1998	63	8(1)	2(3)	0(1)	0(1)	0(1)	0(1)	81(1)	20(3)	5.3(5)	61(5)	0.0(5)	54(1)	28	5.7
7.50	D	07/21/1998	75	11(3)	6(5)	1(1)	0(1)	0(1)	3(1)	79(1)	19(3)	2.7(3)	78(5)	0.0(5)	23(1) *	30	4.8
7.50	D	09/01/1998	75	9(1)	6(5)	1(1)	0(1)	0(1)	13(1)	79(1)	46(1)	4.9(3)	49(3)	0.0(5)	20(1) *	24	4.0
Walnut Creek - (17411)																	
Year: 1998																	
4.50	E	08/19/1998	22	14(3)	3(3)	2(3)	0(1)	0(1)	21(3)	86(1)	13(5)	1.3(3)	18(1)	0.0(5)	128(1)	30	5.7
0.60	D	07/21/1998	48	6(1)	2(3)	1(1)	0(1)	0(1)	7(1)	86(1)	43(1)	0.0(1)	50(1)	0.0(1)	3(1) * *	14	2.9
0.60	D	09/01/1998	48	9(1)	5(5)	0(1)	0(1)	0(1)	0(1)	84(1)	0(5)	5.4(5)	95(5)	0.0(5)	12(1) *	32	3.5
E Br S Fk Sugar Cr. - (17414)																	
Year: 1998																	
1.70	E	09/04/1998	25	9(3)	2(3)	1(1)	0(1)	0(1)	12(1)	95(1)	13(5)	2.9(3)	23(1)	0.0(5)	36(1)	26	na
1.70	D	08/14/1998	25	5(1)	1(1)	0(1)	0(1)	0(1)	0(1)	95(1)	19(5)	5.1(5)	27(3)	0.0(5)	5(1) *	26	3.4

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low end adjusted.

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● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of					Percent of Individuals									
River Mile	Type	Date	Drainage area (sq mi)	Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)		IBI	Modified Iwb
S. Fk. Sugar Creek - (17410)																		
Year: 1998																		
7.50	D	07/21/1998	75	11(3)	6(5)	1(1)	0(1)	0(1)	3(1)	79(1)	19(3)	2.7(3)	78(5)	0.0(5)	23(1)	*	30	4.8
7.50	D	09/01/1998	75	9(1)	6(5)	1(1)	0(1)	0(1)	13(1)	79(1)	46(1)	4.9(3)	49(3)	0.0(5)	20(1)	*	24	4.0

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Brandywine Creek - (17-401)																
Year: 1998																
2.00	E	09/04/1998	3.5	9(3)	5(3)	1(1)	0(1)	1(1)	1(1)	64(1)	1(5)	58(1)	29(3)	0.0(5)	718(5)	30
0.20	E	09/04/1998	5.5	11(3)	5(3)	2(3)	0(1)	2(3)	2(1)	73(1)	13(5)	71(1)	30(3)	0.0(5)	144(3)	32
Broad Run - (17-402)																
Year: 1998																
2.80	E	08/20/1998	8.2	15(5)	7(5)	1(1)	1(1)	1(1)	3(3)	60(1)	45(1)	68(1)	39(3)	0.0(5)	546(3)	30
0.20	E	08/20/1998	20.0	14(3)	5(3)	1(1)	2(1)	3(3)	3(1)	30(3)	29(3)	30(3)	59(5)	0.0(5)	128(1) *	32
Turkeyfoot Run - (17-403)																
Year: 1998																
0.20	E	08/20/1998	4.2	1(1)	1(1)	0(1)	0(1)	0(1)	0(1)	100(1)	0(1)	100(1)	0(1)	0.0(1)	0(1) * *	12
Elm Run - (17-405)																
Year: 1998																
1.70	E	08/13/1998	5.5	13(5)	5(3)	2(3)	0(1)	2(3)	3(3)	77(1)	33(1)	65(1)	21(3)	0.0(5)	150(3)	32
0.40	E	08/13/1998	6.6	11(3)	2(1)	0(1)	0(1)	0(1)	1(1)	48(3)	18(3)	31(3)	51(5)	0.0(5)	210(3)	30
Misers Run - (17-407)																
Year: 1998																
0.20	E	08/13/1998	2.1	10(5)	7(5)	3(3)	0(1)	0(1)	4(5)	78(1)	9(5)	48(3)	21(3)	0.0(5)	288(5)	42
Crabapple Creek - (17-408)																
Year: 1998																
2.90	E	08/12/1998	5.1	15(5)	8(5)	2(3)	1(1)	1(1)	4(3)	64(1)	16(3)	41(3)	29(3)	0.0(5)	2046(5)	38
0.30	E	08/12/1998	10.8	15(5)	8(5)	3(3)	3(3)	3(3)	6(3)	56(3)	10(5)	47(3)	38(3)	0.0(5)	692(3)	44

