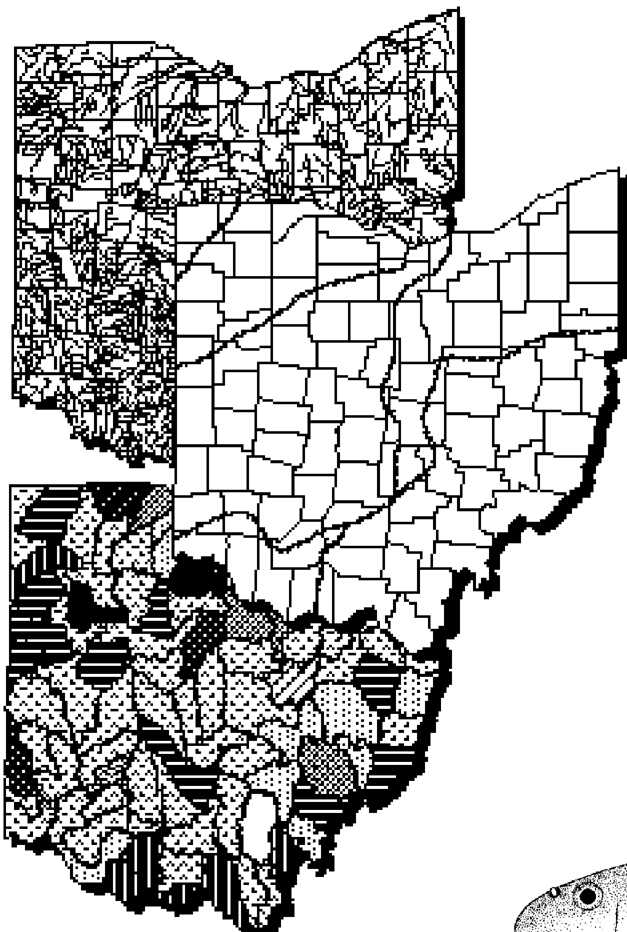
State of Ohio
Environmental Protection Agency

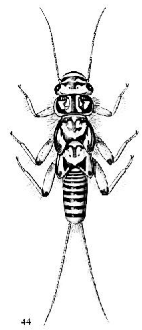
Ecological Assessment Unit
Division of Surface Water

Biological and Water Quality Study of The Grand and Ashtabula River Basins

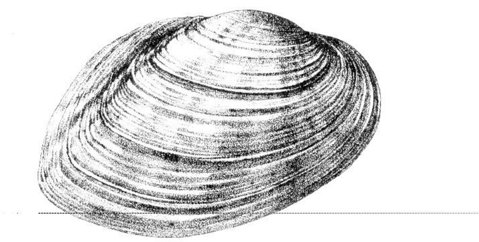
including Arcola Creek, Cowles Creek and Conneaut Creek

Ashtabula, Geauga, Lake and Trumbull Counties

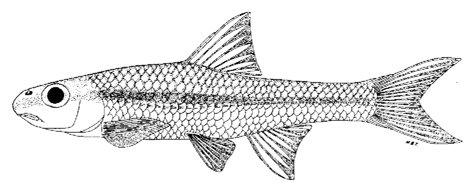




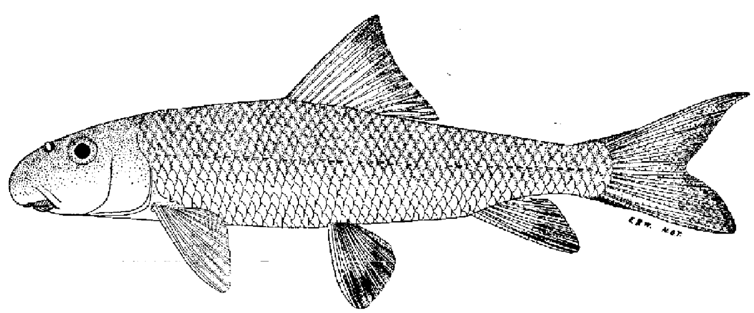
Stonefly
(*Acroneuria evoluta*)



Mucket
(*Actinonaias ligamentina carinata*)



Bigeye Chub
(*Notropis amblops*)



Black Redhorse (*Moxostoma duquesnei*)

January 7, 1997

P.O. Box 1049, 1800 WaterMark Dr., Columbus, Ohio 43216-1049

Biological and Water Quality Study of the Grand and Ashtabula River Basins including Arcola Creek, Cowles Creek and Conneaut Creek

Ashtabula, Geauga, Lake and Trumbull Counties

January 7, 1997

OEPA Technical Report
Number MAS/1996-11-5

prepared by

State of Ohio Environmental Protection Agency
Division of Surface Waters
Ecological Assessment Unit
1685 Westbelt Drive
Columbus, Ohio 43228
and
Water Quality Section
Northeast District Office
2110 East Aurora Road
Twinsburg, Ohio 44087

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CHAPTER II
The Ashtabula River Basin

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 can be obtained by writing to:

Ohio EPA, Division of Surface Water
Monitoring and Assessment Section
1685 Westbelt Drive
Columbus, Ohio 43228-3809
(614) 728-3377

Acknowledgements

Paul Anderson - Arcola Creek and Cowles Creek surface water and sediment chemistry, pollutant loadings and facility descriptions.

Ken Frase - Ashtabula River surface water, sediment chemistry and chemical trends.

Steve Tuckerman - Grand River basin surface water and sediment chemistry, pollutant loadings, facility descriptions.

Jack Freda - Ashtabula River basin macroinvertebrate community assessments.

Martin Knapp - Grand River basin macroinvertebrate community assessments.

Robert Miltner - Ashtabula and Grand River basin fish community assessments, Grand River basin sediment chemistry, and TSD editor.

Jeff DeShon, Marc Smith and Chris Yoder - Reviewers.

Water chemistry analysis was provided by the Ohio EPA division of Environmental Services. Numerous college interns and district office staff assisted in the collection of field samples. Landowners who granted permission for site access are duly appreciated.

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]), and are eventually incorporated into Water Quality Permit Support Documents (WQPSDs), 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 is outlined in Figure 1 and 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 (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.*

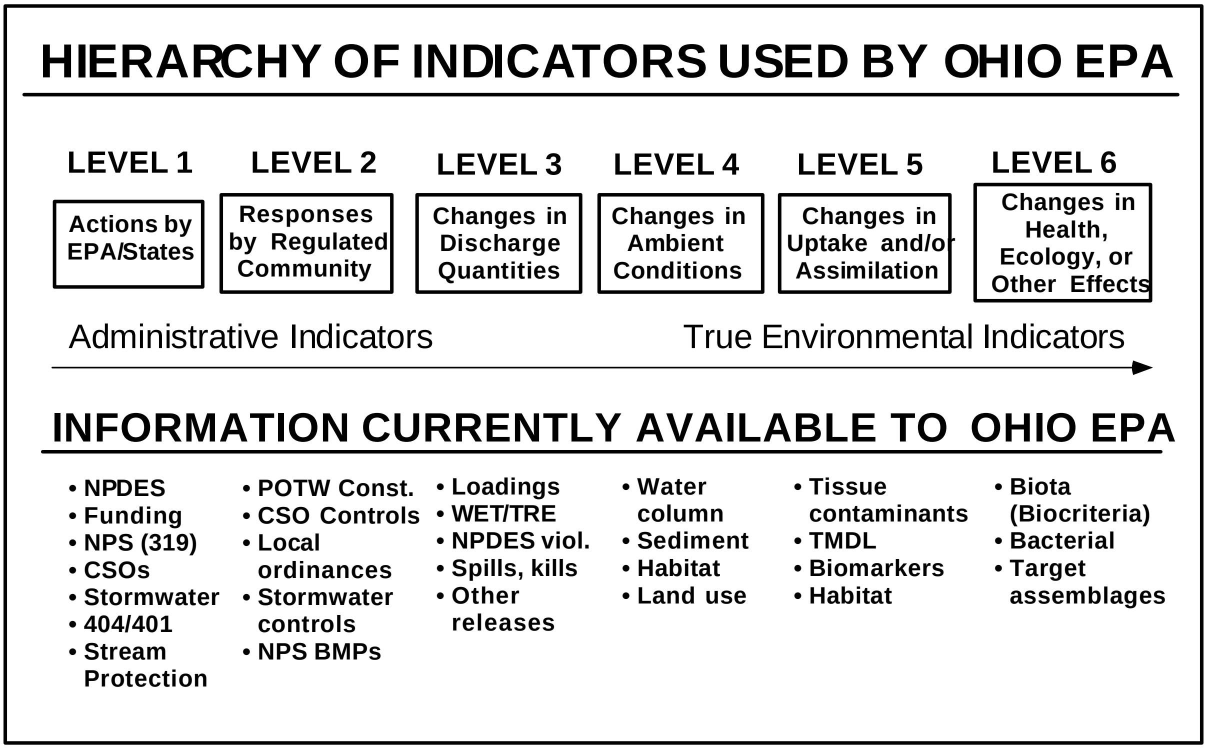


Figure 1. Hierarchy of administrative and environmental indicators used by Ohio EPA for monitoring, assessment, reporting and evaluating program effectiveness. This is patterned after a model developed by the U.S. EPA, Office of Water.

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 and detailed in other documents.

Chapter I

Biological and Water Quality Study of the Grand River, Big Creek and Select Tributaries

Ashtabula, Geauga, Lake and Trumbull Counties

INTRODUCTION

The 1995 Grand River study area consisted of the Grand River mainstem from State Route 422 near Parkman in Geauga County at river mile (RM) 95.4 to Kiwanis Park in Painesville, Lake County at RM 6.1. The study area also included the following tributaries (river mile at confluence): Big Creek (9.32); Jenks Creek (Big Creek at RM 11.52); Paine Creek (14.31); Mill Creek (41.28); Cemetery Creek (Mill Creek at RM 8.42); Rock Creek (50.59); Phelps Creek (72.02); Swine Creek(75.17); and Baughman Creek (80.76). See Table x and Figures x for a complete list of sampling locations.

Specific objectives of this study were to:

1) evaluate the physical habitat, surface water and sediment quality, and the biological integrity of the Grand River study area,

2) assess impacts from municipal wastewater treatment plants, nonpoint sources of pollution, habitat alterations and suburban development,

3) determine attainment status of aquatic life and non-aquatic use designations, and recommend changes where appropriate, and

4) compare results of this survey with previous surveys to assesses changes in water quality and biological integrity.

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

The Ohio EPA Division of Surface Water performed a study of the lower Grand River in 1994 at the request of the Ohio EPA Division of Emergency and Remedial Response. The report is entitled "Biological and Sediment Quality Study of the Grand River in the Vicinity of the Diamond Shamrock Waste Lagoons Area, 1994", Ohio EPA Report Number MAS/1995-8-11. Because this section of the river was evaluated in 1994, it was not included as part of the 1995 survey. The reader is referred to the 1994 report for information concerning the lower section of the Grand River.

SUMMARY

A biological and water quality survey of the Grand River basin was conducted 15 June - 10 October 1995. Most locations surveyed throughout the basin met assigned aquatic life uses as determined by the applicable biological criteria. Exceptions were the headwaters of Big Creek and Cemetary Creek where urban runoff and municipal wastewater impinged on water quality and the biotic communities. Exceptional biological communities were found in the Grand River

mainstem owing to the relatively undeveloped watershed. Despite these exceptional communities, the Grand River is considered fragile due to low summer flows; therefore, this condition must be considered before additional pollutant loads can be expanded or new loads (including nonpoint loads generated by development) added.

Grand River Mainstem

The Grand River was in full attainment of EWH criteria at all locations sampled in the 25.4 mile designated reach. In the reach designated WWH, all locations sampled fully met criteria except RM 65.9, which partially met WWH, yielding 47.1 miles in full attainment and 15.6 miles in partial attainment; no miles exhibited non-attainment. The partially attaining segment was influenced by extensive wetland areas upstream and low stream gradient. Excellent water quality, owing to wide forested riparian buffers, limited (but increasing) residential development within the watershed, minor agricultural impacts, and minimal point source loadings of pollutants, enabled outstanding biological communities to thrive in the Grand River. The rich aquatic insect base generally supported a diverse insectivorous community, including an abundance of redhorse, river chub, and in the riffles, madtoms and darters.

The benefits of minimal pollutant loadings from point sources, residential septic systems and storm-water runoff are manifest in the high relative abundance of species sensitive to pollution. Strong populations of several fish species that have declining populations throughout Ohio due to habitat loss and pollution are found in the Grand River. These species are river chub, rosyface shiner, mimic shiner, black redhorse and river redhorse. Moreover, the Grand River supports muskellunge, a state endangered species.

Much of the Grand River is underlain by a shallow, low yielding, shale bedrock aquifer. Consequently it periodically experiences very low flows in late summer, and therefore, has a limited ability to assimilate pollutants.

Big Creek

Biotic communities upstream (RM 16.3) and immediately downstream (RM 15.9) from the Chardon WWTP did not meet WWH criteria (Table 1) producing 4.2 miles in Non attainment. The remaining 9.6 miles were in Full attainment. Sediments in the creek upstream from the plant were impacted by urban runoff and high density septic systems leading to an impaired biological community. Downstream from the plant, discharges exceeding the design flow of the WWTP have been occurring since 1989, indicating that episodic discharges of poorly treated sewage contribute substantially to the impaired communities. However, the fish and macroinvertebrate communities downstream from the Chardon WWTP improved significantly in 1995 compared to 1987. The improved communities reflect upgrades to the treatment plant, especially nitrification and dechlorination (see *Pollutant Loadings* section). The benefits of nitrification and dechlorination in the treatment process were demonstrated at RM 13.9, where in 1987 no darters were collected, but rainbow darters, a species sensitive to ammonia, were comparatively abundant in 1995. As the upgrades to the plant were implemented recently (dechlorination as late June 1995), the communities most likely were still recovering during the 1995 sampling period.

Cemetary Creek
The two sites bracketing the Jefferson WWTP did not meet the WWH criterion (Table xx) yielding 1.3 miles in non-attainment. The site upstream from the plant (RM 2.5) is heavily modified and degraded by sanitary sewer overflows. Downstream from the WWTP, the creek is effluent dominated. Though not meeting the WWH criterion, the fish community included elements of a balanced fauna, suggesting that the effluent was not acutely toxic, and the community is capable of recovering to WWH standards following completion of the plant upgrade.

Other Tributaries
All other tributaries sampled (Baughman Creek, Swine Creek, Phelps Creek, Rock Creek, Mill Creek, Paine Creek and Jenks Creek) fully met the applicable WWH criteria reflecting intact stream habitats afforded by the lack of channel modifications and minimal encroachment in riparian areas.

RECOMMENDATIONS

Grand River
Status of Aquatic Life Uses
The Grand River is currently designated Exceptional Warmwater Habitat (EWH) from the Harpersfield Dam (RM 30.9) to SR 2 (RM 5.5). Performance of the biological communities upstream from Harpersfield Dam warrant extension of the EWH use designation to Sweitzer Road (RM 42.4). Exceptional biological communities were also found in the headwaters of the Grand River; therefore, the EWH use designation should be applied upstream from SR 608 (RM 91.8) to US 422 (RM 95.5). The remaining segment, RM 91.7 to 42.5 should be designated WWH. The Seasonal Salmonid use designation currently in place should be retained.

Status of Non-aquatic Life Uses
All non-aquatic life uses should remain as presently designated in the Ohio Water Quality Standards.

Other Recommendations
The exceptional biological communities, including rare and endangered species, pristine habitat, and the unique recreational opportunities afforded by the Grand River warrants dose monitoring of developments within the watershed. Because the shallow bedrock and low yielding aquifers results in low summer flows, the river is especially sensitive to disturbances within the watershed, particulary increases in the ammount of impervious surface and loss of forrest cover. And as flow is critical to the biological integrity of the river, future development should be planned with minimal impact on the hydrologic budget of the basin. Also, riparian buffers, including a buffer on the highly erodible shale bluffs overlooking the river, being instrumental in maintaining water quality and aesthetic beauty, should be preserved and restored. The low summer flows also result in negligible assimilative capacity; therefore, any increases or additional pollutant loadings must address this issue. The lightly developed nature of the Grand River watershed enables highly aesthetic surroundings, including clear running streams with good water quality. Increasing

residential development threatens this character.

Future Monitoring Concerns
The exceptional biological communities in the Grand River must be monitored to assess threats from pollution loadings and suburban development.

Big Creek
Status of Aquatic Life Uses
Big Creek is currently designated WWH, and performance of the biological communities warrants this designation. As Big Creek supports seasonal runs of steelehead, it should have the Seasonal Salmonid Habitat use designation from the mouth to Girdled Road (RM 7.1).

Status of Non-aquatic Life Uses
All non-aquatic life uses should remain as presently designated in the Ohio Water Quality Standards.

Other Recommendations
Residential development is increasing rapidly in Chardon and Concord Townships. Riparian buffers and ground water flow, being integral to sustaining high quality biological communites, must be given consideration in plans for development.

Future Monitoring Concerns
Biological communities in Big Creek are improving following the recent upgrades to the Chardon WWTP, such that the macroinvertebrate community is now performing in the exceptional range. The exceptional performance of the macroinvertebrate community and the high quality of the instream and riparian habitat suggest that Big Creek has the capacity to harbor an exceptional fish community. With the proposed WWTP expansion, continued monitoring is needed to determine if the biological communities in Big Creek continue to improve, stay the same, or regress.

Cemetary Creek
Status of Aquatic Life Uses
Cemetary Creek is currently designated Limited Warmwater Habitat (LWH). The habitat quality downstream from the Jefferson WWTP indicates that a WWH use designation is reasonable and attainable and should replace the existing LWH designation in this reach.

Status of Non-aquatic Life Uses
All non-aquatic life uses should remain as presently designated in the Ohio Water Quality Standards.

Other Recommendations
A riparian corridor should be allowed to recover along the creek upstream from Market Street.

Future Monitoring Concerns

The upgrades to the Jefferson WWTP should result in improved biotic communities in Cemetary Creek. Monitoring is needed to ascertain this. The unsewered discharge entering the creek upstream from Market Street should also be investigated.

Cutts Creek

Though not sampled as part of the Grand River survey, Cutts Creek was qualitatively evaluated for fish and macroinvertebrates as part of a power line siting study. Nine coldwater macroinvertebrate taxa and one coldwater fish species (redside dace) were collected. Additionally, the presence of fantial, rainbow and johnny darters, species requiring continuous flow, in a stream with 0.9 mi^{-2} drainage area suggests continuous flows supported by groundwater. Therefore, Cutts Creek should be designated Coldwater Habitat.

Other Tributaries

Status of Aquatic Life Uses

All other tributaries sampled met applicable biological criteria for WWH aquatic life use designations. Performance of the biological communities in Paine Creek warrant an EWH use designation from the mouth to Paine Falls (RM 2.9). Also, Paine Creek should be assigned the Seasonal Salmonid Habitat use designation from the mouth to Paine Falls.

Status of Non-aquatic Life Uses

All non-aquatic life uses should remain as presently designated in the Ohio Water Quality Standards.

Other Recommendations

Baughman Creek supports a population of northern brook lamprey, a state endangered species. Efforts should be made to minimize the access of cattle to the stream, and prevent increases in livestock density in creek-side pastures.

Residential development is increasing rapidly in Leroy Township. Because Paine Creek is underlain by low-yielding shallow bedrock aquifers, it is susceptible to disturbances within its watershed. To insure continued existences of exceptional biological communities in the creek, the wide riparian buffers, high percent of forrest cover and low density development must be maintained.

Future Monitoring Concerns

The tributaries to the Grand River should be monitored to ascertain localized impacts, and cumulative impacts to the mainstem, from nonpoint sources, increases in residential developments, and pollutant loadings from WWTPs. Also, only a handful of tributaries within the watershed have been assessed. In order to monitor changes in water quality within the watershed, greater sampling coverage is needed.

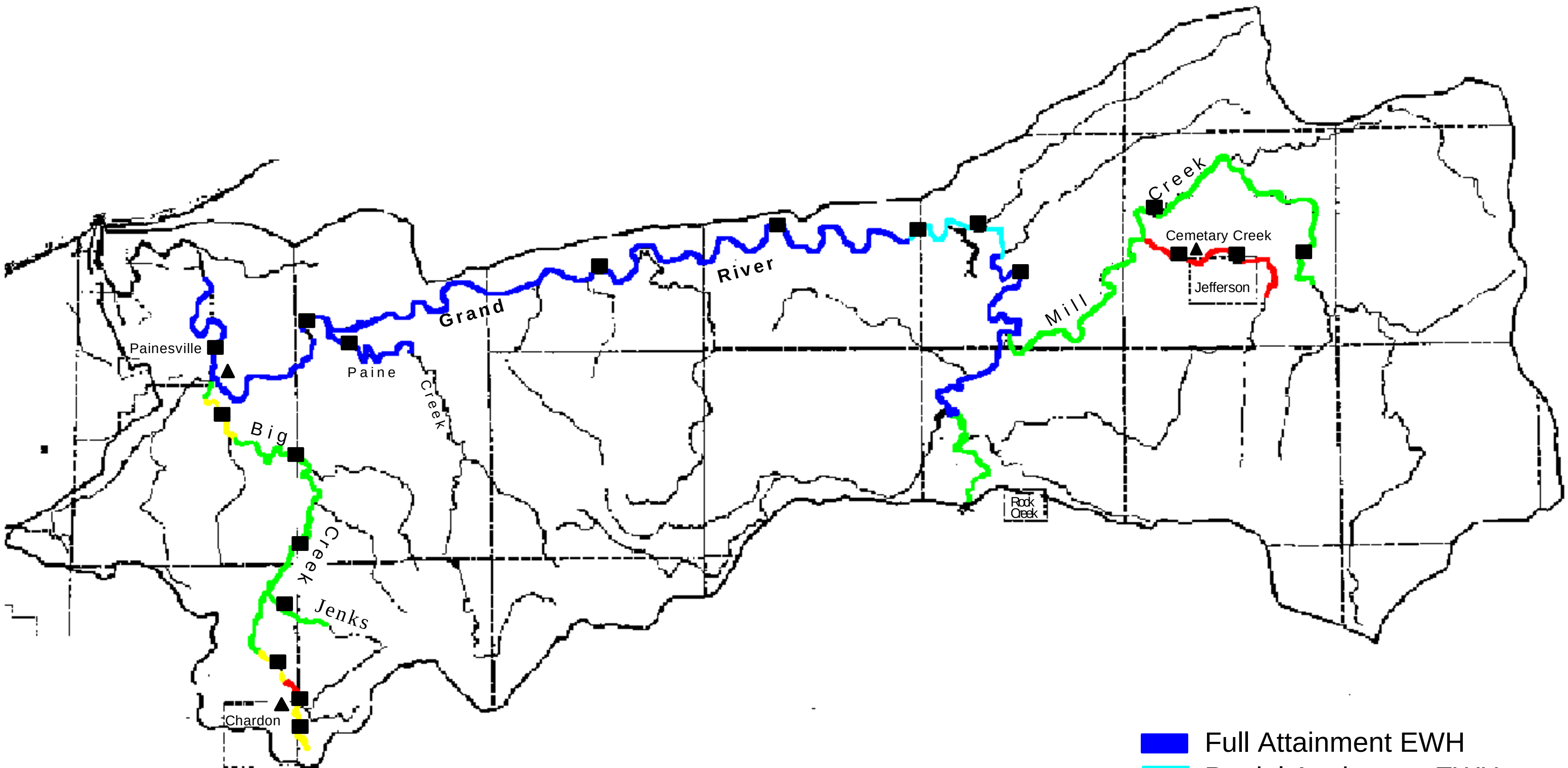


Figure 2. Attainment status for stream segments in the lower Grand River basin surveyed in 1995, based on performance of biological indicators. See Tables 1 and 2, respectively, for the use designation and attainment by segment or tributary, and specific sampling location.

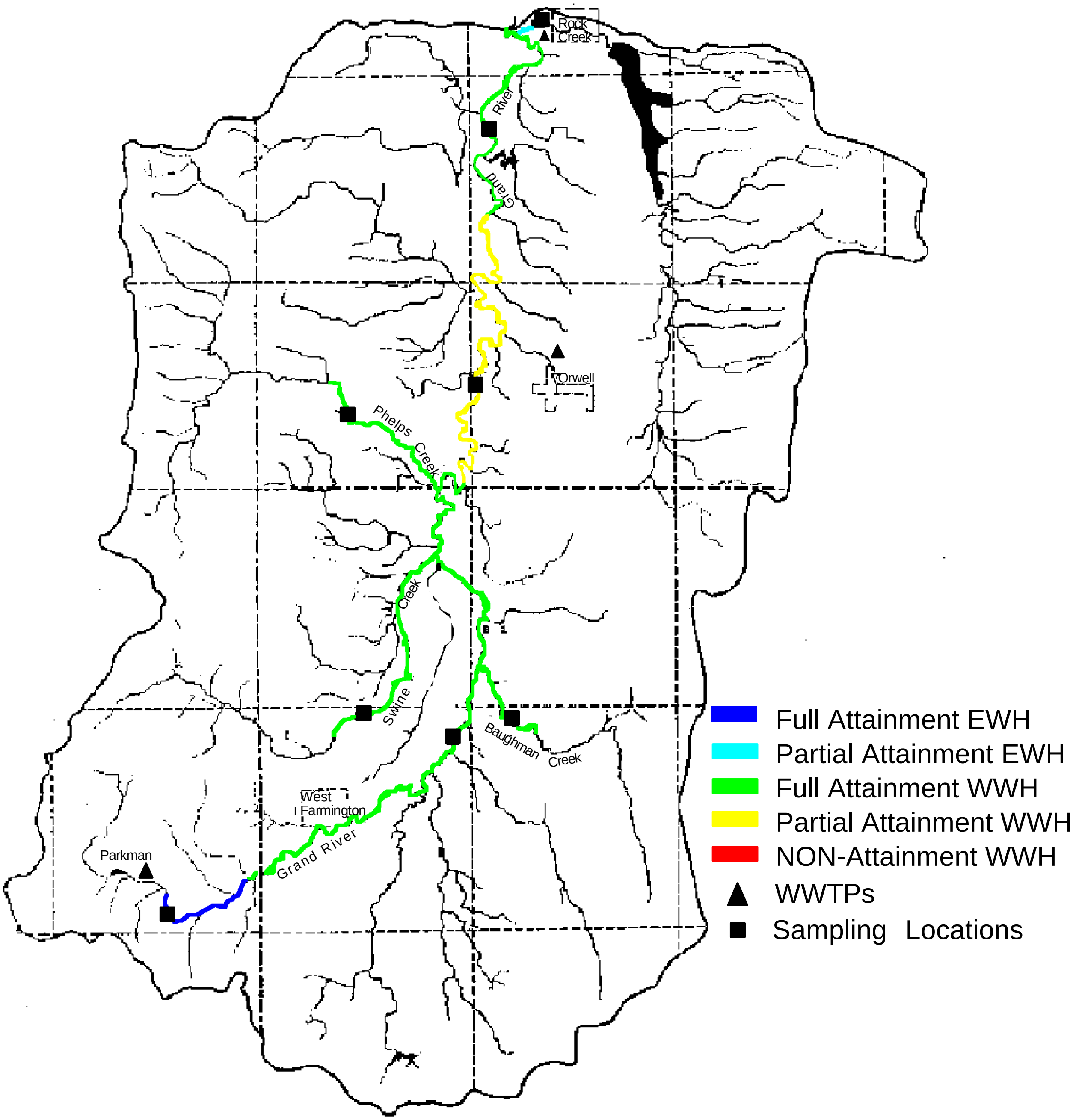


Figure 3. Attainment status for stream segments in the upper Grand River basin surveyed in 1995 based on performance of biological indicators. See Tables 1 and 2, respecitively, for the use designation and attainment by segment or tributary, and specific sampling locations.

Table 1. Aquatic life use attainment status for stations sampled in the Grand River basin based on data collected July-September, 1995. The Index of Biotic Integrity (IBI), Modified Index of well being (MIwb), and Invertebrate Community Index (ICI) are scores based on the performance of the biotic community. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biotic community.

River Mile Fish/Invertebrate	IBI	MIwb[a]	ICI[b]	QHEI	Attainment Status[c]	Comment
Grand River (1995)		*WWH existing/EWH proposed*				
94.3[H]/95.5	51	NA	E[b]	71	FULL/FULL	dst Parkman WWTP, EWH
			WWH existing			
83.5[W]/83.3	41	7.6	46	54	FULL	wetlands, WWH
65.9[B]/65.8	45	8.1*	46	57	PARTIAL	lentic, WWH
52.7[B]/56.0	45	8.7	34	62	FULL	lentic, WWH
		WWH existing / EWH proposed				
40.9[B]/44.7	49	9.2[ns]	42[ns]	67	FULL/FULL	lentic/lotic, EWH
36.3[B]/NA	47[ns]	8.5*		57	FULL/PARTIAL	lentic, EWH
34.0[B]/32.9	50	8.6*	E[b]	60	FULL/PARTIAL	lentic, EWH
			EWH existing			
28.4[B]/	54	10.1		82	FULL	EWH
28.4[W]/28.4	48[ns]	8.9[ns]	54	82	FULL	EWH
22.1[W]/22.6	48[ns]	9.5	50	88	FULL	EWH
13.4[B]/13.6	52	9.1[ns]	52	91	FULL	EWH
8.0[B]/8.5	52	9.2[ns]	E[b]	78	FULL	unsewered discharge, EWH
6.2[B]/6.2	47[ns]	9.4[ns]	44[ns]	76	FULL	EWH
Big Creek (1995)			*WWH existing*			
16.2[H]/16.2	40	NA	F[b]	62	PARTIAL	urban impacts
15.9[H]/16.0	37[ns]	NA	<u>12</u>*	54	**NON**	dst Chardon WWTP impact
13.9[H]/14.2	32*	NA	50	71	PARTIAL	impact/recovery
9.5[H]/9.4	38[ns]	NA	E[b]	73	FULL	recovery
5.3[W]/--	40	7.8[ns]	--	71	FULL	recovery, SSH
2.5[W]/2.5	36[ns]	6.7*	52	59	PARTIAL	marg. habitat, SSH
Jenks Creek (1995)			*WWH existing*			
0.1[H]/0.1	42	NA	E[b]	70	FULL	Headwaters “control” site
Baughman Creek (1995)			*WWH existing*			
3.0[H]/4.1	38	NA	50	51	FULL	reference, livestock access
Mill Creek (1995)				*WWH existing*		
18.1[W]/18.1	40	8.0	E[b]	80	FULL	reference, low flow

Table 1. Continued.

River Mile Fish/Invertebrate	IBI	MIwb	ICI	QHEI	Attainment Status	Comment
Mill Creek - continued.						
10.0[W]/12.1	47	8.6	G[b]	80	FULL	reference
Cemetary Creek (1995)			*WWH existing*			
2.5[H]/2.5	<u>26</u>[*]	NA	F[b]	42	**NON**	unsewered, impacted
		LWH existing[d]/WWH proposed				
1.3[H]/1.25	<u>27</u>[*]	NA	F[b]	56	**NON**/**NON**	dst Jefferson WWTP
Rock Creek (1995)			*WWH existing*			
0.8[W]/0.8	48	8.1	46	72	FULL	reference, part. EWH
Paine Creek (1995)			*WWH existing*			
0.2[W]/0.5	51	8.7	E[b]	75	FULL	ref., EWH, SSH
Phelps Creek (1995)			*WWH existing*			
4.9[W]/4.9	40	7.5[ns]	VG[b]	78	FULL	reference, nps, low flow
Swine Creek (1995)			*WWH existing*			
5.2[H]/5.2	44	NA	56	59	FULL	reference, nps

Ecoregion Biocriteria: Erie-Ontario Lake Plain

Site Type	IBI WWH	IBI EWH	IBI MWH[f]	MIwb WWH	MIwb EWH	MIwb MWH[f]
Headwaters	40	50	24			
Wading	38	50	24	7.9	9.4	5.6
Boat	40	48	24	8.7	9.6	5.7

H - Headwater site.
W - Wading site.
B - Boat site.
a - MIwb is not applicable to headwater streams with drainage areas ≤ 20 mi^2.
b - A qualitative narrative evaluation based on best professional judgement and sampling attributes such as community composition, EPT taxa richness, and QCTV scores was used when quantitative data were not available or considered unreliable due to current velocities less than 0.3 fps flowing over the artificial substrates.
c - Attainment status is given for both existing and proposed use designations.
ns - Nonsignificant departure from biocriteria (≤4 IBI or ICI units, or ≤0.5 MIwb units).
* - Indicates significant departure from applicable biocriteria (>4 IBI or ICI units, or >0.5 MIwb uits). Underlined scores are in the Poor or Very Poor range.
d - Limited Warmwater Habitat is an archaic use designation.
e - Low flows precluded use of boat method on the second pass.
f - Modified Warmwater Habitat criteria for channel modified habitats.

Table 2. Waterbody use designations for the Grand River basin. Changes to existing use designations appear in ***bold italics***; designations based on the 1978 water quality standards for which results of biological field assessments are now available appear as plus signs to the right of existing markers.

Stream Segment	**Use Designations**												
		Aquatic Life Habitat						**Water Supply**			**Recreation**		
	SRW	**WWH**	**EWH**	**MWW**	**SSH**	**CWH**	**LRW**	**PWS**	**AWS**	**IWS**	**BW**	**PCR**	**SCR**
Marsh Creek		*							*	*		*	
Mentor Creek and Mentor Marsh	*	*							*	*		*	
Black Brook		*							*	*		*	
Heisley Creek		*							*	*		*	
Grand River - Rt. 322 in Ashtabula Co. to Norfolk and Western railroad trestle south of Painesville	*	*							*	*		*	
U.S. 422 (RM 95.5) to SR 608 (RM 91.8)	*	*	▲						*	*		*	
SR 608 to Sweitzer Rd (RM 42.4)	*	*/+							*	*		*	
Sweitzer Road (RM 42.4) - to S.R. 2 (RM 5.5)	*	*	▲						*	*		*	
Harpersfield Dam (RM 30.9) to S.R. 2			+		o				*	*		*	
- S.R. 2 to mouth		*			o				*	*		*	
- all other segments		*							*	*		*	
Pebble Branch		*							*	*		*	

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Red Creek	▲	*			▲				*	*		*	
Kellogg Creek	▲	*/+			▲				*	*		*	
Ellison Creek		*							*	*		*	
Big Creek		*/+							*	*		*	
- from Girdled Rd (RM 7.1) to mouth		*/+			▲				*	*		*	
Gordon Creek		*							*	*		*	
East Creek		*							*	*		*	
Aylworth Creek		*				▲			*	*		*	
Jenks Creek		*/+							*	*		*	
Cutts Creek		*				▲			*	*		*	
Paine Creek from ***Paine Falls (RM 2.9 to mouth***	▲	*	▲		▲				*	*		*	
all other segments		*							*	*		*	
Bates Creek		*							*	*		*	
Phelps Creek		*							*	*		*	
Talcott Creek		*							*	*		*	
Griswold Creek		*							*	*		*	
Mill Creek	▲	*			▲				*	*		*	
Coffee Creek		*							*	*		*	
Center Creek		*							*	*		*	

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Mill Creek		*/+							*	*		*	
Cemetery Creek - Jefferson STP to confluence with Mill Creek		*L/+							*	*		*	
- all other segments		*/+							*	*		*	
Griggs Creek		*							*	*		*	
Askue Run		*							*	*		*	
Peters Creek		*							*	*		*	
Bronson Creek		*							*	*		*	
Trumbull Creek		*							*	*		*	
Spring Creek		*							*	*		*	
Three Brothers Creek		*							*	*		*	
Badger Run		*							*	*		*	
Rock Creek		*/+							*	*		*	
Plum Creek		*							*	*		*	
Sugar Creek		*							*	*		*	
Whetstone Creek		*							*	*		*	
Lebanon Creek		*							*	*		*	
Shanty Creek		*							*	*		*	
Crooked Creek		*							*	*		*	
Mud Creek		*							*	*		*	

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	**WWH**	**EWH**	**MWW**	**SSH**	**CWH**	**LRW**	**PWS**	**AWS**	**IWS**	**BW**	**PCR**	**SCR**
Hoskins Creek		*							*	*		*	
Indian Creek		*							*	*		*	
Montville Ditch		*							*	*		*	
Phelps Creek		*/+							*	*		*	
North Branch		*							*	*		*	
South Branch		*							*	*		*	
Mill Creek		*							*	*		*	
Garden Creek		*							*	*		*	
Swine Creek	▲	*/+							*	*		*	
Grapevine Creek		*							*	*		*	
Andrews Creek		*							*	*		*	
Plum Creek		*							*	*		*	
Coffee Creek		*							*	*		*	
Baughman Creek		*/+							*	*		*	
Center Creek		*							*	*		*	
Mud Run	▲	*							*	*		*	
Dead Branch	▲	*							*	*		*	
McKinley Creek		*							*	*		*	
Big Creek		*							*	*		*	

STUDY AREA

The Grand River watershed drains an area of 712.1 square miles or 455,744 square acres (See Figures 2-A and 2-B). The Grand River mainstem, 98.5 river miles in length, originates in Parkman Township, and flows east into Trumbull County, then north into Ashtabula County, then west into Lake County, where it flows into Lake Erie. The average gradient is 5.6 feet per mile (from an elevation of 1117 to 573 feet above mean sea level). Principal tributaries to the Grand River include Big Creek, Paine Creek, Mill Creek and Rock Creek. Impoundments within the Grand River watershed basin include Lake Roaming Rock, Armington Lake, Lake Cardinal and Cloverdale Lake; all are relatively small recreational waters. This watershed basin also includes Mentor Marsh, which is near the mouth of the river. Specific sampling locations are listed in Table 3.

The Grand River watershed is situated within the gently rolling dissected glacial plateau of the Erie-Ontario Lake Plain ecoregion. The majority of streams in this watershed are perennial. During the Pleistocene era varying thicknesses of glacial drift were deposited over Pennsylvanian shales and Mississippian sandstones. The majority of this watershed exists in ground moraines and end moraines. Only the northern section of this watershed lies in beach ridge deposited sediments. The preglacial valleys within the underlying bedrock shale and sandstone were also buried by glacial clays, sands and gravels. This watershed exhibits a mosaic of urban development, cropland, pasture, livestock, woodland and forest. Some oil/gas extraction occurs within the watershed.

The Grand River is one of only two rivers in Ohio designated as a State wild and scenic river. The scenic designation is 23 miles in length, from U.S. 322 downstream to the Harpersfield covered bridge in Ashtabula County. The riparian corridor consists primarily of elm, ash, maple, pine, pin oak and swamp white oak. The wild and scenic designation is 33 miles in length, from the Harpersfield covered bridge downstream to the Norfolk and Western railroad trestle in Lake County. This lower section is characterized by steeply-incised valley walls of chagrin shale. The Lake Metro Parks has acquired over 3,500 acres along the Grand River and conjoining tributaries. Over 95% of this property is in a natural state and will remain as such through the stewardship program.

Ohio Water Quality Standards (WQS;OAC 3745-1-25) list the current use designations for the Grand River system as: agricultural and Industrial Water Supply and Primary Contact Recreation. The mainstem in Geauga and Trumbull Counties, plus all tributaries to the Grand River have been designated Warmwater Habitat. The section of the mainstem identified as scenic has been designated Warmwater Habitat and State Resource Waters. The section of the mainstem identified as wild as been designated Exceptional Warmwater Habitat, State Resource Water and Seasonal Salmonid Habitat. Groundwater yields in the Grand River can range from less than 5 gallons per minute to 100 gallons per minute, depending on depth, thickness of aquifer and proximity to the source of recharge. In general, the groundwater yields are less than 5 gallons per minute around most of the mainstem.

The upper watershed remains relatively undeveloped due to the extensive swamps bordering the river, and distance from large urban centers. The flood plain in the lower watershed has remained largely undeveloped due to steep walls of Chagrin shale. The major existing or potential environmental threats to the Grand River include the Diamond Shamrock waste lagoons near Painesville, the Old Mill superfund site in Rock Creek, the remediated New Lyme landfill superfund site currently in operation and maintenance, the Jefferson WWTP, and the Orwell WWTP. Population in the Grand River watershed has increased nearly 7% between 1980 and 1990, while the population in northeast Ohio as a whole has decreased. Changing land use patterns are altering the types and rates of nonpoint source pollutants impacting the Grand River.

Nonpoint Sources

The quality of surface waters in Ohio have generally improved over the past 25 years. Credit must go to private industries and government entities who have improved point source discharges and upgraded sewage treatment facilities. Now Ohio's major water pollutants primarily come from nonpoint sources; storm water run-off which transports contaminants from broad areas of a landscape. Specific nonpoint source pollution concerns within the Grand River watershed include:

Construction Sites

Construction of individual houses, residential developments, commercial properties and industrial sites are occurring throughout this watershed. Uncontrolled storm water runoff from construction sites can carry tons of soil into local streams, and devastate aquatic communities. If the excavated area is to exceed 5 acres an NPDES permit must be filed with the Ohio EPA and a storm water management plan developed.

Farms, Orchards and Nurseries

The Grand River basin includes numerous farms, orchards and nurseries. Plowing fields to the edge of waterways can cause significant soil loss into local streams. Sudden sediment loads can totally change stream bottom habitat, which directly impacts the entire aquatic community. Over application or untimely application of herbicides/pesticides can stress or eliminate aquatic organisms. Fertilizer run-off can cause aquatic plants and algae to grow at high rates, creating an imbalance in the ecosystem.

Local Soil and Water Conservation Districts have been working with farms and nurseries on conservation practices. The districts have encouraged practices such as no-till farming, animal waste storage structures, minimal usage of chemicals, filter stripping, livestock exclusion fencing, etc.. Many of these operators have discovered that new techniques may not only improve the environment, they often save time and money. Continuing education throughout the watershed is necessary.

Failing Septic Systems

A major portion of the Grand River watershed is not serviced by sanitary sewers. A high percentage of the septic systems in this watershed are well beyond 20 years in age (the expected life of a system). Additionally, high percentages of clay content in the local soils contribute to the high failure rates of septic systems. Inadequately treated sewage can impact the water quality of roadside ditches, wetlands, streams and lakes. This can cause health hazards in drinking and recreational waters, decreased oxygen levels, excessive aquatic plant growth and offensive odors. Areas identified with large concentrations of failing septic systems include:

Lake County - Imperial Meadows Development (Painesville Township),

Trumbull County - Bristol,

Ashtabula County - Austinburg (Coffee Creek subwatershed); Driftwood Trailer Park and surrounding houses (Wheeler Creek subwatershed), and

Geauga County - Parkman.

Data indicating how many failing systems are within this watershed is currently not available.

Urban Runoff

Large and small communities have storm sewer systems which discharge to all of the watershed basins. Urbanized pollutants (*e.g.*, road salts, vehicle fluids, litter and debris, lawn chemicals, pet wastes) can be detrimental to local water quality. City ordinances and programs which help control these concerns are important. Educating the community at large about these effects is very important in establishing support for, and compliance with existing or proposed ordinances and programs. Furthermore, watersheds with greater than 25% of their area in impervious surfaces are not likely to support viable WWH biological communities (citation 1996).

Sanitary Landfills

Up to the mid 1970s it was common for every community and township to have at least one garbage dump. Many of these dumps closed when state regulations required licensing and daily cover. Some of these abandoned garbage dumps certainly continue to degrade surface water and groundwater. The garbage dumps which survived the mid 1970s evolved into sanitary landfills. More stringent state regulations continue to upgrade all existing sanitary landfills. Leachate from closed and operating landfills can negatively impact local groundwater quality. Major sanitary landfills in this watershed are listed by county.

Lake County- Lake County Baler near Painesville

Ashtabula County - Daugherty Sanitary Landfill (Cowles Creek subwatershed)
New Lyme Landfill (now in superfund operation and maintenance).

Trumbull County - None

Geauga County - None

Portage County - None

Timber Harvesting Operations

Heavy timbering activities are occurring in the Grand River watershed basin. Poor road layout and construction can contribute enormous volumes of sediment during active operations. If the timber has been over harvested, erosion will continue until a natural vegetative cover has been established. Professional foresters are available to monitor and educate timber harvesting operations.

Oil and Gas Extraction

Hundreds of oil and gas wells have been developed in this watershed basin. Oil and brine spills from a well or tank can devastate a local waterway. The Ohio Department of Natural Resources Division of Oil and Gas and the Ohio EPA Division of Emergency and Remedial Response have jurisdiction over spills.

Riparian Corridor Protection

Vegetation along the embankments of streams and lakes offers many benefits including stream bank stabilization, filtration of run-off waters, food source for fish and wildlife, cooler water temperatures, and habitat enhancement. Conservation easements, land trusts, education and responsible legislation are valuable tools for riparian corridor protection. Currently the Grand River Partners have a Section 319 grant and Nature Works money for obtaining conservation easements. These major nonpoint source activities all contribute to the water quality in this watershed basin. Educating public officials and local citizens abut nonpoint source issues is imperative. Developing watershed plans and implementing best management practices is equally important. By establishing committed partnerships improved, water quality in Ohio can be accomplished.

Table 3. Sampling locaitons in the Grand River study area, 1995 (C - conventional water chemistry, C_o - conventional plus organics; S - sediment metals, additional scans noted by the following subscripts: v = volatile organic compounds, b = base neutral acid extractable compounds, p = pesticide/polychlorinated biphenyls; B - benthic macroinvertebrates, F - fish, D - Datasonde®).

Stream/ River Mile	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 Minute Quadrangle Map
Grand River				
95.4	B,C	41 21 10 / 81 02 21	UST U.S. 422	Garrettsville
94.3	F	41 21 24 / 81 01 23	Ust Hobart Rd.	Garretsville
83.5	B,F,C,S_o	41 24 52 / 80 54 58	Hyde Rd.	West Farmington
65.9	F,C,S	41 32 04 / 80 54 04	Ust US 322	Windsor
65.8	B	41 32 09 / 80 54 04	Dst US 322	Windsor
56.0	B	41 39 01 / 80 52 11	Schaffer Rd.	East Trumbull
52.7	B,F	41 38 12 / 80 53 24	Callender Rd.	East Trumbull
44.7	B	41 41 48 / 80 53 39	Fobes Rd.	East Trumbull
42.4	C	41 42 36 / 80 52 11	Sweitzer Road	East Trumbull
39.9	F	41 43 26 / 80 52 07	Cork Cold Springs Rd.	East Trumbull
36.3	F,C,S	41 45 19 / 80 52 07	Tote Road	Ashtabula South
34.0	F,C	41 45 30 / 80 54 30	Sexton Rd.	Geneva
32.9	B	41 45 14 / 80 55 07	Dst Mechanicsville	Geneva
28.4	B,F,C	41 45 27 / 80 58 14	Brandt Rd.	Geneva
22.6	B	41 44 27 / 81 02 49	Ust SR 528	Thompson
22.1	F,C	41 44 32 / 81 03 05	Dst SR 528	Thompson
13.6	B,C	41 43 32 / 81 11 09	Dst Vrooman Rd.	Painesville
13.4	F	41 43 47 / 81 11 06	Dst Vrooman Rd.	Painesville
8.5	B,C,D	41 43 09 / 81 13 39	Dst SR 84	Painesville
8.4	F	41 43 16 / 81 13 58	Dst SR 84	Painesville
6.2	B,C,F,S_o	41 44 03 / 81 14 09	@ Recreation Park	Painesville
Big Creek				
16.3	C	41 35 03 / 81 11 25	Ust Chardon WWTP	Chardon
16.2	B,F,D	41 35 20 / 81 11 30	Ust Chardon WWTP	Chardon
16.0	B	41 35 25 / 81 11 28	Dst Chardon WWTP	Chardon
15.9	F	41 35 24 / 81 11 30	Dst Chardon WWTP	Chardon
15.8	C	41 35 28 / 81 11 26	Dst Chardon WWTP	Chardon
15.1	D	41 35 59 / 81 11 48	Adj residential area	Chardon
14.2	B,C	41 36 19 / 81 11 59	Ust Woodin Road	Chardon

Table 3. Continued.

Stream/ River Mile	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 Minute Quadrangle Map
Big Creek - continued.				
13.9	F,D	41 36 26 / 81 12 02	Dst Woodin Road	Chardon
9.5	B,F,D	41 38 52 / 81 11 18	Ust SR 608	Chardon
5.2	F	41 40 40 / 81 11 38	Adj Cascade Rd	Painesville
5.0	F,C	41 40 49 / 81 11 58	Ust Williams Rd	Painesville
2.5	B,C,F,D	41 41 09 / 81 13 24	Ust Fry Rd	Painesville
Jenks Creek *(trib. to Big Creek)*				
0.1	F,B_q, C	41 37 51 / 81 12 17	@ Robinson Rd	Painesville
Mill Creek				
18.2	F,B,C,S_o	41 44 16 / 80 43 54	Dst Netcher Rd	Dorset
12.1	B	41 46 54 / 80 45 50	Ust SR 46	Ashtabula South
10.0	F,C,S_o	41 45 44 / 80 47 25	Ust Doyle Rd	Ashtabula South
Cemetary Creek				
2.5	F,B,C	41 44 38 / 80 45 48	Ust Market St	Jefferson
2.1	C	41 44 45 / 80 46 11	Dst Chestnut St	Jefferson
1.3	F	41 44 39 / 80 46 50	Ust Poplar St	Jefferson
1.25	B,C	41 44 40 / 80 46 55	Dst Poplar St	Jefferson
Baughman Creek				
4.1	B	41 24 37 / 80 52 07	Ust SR 45	Bristolville
3.3	C,S_o	41 25 10 / 80 52 38	Messic Rd	West Farmington
3.0	F	41 25 05 / 80 52 50	Messic Rd	West Farmington
Rock Creek				
0.8	F,B,C	41 39 38 / 80 51 56	Union Cemetary	Jefferson
Paine Creek				
0.5	B,C	41 43 01 / 81 10 14	Ust Seely Rd	Painesville
0.3	F	41 43 10 / 81 10 21	Dst Seely Rd	Painesville
Phelps Creek				
5.3	F,B,C	41 42 39 / 80 57 50	Adj Wiswell Rd	Windsor
Swine Creek				
5.2	F,B,C	41 25 20 / 80 57 20	Ust SR 534	West Farmington

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 xx.

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 7-17). 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 (see 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 comments and observations for each sampling location.

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 7-17). 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) in conjunction with a qualitative assessment of the available natural substrates. During the present study, macroinvertebrates collected from the natural substrates were also evaluated using an assessment tool currently in the testing and refinement 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 Grand and Ashtabula River study areas, 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 Grand and Ashtabula study areas 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 using wading or boat method pulsed DC electrofishing gear. The wading method was used at a frequency of one or two samples at each site. The boat method was used at a frequency of two samples at each site except at RM 28.1 of the Grand River where the boat method was used on the first pass, and the wading method on the second pass due to low flows.

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 togather. 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.

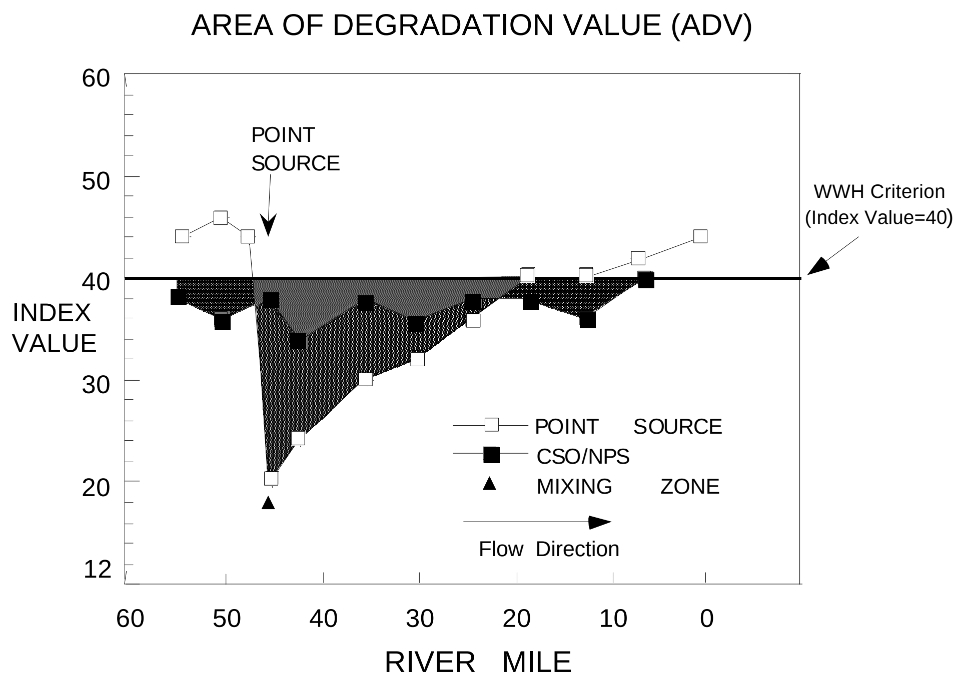


Figure 4. Graphic illustration of the Area of Degradation Value (ADV) based on the ecoregion biocriterion (WWH in this example). the index value trend line indicated by the unfilled boxes and solid shading (area of departure) represents a typical response to a point source impact (mixing zone appears as a solid triangle); the filled boxes and dashed shading (area of departure) represent a typical response to a nonpoint source or combined sewer overflow impact. The blended shading represents the overlapping impact of the point and nonpoint sources.

RESULTS AND DISCUSSION

Pollutant Loadings: 1985 - 1995

Grand River - Vari-Seal (RM 100.5)

Vari-Seal is a rubber extruding operation using a liquid sodium nitrate-nitrite salt bath for rubber curing. The facility has both contact and non-contact cooling water discharges. Sanitary wastes are disposed in an on-lot dissipation system. The cooling water treatment system consists of an aerated lagoon discharging to an unnamed ditch to the Grand River. Sanitary wastes are disposed in an on-lot dissipation system.

In 1989, Ohio EPA sampling showed a noticible increase in nitrates (from 1.49 to 4.63) in the Grand River downstream from the Vari-Seal discharge while there were no significant in-stream BOD and TSS increases. High iron concentrations in the facility's source water were noted causing stains in the treatment lagoon and discharge ditch. High, naturally occuring iron concentrations are common in the area as evidenced by the iron stains along the bedrock outcroppings in the Grand River.

The facility has reduced TSS loadings since 1992 with no obvious trend in nitrate-nitrite or other pollutant loadings. One oil & grease violation was reported in June 1994. The treatment lagoon was short circuited in 1995 which resulted in elevated TSS, chlorine and nitrate-nitrite concentrations. Per a consent agreement, the facility submitted a best management practices plan to reduce spills and impact from on-site storage and use of salts. Also, contact cooling water is to be changed to a closed loop system. Therefore, only non-contact cooling water will be discharged.

Bioassay tests between 1991 and 1996 of the Vari-Seal effluent were not acutely toxic to fathead minnows. One test indicated toxicity at the nearfield instream site for fathead minnows but 100% effluent was not toxic. Eight of 12 effluent tests were acutely toxic to *Ceriodaphnia*.

Grand River - Parkman unsewered area (RM - 98)

This small community (3,300 in the township) is unsewered. Many of the residential and commercial properties have no treatment systems and are connected directly to storm sewers which discharge to the Grand River. A developer has proposed to construct a new WWTP for a proposed subdivision. The new plant will allow existing homes in the community to connect to the proposed WWTP and eliminate the untreated or poorly treated discharges to the river.

Unnamed Tributary to Grand River - Nelson Ledges Estates WWTP (RM 94.72/1.59/0.4)

The Nelson Ledges WWTP currently consists of a trash trap, aeration, chlorination and sludge storage. This plant is hydraulically overloaded which results in frequent violations of their NPDES discharge permit for cBOD5, TSS and D.O.. Findings and Orders were issued in 1994 to upgrade the facility.

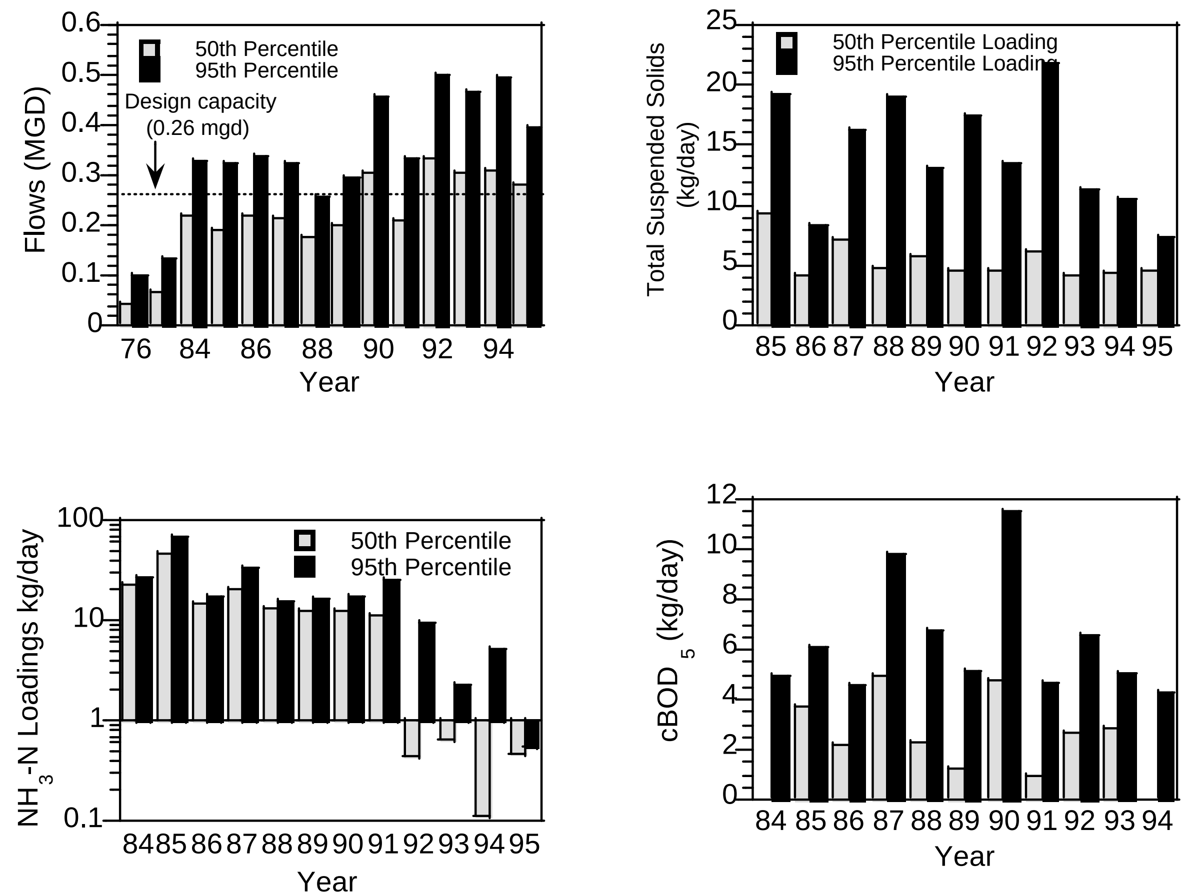
Unnamed tributary to the Grand River - Village of Orwell WWTP (RM 62.6/2.6)
The Village of Orwell WWTP was built in 1968 and modified in 1981 and upgraded in 1992 to advanced secondary treatment. Design flow of the plant is 0.260 MGD (Figure 4). Current treatment processes include an aerated equilization basin, three oxidation ditches operated in parallel, settling, sludge storage tank and lagoon, and chlorination. The final effluent is discharged to an unamed tributary that enters the Grand River at RM 62.60. The WWTP has a long history of compliance problems with total suspended solids (TSS), five-day carbonaceous biochemical oxygen demand ($cBOD_5$), fecal coliform bacteria and ammonia-N (NH_3). Ohio EPA inspections and a citizen's complaint identified poor quality effluent (solids, gray discoloration, foam) from the facility.