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

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● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Little Sugar Creek - (17-418)																
Year: 1998																
4.90	F	09/01/1998	8.1	7(3)	4(3)	0(1)	0(1)	0(1)	2(1)	93(1)	52(1)	80(1)	25(3)	0.0(5)	20(1)	22
4.90	E	07/15/1998	8.1	7(3)	4(3)	0(1)	0(1)	0(1)	2(1)	96(1)	65(1)	88(1)	17(1)	0.0(5)	38(1)	20
0.80	E	08/12/1998	13.3	16(5)	7(5)	2(3)	2(1)	3(3)	4(3)	53(3)	34(1)	59(1)	46(5)	0.0(5)	1190(5)	40
Cherry Run - (17-419)																
Year: 1998																
0.20	E	08/20/1998	3.5	1(1)	1(1)	0(1)	0(1)	0(1)	0(1)	100(1)	0(1)	100(1)	0(1)	0.0(1)	0(1) * *	12
Goettge Run - (17-422)																
Year: 1998																
0.30	F	09/03/1998	4.6	5(1)	2(1)	2(3)	0(1)	1(1)	1(1)	91(1)	0(5)	70(1)	15(1)	0.0(5)	8(1) *	22
Trib to S. Fk. Sugar - (17-424)																
Year: 1998																
0.20	E	08/19/1998	3.2	5(1)	2(1)	0(1)	0(1)	0(1)	0(1)	98(1)	25(1)	64(1)	73(5)	0.0(5)	2(1) *	20
0.10	E	08/19/1998	3.2	11(5)	5(5)	1(1)	0(1)	0(1)	1(1)	92(1)	21(3)	80(1)	26(3)	0.0(5)	58(1)	28
Trib to M. Fk. Sugar - (17-427)																
Year: 1998																
0.50	E	08/13/1998	2.9	12(5)	7(5)	3(3)	0(1)	1(1)	4(5)	74(1)	4(5)	57(1)	25(3)	0.0(5)	154(3)	38
Trib to M. Fk. Sugar - (17-428)																
Year: 1998																
0.20	E	08/13/1998	2.3	10(5)	7(5)	2(3)	0(1)	1(1)	4(5)	84(1)	5(5)	39(3)	6(1)	0.0(5)	386(5)	40

▲ - IBI is low end adjusted.

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● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Trib to S. Fk. Sugar - (17-429)																
Year: 1998																
0.70	E	08/13/1998	3.0	7(3)	4(3)	1(1)	0(1)	1(1)	2(3)	98(1)	7(5)	79(1)	1(1)	0.0(5)	14(1)	26
Trib to S. Fk. Sugar - (17-430)																
Year: 1998																
0.20	F	09/01/1998	2.3	4(1)	2(1)	1(1)	0(1)	0(1)	1(1)	97(1)	0(5)	87(1)	3(1)	0.0(5)	3(1) *	20
Trib to S. Fk. Sugar - (17-431)																
Year: 1998																
1.10	E	08/19/1998	2.1	4(1)	3(3)	1(1)	0(1)	0(1)	1(1)	100(1)	1(5)	92(1)	1(1)	0.0(5)	0(1)	22
Trib. to Walnut 3.92 - (17-432)																
Year: 1998																
0.40	E	08/19/1998	0.8	6(3)	4(5)	2(3)	0(1)	0(1)	3(5)	93(1)	2(5)	86(1)	0(1)	0.0(5)	30(3)	34
Trib to Indian Trail - (17-433)																
Year: 1998																
0.40	E	08/17/1998	0.7	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0.0(1)	0(1) * *	12
Trib. to E Br S. Fk. - (17-434)																
Year: 1998																
0.70	F	09/01/1998	3.1	3(1)	2(1)	1(1)	0(1)	0(1)	1(1)	100(1)	0(5)	94(1)	13(1)	0.0(5)	0(1) *	20

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Table A-10. Index of Biotic Integrity (IBI) metric sscores for the Sugar Creek study area, 1998

				Number of						Percent of Individuals						
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Trib. to E Br S. Fk. - (17-435)																
Year: 1998																
0.70	F	09/04/1998	1.3	3(1)	2(3)	1(1)	0(1)	0(1)	1(1)	100(1)	0(5)	37(3)	8(1)	0.0(5)	0(1)	24
Trib. to Brush Run - (17-436)																
Year: 1998																
0.10	F	09/03/1998	0.2	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0(1)	0.0(1)	0(1) * *	12
Trib to L. Sugar 0.5 - (17-437)																
Year: 1998																
1.00	E	08/06/1998	4.9	11(3)	7(5)	1(1)	1(1)	0(1)	3(3)	54(3)	39(1)	64(1)	40(5)	0.0(5)	1665(5)	34

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.