Despite the compliance problems at the WWTP, average daily ammonia-N loadings reported by the Orwell WWTP have declined recently even though the average daily flows have increased (Figure 4). The ammonia-N reductions have resulted in dramatically lower reported ammonia-N concentrations in the unnamed tributary downstream from the facility's discharge. Average total phosphorus (Total P), total suspended solids (TSS) and five day carbonaceous biochemical oxygen demand ($cBOD_5$) loadings have remained fairly constant. However, the 95th percentile loadings for these parameters appear to be decreasing which indicates relatively better operation and maintenance of the WWTP (Figure 4).

The Village has a large volume industrial user, Kennametal, which discharges greater than one half of the wastewater flow (0.17 MGD) to the Orwell WWTP. Kennametal manufactures metal cutting inserts (e.g. drill bits) with tungsten carbide and titanium carbide coatings. The manufacturing process includes chemical vapor deposition, grinding and electropolishing. Their pretreatment permit includes limits for pH, fluoride, copper, molybdenum, and nickel.

Increased flows may be attributed to acknowleged infiltration and inflow into the sanitary sewers or the Kennametal discharge. These low nutrient, high flow, discharges may be contributing to operating problems at the plant.

Rock Creek - New Lyme Landfill WWTP (RM 50.59/9.61/5.6)
The New Lyme Landfill was a 42 acre disposal facility for residential, commercial and industrial wastes. The site is located at the headwaters of the Lebanon Creek (tributary to Rock Creek) and Pymatuning Creek (tributary to the Shenango River) watersheds. The landfill was closed in 1979 by the Ashtabula County Health Department for inadequate disposal practices and for producing leachate that entered Lebanon Creek. A U.S. EPA remedial investigation was conducted in 1983-4 under CERCLA (aka. Superfund) and found various organic and inorganic contaminants as well as asbestos fibers at the site. As a result, remedial action was conducted to treat contaminated groundwater, prevent groundwater and rainfall from entering the wastes, and



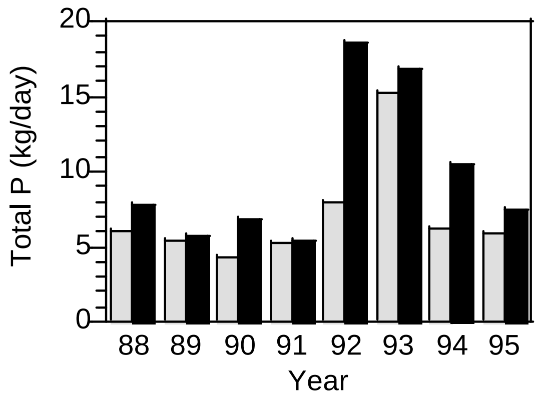


Figure 5. Trends in 50th and 95th percentile flows and pollutant loadings by the Orwell WWTP to an unnamed tributary to the Grand River at RM 62.6. All graphs represent 3rd quarter data.

to minimize direct exposure to humans. A multilayer (synthetic liner, geotextile drainage net, filter fabric, clay and soil) cap was constructed over the landfill. A new wetland was created on the site from a borrow pit of 700,000 CY of clay used for the cap. The Ohio Department of Natural Resources now manages the wetland. A groundwater extraction and treatmentsystem was installed as well as a gas collection and passive venting system .

Rock Creek - Old Mill Site WWTP (RM 50.59/1.82/0.3)
The Old Mill site covers a total of 13 acres in Rock Creek Village. This site was used for the storage of materials for the supposed manufacture of potting soil additives. Superfund monies were used for the Emergency Removal of 1200 drums of waste solvents, oils, resins and polychlorinated biphenyls (PCBs). Many of the drums were in poor condition and had leaked into the soil which required the excavation and off-site disposal of 80 yd^3 of contaminated soil. These removal activities occurred in 1981-2.

A Remedial Investigation was conducted in 1983–4. As a result, 1,1,1-trichloroethane (TCA) (6100 μg/l), TCA degredation products, ethylbenzene, xylene, polynuclear aromatic hydrocarbons and heavy metals such as lead were found in soils and groundwater at the site. These findings resulted in the removal of an additional 12,100 yd^3 of soils and the completion of a groundwater monitoring, extraction and treatment system in 1990. Additional trenches were constructed on site in 1992 to collect fugitive contaminants. Currently, groundwater at the site still exceeds drinking water maximum concentration limits.

The groundwater treatment system is an air stripping tower designed for a wastewater flow of 10 gpm and is expected to be needed for 30 years. The treated wastewater contains concentrations less than the laboratory method detection limit of 1.0 μg/l of dichloroethane, trichloroethane, trichloroethylene and tetrachloroethane and is discharged to an unnamed tributary to Rock Creek.

Rock Creek - Village of Rock Creek WWTP (RM 50.59/1.1)
The Village of Rock Creek WWTP is a 0.07 MGD plant built in 1990. Treatment consists of extended aeration, activated sludge, settling, slow surface sand filters, aerated sludge holding, chlorination, dechlorination and sludge drying beds. A 1992 inspection indicated problems with sludge handling at the facility.

In June, July and August of 1993 there were permit violations for ammonia-N (9.3, 7.84, 1.83 -30 day average and 32, 5, 23.1 for 7day average). Fecal coliform bacteria permit violations occurred in August 1993 . Dissolved oxygen violations occurred in June (21 of 30 days), July (19 of 31), August (16 of 31), September (9 of 30) and October (10 of 31) 1993.

Rock Creek - Village of Roaming Shores WWTP (RM 50.59/2.6)
The Roaming Shores WWTP was built 1968 and upgraded in 1987. The facility has a design flow of 0.120 MGD. Treatment includes comminutors, bar screen, extended aeration/ activated sludge, settling, polishing pond, aerobic sludge digestion, chlorination and dechlorination.

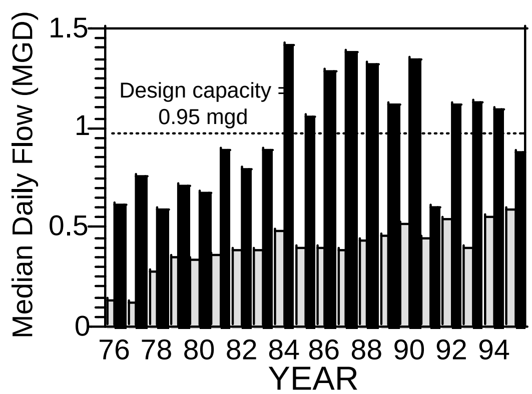
The plant usually produces a good quality effluent and is in general compliance with their NPDES permit.

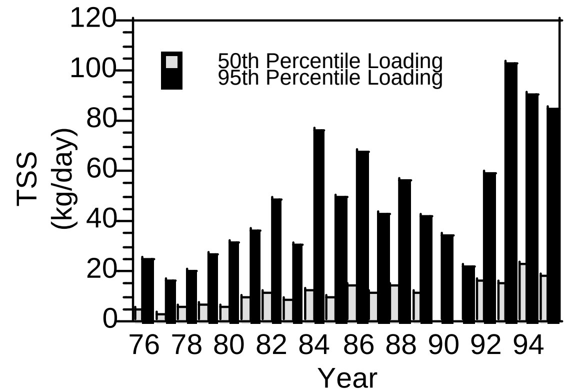
Cemetery Creek - Jefferson Village WWTP (RM 41.28/8.42/1.65)
The Village of Jefferson WWTP was built in the 1950s as an activated sludge plant. It was improved and expanded to 0.95 MGD in 1974 (Figure 5). Treatment processes include comminutor and bar screens, flow equalization, primary settling, aeration, secondary settling, chlorination, aerobic sludge digestion, belt filter press and sludge drying beds. Cemetery Creek is a zero low flow stream. During low flow conditions, the creek essentially begins at the WWTP discharge and any malfunctions at the plant can have an immediate adverse impact on the stream. Total suspended solids, $cBOD_5$, total phosphorus and ammonia-N loadings have increased at the Jefferson WWTP, especially in the last four years.

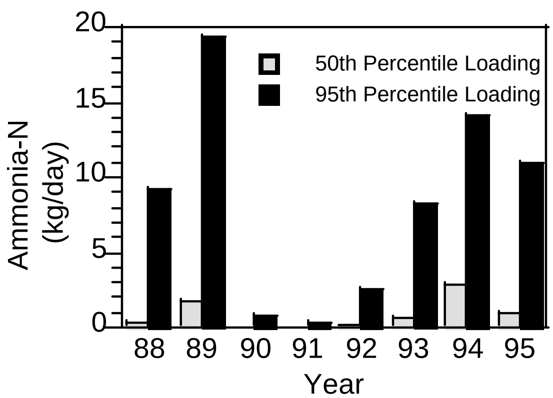
The facility has a long history of operation and maintenance problems that have resulted in bypasses of treatment processes, discharge of sludge to the stream and violation of their NPDES permit for ammonia-N, chlorine, TSS, $cBOD_5$ and phosphorus. Past MOR data is also suspect because of laboratory problems found during inspections. Ohio EPA offered, and the Village accepted, operation assistance at the WWTP in March 1993. The operation assistance team made several recommendations including: flow monitor calibration, better charting of current laboratory and process control data, investigate and correct inflow and infiltration (I&I) problems, redesigning secondary clarifiers, rerouting waste activated sludge, reconfiguring scum trough, and an alternative chlorine delivery system.

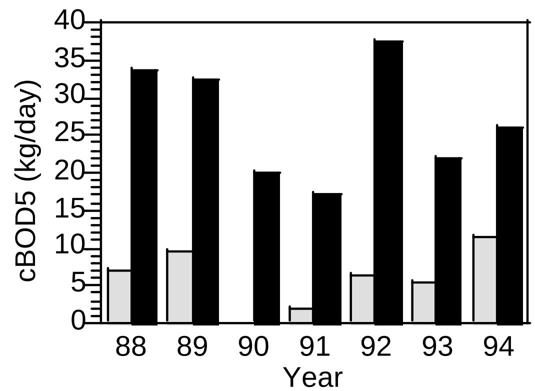
Cemetery Creek - Poplar Oil Landfill WWTP (RM 41.28/8.42/1.25)
This site ia located downstream from the Jefferson WWTP adjacent to Cemetery Creek . The facility was originally the site for greenhouses used to grow tomatoes. The owner accepted waste oil for boiler fuel to heat the greenhouses. The waste oil contained solvents and PCBs and dioxin was produced in the oil fired boilers. Wastes from treatment of the waste oils and runoff from the facility were treated in on–site ponds and discharged to Cemetery Creek. The operation resulted in Ohio EPA enforcement actions in the late 1970's for air and wastewater emisions. Several emergency removal actions were conducted at the site to prevent oils from spilling into the creek. Waste oil generators removed 250,000 gallons of waste oil in 1986.

Final cleanup of the site resulted in the removal of an additional 6200 gallons of oil, the treatment and disposal of 164,360 gallons of wastewaster and the incineration of 280,000 gallons of waste and 3000 CY of contaminated soils and sludges. Remaining wastes (including dioxin wastes) and ashes were buried under a multilayer cap and the site was prepared to prevent groundwater infiltration into the site. The site is considered remediated and there is no curent on-site treatment.









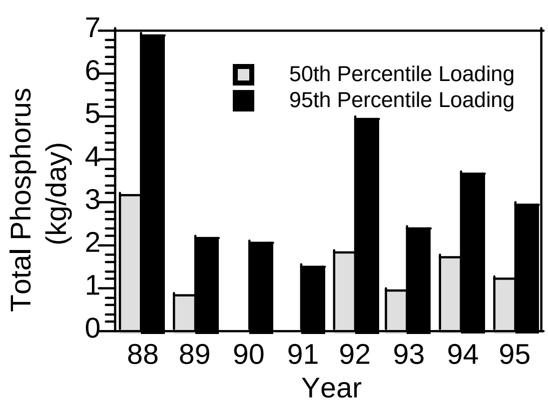


Figure 6. Trends in 50th and 95th percentile flows and loadings of pollutants to Cemetery Creek by the Jefferson WWTP. All graphs depict 3rd quarter data.

A 1994 study by the Village revealed severe I&I inputs to the sanitary sewer system including storm water (roof drain) connections. Consent Orders were issued in 1987 and 1995 to address operation problems at the facility that resulted in violation of their NPDES permit limits. A schedule of compliance for the Findings and Orders were amended several times due to engineering problems encountered by the Village. New construction to comply with the 1995 Order was completed in January 1996.

Big Creek - Chardon Village WWTP (RM 9.32/16.1)
The Chardon Village Waste Water Treatment Plant was originally built in 1916 and the most recent upgrade to the facility was completed in 1989. The current treatment facility consists of: flow equalization basins, bar screens, grit chamber, comminutor, primary settling, trickling filters, intermediate settling, activated sludge-nitrification, phosphorus removal, final settling, sand filters, and chlorination. Sludge is processed in aerobic digestors, sludge drying beds and a belt filter press. The Village installed de-chlorination in June 1995 one year prior to requirements in their permit.

In 1988, Chardon was referred to the Attorney General's Office for not meeting the final effluent limits for ammonia-N established in the NPDES permit compliance schedule. The Village claimed there was insufficient time in the compliance schedule to meet the final effluent numbers. A 1989 consent agreement established June 1, 1989 as the date to comply with the permit limits. In 1990 Ohio EPA requested a new General Plan citing expansion of the Chardon service area and anticipated increased flows. In 1991, the Village responded to Ohio EPA's recommendation and stated that the existing capacity at the plant should be sufficient for the next ten years. Monthly average flows for some months in 1993 and 1994 exceeded the design flow of 1.1 MGD (Figure 6). Chardon submitted a General Plan to Ohio EPA in 1994 for expansion from 1.1 to 2.0 MGD.

A new General Plan for the Chardon WWTP was reviewed by Ohio EPA in 1995. The Agency is awaiting biological and water quality modeling information from the 1995 sampling prior to issuing a decision on the General Plan. The Plan calls for replacing the current treatment system with a new treatment design which includes an equalization basin, oxidation ditch, sand filters, chlorination and de-chlorination. Existing aeration tanks will be converted to sludge holding tanks.

Dramatic reductions in ammonia-N, $cBOD_5$ and TSS occurred after the new processes in 1989 were brought on line (Figure 6). Also, the plant has reduced nitrate-nitrite loadings following implementation of nitrification. Mercury, copper and zinc are elevated in the WWTP effluent. Chardon currently does not have metal limits in the permit. Bioassay tests performed by the facility indicate there is no acute toxicity in the Chardon WWTP discharge.

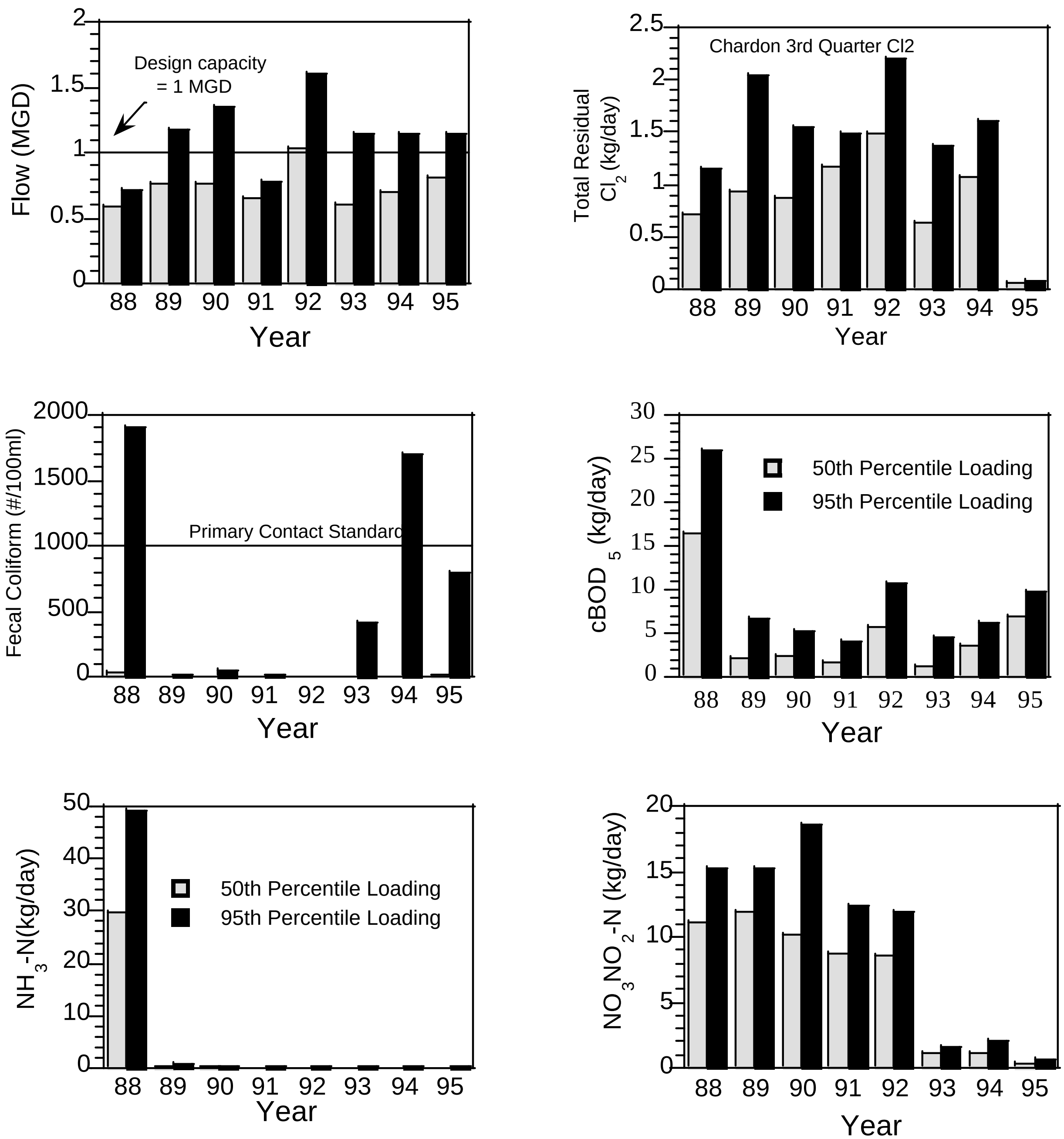


Figure 7. Trends in 50th and 95th percentile flows and pollutant loadings to Big Creek by the Chardon WWTP. All graphs depict 3rd quarter loadings.

Cutts Creek - Terrace Glen Estates WWTP (RM 9.32/15.72/2.3)
This treatment plant is located on Woodin Road in Hambden Township and has a design flow of 0.02 MGD for 99 connections. Treatment systems include trash trap, extended aeration, settling, dosing chamber, surface sand filter and chlorination.

The WWTP has had a history of operational problems which has resulted in citizen's complaints and frequent violations of ammonia-N, TSS and fecal coliform bacteria. Severe infiltration and inflow causes plant bypasses during storm runoff events. Sludge handling has also been problematic and sludge deposits have been observed in the stream. The facility has also failed to submit required monthly operating reports.

Unnamed Tributary to East Creek - Lake County Sunshine Acres WWTP (RM 9.32/6.25/1.48/1.2)
This treatment facility is located at Lester Drive and S.R. 86 in Leroy Township. It was built in 1961 and has a design flow of 0.020 MGD. Treatment consists of a bar screen (changed from a comminutor in 1988), extended aeration, settling, chlorination, sand filters and a sludge holding tank. The sand filters were installed in 1988 in response to TSS and $cBOD_5$ violations. Diffused air was added in 1990 to raise the low dissolved oxygen in the effluent. The 1994 average annual flow for the WWTP was 0.007 MGD from 48 connections.

Big Creek - Lake County Rio Grande WWTP (RM 9.32/4.04/1.18/1.3)
This treatment plant was built in 1976 and is located on Leroy Center Road in Concord Township. Design flow for this plant is 0.0215 MGD. Treatment includes comminutoin, extended aeration, sludge holding, rapid sand filtration and chlorination. Additional diffused air was added in 1990 to raise DO. The 1994 average annual flow for the WWTP was 0.007 MGD for 33 connections. This facility discharge is in general compliance with their permit but failed to report some temperature and total phosphorus data in 1994 and 1995.

Big Creek - Lake County Far Hills WWTP (RM 9.32/2.85/1.25)
This treatment plant was built in 1975 and is located on Christian Drive in Concord Township. Design flow for this plant was 0.040 MGD. Treatment systems included bar screen, extended aeration, sludge holding tank, rapid sand filter, chlorination and surface sand filter (for rapid sand backwash). This plant was susceptible to upsets and had reported occasional violations of TSS, cBOD5, DO, NH3 and fecal coliform bacteria. The 1994 average annual flow for the WWTP was 0.0520 MGD. This plant was abandoned in January 1995 and converted to a pump station to the Mentor WWTP.

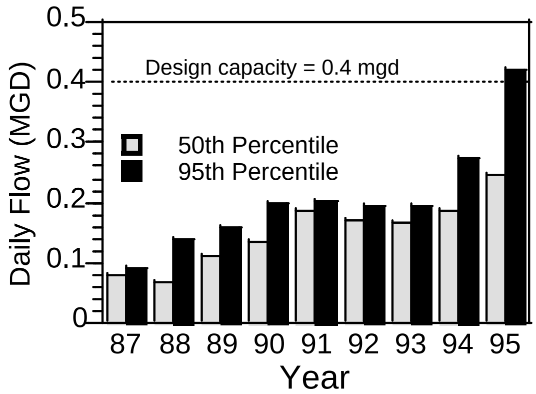
Kellogg Creek - Lake County Concord Kellogg WWTP (RM 9.32/0.17/1.2)
This activated sludge treatment plant is located on Cheryl Drive in Concord Township. The facility was built in 1978 and is designed for 0.037 MGD. Treatment consists of fine and course screening, aeration, settling, sand filtration, chlorine contact and sludge holding. This plant has been susceptible to upsets and improvements in operation and maintenance in 1990 have reduced

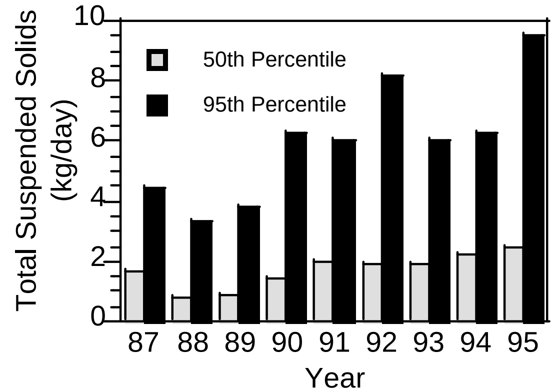
problems at the plant. The 1994 average annual flow for the WWTP was 0.0230 MGD for 82 connections.

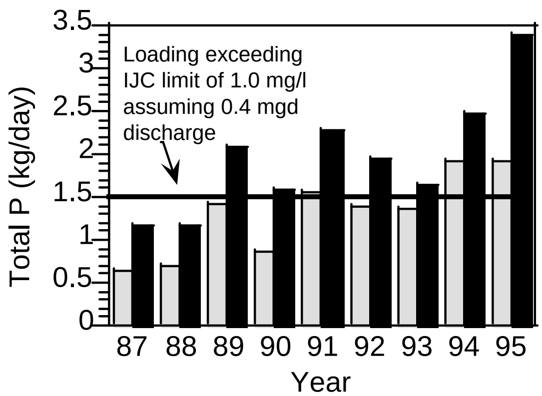
Grand River - Lake County Heatherstone WWTP (RM 8.8)
The Heatherstone WWTP was constructed in 1975 and discharges to the Grand River at RM 8.8. The discharge is near the downstream boundary (State Route 84 at RM 8.5) of the State Resource Water Use Designation for the Grand River. The treatment system consists of comminution, aeration, sludge holding and drying beds, rapid sand filters, and chlorination. Design flow for the WWTP is 0.400 MGD. The average annual flow is 0.196 MGD. There is no phosphorus removal.

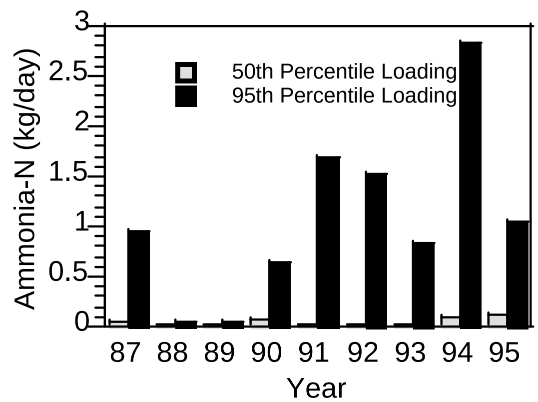
The facility failed to meet deadlines for October 1995 dechlorination (sodium bisulfate) as stated in their General Plans. The facility generally meets effluent limits, but has had several monitoring frequency violations and several scattered ammonia-N, total suspended solids (TSS), fecal coliform bacteria and total residual chlorine violations from 1984 to 1991. Loadings of $cBOD_5$ have increased more than can be attributed to increased in flow. Also, 95th percentile ammonia-N loadings show an exponential increase in ammonia-n loading to the Grand River (Figure 7). Inspection by Ohio EPA staff indicated improper sludge wasting as the cause of the ammonia-N and TSS violations, and the consequent additional $cBOD_5$ loadings. Treatment plant removal efficiencies have remained constant for TSS, and total phosphorus concentrations, resulting in increased loadings with increased flows. Lake County has stated that they will probably request an expansion at Heatherstone in the near future for increased flow from the current 0.4 MGD design capacity to flows ranging from 2.0 to 4.0 MGD.

Red Creek - Lake County Park Estates WWTP (RM 4.82/2.78)
This plant was eliminated in August 1994 and is now a pump station to the Heatherstone WWTP. The plant design was for 0.055 MGD and was built in 1977. Treatment consisted of extended aeration, settling, chlorination, rapid sand filters and a sludge holding tank . In 1990, the sludge collection system was replaced and the filters were reconditioned and diffused air was added to raise low DO in the effluent. The 1994 average annual flow for the WWTP was 0.0820 MGD for 143 connections.









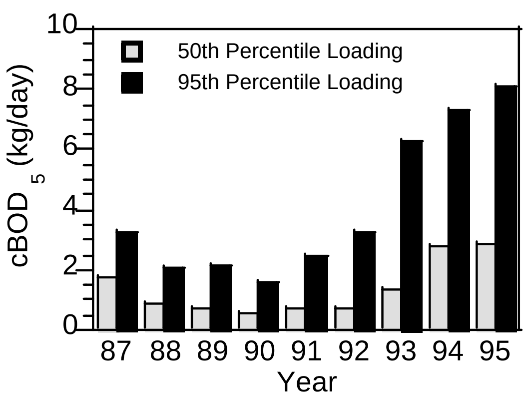


Figure 8. Trends in 50th and 95th percentile flows and pollutant loadings by the Heatherstone WWTP to the Grand River at RM 8.5. All graphs represent 3rd quarter data.

Spills, Overflows, and Unauthorized Releases

Pollutant discharges from spills are not a significant source of lethal and sublethal stresses for aquatic communities in the Grand River watershed. Only six incidents have been recorded in the Grand River Basin by the Ohio EPA Emergency Response Section during 1995. Petroleum related spills released 6240 gallons and accounted for 99.9% (5 events) of the spills. Crude oil was the most common petroleum contaminant spilled with one spill near West Farmington responsible for 6000 of the 6340 gallons of materials spilled in 1995. The only non-petroleum related "spill" reported in 1995 was 100 gallons of leachate from sawdust piles at a saw mill. Overflows, permit violations, and other unauthorized releases to Cemetery Creek from the Jefferson WWTP and sewer system were chronic problems until the expansion at the facility was completed.

Fish Kills

A review of Water Pollution, Fish Kill and Stream Litter Investigation Reports from the Ohio Division of Wildlife covering the period 1985-1995 revealed no fish kills on the Grand River mainstem. Thirteen fish kills have been reported, however, in the upper Grand River basin in Ashtabula and Trumbull counties, all occurring on different tributaries. Six of the thirteen kills involved petroleum products (*e.g.*, gasoline, diesel fuel, fuel oil), likely the result of transfer spills. The remainder resulted from releases by commercial or agricultural enterprises.

Chemical Water Quality

Grand River

Water quality sampling (excluding fecal coliform) was conducted five times between July 12 and September 6, 1995 in the Grand River basin from 11 stations on the mainstem and 17 stations on tributary streams. All stations were sampled on the same day for each of the five sampling events. Samples were generally collected under low stream flow conditions ranging from 66 to 608 ft^3/s as measured at the U.S.G.S. gaging station (# 04212100) at RM 8.5 on the Grand River (located on the west side of State Route 84 north of Painesville). The period of record for this gage is from 1974 to present. Minimum average daily discharge observed at the Painesville station was 5.1 ft^3/s in 1991. Maximum average daily discharge was 15300 ft^3/s in 1985. Annual mean flow at the Painesville station for the period of record is 663 ft^3/s. Natural Q_{7-10} for the period May to November is calculated by U.S.G.S. as 26.7 ft^3/s (0.089 $ft^3/s/mi^2$).

Samples were collected under relatively low stream flow conditions, ranging from 66 to 608 ft^3/s (Figure 8). Low flow sampling was conducted to document possible exceedences of chronic (i.e. 30-day average) water quality standards and to determine possible impacts from NPDES permitted wastewater treatment facilities.

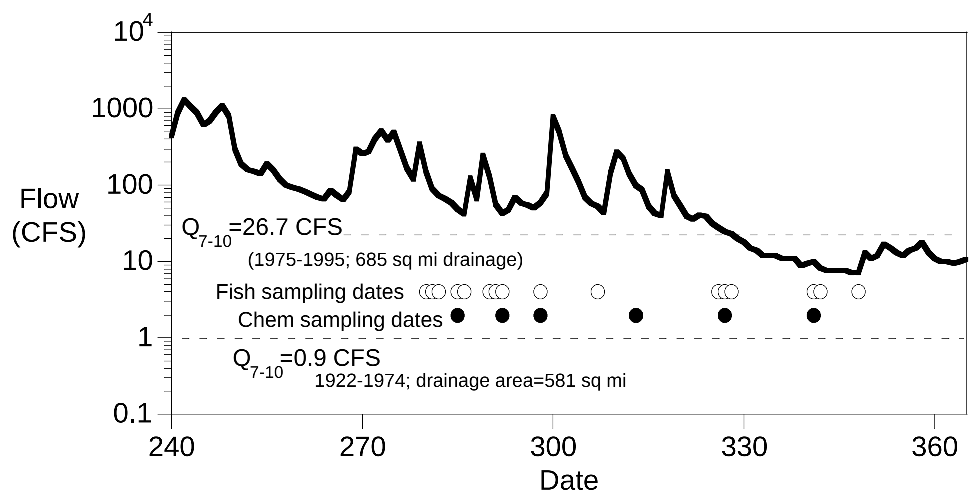


Figure 9. Flow hydrograph for the Grand River measured by the U.S.G.S. gage at SR 84 near Painesville. The Q_{7-10} value derived from the gage data is for a limited period of record and must be interpreted with caution. Low flows in four of the last seven years have been less than the calculated value. The Q_{7-10} from the defunct Madison gaging station is shown for comparison.

Fecal coliform bacteria samples were collected twice at most stations. Unlike the water quality sampling, bacteria sample collections had to be split into two separate days because of laboratory constraints (07/25/95; 07/26/95 and 07/19/95; 08/23/95). These samples were also collected under low flow conditions. Rain event samples were not collected as a part of this survey. If water samples were collected during higher stream flows, the samples may have had higher concentrations of TSS, fecal coliform bacteria and heavy metals than the values recorded during this 1995 survey.

A steady decline in D.O. concentrations were noted in the upper, wetland portions of the river from U.S. 422 (RM 95.4) to Tote Road (RM 36.3) (Figure 9). Exceedences of the 24 hour criteria in chemical grab samples were documented at Sexton Road (RM 34.0), Tote Road (RM 36.3), Schweitzer Road (RM 42.4), U.S. 322 (RM 65.9), and near Hyde Road (RM 83.5) (Table 4). No other exceedence of the WWH D.O. criteria was documented on the mainstem. No exceedences of the EWH criteria of 6.0 mg/l were documented in grab samples collected from the Grand River in the designated reach downstream from Harpersfield Dam (RM 30.9). However, night-time DO concentrations at RM 28.4 measured by Datasonde® continuous recorders fell below 6.0 mg/l at night (Figure 10). The low dissolved oxygen levels recorded in the upper

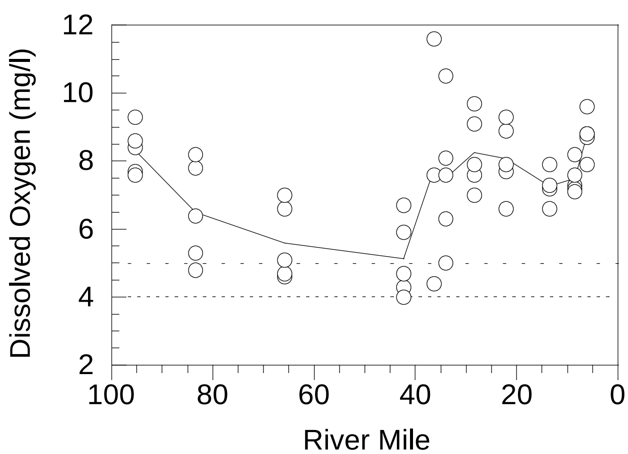


Figure 10. Dissolved oxygen concentrations measured in water quality grab samples collected from the Grand River, 1995. The stippled lines show the proposed EWH WQS minimum (5.0 mg/l) and the existing WWH WQS minimum (4.0 mg/l).

Grand River are not caused by anthropogenic loadings, but are caused by the deep, low gradient physical characteristics of the reach and decomposition of detritus. The low night time concentrations at RM 28.4 were likely due to low flows and possibly residual effects from upstream.

Levels of the primary macronutrients nitrogen and phosphorus were low at all stations sampled, and were below the median levels recorded for statewide wadeable and small river reference sites.

Nitrate-Nitrite (NO2-NO3), total Kjeldahl nitrogen (TKN) and phosphorus concentrations were higher at Tote Road (RM 36.3) and Sexton Road (RM 34.0) compared to adjacent sites (Figure 11). due to low flows and possibly residual effects from upstream. The river at these sites is deep (>3 m) and slow moving, and is at the downstream end of a long, low gradient, swamp and wetlands influenced reach. The increased concentration of nitrogen and phosphorus is likely due to a combination of remineralization from decomposing dissolved and particulate organic matter, and loadings from the Jefferson WWTP. Evidence for the decomposition of organic matter and remineralization of nutrients is given by a corresponding increase in chemical oxygen demand (COD - Figure 12) and decreased dissolved oxygen levels (Figures 9 and 10). The Jefferson

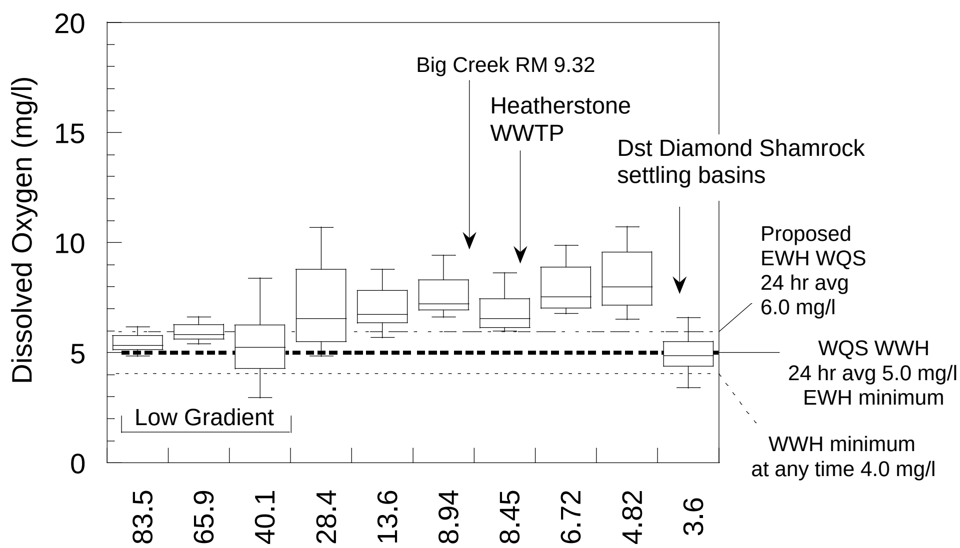


Figure 11. Distribution of dissolved oxygen concentrations by river mile in the Grand river, measured hourly with Datasonde® continuous recorders over a 48 h interval, July 25-27, 1995.

WWTP discharges relatively high levels of phosphorus and nitrogen to the Grand River via Mill Creek, which flows into the Grand River upstream from Tote Road and Sexton Road. A low (but increasing) density cluster of unsewered residential homes and vacation cottages in the Mechanicsville area may also contribute nutrients to this reach; however, evidence for inputs of raw sewage from failing or poorly sited septic systems was not apparent as ammonia-nitrogen (Figure 11) and fecal coliform (Figure 12) levels did not differ from adjacent sampling sites. Nitrate-nitrite concentrations were also noticeably elevated downstream of the Heatherstone WWTP plant.

Total dissolved solids (TDS) concentrations were generally low at all sampling sites, but were higher in the head waters and wetlands influenced reach than in the lower reach, and showed a significant increase downstream of the Heatherstone WWTP compared to upstream sites (Figure 12).

Table 4. Exceedences of Ohio EPA Warmwater Habitat criteria (OAC 3745-1) for chemical/physical water parameters measured in grab samples taken from the Grand River study area during 1995 (units are μg/l for metals and organics, # colonies/100ml for fecal coliform μmhos/cm for conductivity, °C for temperature, and mg/l for all other parameters).

Stream	River Mile	Parameter (value)
Grand River		
	83.5	Dissolved Oxygen (4.8†)
	65.9	Dissolved Oxygen (4.7†; 4.6†)
	42.4	Dissolved Oxygen (4.7†; 4.3†; 4.0†)
	36.3	Dissolved Oxygen (4.4†)
Cemetery Creek		
	41.28/8.42/2.1	Dissolved Oxygen (4.0†)
	41.28/8.42/2.5	Dissolved Oxygen (3.45‡)
Swine Creek		
	75.17/5.2	Fecal Coliform Bacteria (1100◊; 11,000◊◊◊)
Mill Creek		
	41.28/18.2	Fecal Coliform Bacteria (25,000◊◊◊)
	41.28/12.1	Fecal Coliform Bacteria (2400◊◊)
Paine Creek		
	14.31/0.5	Dissolved Oxygen (4.0‡)
Phelps Creek		
	72.02/5.3	Dissolved Oxygen (4.9‡)
Big Creek		
	9.32/16.3	Dissolved Oxygen (4.0†; 3.8‡; 3.4‡; 1.2‡); Total Dissolved Solids (1700*; 1750*)

* exceedence of numerical criteria for prevention of chronic toxicity (Chronic Aquatic Concentration [CAC]).
** exceedence of numerical criteria for prevention of acute toxicity (Acute Aquatic Concentration [AAC]).
# exceedence of numerical criteria for human health 30-day average.
† exceedence of the average warmwater habitat dissolved oxygen (D.O.) criterion (5.0 mg/l).
‡ exceedence of the minimum warmwater habitat dissolved oxygen (D.O.) criterion (4.0 mg/l).
◊ exceedence of the average Primary Contact Recreation criterion (fecal coliform 1000/100ml; E. coli 126/100ml).
◊◊ exceedence of the maximum Primary Contact Recreation criterion (fecal coliform 2000/100ml; E. coli 298/100ml).
◊◊◊ exceedence of the maximum Secondary Contact Recreation criterion (fecal coliform 5000/100ml; E. coli 576/100ml).

NOTE: There were no exceedances of the EWH criteria of 6.0 mg/l dissolved oxygen for the Grand River from RM 28.4 to 6.1.

The increase in TDS downstream of the WWTP was also noticed during a single sampling event conducted by the Ohio EPA modeling group. Fecal coliform bacteria counts were very low in the mainstem. The bacteria counts increased in the river near Painesville, but were still within the primary contact recreation criteria. All other water quality parameters measured in grab samples, including all metals except iron, were near background levels. Iron levels were high throughout the watershed due to its presence in the parent material. For a complete listing of water quality data from all grab samples, see Appendix A.

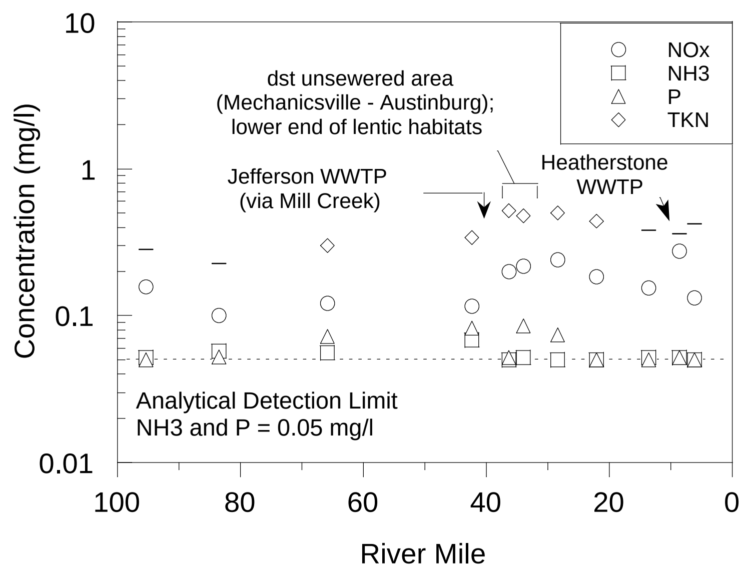


Figure 12. Concentrations of nitrate-nitrite-nitrogen, ammonia-nitrogen, phosphorus, and total Kjeldahl nitrogen (TKN) in water qualtiy grab samples collected from the Grand River, 1995, in relation to select point and nonpoint sources.

Big Creek

Dissolved oxygen concentrations in Big Creek (Figures 13 and 14) upstream from the Village of Chardon WWTP at U.S Route 6 (RM 16.3) were low and variable due to low flow conditions and organic enrichment possibly originating from home septic systems. Immediately downstream from the WWTP (RM 15.9), D.O. concentrations met the WWH criteria, and were more stable due to the influence of the WWTP discharge. Further downstream (RM 15.6) concentrations, as measured by a Datasonde® continuous data logger were higher but more variable due to increased algal photosynthesis and respiration fueled by nutrient enrichment from the WWTP and unsewered inputs upstream of the plant. High gradient and current velocities provide good reaeration downstream of the plant, and help maintain D.O. concentrations.

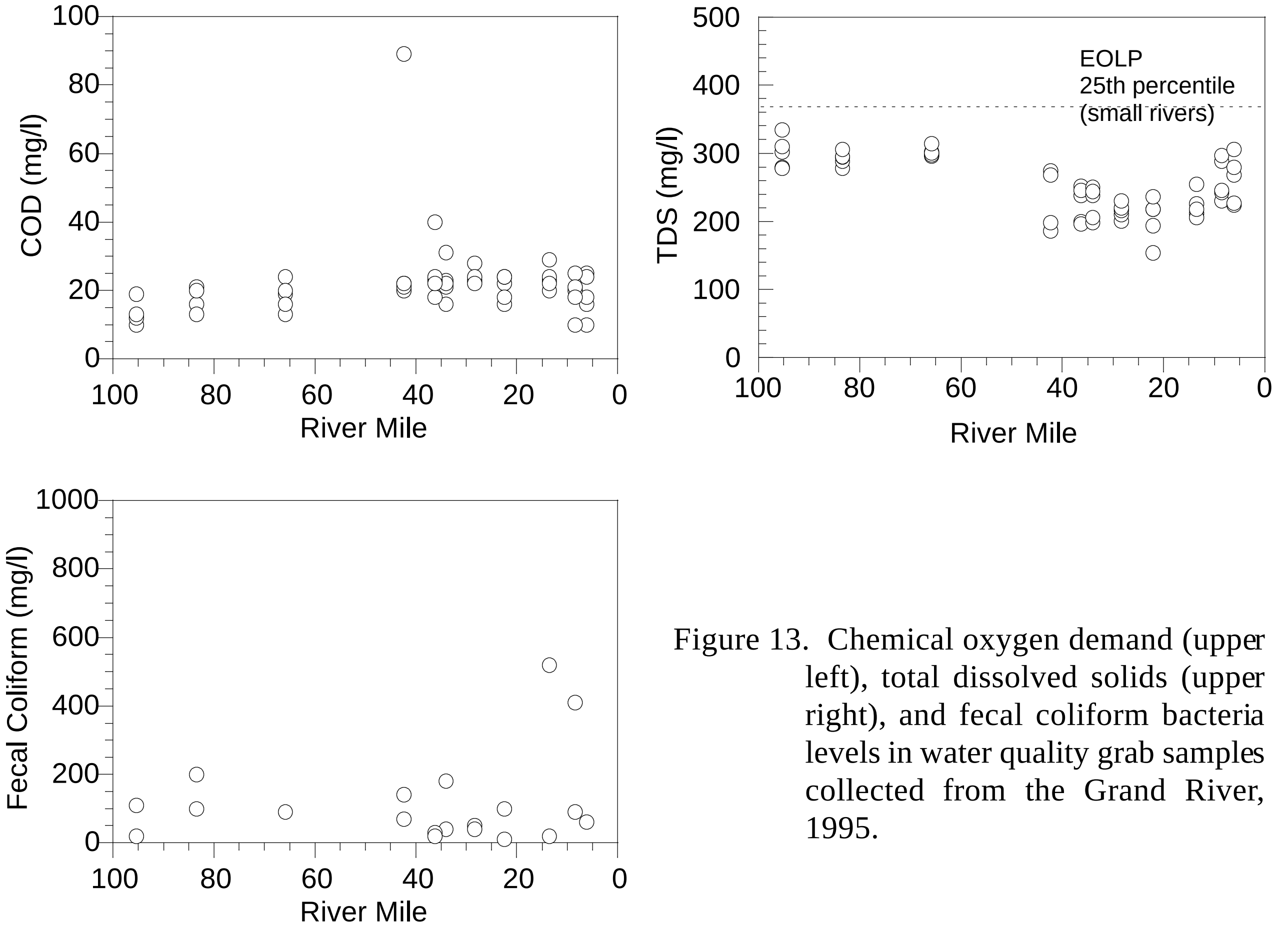


Figure 13. Chemical oxygen demand (upper left), total dissolved solids (upper right), and fecal coliform bacteria levels in water quality grab samples collected from the Grand River, 1995.

Evidence for untreated sanitary waste entering the creek upstream of the plant was given by high ammonia-N, TKN, COD and P concentrations relative to downstream sites (Figures 15 and 16), and total dissolved solids (TDS) concentrations in excess of water quality standards (Figure 16). The source of the ammonia-N and P is is likely from septic systems in the area outside of the Village limits not served by sanitary sewers, and possibly lawn fertilizers. Nitrate-nitrite (NO_x) concentrations in Big Creek reveal a classic stream response to pollution (Figure 15). The concentrations are high in the WWTP discharge and immediately downstream, and slowly decline towards the mouth as biological processes within the creek assimilate the wastes and additional dilution occurs. COD and total P follow a similar pattern, however, unlike NO_x, both are elevated upstream of the plant (Figures 15 and 16), suggesting the nutrient enrichment effect observed downstream of the plant (*i.e.*, wide diurnal D.O. swing) is exacerbated by the organic enrichment upstream. Also, pH increased steadily downstream from the headwaters. The increase may represent removal of CO2 due to uptake by algal photosynthesis, and assimilation of nutrients.

Fecal coliform bacteria counts were elevated downstream of the Chardon Village WWTP, but did not exceed the primary contact recreation criteria of 1000 colonies/100 ml. The counts then decline to very low levels. Only one fecal coliform sample was collected from the site upstream of the plant and did not contain an elevated count.

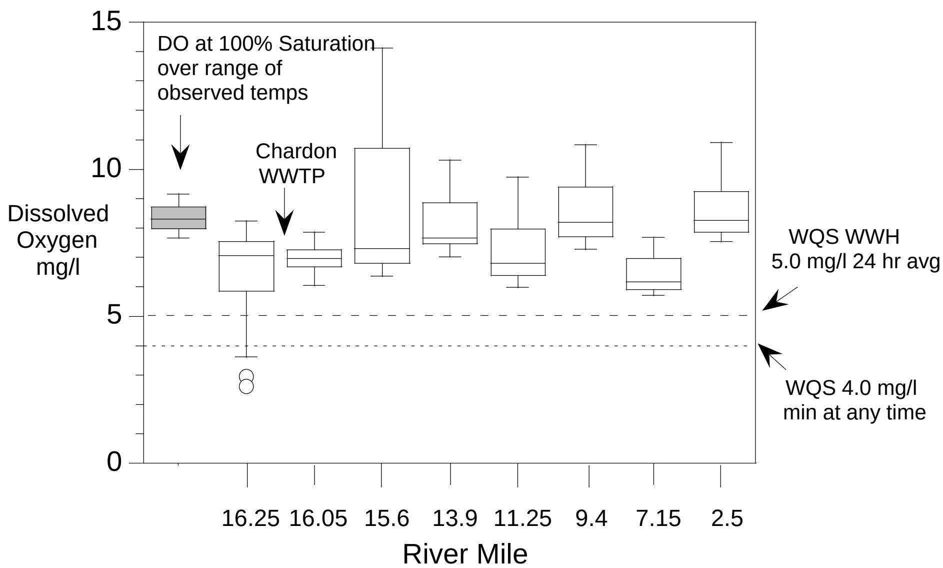


Figure 14. Box plot distributions of hourly dissolved oxygen measurements recorded over a 48 hr period August 22 - 24, 1995 in Big Creek.

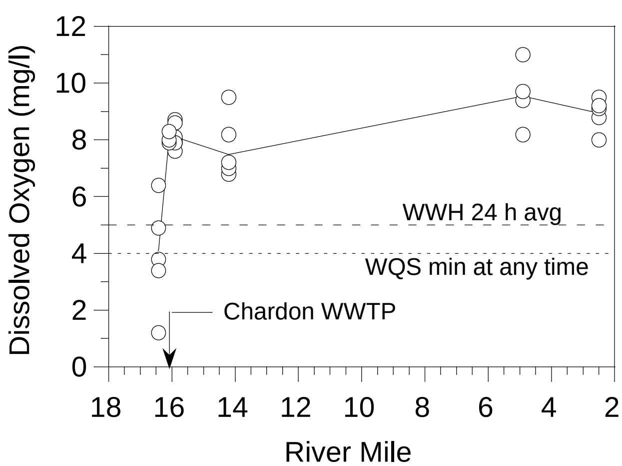


Figure 15. Concentrations of dissolved oxygen in water quality grab samples collected from Big Creek, 1995, in relation to the Chardon WWTP.

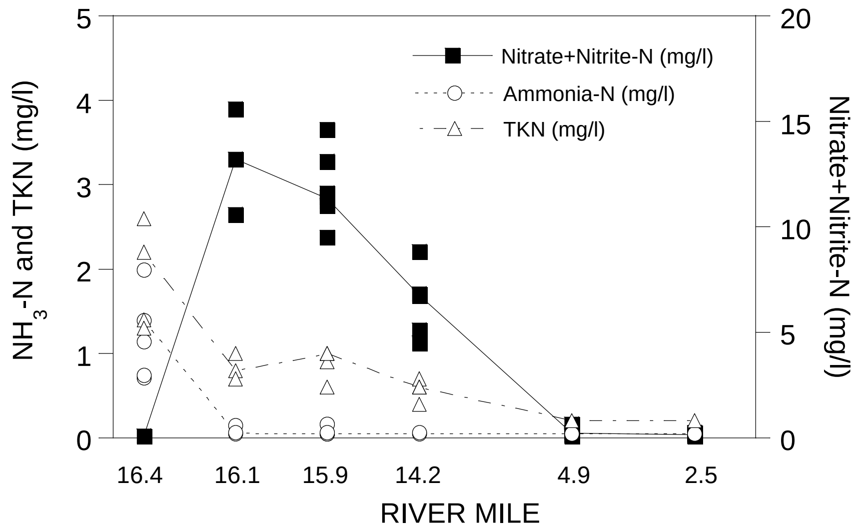


Figure 16. Concentrations of ammonia-nitrogen and total Kjeldahl nitrogen (left axis), and nitrite+nitrate-nitrogen (right axis) in water quality grab samples collected from Big Creek, 1995.

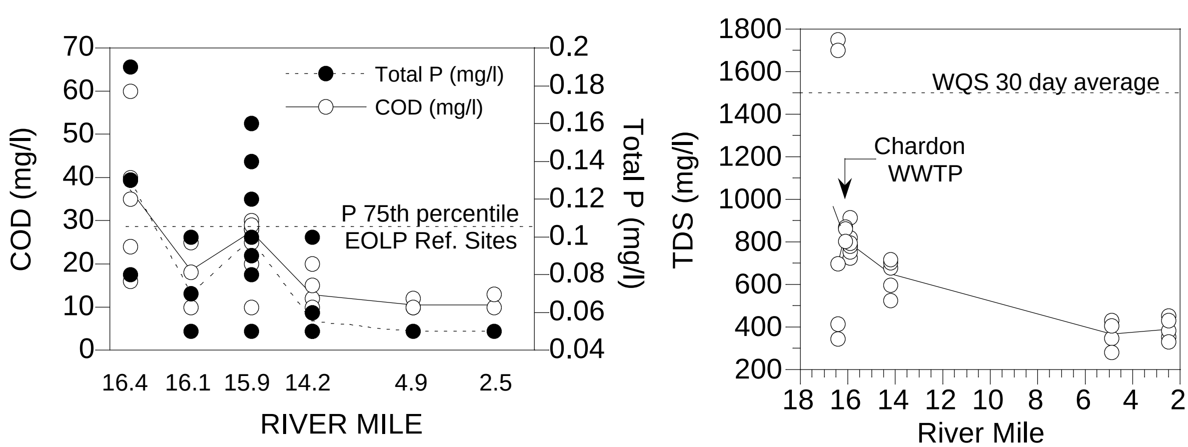


Figure 17. Scatter plots of chemical oxygen demand and phosphorus concentrations (left) and total dissolved solids concentrations (right) in water quality grab samples collected from Big Creek, 1995. Means are joined by lines.

Heavy metal concentrations do not appear to be of significant concern in Big Creek as arsenic, copper, cadmium and lead concentrations were generally below method detection limits. Zinc concentrations were also generally low, but one value of 152 μg/l was recorded at Woodin Road (RM 14.2). The reason for this higher value is unknown but may be related to an unauthorized discharge found in Chardon as a result of a citizen's complaint. Ohio EPA received complaints of suds in an unnamed tributary (RM 14.15) which enters Big Creek just upstream of Woodin Road and drains the western portion of Chardon. Some of the complaints reported suds as far down stream as Fay Road (RM 2.5) in Big Creek. After several investigations Ohio EPA traced the suds to Structural North America on Industrial Parkway in Chardon. This company discharged intermittent batches of soapy water which were used for hydrostatic testing of the fiberglass storage tanks they manufacture. Water quality samples collected from the area did not indicate elevated concentrations of "conventional" pollutants except for one high zinc concentration. Also discharging to this same Creek were floor drains from the Chardon Rubber Company. The discharges from these companies have stopped.

Jenks Creek (RM 9.32/11.52)
Five grab water samples were collected from Jenks Creek at RM 0.4 near Robinson Road. This small stream receives discharge from a small (25,000 gallons per day) sanitary WWTP. No departures from WQS were noted.

Paine Creek (RM 14.31)
Five grab water samples were collected from Paine Creek at RM 1.4 near Seely Road. One dissolved oxygen exceedence (4.0 mg/l) was documented, and is attributed to low stream flow. There were no other exceedences of the WWH criteria for Paine Creek.

Mill Creek (RM 41.28)
Five grab water samples were collected from Mill Creek at State Route 46 (RM 12.1) and five samples at Netcher Road (RM 18.2). Two fecal coliform bacteria exceedences were documented in Mill Creek. A count of 25,000 colonies/100 ml was found at Netcher Road (RM18.2) and 2400 colonies/100 ml at S.R. 46 (RM 12.1) on the same day. These samples were collected during higher flows after a localized rainstorm. There were no other exceedences of the WWH criteria for Mill Creek. However, the high fecal counts are likely derived from livestock (dairy cattle and horses). Nutrient enrichment was also evident in elevated ammonia-nitrogen levels (Figure 17) and supersaturation of D.O. at RM 12.2 (10.0 mg/l at 27.1°C). Other than the high fecal counts, there were no other exceedences of WWH criteria.

Cemetary Creek (RM 41.28/8.42)
Five grab water samples were collected from Cemetery Creek at RM 1.25 near Poplar Street, four samples at RM 2.1 just upstream from the Jefferson WWTP and one sample from RM 2.5 at Market Street. Ammonia-N, NO_3-NO_2 and phosphorus concentrations in Cemetary Creek significantly increased downstream from the Jefferson WWTP (Figure 17). Phosphorus

concentrations were highly elevated, and exceeded the recommended effluent limit of 1.0mg/l for discharges on Great Lakes tributaries. Two dissolved oxygen exceedences (3.45 and 4.0 mg/l) were documented upstream from the WWTP. All D.O. concentrations met the WWH criteria downstream from the WWTP. However, supersaturated D.O. of 11.6 mg/l at 25°C reflects the increased algal photosynthesis spurred by nutrient enrichment.

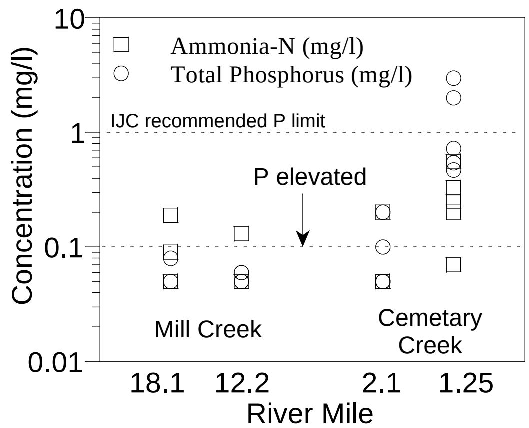


Figure 18. Concentrations of ammonia-nitrogen and phosphorus in grab samples collected from Mill Creek and Cemetery Creek, 1995.

Rock Creek (RM 50.59)

Five grab water samples were collected from Rock Creek at RM 0.8 near Union Cemetery. There were no exceedences of the WWH criteria for Rock Creek. One value above 1.0 mg/l for phosphorus (9/6/95) was documented. This high phosphorus value and slightly elevated NO2-NO3, TKN and ammonia-N concentrations may be attributed to hydroseeding (sprayed slurry of seed mulch and fertilizer) of the stream banks at a highway construction project at the sampling site. There were no exceedences of the WWH criteria and the water quality of Rock Creek can be described as generally good.

Phelps Creek (RM 72.02)

Five grab water samples were collected from Phelps Creek at RM 5.3 near Wiswell Road. One dissolved oxygen exceedence (4.9 mg/l) was documented during low stream flow conditions. There were no other exceedences of the WWH criteria for Phelps Creek.

Swine Creek (RM 75.17)

Five grab water samples were collected from Swine Creek at RM 5.2 near State Route 534. Two fecal coliform bacteria exceedences (1100 and 11,000 colonies/100 ml) were documented. These exceedences were probably a result of livestock from nearby farms. Also, livestock had unrestricted access to the stream in the pasture just downstream from the sampling site. There were no other exceedences of the WWH criteria for Swine Creek and the water quality was generally good.

Baughman Creek (RM 80.76)
Five grab water samples were collected from Baughman Creek at RM 3.3 near Messic Road. There were no exceedences of the WWH criteria for Baughman Creek despite unrestricted access of livestock immediately upstream from the sampling site.

Chemical Sediment Quality

During the Fall of 1995, sediment samples were collected for analysis of heavy metal concentrations from five sites along the Grand River mainstem and four sites at selected Grand River tributaries. Sediment sample locations were selected to match biological sample stations as part of a synoptic survey and were not selected to specifically identify present or past effluents as potential sources. All sediment samples were a composite of surface grab samples and were collected near the stream margins using a stainless steel scoop.

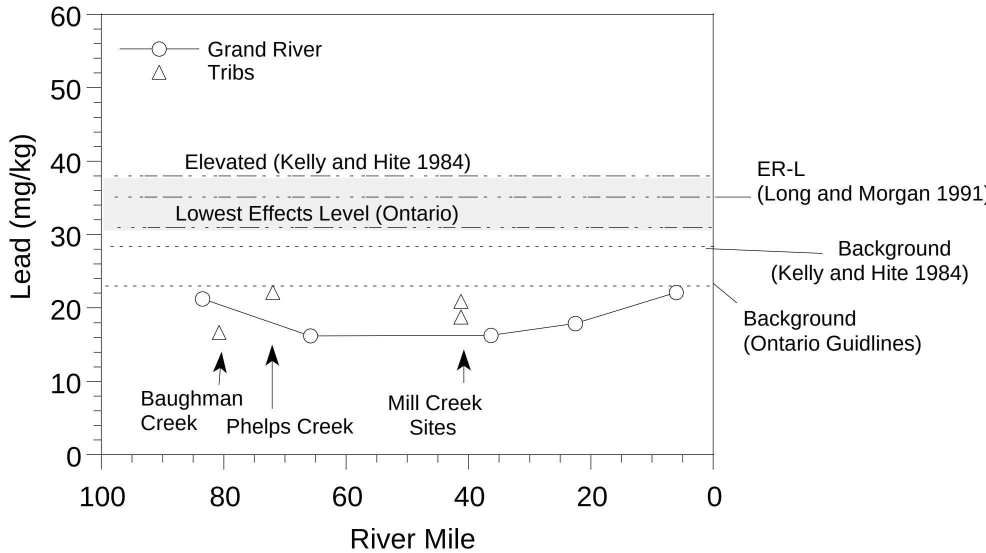
Sediment contaminant levels were evaluated according to a statistical scheme developed by Kelly and Hite (1984), and guidelines established for Ontario, Canada (Persuad et al. 1993). The Kelly and Hite (1984) guidelines are based on standard deviations from background means of a large number of stream sediment samples collected in Illinois. Highly elevated values represent numbers that exceed four standard deviations of the mean. The Ontario guidelines are based upon a 95th percentile screening level concentration derived from field data on the occurrence in sediments of benthic infaunal species and different concentrations of contaminants. The criterion of “severe effect level” indicate levels of pollutants that would have a very high probability of being toxic to aquatic life at the concentrations measured. Ontario recommends that any sites with levels above “severe effect levels” be further tested using sediment bioassay protocols.

Sediment results for heavy metals from the Grand River mainstem the selected tributaries showed no sites with highly elevated concentrations of heavy metals based on Kelly and Hite (1984) and the Ontario guidelines (Table 5). No heavy metal concentrations exceeded the Ontario severe effects levels. Concentrations of lead and mercury (Figure 18) were near background levels given by Persaud et al. (1993) and Kelly and Hite (1984), reflecting the relatively undeveloped nature of the watershed. No specific longitudinal trends in sediment chemical quality were apparent for individual metals. Collectively, however, concentrations of trace metals were highest in samples collected from the upper watershed (Figure 19). This may be due to the higher degree of agricultural development in the upper watershed, juxtaposition of glacial deposits, or both (*i.e.*, farming exposes more of the parent material to erosion). The elevated mercury concentrations at RM 83.5 of the Grand River and in Baughman Creek and Mill Creek (Figure 18) are likely related to their proximity to agriculture, as mercury residues are associated with agricultural chemicals (Budavari et al. 1989). Though elevated, the levels are below those associated with biological effects. Concentrations of lead, a contaminant strongly associated with urban runoff, were at or below background levels reported by Persaud et al. (1993) and Kelly and Hite (1984). A compilation of all sediment sample results are included in the Appendix of this report.

Table 5. Concentrations of heavy metals in sediments of the Grand River Basin study area, 1995. All parameter concentrations, excluding selenium and nickel, were ranked based on a stream sediment classification system described by Kelly and Hite (1984) and Persaud et al. (1993). The Kelly and Hite classification system addresses relative concentrations, but does not directly assess toxicity. The Ontario guidelines (Persaud et al. 1993) are based on field data relating 95th percentile concentrations of contaminants to the occurrence in sediments of benthic infaunal species.

Stream River	**Sediment Concentration (mg/kg dry weight)**									
Mile	**As**	**Cu**	**Cd**	**Cr**	**Fe**	**Pb**	**Ni**	**Zn**	**Se**	**Hg**
Grand River										
83.50	[c]*12.60*†	18.40†	0.169	[b]*<21.2*	7790	<21.2	<28.3†	[b]*98.2*	<1.41	[c]*0.1230*
65.90	[b]*10.80*†	9.17	0.259	[c]*25.9*	[b]*19500*	<16.2	<21.6†	[b]*82.0*	<1.08	0.0726
36.30	5.58	8.13	0.179	[b]*<16.3*	11600	<16.3	<21.7†	47.2	<1.08	0.0802
22.60	[b]*10.30*†	13.00	0.149	[b]*<17.9*	[c]*23700*†	<17.9	<23.8†	66.0	<1.19	0.0635
6.10	5.77	15.70	0.299	[b]*<21.4*	14600	22.1	<28.5†	74.9	<1.43	0.0545
Mill Creek										
18.20	6.32	10.00	0.200	[b]*<18.8*	12300	<18.8	<25.0†	55.0	<1.25	[c]*0.1320*
12.10	4.67	8.46	0.348	[b]*<20.9*	10600	<20.9	<27.9†	73.1	<1.39	[c]*0.1380*
Baughman Creek										
80.76	[b]*9.61*	<5.59	0.182	[b]*<16.7*	9460	<16.7	<22.4†	46.0	<1.11	[c]*0.1040*
Phelps Creek										
5.30	7.00	13.30	0.309	[c]*<22.1*	[c]*21900*†	<22.1	<29.5†	[c]*100.0*	1.47	0.0684

[a] Non-elevated [b] *Slightly elevated* [c] *Elevated* [d] **Highly elevated** [e] **Extremely elevated**
"<" - indicates the concentration is less than the stated detection limit for that sample. Evaluations based upon the Kelly and Hite (1984) criteria for the "<" samples assume the concentration of the sediment sample is at the stated detection limit.
† Exceeds the Lowest Effect Level given by Persaud et al. (1993).
None of the concentrations exceeded the Ontario Severe Effect Level (Persaud et al. 1993).



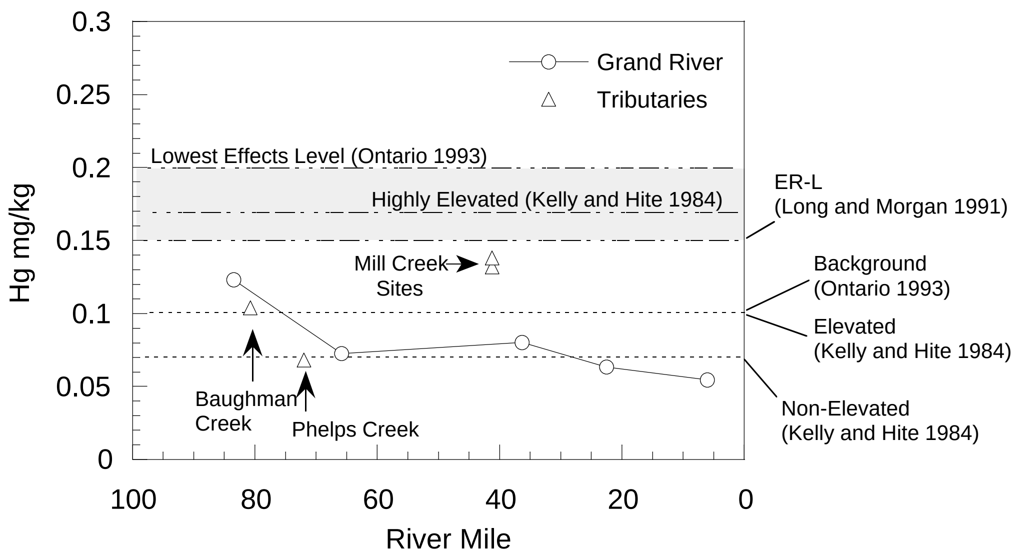


Figure 19. Concentrations of mercury (top) and lead (bottom) in sediment samples collected from the Grand River and several of its tributaries, 1995. Background levels are given by Persaud et al. (1993 - i.e., Ontario Guidelines) and Kelly and Hite (1984). The shaded area in each graph reprsents a range of concentrations where biological effects first become apparent (Persaud et al. 1993; Long and Morgan 1991), or that are considered “Elevated” by Kelly and Hite (1984). ER-L is the Effects Range-Low given by Long and Morgan (1991).

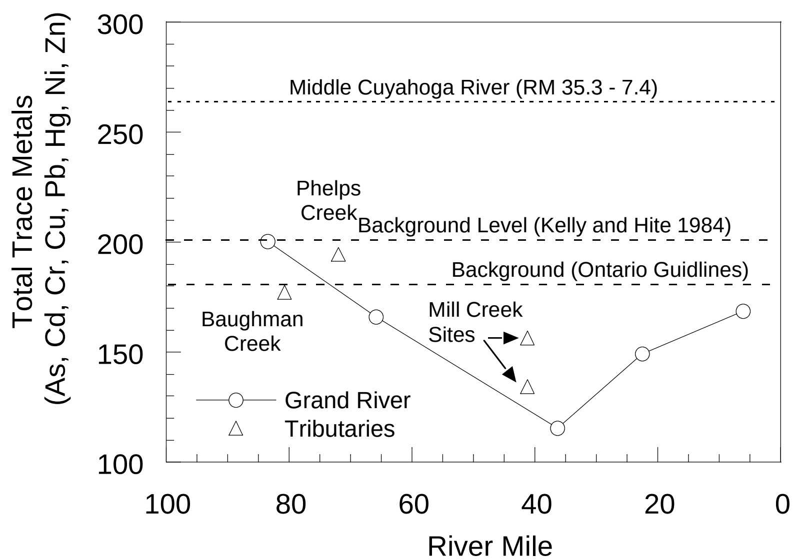


Figure 20. Concentrations of total trace metals (As, Cd, Cr, Cu, Pb, Hg, Ni and Zn) in sediments collected from the Grand River and several of its tributaries, 1995. Background levels for sediment metalsgiven by Persaud et al. (1993 - i.e., Ontario guidelines) and Kelly and Hite (1984), and average levels found in an urban influenced reach of the Cuyahoga River are given for comparison.

Fish Tissue

Concentrations of contaminants in fish tissue measured in fishes collected from the Grand River near Mechanicsville (RMs 36.4 - 31.0), 1994, are reported in Table x. Concentrations of nearly all measured contaminants, except mercury, were below method detection limits. Mercury concentrations were elevated in all tissue samples, especially smallmouth bass and walleye, where concentrations exceeded the 75th percentile from statwide collections for both species (Figure x). Mercury concentrations for all samples also exceeded risk based consumption advisory limits recommended by the U.S. EPA (1994) (Figure x). No point source of contamination was identified. Mercury concentration in sediment collected from RM 36.3 were very low (see **Chemical Sediment Quality** section above), however, concentrations in the headwaters and several tributaries were elevated, suggesting a diffuse nonpoint origin.

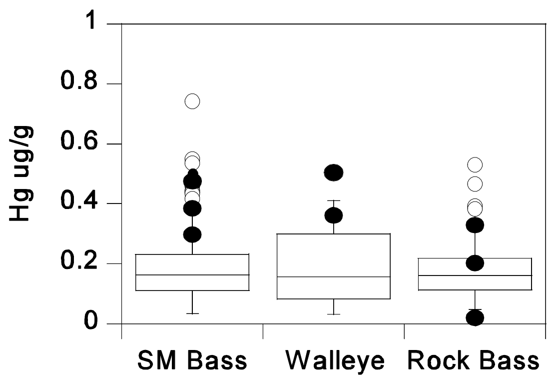


Figure 21. Mercury concentrations in fish tissue samples collected from the Grand River (black dots), 1994, compared to ranges from state wide collections.

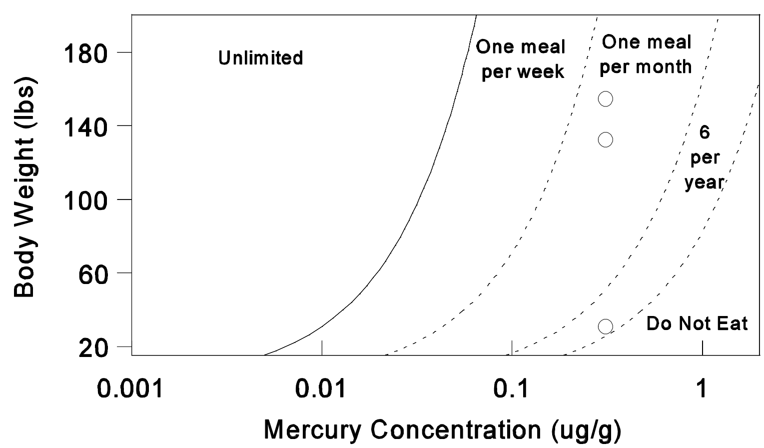


Figure 22. Mean mecury concentration in smallmouth bass tissue samples (open circles) collected from the Grand River, 1994, plotted for three body weights (repsenting average male, female and 0-6 year old child) in relation to suggested risk based consumption advisory groups.

Table 6. Concentrations of contaminants in fishes collected from the Grand River near Mechanicsville (RM 31.0 - 36.4), 1994.

River Mile	36.4	36.4	36.4	34.4	34.4	31.0	31.0	31.0
Species	Walleye	White Crappie	Small-mouth Bass	Small-mouth Bass	Yellow Bullhead	Small-mouth Bass	Rock Bass	Rock Bass
Parameter								
Metals ($\mu g \bullet g^{-1}$)								
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND
Lead	ND	0.0635	ND	ND	ND	ND	ND	ND
Mercury	0.299	0.153	0.396	0.313	0.185	0.245	0.166	0.270
Pesticides ($\mu g \bullet kg^{-1}$)								
Aldrin	ND	ND	ND	ND	ND	ND	ND	ND
a-BHC	ND	ND	ND	ND	ND	ND	ND	ND
b-BHC	ND	ND	ND	ND	ND	ND	ND	ND
d-BHC	ND	ND	ND	ND	ND	ND	ND	ND
y-BHC	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDD	ND	ND	ND	ND	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND	17.51	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND	ND	ND	ND
EndosulfanI	ND	ND	ND	ND	ND	ND	ND	ND
EndosulfanII	ND	ND	ND	ND	ND	ND	ND	ND
EndosulfanSulfate	ND	ND	ND	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND	ND	ND	ND
HeptachlorEpoxide	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ND	ND	ND	ND	ND	ND	ND	ND
Methoxychlor	ND	ND	ND	ND	ND	ND	ND	ND
Mirex	ND	ND	ND	ND	ND	ND	ND	ND
Alpha-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND
Gamma-Chlordane	ND	ND	ND	ND	ND	ND	ND	ND
Oxychlordane	ND	ND	ND	ND	ND	ND	ND	ND
Cis-Nonachlor	ND	ND	ND	ND	ND	ND	ND	ND
Trans-Nonachlor	ND	ND	ND	ND	ND	ND	ND	ND
PCBs ($\mu g \bullet kg^{-1}$)								
PCB-1016	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1221	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1232	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1242	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1248	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1254	ND	ND	ND	ND	ND	ND	ND	ND
PCB-1260	ND	ND	ND	ND	ND	ND	ND	ND
$\bar{x}$ Length; number	398; 2	186; 2	234; 1	246; 1	310; 1	259; 5	160; 6	240; 1
Percent lipid	0.49	0.51	0.49	0.58	0.22	1.61	0.74	0.57

ND - Parameter not detected in sample.

Physical Habitat for Aquatic Life

Grand River

The majority of the Grand River is divided into two very distinct reaches. The quality of the habitat within each reach was assessed using the Qualitative Habitat Evaluation Index (QHEI - Table 6). The first reach, extending from West Farmington (RM 91.0) to Mechanicsville (RM 34.0) is a deep, low gradient (gradient $\approx$ 1.5 ft $\cdot mi^{-1}$) swamp stream meandering through a glacial lake bed. The 7 QHEI scores from this segment averaged 58.5 ± 4.7sd, indicating fair to good habitat capable of supporting a Warmwater Habitat (WWH) fauna. Habitat attributes common to this reach that limit the diversity of aquatic life are slow current, no riffles, hardpan and lacustrine substrates, and sparse cover. Although the habitat is moderately limited by natural conditions, the channel had not been modified and meandered freely. Also wide, forested riparian buffers existed throughout the reach, and in many of the feeder streams throughout the basin. Consequently, large woody debris were present, the substrates were not embedded by silt, and the water, though stained by tannins, was clear.

The second reach, extending from Mechanicsville (RM 34.0) to Painesville (RM 5.0) flows through a shale gorge and has an average gradient of $\approx$ 6.1 ft$\cdot mi^{-1}$. The channel in this reach is sinuous and highly developed. High flows from snow melt scours the parent bedrock resulting in an alternating series of long bedrock glides, riffles, and deep pools. The pools and riffles are littered with glacial till and shale slabs, and the pools contain large woody debris supplied by the wide forested riparian. The erodible shale bluffs add silt to the channel, though the silt is largely confined to depositional areas. Urban impacts on habitat quality were evident at RM 6.2, where the riffles were moderately embedded and silt was more prevalent. The excellence of the habitat within this reach was reflected in the mean QHEI of 82.8 ± 6.3sd, n=5.

Big Creek and Jenks Creek

Instream macrohabitat quality was assessed at the six fish sampling locations in Big Creek using the QHEI (Table 6). QHEI scores averaged 64.9 ± 7.8 s.d. indicating the ability of the physical habitat to generally support a fish assemblage capable of meeting WWH criteria. However, marginal habitat conditions were found at the two sites adjacent to the Chardon WWTP (RMs 16.3, 15.9) owing to channelization at RM 16.3 and sandy-wetland substrate origin at RM 15.9. Consequently, marginal habitats were over represented and the average QHEI score does not necessarily reflect the true overall habitat quality in Big Creek. Large amounts of glacial till, though patchily distributed, were present in the middle reach (RMs 13.9 to 5.3) providing excellent habitat (QHEI averaged 71.7) able to support good to exceptional fish assemblages. The QHEI score obtained at one site in the lower reach was 59.0, due to scouring of the channel by torrential flows from heavy snow melt and the resulting increased patchiness in distribution of glacial till. The flood plain and surrounding hillsides, though interspersed with residential units, was largely forested. Consequently, the stream was relatively free from silt and very clear.

Jenks Creek, a tributary to Big Creek, was assessed at RM 0.1. The macrohabitat was good to excellent (QHEI= 70) and capable of supporting a WWH fish assemblage. The channel was littered with glacial till and large woody debris providing a variety of substrate types and sizes. Although the physical habitat was excellent, flows were low, limiting the amount of available habitat.

Paine Creek

The substrate in the lower reach of Paine Creek is dominated by shale bedrock, as torrential flows from snow melt have depleted the channel of glacial till. The prevalence of shallow bedrock in the watershed also results in low summer flows limiting the availability of habitat. Though bedrock and low summer flows pose limitations, fractured bedrock and patches of glacial till are present adding to habitat heterogeneity. Also, the channel is well developed and sinuous flowing through a forested valley. Consequently, the creek has sustained flow and is relatively free of silt and very clear. The QHEI score of 74.5 reflects those positive habitat attributes.

Mill Creek

Habitat quality at two reference sites on Mill Creek, RMs 10.0 and 18.1, was assessed using the QHEI (Table 6). The respective QHEI scores were 79.5 and 80.0, reflecting the excellent habitat quality present. Both sites have similar habitat attributes. The channels are sinuous and well developed, and contain a variety of substrate types and sizes. Substrates at RM 18.1 are composed of fractured shale bedrock and glacial till. RM 10.0 flows through the transition zone from shale bedrock to glacial lake bed, so lacustrine substrates (sand and hardpan) are present there. Lizards tail (*Saururus cernuus*), an aquatic macrophyte, was abundant in the stream margins at both sites.

Cemetery Creek

The macrohabitats at two locations on Cemetery Creek, RMs 1.3 and 2.5 were evaluated with the QHEI. RM 2.5 flows through a cemetery in suburban Jefferson, and though not channelized, has 2.25 times more modified habitat attributes than warmwater habitat attributes. Lack of a riparian buffer combined with urban runoff resulted in little instream cover, and heavily embedded and homogenized substrates. The homogenized substrates togather with siltation resulted in no riffles and poor channel development. The QHEI score of 42.0 reflects the limited ability of this site to support a WWH fauna.

Habitat quality improved at RM 1.3, downstream from the Jefferson WWTP. The creek meanders through a wooded valley, and original substrates, though moderately embedded, are present. The channel is well developed, but limited flow renders the riffle habitatnonfunctional. Addition of three WWH attributes and loss of two MWH attributes resulted in a MWH:WWH attribute ratio of 1.17 and increased the QHEI score to 55.5, implying that the physical habitat is marginally able to support a WWH fauna.

Table 7. QHEI matrix for sites sampled in the Grand River basin, 1995.

Key QHEI Components

			WWH Attributes											MWH Attributes: High Influence						MWH Attributes: Moderate Influence														
River Mile	QHEI	Gradient (ft/mile)	No channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max. Depth > 40cm	Low/No Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max. Depth < 40 cm (WD/HW)	**Total H.I. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**MWH H.I./WWH Ratio**	**MWH M.I. WWH Ratio**
(03 -001) GrandRiver																																		
94.3	71.0	21.28	■			■	■		■	■	■	■	7				●		1													0	0.25	0.25
83.5	54.0	2.74	■				■	■			■		4		●				1		▲			▲		▲		▲	▲		▲	6	0.40	1. 6 0
83.5	53.5	2.74	■				■			■	■		4		●		●		2		▲			▲				▲			▲	4	0.60	1.40
65.9	56.5	1.39	■				■	■		■	■		5				●		1		▲		▲	▲				▲			▲	5	0.33	1.17
52.7	62.0	1.08	■				■	■		■	■		5						0				▲	▲				▲			▲	4	0.17	0.83
40.9	66.5	0.82	■	■		■	■		■	■	■	■	8				●		1				▲	▲				▲				3	0.22	0.56
36.3	57.0	0.82	■							■	■		3				●		1				▲	▲	▲			▲			▲	5	0.50	1.75
34.0	60.0	0.82	■			■	■			■	■		6				●		1				▲					▲				2	0.29	0.57
28.4	81.5	7.14	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
22.1	87.5	3.14	■	■		■	■	■	■	■	■	■	9						0													0	0.10	0.10
13.4	91.0	7.81	■	■		■	■	■	■	■	■		9						0													0	0.10	0.10
8.0	78.0	6.21	■	■		■	■	■	■	■	■		8				●		1													0	0.22	0.22
6.2	76.0	6.06	■	■		■	■	■	■	■	■		9				●		1		▲								▲	▲		3	0.20	0.50
(03-022) Baughman Creek																																		
3.0	50.5	7.35	■				■	■			■		4		●		●		2		▲			▲				▲	▲		▲	5	0.60	1.60
(03-100) Big Creek																																		
16.3	61.5	31.25	■	■		■	■	■			■		6						0		▲		▲	▲				▲	▲		▲	6	0.14	1.00
15.9	54.0	66.67	■			■	■	■			■		5		●				1		▲			▲				▲	▲		▲	5	0.33	1.17
13.9	71.0	34.48	■	■		■	■	■			■		6						0		▲							▲	▲	▲		4	0.14	0.71
9.5	73.0	20.83	■	■		■	■	■		■	■		8						0		▲							▲		▲		3	0.11	0.44
5.3	71.0	35.71	■	■		■	■	■	■		■		8						0										▲	▲		2	0.11	0.33
5.0	71.0	30.30	■	■		■	■	■	■	■	■		9				●		1													0	0.20	0.20
2.5	59.0	33.33	■	■		■	■			■		■	6				●	●	2		▲					▲		▲				3	0.43	0.86
(03-104) Jenks Creek																																		
0.1	70.0	111.10	■	■		■	■	■		■	■	■	8						0									▲				1	0.11	0.22
(03-110) Paine Creek																																		
0.2	74.5	21.05	■	■		■	■	■		■	■	■	8						0									▲				1	0.11	0.22

Table7. Continued.

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes											MWH Attributes: High Influence						MWH Attributes: Moderate Influence														
			No channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max. Depth > 40cm	Low/No Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max. Depth < 40 cm (WD/HW)	**Total H.I. MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**MWH H.I./WWH Ratio†**	**MWH M.I. WWH Ratio†**
Mill Creek (03-120)																																		
18.1	80.0	16.13	■	■		■	■	■	■	■	■	■	9						0									▲				1	0.10	0.20
10.0	79.5	5.18	■	■		■	■	■	■	■	■	■	9						0		▲							▲				2	0.10	0.30
(03-124) Cemetery Creek																																		
2.5	42.0	16.39	■	■			■						3				●	●	2		▲		▲		▲			▲	▲		▲	6	0.75	2.25
1.3	55.5	14.29	■	■		■	■				■		5				●		1		▲		▲					▲	▲		▲	5	0.33	1.17
(03-130) Rock Creek																																		
0.8	71.5	12.35	■	■		■	■	■		■	■	■	8						0									▲				1	0.11	0.22
(03-150) Phelps Creek																																		
5.3	78.0	43.48	■		■	■	■	■		■	■	■	8						0									▲				1	0.11	0.22
(03-160) Swine Creek																																		
5.2	58.5	18.52	■	■		■	■	■			■		6						0		▲		▲					▲	▲	▲	▲	6	0.14	1.00

† The ratio of high influence modifed habitat to warmwater habitat attributes is calculated as (high influence MWH attributes+1)/WWH attribute+1). The ratio of moderate influence to WWH is calculated as (high influence MWH attributes+1+number of moderate influence attributes)/(WWH attributes+1).

Rock Creek

The reference site at RM 0.8 in Rock Creek contained good to excellent habitat (QHEI = 71.5, Table 6). Fractured sandstone bedrock and glacial till provided a variety of particle sizes, and a mature riparian buffer contributed woody debris to the natural channel. The substrates were free of embedding silt and clay.

Phelps Creek

The physical habitat in Phelps Creek at RM 5.3 was excellent as reflected in the QHEI score of 78.0 (Table 6). The channel has a complex and sinuous morphology with fractured sandstone bedrock slabs strew throughout the channel providing excellent cover. Glacial till is also present adding to substrate size and complexity. The forested riparian buffer supplies woody debris to the channel.

Swine Creek

Poor riparian practices resulted in marginal habitat quality (QHEI = 58.5) at the site assessed (RM 5.2) in the lower reach of Swine Creek. Previous removal of riparian vegetation had resulted in bank destabilize and an ensuing attempt to restabilize it with rip-rap. Because the lower reach of Swine Creek flows through lacustrine deposits, the channel naturally contains a high proportion of fine grain sediment. However, the exposed banks, being especially susceptible to erosion, contribute sediment to the channel, embedding substrates and lessening habitat complexity.

Baughman Creek

Baughman Creek is a low gradient stream flowing through pasture land underlain by lacustrine deposits. Consequently, substrates are composed of silty-sand and gravel, and the creek harbors emergent and submergent vegetation. Reflected in the QHEI score of 50.5 was the lack of riparian habitat in the sampling zone due to pasturing, and the exacerbated homogeneous condition of the substrates. Although livestock have impinged on substrate quality, pastures are not overgrazed, maintaining water clarity and allowing aquatic vegetation to persist.

Biological Assessment - Macroinvertebrates

Grand River

Macroinvertebrate assemblages were sampled and evaluated at 11 sites on the Grand River from Parkman (RM 95.5) to Painesville (RM 6.2). Narrative evaluations of the assemblages ranged from very good to exceptional quality in the free flowing section and good to exceptional in the low gradient section of the river. Invertebrate Community Index (ICI) scores, excluding sites affected by slow current, ranged from a low of 42 (Fobes Road) to a high of 54 at Brandt Road (Figure 20).

A total of 238 macroinvertebrate taxa were collected from the Grand River mainstem in 1995. By sampling location, the highest cumulative total number of macroinvertebrate taxa (97) were collected at Brandt Road (RM 28.4), the highest cumulative number of EPT (Ephemeroptera, Plecoptera, Trichoptera; *i.e.*, mayflies, stoneflies, and caddisflies) taxa (31) were collected at SR 528 (RM 22.6), and the highest cumulative number of unionid mussel taxa (9) were observed at Hyde-Oakfield Road (RM 83.3).

Many of the macroinvertebrate taxa collected in the Grand River are characteristic of high quality rivers and streams in Ohio. Sensitive taxa collected were the mayflies *Baetis armillatus* (one site), *Baetis dubius* (three sites), *Labiobaetis propinquus* (two sites), *Stenonema mediopunctatum* (four sites), and *Serratella deficiens*, and the caddisfly *Leucotrichia pictipes* (one site). Six taxa of stoneflies were collected including *Acroneuria abnormis* (three sites), *Acroneuria carolinensis* (one site), *Acroneuria evoluta* (seven sites), *Acroneuria internata* (five sites), *Agnetina capitata* complex (six sites), and *Neoperla clymene* complex (two sites). Sensitive midge taxa collected were *Synorthocladius semivirens* (two sites) and *Rheotanytarsus distinctissimus* group (five sites). Rare taxa collected included the mayfly genus *Acentrella* (one site), and the midges *Demicryptochironomus* (one site), *Polypedilum (Polypedilum)* Type 1 (two sites), and *Stelechomyia perpulchra* (two sites).

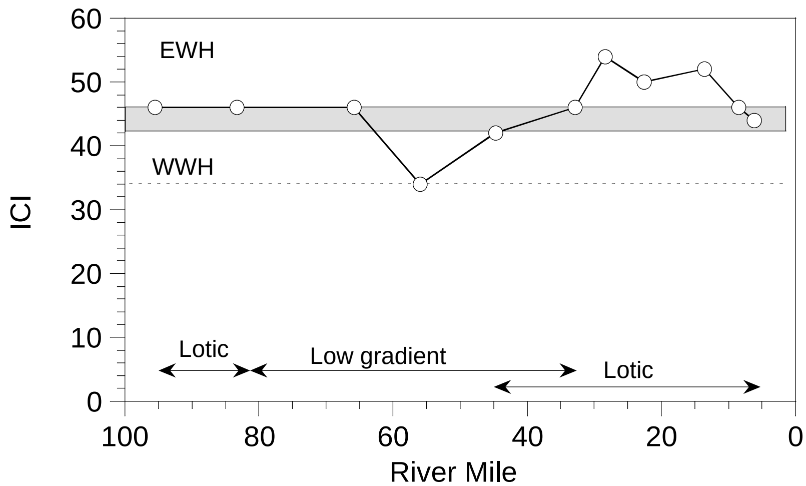


Figure 23. Longitudinal trends in the Invertebrate Community Index (ICI) from the Grand River, 1995, relative to gradient. The shaded box defines the region of non-significant departure from EWH, the horizontal dashed line is the lower boundary of WWH.

During qualitative macroinvertebrate sampling, Ohio EPA biologists observed 16 unionid mussel species at nine Grand River mainstem sites from Old Hyde-Oakfield Road (RM 83.3) to Painesville (RM 6.2). The most common mussels observed were *Actinonaias ligamentina carinata* (five sites) and *Lasmigona costata* (four sites). *Simpsonaias ambigua*, listed as an Ohio Endangered Species and Federal Category 2 (*i.e.*, rare but not threatened or endangered), was observed at Schaffer Road (RM 56.0).

A unionid (freshwater mussel) survey was conducted during July 1995 by Zimmerman (1995) between RM 30.8 and RM 9.2. A total of 4,264 living and 1999 dead mussels comprising 23 species were found. *Actinonaias ligamentina carinata* was the most abundant (64% of the live mussels). Three of the species found, *Lampsilis fasciola*, *Liguma recta*, and *Truncilla truncata* are listed as Ohio Special Interest. Two others collected, *Epioblasma triquetra* and *Simpsonaias ambigua*, are also listed as Federal Category 2.

The macroinvertebrate community in high gradient headwaters downstream from Parkman (21 ft./mi. at RM 94.3) was evaluated as exceptional. The number of qualitative EPT taxa (20), the total number of qualitative taxa (56), and the QCTV score (39.7) were similar to other headwater tributaries in the Grand River basin which were evaluated as exceptional. This was the only Grand River mainstem site where cool-water macroinvertebrate taxa were collected (the midges *Parametriocnemus* and *Polypedilum (Polypedilum) aviceps*). The drainage area at this site was less than 15 sq. mi.; cool-water macroinvertebrate taxa were only collected at sites in the Grand River basin with drainage areas less than 30 sq. mi.. Although this site was evaluated as exceptional, the field crew observed possible sewage bacteria in the riffle and abundant silt on top of most natural substrates indicating a possible enrichment effect from the Parkman unsewered area.

Macroinvertebrate communities sampled in the lentic upper Grand River mainstem from Old Hyde-Oakfield Road (RM 83.3) to upstream from Mechanicsville (RM 44.7) were evaluated as good to exceptional (Table 7, Figure 20). This section of the Grand River meanders sluggishly through an old lake bed in a south to north direction. The gradient ranged from 0.82 to 2.74 ft./mi., and drainage area from 85 to 405 sq. miles at these sites. Riffle development was absent or poor in this section, being limited to bridge crossings in most cases. The lowest ICI score (34) in this section was flow affected (less than 0.3 fps over the artificial substrates). A large population of the hydroid genus *Hydra* accounted for 48.3% of the organisms collected from the artificial substrates, which lowered several metric values resulting in the less than exceptional ICI score. ICI scores at the other sites in this section were between 42 and 46.

The middle to lower section of the Grand River flows east to west through a shale escarpment, with excellent pool-riffle-run development. Gradient in this section ranged from 3.14 to 7.14 ft./mile. Macroinvertebrate communities sampled in this section of the mainstem downstream from Mechanicsville (RM 32.9) to Painesville (RM 6.2) were evaluated as very good to exceptional. ICI values (range 44 to 54) attained or were within the nonsignificant departure range of the EWH criterion.

Big Creek

A total of 125 macroinvertebrate taxa were collected at five stations on Big Creek from Chardon to the mouth (Table 7). Three coldwater taxa, the caddisfly *Ceratopsyche slossonae* (RMs 14.2 and 9.4), and the midges *Parametriocnemus* (RMs 16.1, 16.0, and 14.2) and *Polypedilum (Polypedilum) albicorne* (RM 16.1) were collected at sites in the upper section of Big Creek from RM 16.1 to RM 9.4, but not in the lower section at RM 2.5. Three stonefly taxa, *Acroneuria carolinensis*, *Agnetina capitata* complex, and a species from the family Chloroperlidae, along with the sensitive midge *Sublettea coffmani* were collected downstream from Chardon between RMs 14.2 and 2.5. Two rare taxa, the mayfly genus *Acentrella* and the midge genus *Lopescladius*, were collected at RM 2.5.

Macroinvertebrates collected upstream and downstream from the Chardon WWTP were indicative of fair (RM 16.1) to poor (RM 16.0) stream quality, respectively (Table 7, Figure 21). The ICI scores were 12 (poor) at both sites, but artificial substrates of the upstream site were affected by slow current which generally reduces ICI scoring. The qualitative sample collected from the natural substrates at the upstream station (RM 16.1) was dominated by the mayfly *Baetis flavistriga*, caddisflies, and an assortment of midges, with a QCTV score (35.7) was in the good range. However, total taxa (36) and number of EPT taxa (4) were low and indicated a fair community at best. The macroinvertebrate community downstream from the Chardon WWTP at RM 16.0 were dominated by *Baetis flavistraga* and the midge *Cricotopus* (*Cricotopus*) *bicinctus*; the QCTV score (34.2) was below ecoregional expectations. The midge *Cricotopus* (*Cricotopus*) *bicinctus* has been noted as the dominant midge species on natural and artificial substrates in areas of poor water quality by the Ohio EPA.

The sites located downstream at RMs 14.2, 9.4, and 2.5 were evaluated as exceptional. ICI scores of 50 (RM 14.2) and 52 (RM 2.5) were in the exceptional range (Figure 21). Natural substrates were dominated by caddisflies, mayflies, and an assortment of midges, with numbers of EPT taxa (17 to 21) and QCTV scores (39.9 to 41.5) in the range of the other exceptional sites in the area.

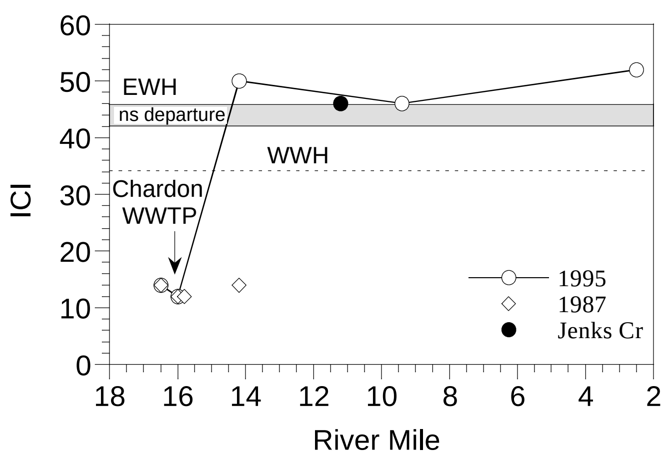


Figure 24. Longitudinal trends in Invertebrate Community Index (ICI) scores for Big Creek and Jenks Creek 1995, and Big Creek 1987.

Jenks Creek

The macroinvertebrate community in Jenks Creek at Pearl Road (RM 0.5) was evaluated as exceptional. The number of qualitative EPT taxa (17), the total number qualitative taxa (40), and the QCTV score (41.3) were in the range of similar tributaries in the Grand River basin with exceptional water quality. The fauna included 5 cool-water macroinvertebrate taxa indicative of groundwater flow from springs: the caddisflies *Dolophilodes distinctus* and *Ceratopsyche slossonae*, and the midges *Trissopelopia*, *Zavrelmyai*, and *Paratanytarsus* n. sp. 1. Also collected were the stoneflies *Acroneuria carolinensis*, *Acroneuria evoluta* and *Agnetina capitata* complex, and two sensitive taxa, the caddisfly *Psychomyia flavida* and the midge *Rheotanytarsus distinctissimus*.

Baughman Creek
The ICI score (50) was exceptional on Baughman Creek downstream from SR 45 (RM 4.1). This station had a taxa rich caddisfly community (11 taxa) among the 75 total macroinvertebrate taxa collected from the artificial and natural substrates. Three cool-water midge taxa were found to inhabit this station, *Zavrelimyia*, *Parametriocnemus*, and *Polypedilum (Polypedilum) aviceps*.

Mill Creek
The artificial substrates were affected by slow current at Netcher Road (RM 18.2) and no detectable current at SR 46 (RM 12.1). As a result, ICI values scored 36 and 26, respectively. The upper site was evaluated as exceptional and the lower site as good based on the assemblage of macroinvertebrates collected from both the artificial and natural substrates.

At Netcher Road, the number of qualitative EPT taxa (16), the total number qualitative taxa (61), and the QCTV score (38.2) were in the range of similar tributaries in the Grand River basin with exceptional water quality. This site had a higher number of total taxa (79) collected on both the artificial and natural substrates than any other Grand River tributary site sampled in 1995. The stonefly *Acroneuria evoluta* was collected and three unionid mussels, *Fusconaia flava, Lampsilis radiata luteola,* and *Lasmigona costata*, were also found.

At SR 46, the number of total taxa (73), number of total EPT taxa (13), and QCTV score (37.8) were similar to the sites in the low gradient section of the Grand River (RM 56.0 to RM 47.7) which were evaluated as good and very good. Two unionid mussels, *Anodonta grandis* and *Villosa iris*, were observed at this site.

Cemetery Creek
Macroinvertebrates assemblages collected from Cemetery Creek upstream and downstream from the Jefferson WWTP were rated as fair, indicating degraded resource conditions (Table 7).
In late August 1995, the flow condition in Cemetery Creek upstream from Market Street was intermittent with no detectable current. Macroinvertebrates were collected at RM 2.5 in a pooled section. Riffles and runs were not present. Although only 2 EPT taxa were collected at this site, 35 total taxa were collected from the natural substrates. Predominant organisms collected were characteristic of stream margin habitats or intermittent streams and included the mayfly *Stenonema femoratum*, damselflies and dragonflies, the midge *Chironomus decorus* group, and the snail genus *Physella*.

In contrast, the site downstream from Poplar Street (RM 1.3) had pool, riffle, and run zones with moderate current velocity. Flow was augmented, or composed entirely, by effluent from the Jefferson WWTP. The impact by the Jefferson WWTP appeared to be primarily organic enrichment in nature. The macroinvertebrate assemblage was characteristic of enrichment, being predominated by flatworms, the caddisfly *Hydropsyche depravata* group, and the midges *Conchapelopia* and *Rheotanytarsus exiguus* Only 1 EPT taxon and 22 total taxa were collected from the natural substrates.

Rock Creek

The macroinvertebrate community sampled downstream from the Union Cemetery (RM0.8) was evaluated as exceptional (ICI = 46). A total of 64 macroinvertebrate taxa were collected at this station including the sensitive midge *Synorthocladius semivirens*.

Paine Creek

The macroinvertebrate community performance in Paine Creek (RM 0.5) upstream from Seeley Road was evaluated as exceptional. The number of qualitative EPT taxa (16) and the QCTV score (39.8) were in the range of similar tributaries in the Grand River basin which were evaluated as exceptional. The fauna included the cool-water midge taxon *Parametriocnemus*, two stonefly taxa, *Acroneuria evoluta* and *Acroneuria internata*, and the rare mayfly genus *Acentrella*.

Phelps Creek

The macroinvertebrate community in Phelps Creek upstream from the covered bridge (RM 4.9) was evaluated as exceptional. The number of qualitative EPT taxa (16), the total number of qualitative taxa (47), and the QCTV score (39.8) were in the range of similar tributaries in the Grand River basin which were evaluated as exceptional. The fauna included three cool-water midge taxa (*Zavrelimya*, *Parametriocnemus*, and *Polypedilum (Polypedilum) aviceps*), two stonefly taxa (*Acroneuria evoluta* and *Neoperla clymene* complex), and the rare midge taxon *Polypedilum (Polypedilum)* Type 1. The unionid mussel *Strophitus undulatus undulatus* was observed at this site during qualitative sampling.

Swine Creek

The macroinvertebrate assemblage collected upstream from SR 544 (RM 5.2) was evaluated as exceptional (ICI=56). This station had a relatively taxa rich (16) mayfly community with 66 total taxa. Two sensitive mayfly taxa, *Acerpenna macdunnoughi* and *Labiobaetis propinquus*, and two cool-water taxa, the caddisfly *Ceratopsyche slossonae* and the midge *Parametriocnemus*, were collected from this station.

Table 8. Summary of macroinvertebrate data collected from artificial substrates (quantitative evaluation) and from natural substrates (qualitative evaluation) in the Grand River basin, 1995.

Stream/River Mile	Relative Density	Quant Taxa	Qual Taxa	Qual EPT[a]	Total Taxa	QCTV[b]	ICI	Evaluation[c]
				Quantitative Evaluation				
Grand River								
			Erie-Ontario Lake Plain - WWH Use Designation (Existing)					
95.5	-	-	56	20	-	39.7	-	Exceptional[c]
83.3	280	53	52	12	82	37.7	46	Exceptional
65.8	274	39	52	11	75	38.2	46	Exceptional
56.0	1382	40	55	7	75	35.3	34	Good
			Erie-Ontario Lake Plain - EWH Use Designation (Proposed)					
44.7	962	49	41	8	72	37.2	42[ns]	Very Good
32.9	-	-	74	19	-	39.1	-	Exceptional[c]
			Erie-Ontario Lake Plain - EWH Use Designation (Existing)					
28.4	1570	53	78	23	97	41.3	54	Exceptional
22.6	601	56	65	22	94	40.5	50	Exceptional
13.6	1115	48	55	16	81	39.7	52	Exceptional
8.5	-	-	55	23	-	42.2	-	Exceptional[c]
6.2	3785	38	55	20	71	40.3	44[ns]	Very Good
Big Creek				*Erie-Ontario Lake Plain - WWH Use Designation (Existing)*				
16.1	176	21	25	4	36	35.8	12[c]	Fair[c]
16.0	225	20	27	3	36	34.2	12	Poor
14.2	242	38	51	17	63	41.3	50	Exceptional
9.4	207	34	53	25	70	39.9	32[c]	Exceptional[c]
2.5	269	45	51	21	73	40.5	52	Exceptional
Jenks Creek								
0.5	-	-	40	17	-	41.3	-	Exceptional[c]
Baughman Creek								
4.1	238	55	41	17	75	39.7	50	Exceptional
Mill Creek								
18.2	584	45	61	16	79	38.2	36[c]	Exceptional[c]
12.1	731	47	44	9	73	37.8	26[c]	Good[c]
Cemetery Creek								
2.5	-	-	35	2	-	30.3	-	Fair
1.3	-	-	22	1	-	34.2	-	Fair

Table 8. Continued.

Stream/River Mile	Relative Density	Quant Taxa	Qual Taxa	Qual EPT[a]	Total Taxa	QCTV[b]	ICI	Evaluation[c]
				Quantitative Evaluation				
Rock Creek								
0.8	296	41	46	14	64	38.9	46	Exceptional
Paine Creek								
0.5	-	-	37	16	-	39.8	-	Exceptional
Phelps Creek								
4.9	102	26	47	16	64	39.8	36[c]	Exceptional[c]
Swine Creek								
5.2	692	48	45	18	66	40.3	56	Exceptional

Qualitative Evaluation

Stream/River Mile	Qual Taxa	QCTV[b]	Qual EPT[a]	Relative Density	Predominant Organisms	Narrative Evaluation
Grand River						
95.5	56	39.7	20	Low-Moderate	Midges, hydropsychid caddisflies, maetid mayflies	Exceptional
32.9	74	39.1	19	High	River snails, hydropsychid caddisflies, odonates	Exceptional
8.5	55	42.2	23	Moderate	Caddisflies, mayflies, midges	Exceptional
Big Creek						
16.1	25	35.8	4	Low-Moderate	Caddisflies, baetid mayflies, midges	Fair
9.4	53	39.9	25	Moderate	Mayflies, midges, hydropsychid caddisflies	Exceptional

Table 8. Continued.

			Qualitative Evaluation			
Stream/River Mile	Qual Taxa	QCTV[b]	Qual EPT[a]	Relative Density	Predominant Organisms	Narrative Evaluation
Jenks Creek						
0.5	40	41.3	17	Moderate	Caddisflies, midges, water pennies	Exceptional
Cemetery Creek						
2.5	35	30.3	2	Low	Midges,odonates	Fair
1.3	22	34.2	1	Low	Caddisflies, midges	Fair
Paine Creek						
0.5	37	39.8	16	Low	Caddisflies, mayflies	Exceptional

[a] EPT=total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxarichness.

[b] Qualitative Community Tolerance Value (QCTV) calculated as the median of the tolerance values determined for each qualitative taxon collected.

[c] The narrative evaluation using the qualitative sample is based on best professional judgement utilizing sample attributes such as taxa richness, EPT taxa richness, QCTV score, and community composition and is used in lieu of the ICI when artificial substrates are lost or deemed not useable.

[ns] Nonsignificant departure from ecoregional biocriterion ($\leq$ 4 ICI units).

Biological Assessment: Fish Community

Grand River

Excellent water quality owing to wide forested riparian buffers, limited (but increasing) residential development within the watershed, minor agricultural impacts, and minimal point source loadings of pollutants enables an outstanding fish community to thrive in the Grand River (Table 8, Figure 22). The importance of each element contributing to high water quality is reflected in various components of the fish fauna. Riparian forests absorb nutrients originating from nonpoint sources and filter sediment borne by surface runoff. Also, conservative farming practices on small acreage farms export less nutrients and sediments to tributaries, and because the tributaries are not channelized, those pollutants are better assimilated. Consequently, the Grand River has unembedded substrates providing habitat for aquatic insects, and good water transparency allowing sight feeding insectivorous fishes to forage. Accordingly, strong populations of obligate sight feeders (mimic shiner, rosyface shiner and silver shiner) are present in the lotic reaches. Also, the rich aquatic insect base generally supports a diverse insectivorous community, including an abundance of redhorse, river chub, and in the riffles, madtoms and darters.

The benefits of minimal pollutant loadings from point sources, residential septic systems and stormwater runoff are manifest in the high relative abundance of species sensitive to pollution. In the lotic reaches, sensitive species composed over 62% of the catch on average, with approximately half of those being considered highly intolerant (Figure 23). In the lentic reach, species sensitive to pollution numerically composed over 40% of the total catch (excluding the wetlands and headwater segments). Strong populations of several fish species that have declining populations throughout Ohio due to habitat loss and pollution are found in the Grand River. These species are river chub, rosyface shiner, mimic shiner, black redhorse and river redhorse. Moreover, the Grand River supports one of the strongest populations of black redhorse in the state (Figure 24). Also, muskellunge, a state endangered species, are present.

Differences between the lentic and lotic reaches are reflected in the IBI and MIwb scores (Figure 22). In the lotic reaches, both index scores either fully or marginally met Exceptional Warmwater Habitat (EWH) criterion, but in the lentic reaches, the MIwb did not meet the EWH criterion. The lower MIwb scores in the lentic reaches are due, in part, to depth because electrofishing efficiency is reduced in deep water, and MIwb scores are a function of relative abundance. The natural constraints imposed by lentic conditions, primarily reduced habitat heterogeneity and low dissolved oxygen levels, and the attendant loss of species, also contributed to the lower scores in both indexes, especially at RM 83.5, where the river flowed through an extensive wetland.

None of the evaluated segments showed significant impairment due to identified sources of either point source or non-point source pollution (Table 8). An anomalous IBI score (IBI = 42) was obtained on the second pass at RM 6.2 due to an inexperienced netter, and does not reflect impaired water quality. Also, the nonsignificant departure of most MIwb scores from EWH criteria in the lotic reach does not signify water quality impairment, but is more likely an artifact of the generally high water transparency, and comparatively low ambient nutrient levels (U.S.G.S. 1994).

Three component metrics of the IBI, the number of sunfish, round bodied sucker and darter species, consistently scored low in the lotic reach. The performance of these metrics in the Grand River was constrained by lack of representation of all habitat types in the electrofishing samples, and, for the number of darter species, unrealistic expectations. As noted in *Physical Habitat for Aquatic Life*, different habitat types occur in long stretches and are widely separated, leading to over or under sampling of one or two habitat types. The low numbers of sunfish species and deep pool sucker species (*i.e.*, silver redhorse and spotted sucker) reflect under-sampling of backwater and deep pool habitats. Because few darter species of the genus *Etheostoma* are indigenous to the Lake Erie drainage, expectations for the number of darter species present based on those derived for the Ohio River drainage, are unrealistic. At most, six species of darter (blackside, logperch, greenside, johnny, rainbow and fantail) can be routinely expected from moderate sized streams of the Lake Erie basin.

Table 9. Fish community indices from samples collected in the Grand River study area 1995, 1987, 1984 and 1983.

River Mile	Mean Number Species	Cumulative Species	Mean Rel. No (No./0.3 km)	Mean Rel. Wt. (wt./0.3 km)	QHEI	Mean Miwb[a]	Mean IBI	Narrative Evaluation
Grand River (1995)								
94.3	20.5	25	804.0	4.7	71	NA	51	Except.
83.5	19.5	27	129.0	3.1	54	7.6[ns]	41	M.Good/Good
65.9	17.5	22	212.0	48.7	57	8.1[ns]	45	Fair/V.Good
52.7	21.0	29	177.0	84.8	62	8.7[*]	45[ns]	Good/V.Good
40.9	25.5	34	444.0	52.6	67	9.2[ns]	49	V.Good/Except
36.3	19.5	25	233.0	48.8	57	8.5[*]	47[ns]	M.Good/V.Good
34.0	20.0	28	390.4	54.9	60	8.6[*]	50	M.Good/Except
28.4	22.2	25	676.8	39.8	52	9.5[ns]	51	V.Good/Except
22.1	21.0	23	730.8	20.6	88	9.5[ns]	48	V.Good/Except
13.4	22.5	26	550.0	44.1	91	9.1[ns]	52	V.Good/Except
8.0	22.5	32	362.0	74.6	78	9.2[ns]	52	V.Good/Except
6.2	24.5	32	478.0	40.3	76	9.4[ns]	47[ns]	V.Good
Grand River (1987)								
22.1	22.0	21	421.5	7.3	82	9.3[ns]	50	V.Good/Excpt
13.4	23.5	24	562.0	32.9	91	9.5[ns]	48	V.Good/Excpt
9.0	23.5	23	137.4	15.2	80	8.7[*]	47[ns]	Good/V.Good
6.1	24.5	20	326.0	64.6	77	9.4[ns]	54	V.Good/Excpt
Grand River (1983)								
83.5	24.0		220.0		53	8.3	40	Good
Big Creek (1995)								
16.3	8.0	9	973.0	4.8	62	NA	40	Good
15.9	5.5	7	236.0	1.0	54	NA	37[ns]	M.Good
13.9	8.0	9	560.5	6.8	71	NA	32[*]	Fair
9.5	13.5	15	1502.3	6.8	73	NA	38[ns]	M.Good
5.3	11.5	12	1377.2	7.2	71	7.8[ns]	40	M.Good/Good
2.5	14.0	17	1179.4	4.9	59	6.7[*]	36[ns]	Fair/M.Good
Jenks Creek (1995 - trib to Big Creek)								
0.1	11.0	11	338.3	1.6	70	NA	42	Good
Big Creek(1987)								
16.3	8.0	9	602.5	0.0	40	NA	40	Good
15.9	5.3	8	227.7	0.0	50	NA	23[*]	Poor
13.9	9.0	11	580.5	5.1	67	NA	28[*]	Fair
9.5	14.7	14	1963.5	20.4	83	NA	42	Good

Table 9. Continued.

River Mile	Mean Number Species	Cumulative Species	Mean Rel. No (No./0.3 km)	Mean Rel. Wt. (wt./0.3 km)	QHEI	Mean Miwb[a]	Mean IBI	Narrative Evaluation
Baughman Creek (1995)								
3.0	20.0	22	1880.0	25.6	51	NA	38[ns]	M.Good
Baughman Creek (1984)								
3.0	19.7		274.0		72	NA	38[ns]	M.Good
Mill Creek (1995)								
18.1	16.0	18	732.3	3.3	80	8.0	40	Good
10.0	21.5	25	474.8	7.7	80	8.6	47	Good/V.Good
Mill Creek (1983-84)								
17.2	24.5		666.0		63	8.1	37[ns]	Good/M. Good
10.0	21.3		414.0		90	7.5[ns]	37[ns]	Marg. Good
Cemetery Creek (1995)								
2.5	7.0	7	984.0	2.1	42	NA	26*	Poor
1.3	8.0	11	2138.0	9.1	56	NA	27*	Poor
Cemetery Creek (1987)								
2.5	13.0		1166.0			NA	32*	Fair
2.1	6.0		238.0			NA	24*	Poor
1.2	9.0		648.0			NA	24*	Poor
Rock Creek (1995)								
0.8	26.5	30	495.8	14.0	72	8.1	48	Good/V.Good
Rock Creek (1987)								
0.8	30.0		1191.0		74	8.9	48	Very Good
Paine Creek (1995)								
0.2	23.0	27	598.8	6.1	75	8.7	51	Good/Excpt.
Phelps Creek (1995)								
5.3	15.5	18	645.0	4.0	78	7.5[ns]	40	M.Good/Good
Swine Creek (1995)								
5.2	18.0	18	1236.3	13.0	59	NA	44	Good

Table 9. Continued.

Ecoregion Biocriteria: Erie-Ontario Lake Plain						
	IBI			MIwb		
Site Type	WWH	EWH	MWH[c]	WWH	EWH	MWH[c]
Headwaters	40	50	24	NA	NA	NA
Wading	38	50	24	7.9	9.4	5.6
Boat	40	48	24	8.7	9.6	5.7

a - MIwb is not applicable to headwater streams with drainage areas ≤ 20 mi^2.
ns - Nonsignificant departure from biocriteria (≤4 IBI units or ≤0.5 MIwb units).
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

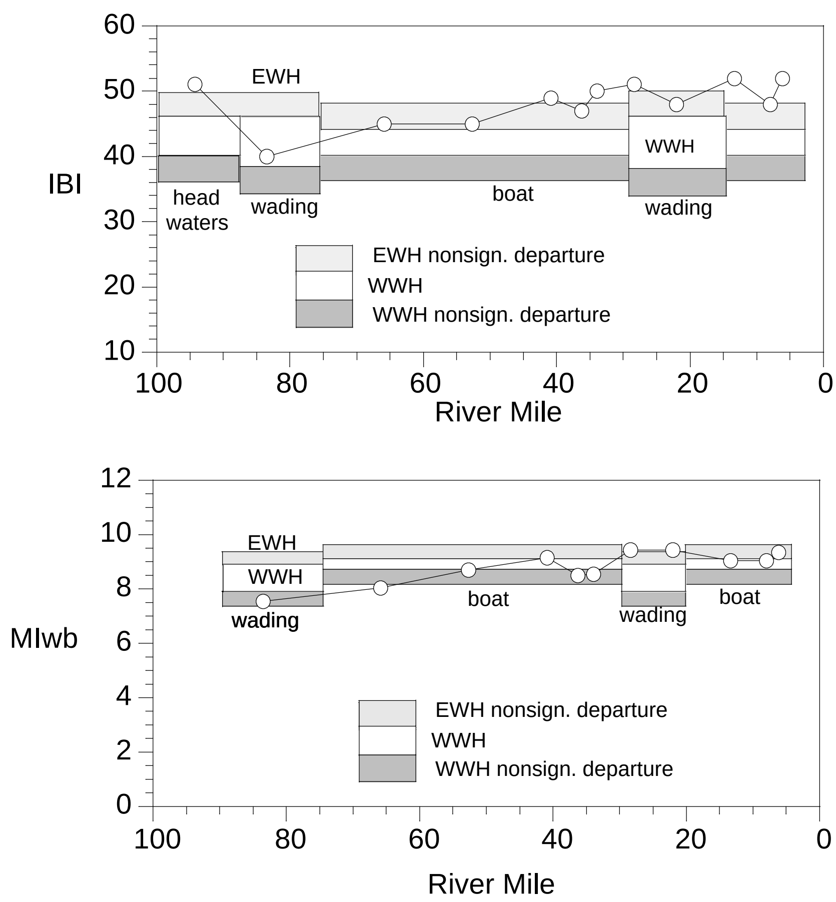


Figure 25. Longitudinal trend in mean Index of Biotic Integrity (IBI-top) and Modified Index of well-being (MIwb-bottom) scores for the Grand River, 1995.

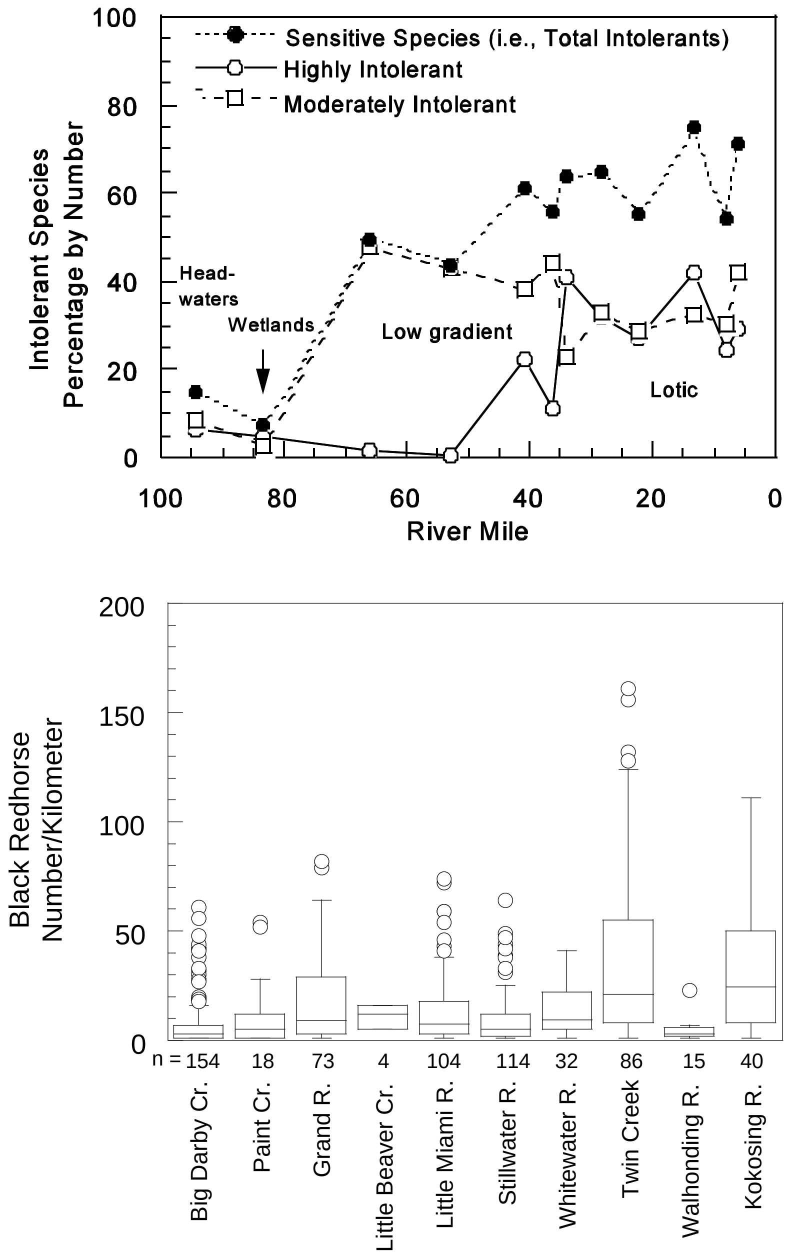
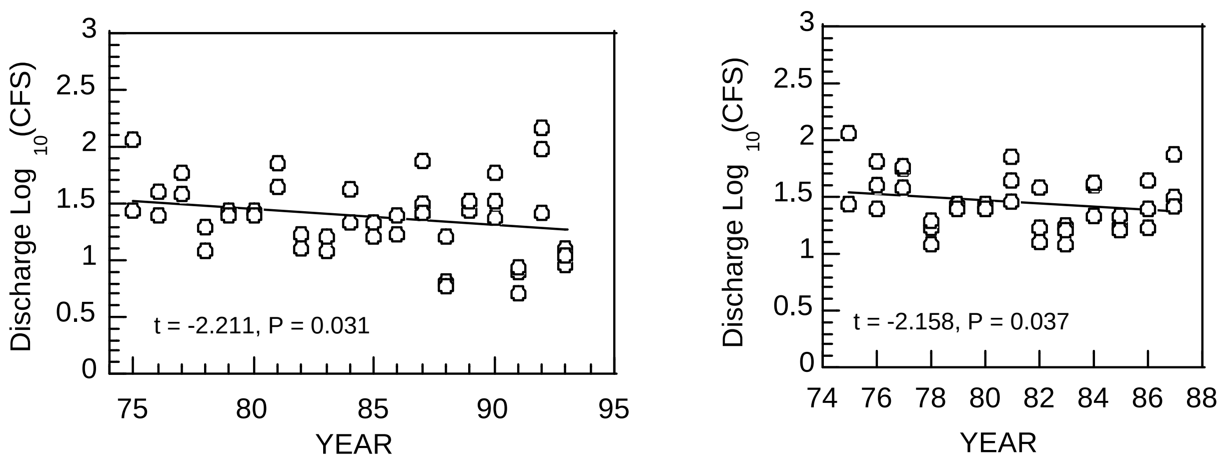


Figure 26. Relative number of pollution sensitive fishes by river mile in the Grand River (top) and the relative number of black redhorse in electrofishing catches in the Grand River compared to other EWH streams in Ohio (bottom).

Much of the Grand River is underlain by a shallow, low yielding, shale bedrock aquifer; consequently it periodically experiences very low flows in late summer (Figure 24), and is vulnerable to perturbations within the watershed. Because of the low summer flows, the Grand River cannot support unrestricted flow appropriations (*i.e.*, wells or irrigation) and has a limited ability to assimilate pollutants. Also, the shallow nature of the aquifer makes its ground water yield susceptible to increases in impervious surfaces within the watershed. Late summer low flows recorded at the USGS gaging station at SR 84 show a decreasing trend for the period of record. The trend is evident when the recent drought cycle (1988-1994) is removed, suggesting possible impingement by anthropogenic factors. The trend may, however, be solely attributable to climatic variability, as suggested by mean annual flows (Figure 24); still the decreasing summer flows demonstrate the vulnerability of the river to perturbations.



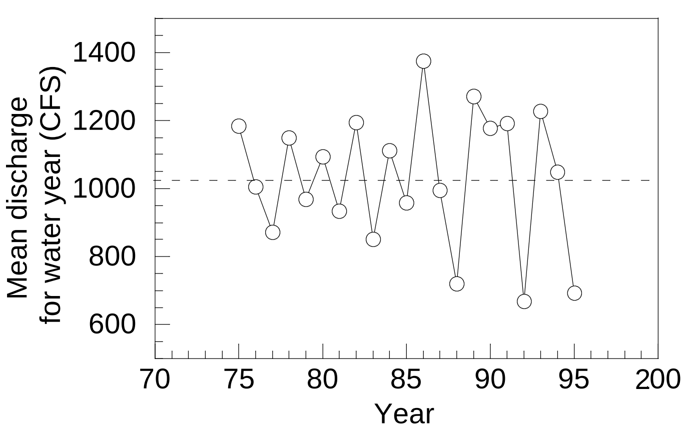


Figure 27. Minimum summer flows July, August and September 1974 - 1994 in the Grand River (upper left). The figure on the right has the recent drought period (1988 - 1994) removed. Increasingly variable mean annual discharge for the period of record (lower left) reflects the recent period of increased climatic variability.

Big Creek

Fish communities in Big Creek were evaluated at six locations to assess the impact of the Chardon WWTP (Table 8, Figure 25). The fish communities upstream (RM 16.3) and immediately downstream (RM 15.9) of the discharge met WWH criterion, though the score downstream only marginally attained. Pollution tolerant fishes composed more than 85% of the total individuals at each site (Figure 26), evidence for degraded water quality. While wading in the creek upstream of the plant, a strong petroleum smell and a sheen on the surface was evident when the bottom sediments were disturbed. These conditions were not observed downstream of the plant. The watershed immediately upsteam drains a construction company with heavy equipment and piles of concrete, a car dealership, and US 6, all potential sources of oil and grease.

The fish community in the far field zone (RM 13.9) was impacted and did not meet WWH criterion. Pollution tolerant fishes continued to be an unusually high percentage of individuals demonstrating impact from the plant. Also, pioneering fishes were most abundant at RM 13.9, suggesting a disturbed environment. This pattern is associated with delayed impacts from loadings of oxygen demanding pollutants. Results of Datasonde® 48 hr continuous hourly monitoring did not show an oxygen sag at RM 13.9 (Figure 13), suggesting routine pollutant loadings by the Chardon WWTP were being assimilated. However, median flows through the plant have been steadily increasing since 1993 and are now near its design capacity of 1.1 MGD (Figure 6). Discharges over its design capacity have been occurring since 1989, indicating that episodic discharges of poorly treated sewage are responsible for impairment in the fish community downstream of the plant.

The percentage of pollution tolerant fishes decreased steadily downstream from RM 13.9 reflecting improved water quality. Recovery was noted at RM 9.5, although the mean IBI score departed nonsignificantly from the WWH criterion. Full recovery was not evident until RM 5.3. Although marginal habitat (extensive bedrock) limited the performance of the fish community at RM 2.5 (Figure 25), excellent water quality was evidenced by the small percentage of pollution tolerant fishes, the relatively high abundance of river chubs (8.25% of individuals), and natural reproduction of rainbow trout, a species requiring well oxygenated, clear and silt free water to reproduce.

The fish community in Jenks Creek was sampled to serve as an unimpacted, small drainage area comparison for the upstream site (RM 16.3) on Big Creek. Although the IBI scores were similar at both sites, component metrics differed widely between the two. Jenks creek had greater species richness and a more balanced community indicating less disturbance from urban impacts. However, it scored similarly to Big Creek because of the high percentage of pollution tolerant and pioneering fishes, likely attributable to the small WWTP servicing a trail park upstream or possibly unsewered discharges.

Paine Creek

The Paine Creek watershed is presently relatively undeveloped. The clear, well oxygenated water and silt-free habitat characteristic of unperturbed watersheds was demonstrated by the presence of a naturally reproduced rainbow trout, and an exceptional fish community. However, residential development within the upper watershed in Leroy Township is increasing at a rapid pace, potentially threatening Paine Creek.

Mill Creek

Two sites were sampled in Mill Creek, RMs 18.1 and 10.0. The QHEI scores at both sites indicated that the physical habitat was capable of supporting an exceptional fauna. However, only the IBI at RM 10.0 marginally met EWH criterion, otherwise scores met WWH criteria. The performance of the biotic community was limited by low stream flows. Historical records from a now defunct USGS gauging station at RM 8.5 demonstrate that the creek typically becomes intermittent or has very low flows ($\approx$ 0.1 cfs) in late summer. Low flows stress fish populations by limiting the amount of habitat available, increasing exposure to predation, and increasing diurnal oxygen swings. The moderately elevated abundance of tolerant and omnivorous fishes, and low number of intolerant species reflect these stresses to the fish community.

Cemetery Creek

The two sites bracketing the Jefferson WWTP were sampled in Cemetery Creek. Neither site met the WWH criterion (Table 8). The site upstream of the plant is heavily modified (QHEI = 42), and becomes intermittent in late summer. Besides a degraded physical habitat, the creek receives septic discharge from a tile line. Also, a grayish-green substance resembling fertilizer (or embalming fluid) had been dumped near the upstream end of the zone. Accordingly, a degraded fauna was present, composed mainly of tolerant fishes. Downstream of the WWTP plant, the creek is effluent dominated. Though not meeting WWH criterion because creek chub composed 80% of the biomass, the community contained elements of a balanced fauna, suggesting the effluent was not acutely toxic, and that the community is capable of recovering following the current plant upgrade.

Rock Creek

The site sampled in Rock Creek was located downstream from an instream impoundment. A cluster of residential and vacation homes are located on the shores of the impoundment, but do not appear to significantly impact the water quality in Rock Creek, as a balanced stream fish assemblage meeting WWH criteria was present. Nutrient inputs from septic discharge or lawn fertilizer are apparently either minimal or assimilated by the impoundment. The impoundment did influenced the composition of the fauna by adding species with a lacustrine affinity (*e.g.*, golden and spotfin shiner, largemouth bass, and yellow perch). The impoundment also helped to stabilize flows, essentially functioning as a larger drainage area. The drainage area at RM 0.8 of Rock Creek is approximately 57 mi^2, yet the fish community there performed more similarly to the community at RM 10.0 of Mill Creek, with a drainage area of 86 mi^2, than that at RM 18.1 with a drainage area of 69 mi^2 (See appendix Table A-4). Although the impoundment

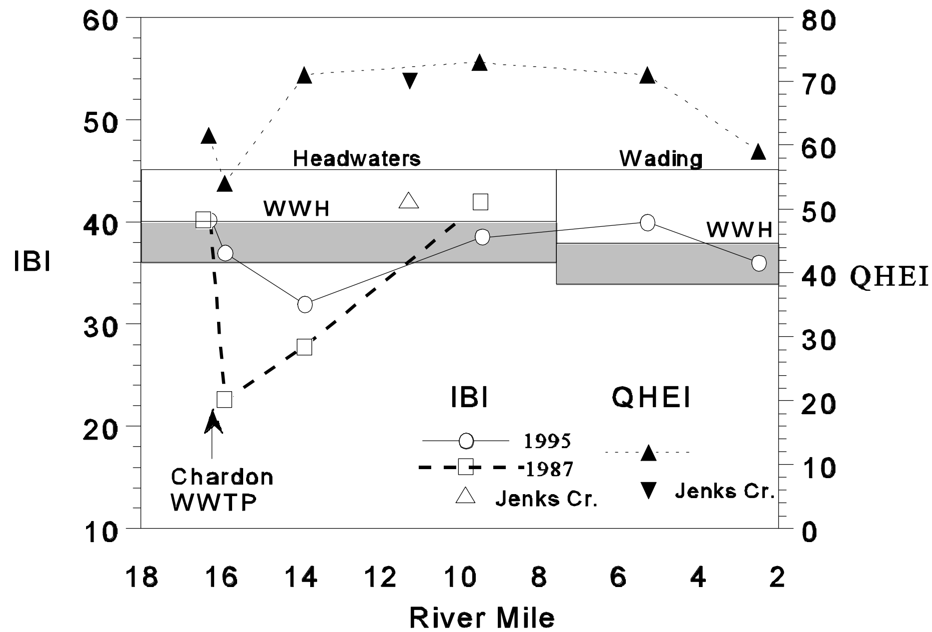


Figure 28. Longitudinal trends in Index of Biotic Integrity (IBI) scores for fish communities sampled in Big Creek, 1995 and 1987, in relation to the Chardon WWTP. The shaded box represents the area of insignificant departure from the applicable WWH criterion.

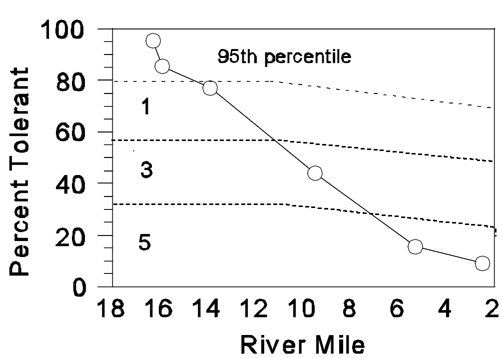


Figure 29. Mean percentage of pollution tolerant fishes in electrofishing samples collected in Big Creek, 1995. The dashed lines depict the boundarys for IBI metric scoring of the percent tollerant fishes. Values above the 95th percentile line deviate strongly from the sample population.

augmented several IBI metrics, in its absence, the community would likely still have attained WWH criteria.

Phelps Creek

Contrary to the excellent habitat, the fish community in Phelps Creek narrowly met WWH standards at RM 5.3 (Table 8). Like other streams in the area (e.g., Mill Creek and the Ashtabula River), the performance of the fish community, in the elevated abundance of tolerant fishes (white sucker, blacknose dace and creek chub), reflected the recurrent low or intermittent summer flows, as opposed to poor water quality. The excellent habitat quality, especially the mature riparian buffer, enabled several cool water fish species to exist despite the low flow conditions.

Swine Creek

Despite marginal habitat, the fish community in Swine Creek fully met WWH criteria, owing in part to sustained flows in late summer. The lower reach of Swine Creek flows through lacustrine deposits, which tend to retain groundwater and release it slowly. American brook lamprey, a species requiring permanent water (Trautman 1981) were present. The relatively homogeneous sand and gravel substrates favored omnivorous and generalist feeders (i.e., white sucker, creek chub and bluntnose minnow) and silverjaw minnow.

Baughman Creek

A diverse fish fauna was sampled in Baughman Creek. Although the sampling location was located in a pasture, the land was not over grazed and aquatic vegetation was present. Sustained flows and clear water enabled the presence of northern brook lamprey, a state endangered species, and hornyhead chub, a species extirpated from much of its former range in Ohio. Nutrient enrichment from pasturing was evident, however, in the high relative abundance of all fishes, particularly tolerant ones, and the prevalence of homogenous fine substrates resulted in few lithophilic species. Consequently, the IBI marginally met the WWH criterion.

Changes in Chemical Water Quality

Grand River

In 1974 the U.S. EPA authored a report entitled "Northeast Ohio Tributaries to Lake Erie Waste Load Allocation Report". The report stated that the water quality within the Grand River Basin was generally "good" but did find exceedences of cadmium (<8- 12 μg/l) and mercury (0.3-0.8 μg/l) throughout the basin which were attributed to non-point sources. The report also stated that they could not rule out "laboratory error" as the reason for the elevated cadmium and mercury concentrations. Bacterial contamination was most severe in urban areas and the lower Grand River near Painesville was the most severely polluted. Dissolved solids from the now closed Diamond Shamrock Corporation discharge into the Grand River had measurable impacts upon the Painesville, Ashtabula and Conneaut water supply intakes in Lake Erie.

In 1987, Ohio EPA conducted a study of the Grand River and Big Creek. The Grand River study area extended from Brandt Road (RM 28.4) to the mouth (RM 0.0). The results of that study were reported in "Biological and Water Quality Survey of the Grand River". The study reported that the Grand River met all water quality criteria upstream from the Diamond Shamrock lagoons near Painesville. Downstream from the lagoons, exceedences of the total dissolved solids criteria were documented in the Grand River.

Since 1975, monthly water quality monitoring, as part of the National Ambient Water Quality Monitoring Network (NAWQMN), has been conducted in the Grand River at State Route 84 (RM 8.5) south of Painesville. A NAWQMN station at S.R. 528 (RM 22.1) was established in 1973 and abandoned in 1974 and another station at S.R. 535 (RM 2.3) was established in 1972 and abandoned in 1994. Analysis of the data from these stations, as illustrated graphically from a plot of ammonia concentrations at S.R. 84 (Figure 27), reveal a strong improvement in ammonia-N concentrations in the watershed. The improvement is probably a result of connections of inadequate or failing sanitary systems to central treatment facilities, consolidation of smaller wastewater facilities and improved treatment at Lake County wastewater plants (despite recent increases in ammonia-N loadings from the Lake County Heatherstone WWTP) and improved treatment at the Chardon WWTP on Big Creek.

The trend in chemical oxygen demand concentrations varied from 1973 to present at S.R. 84. A slight improvement (lower concentrations) in COD is indicated in the early 1980's. The concentrations increased during the middle 1980's and improved again in the late 1980's and early 1990's (Figure 27). The trend in dissolved oxygen concentrations at Route 84 appear to be correlated to the COD trend. No appreciable trend in dissolved oxygen concentrations was noted over the period of record (Figure 27).

Zinc concentrations at SR 84 are at low levels but the concentration in the water appears to be increasing (Figure 27). This apparent trend should continue to be monitored. There is no known significant zinc point source discharge upstream from the SR 84 station. Other heavy metal concentrations do not appear to be of significant concern in the Grand River.

Ammonia-N concentrations at Kiwanis Park (RM 6.1) have improved from the average 0.5mg/l (n=3) concentration reported in the 1987 study to concentrations that were all (n=5) less than method detection limit of 0.05 mg/l.

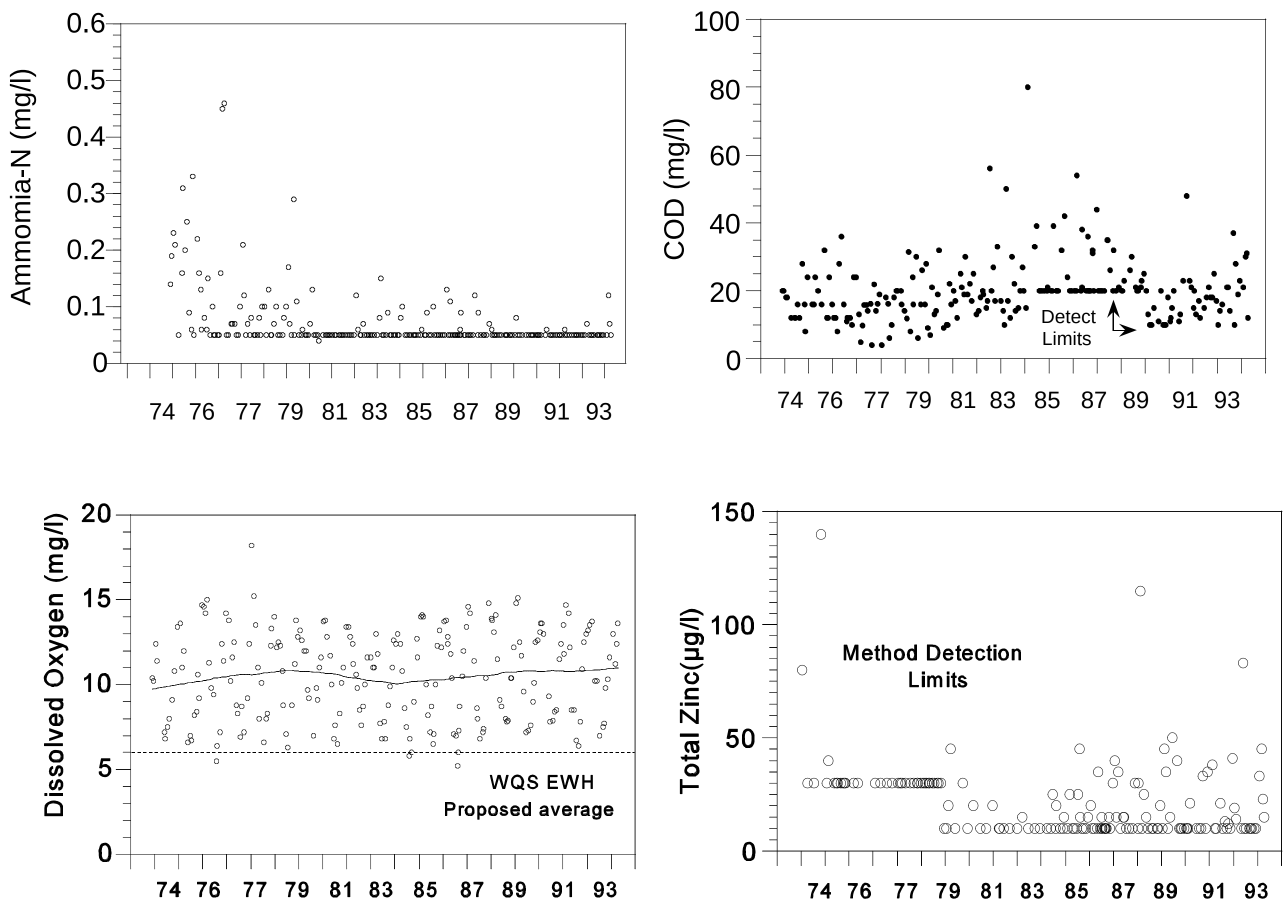


Figure 30. Trends in select chemical water quality parameters from the Grand River measured at the NAWQMN station at SR 84 (RM 8.5) south of Painesville 1974 - 1994.

Big Creek

In 1987, Ohio EPA conducted a study of the Grand River and Big Creek. The Big Creek study area extended from US Route 6 (RM 16.6) to Woodin Rd (RM 14.0). The results of that study were reported in "Biological and Water Quality Survey of the Grand River". The 1987 study indicates that the water quality in Big Creek upstream from the Chardon WWTP apparently has not changed. Exceedences of the minimum dissolved oxygen criteria as well as elevated phosphorus and nitrogen compounds at the Route 6 site were documented in both studies.

The addition of phosphorus removal at the Chardon WWTP appear to be benefitting the stream as total phosphorus concentrations downstream of the WWTP at Woodin Road have been reduced from 1987 concentrations. The 1987 study reported a range of 0.84 to 2.7 mg/l, while the range in 1995 was 0.05-0.16 mg/l. Dissolved oxygen, COD, and ammonia-N during the 1995 study also appeared to improve from 1987 concentrations. (Figure 28). The reduced ammonia concentrations and the increased nitrate-nitrite concentrations (SATWQT-9) indicate improved treatment at the Chardon WWTP.

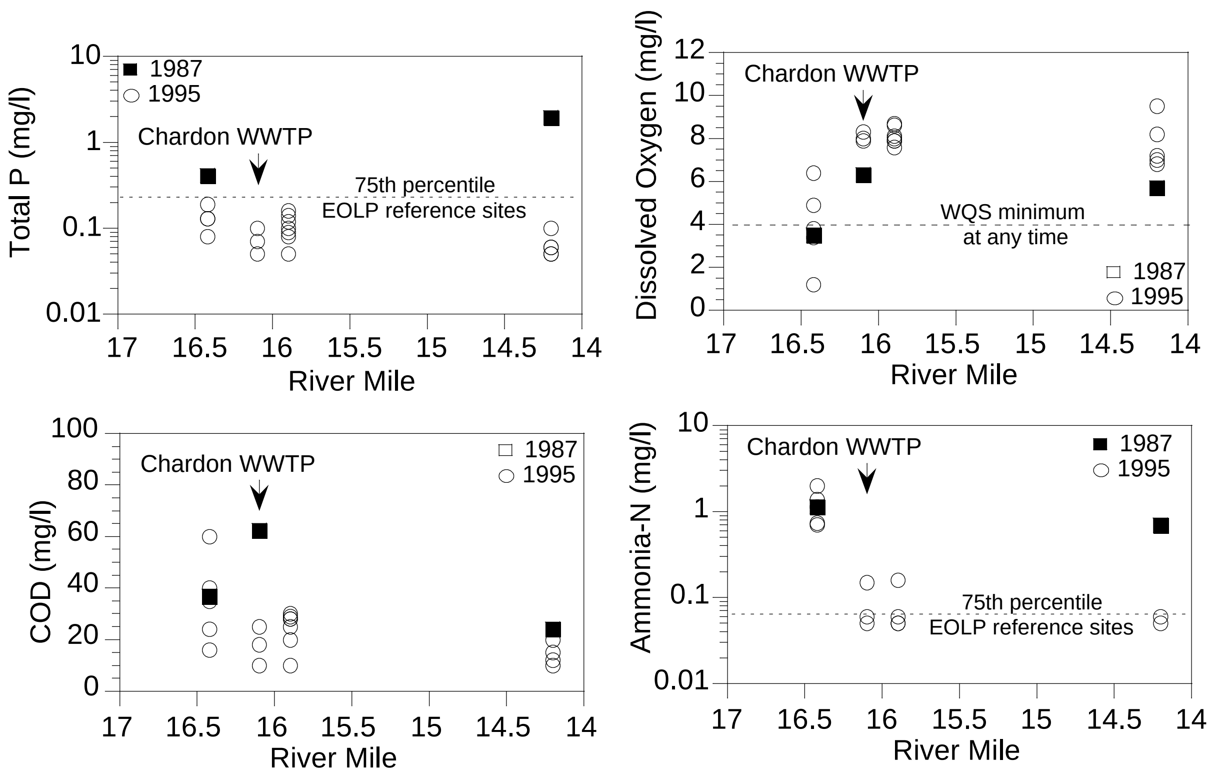


Figure 31. Trends in select chemical water quality parameters measured in water quality grab samples from Big Creek, 1987 (presented as means) and 1995 in relation to the Chardon WWTP.

Cemetery Creek

The 1974 U.S. EPA WLA reported low dissolved oxygen in Mill Creek which they attributed to the Jefferson WWTP discharge to Cemetery. Water quality samples collected from Cemetery Creek in 1986 indicated low dissolved oxygen and elevated concentrations of ammonia-N and TKN downstream from the Jefferson WWTP. Dissolved oxygen concentrations were not of concern during the 1995 study, but the ammonia-N and TKN concentrations continued to be elevated downstream from Jefferson WWTP.

Ecoregional reference sites
In 1985 Ohio EPA collected water quality information from several ecoregional reference sites including Mill Creek at Netcher Road, Mill Creek at Doyle Road, Grand River at Hyde Road and Baughman Creek at Mesic (Fenton) Road. The reference sites were selected to represent water resources that have been least impacted due to human influence in Ohio. The data were used to develop the ecoregional criteria concept that Ohio EPA currently uses to assess water resources. A review of the data indicate no apparent change in water quality from 1985 to 1995 at these reference sites.

Changes in Biological Community Performance - Macroinvertebrates

Grand River
Macroinvertebrate communities in the Grand River have consistently demonstrated very good to exceptional conditions from 1983 to 1995 (Table 9, Figure 29). ICI scores not in the exceptional range were usually a result of slow current conditions or other perturbations not related to water quality. One possible exception was an ICI score of 34 (good range) in 1988 at RM 8.4. This site was located below the influence of the Heatherstone WWTP. Also, 1988 was a drought year. The combination of the WWTP discharge and less water available upstream for dilution may have resulted in the lower ICI score that year. Loadings data from the Heatherstone WWTP do not indicate anomalous plant operation in 1988, however an ammonia-nitrogen concentration approaching chronically acute levels (0.09 mg/l) was detected in a water quality grab sample collected 31 August 1988. Data from 1987 and 1995 at this station showed very good to exceptional communities.

During the 1995 study, there were many macroinvertebrate taxa collected characteristic of high quality waters that have also been collected in previous years: the mayflies *Baetis armillatus*, *Baetis dubius*, *Labiobaetis propinquus*, *Stenonema mediopunctatum*, and *Serratella deficien;* the stoneflies *Acroneuria carolinensis*, *Acroneuria evoluta*, *Acroneuria internata*, *Agnetina capitata* complex, and *Neoperla clymene* complex; and the midge taxa *Synorthocladius semivirens* and *Rheotanytarsus distinctissimus* group. One rare taxa, *Polypedilum (Polypedilum)* Type 1, was collected in 1995 and in 1987.

Big Creek
Macroinvertebrates collected upstream and downstream from the Chardon WWTP showed improvements between 1987 and 1995 (Table 9, Figure 21). Numbers of qualitative EPT taxa and QCTV scores were higher in 1995 at the three common sites. Communities upstream from the Chardon WWTP (RM 16.1) and immediately downstream (RM 16.0/15.8) appeared to be slightly improved, but were still evaluated as poor or fair and not meeting the WWH criterion. The most significant improvement occurred at Woodin Road (RM 14.2) which improved from fair in 1987 to exceptional (ICI = 50) in 1995.

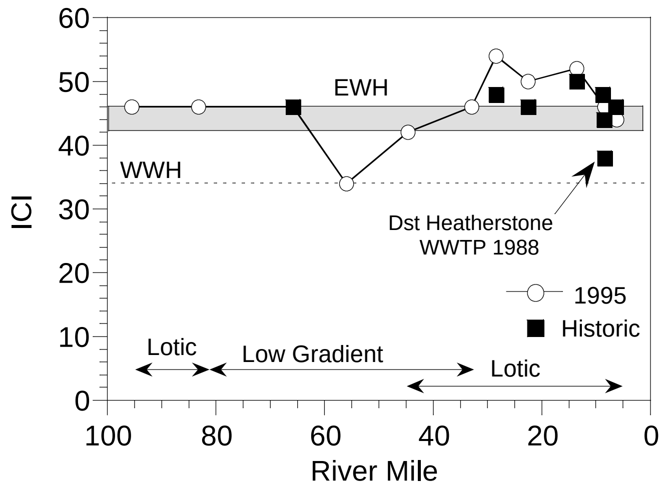


Figure 32. Longitudinal trends in Invertebrate Community Index (ICI) scores from the Grand River, 1995, compared to historical scores (1983-1991).

Baughman Creek
Macroinvertebrate communities were sampled in Baughman Creek in 1984 as an ecoregion reference site. In both 1984 and 1995 the ICI score was 50 (exceptional).

Mill Creek
Artificial substrates at Netcher Road (RM 18.2) and SR 46 (RM 12.0) were affected by slow or no detectable current over the samplers in 1983, 1984, and 1995. Qualitative samples were collected by different methods. The 1983 and 1984 samples were collected by kicking into a dipnet for a distance of 10 feet in a riffle zone. This was the protocol for the Ohio ecoregion project sampling conducted in 1983 and 1984. The qualitative sampling conducted in 1995 was performed in accordance Ohio EPA methods prefaced in the Methods section of this report. Even with these sampling differences, there were 9 to 16 qualitative EPT taxa and QCTV scores ranged from 35.9 to 38.2 during these years at both sites. No apparent change in the stream quality was discernible between 1983 and 1995.

Rock Creek
The ICI score of 46 in 1995 was in the exceptional range. A qualitative sample was collected in 1987 which had similar numbers of qualitative EPT taxa (13 vs. 14) and QCTV score (38.2 vs. 38.9).

Table 10. Summary of macroinvertebrate trend data collected from artificial substrates (quantitative evaluation) and from natural substrates (qualitative evaluation) in the Grand River basin, 1983-1995.

Stream/River Comments/ Mile	(Year)	Relative Density	Quant Taxa	Qual Taxa	Qual EPT[a]	Total Taxa	QCTV Score	ICI	Evaluation
Grand River	*Erie-Ontario Lake Plain - WWH Use Designation (Existing)*								
83.3	(1995)	280	53	52	12	82	37.7	46	Exceptional
83.5	(1984)	174	40	25	4	55	37.2	[24]	No current over HDs
65.8	(1995)	274	39	52	11	75	38.2	46	Exceptional
65.9	(1983)	1136	43	30	7	57	39.7	[44]	Exceptional
	Erie-Ontario Lake Plain - EWH Use Designation (Existing)								
28.4	(1995)	1570	53	78	23	97	41.3	54	Exceptional
	(1987)	2180	35	68	24	76	40.5	48	Exceptional
22.6	(1995)	601	56	65	22	94	40.5	50	Exceptional
	(1987)	549	43	64	23	79	41.3	46	Exceptional
13.6	(1995)	1115	48	55	16	81	39.7	52	Exceptional
	(1987)	1247	44	66	23	83	40.5	50	Exceptional
8.5	(1995)	-	-	55	23	-	42.2	-	Exceptional[b]
8.8	(1991)	1283	56	57	21	81	41.5	48	Exceptional
8.4	(1988)	1177	54	40	14	69	37.2	34	Good
8.6	(1987)	-	-	49	22	-	41.3	-	Good-Except.
8.4	(1979)	304	41	21	14	50	42.4	40[b]	Pre-1980 data
6.2	(1995)	3785	38	55	20	71	40.3	44[ns]	Very Good
6.4	(1994)	43	27	43	17	58	40.3	32[b]	Samples disturbed
6.4	(1987)	1117	44	64	27	77	41.4	46	Exceptional
Big Creek	*Erie-Ontario Lake Plain - WWH Use Designation (Existing)*								
16.1	(1995)	176	21	25	4	36	35.8	12[b]	Fair[b]
	(1987)	-	-	28	2	-	32.3	-	Poor
16.0	(1995)	245	20	27	3	36	34.2	12	Poor
15.8	(1987)	-	-	20	0	-	25.1	-	Poor
14.2	(1995)	241	38	51	17	63	41.3	50	Exceptional
	(1987)	-	-	38	9	-	39.2	-	Fair

Table 10. (Continued).

Stream/River Comments/ Mile	(Year)	Relative Density	Quant Taxa	Qual Taxa	Qual EPT[a]	Total Taxa	QCTV Score	ICI	Evaluation
				Trend Evaluation					
Baughman Creek									
4.1	(1995)	238	41	55	17	75	39.7	50	Exceptional
	(1984)	1200	57	49	14	76	40.0	50	Exceptional
Mill Creek									
18.2	(1995)	584	45	61	16	79	38.2	36[b]	Exceptional[b]
	(1984)	391	41	28	9	54	35.9	26[b]	Flow affected samplers
12.1	(1995)	731	47	44	9	73	37.8	26[b]	Good[b]
	(1983)	412	27	46	10	59	39.3	22[b]	Flow affected samplers
Rock Creek									
0.8	(1995)	296	41	46	14	64	38.9	46	Exceptional
	(1987)	-	-	54	13	-	38.2	-	

[a] EPT=total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness.

[b] The narrative evaluation using the qualitative sample is based on best professional judgement utilizing sample attributes such as taxa richness, EPT taxa richness, QCTV score, and community composition and is used in lieu of the ICI when artificial substrates are lost or deemed not useable.

[ns] Nonsignificant departure from ecoregional biocriterion ($\leq$ 4 ICI units).

Changes in Biological Performance - Fish

Grand River

Index scores collected in 1987 and 1995 show similar community performance (Figure 30), indicating no appreciable degradation in water quality between survey years (Table 10). An increase from 4.4% in 1987 to 8.3% in 1995 in the percent composition of pollution tolerant fishes, mainly bluntnose minnows, was noticed. The difference does not appear to be related to impaired water quality as abundance of pollution intolerant fishes is unchanged. The difference may simply be an artifact, or it may reflect stress on the community from the recent period of recurrent drought. Also, relative abundance of smallmouth bass decreased from 5.6% in 1987 to 3.8% in 1995. Again, the difference may be an artifact, or it may represent stress due to drought and unstable flows as smallmouth bass recruitment and abundance is correlated with flow stability (Lukas and Orth 1995; Sowa and Rabeni 1995).

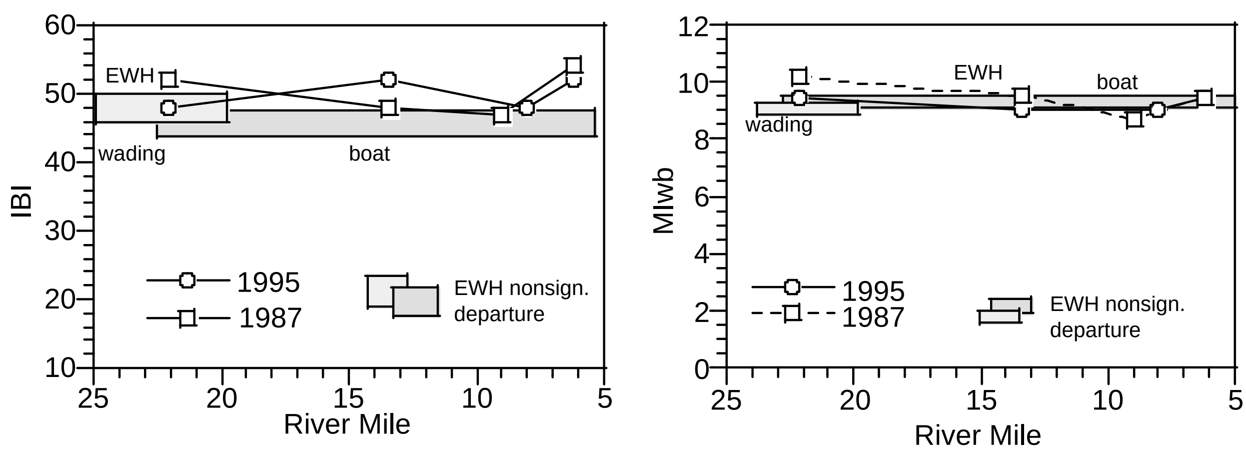


Figure 33. IBI (left) and MIwb (right) scores from similar locations sampled in the 1995 and 1987 surveys of the Grand River. The wading sampling method was used at RM 22.1 in 1995.

Big Creek

Fish community performance downstream of the Chardon WWTP improved significantly in 1995 compared with that found in 1987 (Figure 25). The improved fish communities reflect upgrades to the treatment plant, especially nitrification and dechlorination (see *Pollutant Loadings* section). Althought the stream remains impacted downstream of the plant, the area of degradation (ADV) was reduced and the severity of impact lessend. The ADV per mile was reduced in 1995 to 13.2 from 52.7 in 1987, a 25% decrease (Table 10). Additionally, stream miles in Full attainment

Table 11. Area of Degradation (ADV) statistics for similar segments in the Grand River basin sampled in 1987 and 1995.

	Biological Index Scores					Area of Degradation Values			Attainment Status (Miles)			
Year Index	Upper RM	Lower RM	Mini-mum	Maxi-mum	Mean	ADV	ADV/ Mile	Neg. % of Criteria	Full	Partial	NON	POOR/VP
Grand River												
1995												
IBI			47	54	50.6	0	**0.0**	0.0				
MIwb	28.4	6.2	8.9	10.1	9.4	2	**0.1**	0.2	19.8	2.4	**0.0**	0.0
ICI			44	54	50.0	0	**0.0**	0.0				
1987												
IBI			47	54	50.3	0	**0.0**	0.0				
MIwb	28.4	6.1	8.7	10.2	9.4	41	**2.6**	2.4	18.5	3.8	**0.0**	0.0
ICI			46	50	47.2	0	**0.0**	0.0				
Big Creek												
1995												
IBI			32	40	37	90	**13.2**	8.3				
MIwb	16.3	9.5	--	--	--	--	--	--	2.7	0.0	**4.1**	0.0
ICI			--	--	--	--	--	--				
1987												
IBI			23	42	33	358	**52.7**	30.1				
MIwb	16.3	9.5	--	--	--	--	--	--	1.9	0.0	**4.9**	2.0
ICI			--	--	--	--	--	--				

increased from 1.9 miles in 1987 to 2.7 miles in 1995, and the 2.0 miles of stream in Poor and Very Poor status documented in 1987 were eliminated in 1995. Although the species composition was similar between 1987 and 1995 in the near field zone (RM 15.9), white sucker and creek chub (both omnivorous) composed approximately 92% of the individuals in 1987, suggesting the presence of untreated sewage and nutrient enrichment. In 1995, they composed only 11%. The benefits of nitrification and dechlorination in the treatment process were demonstrated at RM 13.9, where in 1987 no darters were collected, but in 1995 rainbow darter, a species sensitive to ammonium ions (Weichert 1995, Karr et al. 1985), were comparatively abundant (8% by number). As the upgrades to the plant were implemented recently (dechlorination as late June 1995), the fish community may still have been recovering during the 1995 sampling period. Decreased nutrient loadings between 1987 and 1995 resulted in lower relative abundance of fishes downstream of the treatment plant, especially at RM 9.5 where abundance decreased from 3,227 fish/0.3 km to 1,502 fish/0.3 km.

Published historical records documenting fish communities in Big Creek before 1987 do not exist.

Given the habitat quality in the middle reach, and the clear, silt free water, a better fish community was anticipated. Species expected, but not found, were mimic shiner, rosyface shiner and smallmouth bass. Sand shiner and stonecat were present only at RM 2.5, but were rare. The high relative abundance of pollution tolerant fishes in the upper stream reach, and the rarity of pollution intolerant species throughout, suggests that water quality in Big Creek may have been severely degraded in the past.

Mill Creek

Mill Creek was sampled at comparable locations in 1995 and 1983-84 (Table 9). Fish community performance was similar between years at both sampling locations. Although IBI scores at RM 10.0 were higher in 1995 than 1984, the difference was an artifact of how DELT anomalies were scored Wounds from recently detached parasites (leaches and anchor worm) were counted as lesions in 1984, whereas they were counted as parasites only in 1995.

Cemetery Creek

Condition of the fish community in Cemetery Creek was similarly bad in both the 1987 and 1995 surveys (Table 9), reflecting continued operation problems with the Jefferson WWTP (see *Pollutant Loading* section). Additionally, loss of riparian vegetation at RM 2.5 since 1987 resulted in further degradation to the community.

Rock Creek

The fish community at RM 0.8 in Rock Creek performed similarly well in both the 1987 and 1995 surveys, suggesting no appreciable change in water quality.

Baughman Creek

The mean IBI scores recorded for Baughman Creek in 1984 and 1995 were the same. However, the species composition had changed slightly, possibly reflecting an increase in riparian pasturing and the attendant nutrient loads. For example, species requiring relatively silt free conditions, rainbow darter and hog sucker, were collected in 1984, but were absent in 1995, while relative abundance increased from 274.8 to 1880.0 fish/0.3 km. Northern brook lamprey, a state endangered species, were collected in both surveys.

Chapter 2

Biological and Water Quality Study of the Ashtabula River, Cowles Creek, Arcola Creek and Conneaut Creek

Ashtabula and Lake Counties

INTRODUCTION

The free flowing portion of the Ashtabula River including the East and West Branches, Arcola Creek, Cowles Creek and Conneaut Creek were the object of this survey. Specific objectives of this study were to:

1) Evaluate the the physical habitat, surface water and sediment quality, and the biological integrity of the sites within the study area,

2) Assess impacts from municipal wastewater treatment plants, nonpoint sources of pollution, habitat alterations and suburban development,

3) Determine attainment status of aquatic life use and non-aquatic use designations, and recommend changes where appropriate, and

4) Compare results of this survey with previous surveys to assess changes in waterquality and biological integrity.

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

SUMMARY

A biological and water quality survey of the Ashtabula River basin (including Cowles, Arcola and Conneaut Creeks) was conducted 15 June - 10 October 1995. The Ashtabula River and Conneaut Creek generally met biological criteria standards for the WWH and EWH use designations, respectively. Cowles Creek and Arcola Creek had significant areas not meeting WWH biological criteria owing to nutrient enrichment from municipal WWTP plants or extensive habitat and flow alterations.

Ashtabula River
The Ashtabula River, including the East and West Branches, met the WWH biological criteria at 6 of 7 locations sampled giving 27.3 miles in full attainment. One location, RM 19.1, covering 0.3 miles was in partial attainment of WWH criteria due largely to effects from intermittent flows (Table 1 and Figure 1). However, low summer flows limit the ability of the river to assimilate pollutants, and high fecal coliform counts (>1000/100 ml) at several locations following a rain event suggested anthropogenic stresses, either on site sewage disposal or, in the upper watershed, sporadic livestock access, were contributing to the partial attainment. The absence of high values in other water quality parameters indicitive of sewage enrichment (*e.g.*, TKN, TDS) and low nutrient levels, implies that organic enrichment was secondary to intermittent flows as the cause of patial attainment. Dissolved oxygen levels at or below the minimum criterion of 4.0 mg/l were

measured at two locations in the middle reach and in the East Brach while the river was intermittent. Conversely, the benefits of conservation farming practices paired with intact riparian vegetation and low density development were manifest, especially in the middle reaches, by the high relative abundance of mimic shiner and bigeye chub, species requiring clear, silt free habitats to thrive.

Cowles Creek

Fish and macroinvertebrate communities in Cowles Creek were impacted by nutrient loadings from municipal wastewater, urban runoff, and possibly stream dewatering. Urban runoff and apparently unsewered discharges impacted biological communites upstream from the Geneva WWTP resulting in 0.5 miles of partial attainment (Table 1 and Figure 1). A further drop in community performance downstream of the Geneva WWTP relative to that found upstream resulted in 1.7 miles in non-attainment. Periodic toxicity was indicated by the loss of rainbow darters, a species sensitive to ammonia toxicity, downstream from the WWTP. Organic enrichment from the WWTP effluent was evident in it effects on the composition of the fish and macroinvertebrate fauna. The relative number of fish, especially creek chubs and stonerollers, increased by nearly two orders of magnitude downstream of the plant, and the macroinvertebrate assemblage was composed primarily of groups positively affected by enrichment (*e.g.*, oligochaetes, snails and midges). Impacts to the biotic community may be linked to a combination of periodic upsets in the plant due to inflow and infiltration problems and polluted storm water runoff from the city of Geneva. Maximum flows to the Geneva WWTP as high as 6.47 MGD have been reported, and bypasses have resulted from these excessive hydraulic loads. Limited recovery of the aquatic community was observed at RM 1.1, giving 1.4 miles of partial attainment. Also, intermittent stream flows at RM 7.2, possibly derived from stream dewatering, impacted the fish community, resulting in an additional 1.0 mile of partial attainment.

Arcola Creek

The fish communities at all five locations sampled, and the macroinvertebrate communities at four of the five locations in Arcola Creek did not meet WWH criteria resulting in 7.0 miles in non- attainment (Table 1 and Figure 1). Biological impairment was due to habitat modifications, water withdrawals, and nutrient loadings from the Madison WWTP (particularly phosphorus), and an unidentified source of enrichment from upstream of the WWTP. The creek had recently been channelized at the three upper locations (RMs 7.3, 7.1 and 5.0), and had severely degraded physical habitats. The channelization at RM 5.0 was not sanctioned under 404 or 401 permits. Water withdrawals by local nurseries for irrigation captured all of the stream flow in late summer rendering extremely low or no flows from RM 5.0 to the mouth, and severely limiting the amount of habitat available to aquatic life. Evidence for habitat degradation being a contributor to the aquatic life use impairment in the channelized reach is given by attainment of the WWH criterion by the macroinvertebrate community, but non-attainment by the fish community, as fish tend to be more sensitive to overall habitat quality than macroinvertebrates. Channelization likely aggravated the effects of high nutrient loads from the Madison WWTP by reducing the ability of the stream to assimilate and sequester nutrients. Oxygen depletion in the middle reach of

Arcola Creek was evident throughout the 1995 survey, a by-product of enriched conditions. Additionally, the pesticide dieldrin was present at RM 7.3 in concentrations chronicly toxic to aquatic life, and may have contributed to the impairment at that site.

Conneaut Creek

Fish and macroinvertebrate communities sampled in Conneaut Creek met EWH criteria at all sampling locations. Bigeye chub constituted nearly 10% of the total catch by number at both locations, and black redhorse, river chub, mimic shiner and rosyface shiner were also abundant. These species are highly intolerant and have declining populations or a shrinking range across the state.

RECOMMENDATIONS

Ashtabula River

Status of Aquatic Life Uses

The Ashtabula River, including the East and West Branches, is designated WWH. Performance of the biological indicators and habitat limitations imposed by intermittent summer flows demonstrate that this use is appropriate and should be maintained.

Status of Non-aquatic Life Uses

All non-aquatic life uses should remain as presently designated in the Ohio Water Quality Standards.

Other Recommendations

Because the Ashtabula River regularly becomes intermittent in late summer, it has a limited capacity to assimilate oxygen demanding pollutants originating from poorly maintained septic beds and livestock wastes. Consequently, poorly maintained septic discharges need to be identified and remedied, and owners of livestock operations should be encouraged to participate in the ongoing programs offering technical assistance for implementing best management practices.

Future Monitoring Concerns

The Ashtabula River is one of the few streams left in the state harboring a strong population of bigeye chub, and Ohio declining species. The population needs to be monitored, and developments within the watershed need to be tracked to identify threats to its continued existence.

Cowles Creek

Status of Aquatic Life Uses

Cowles Creek is designated WWH. Performance of the biological indicators demonstrate that this use is appropriate and should be maintained. The Seasonal Salmonid use designation for the lower 1.0 mile of Cowles Creek is appropriate and should be continued.

Status of Non-aquatic Life Uses
All non-aquatic life uses should remain as presently designated in the Ohio Water Quality Standards.

Other Recommendations
Daily flows to the Geneva WWTP plant fluctuate widely during rain events as reflected by monthly operating data submitted to the Ohio EPA. Maximum flows to the Geneva WWTP as high as 6.47 MGD have been reported, and bypasses have resulted from these excessive hydraulic loads. Marked differences between the median (50th percentile) and maximum (95th percentile) concentration and loading values for phosphorus and suspended solids are indicative of the stress placed upon the treatment system during high flow events. These events have also resulted in permit violations for phosphorus and total suspended solids loadings in the past. The installation of equalization basins to mitigate the effects of these storm events should be considered as a protective measure for stream water quality. Fecal coliform bacteria contamination in Cowles Creek upstream from the WWTP suggests possible breaches in the collection system.

Cowles Creek is presently highly enriched with nitrogen and phosphorus via loadings from the Geneva WWTP. Reductions in total loadings would likely have a positive effect on the biota in Cowles Creek downstream from the WWTP. Therefore, options to reduce loadings of nitrogen and phosphorus should be examined.

Future Monitoring Concerns
The source(s) of fecal coliform contamination upstream from the WWTP must be identified and corrected in order to restore water quality within the City of Geneva. Random sampling of the storm water system with flow meters during several rain events may help trace illegal tie-ins. Flow appropriation for irrigation of nursery stock needs to be investigated to determine if withdrawals are impinging on summer flows and causing intermittence.

Arcola Creek

Status of Aquatic Life Uses
Arcola Creek is designated WWH. The habitat downstream from US 20 is capable of supporting a WWH fauna, and the fish community could easily recover in the lower reach if flows are maintained. The WWH aquatic life use designation is warranted for this reach. Although the habitats in the reach upstream of US 20 are severely degraded and the fish community in the reach performed near expectations for a Modified Warmwater Habitat (MWH) community, a redesignation to MWH is not warranted for this reach as the channel modifications are not sanctioned by 404 or 401 permits. The Seasonal Salmonid use designation for the lake influenced portion of Arcola Creek is appropriate, but should be expanded to include the lower 3.0 river miles of the free flowing portion of the creek.

Status of Non-aquatic Life Uses
All non-aquatic life uses should remain as presently designated in the Ohio Water Quality

Standards.

Other Recommendations

A water management plan for the nurseries withdrawing water from the creek is needed to maintain minimum stream flows in the summer. Oxygen depletion in the middle reaches of Arcola Creek was evident throughout the 1995 survey. Additional removal of oxygen demanding compounds and reaeration of the Madison Village WWTP effluent to provide D.O. in excess of the current minimum concentration of 5.0 mg/l specified in the NPDES permit should be strongly considered as a mechanism for improving instream D.O. concentrations in Arcola Creek.

Future Monitoring Concerns

Channel maintenance activities in Arcola Creek need to be monitored and unpermitted activities need to be identified.

The Madison Village WWTP is currently undergoing an expansion to 0.5 MGD. Because Arcola Creek is presently over enriched with phosphorus, and loadings of phosphorus from the WWTP have been increasing over time, incorporation of phosphorus removal in the treatment process was aggreed to as necessary to improve water quality in the stream by the Ohio EPA and the Village of Madison. An average effluent phosphorus concentration of 0.73 mg/l was proposed by the Ohio EPA and subsequently accepted by the Village of Madison. This limit should be considered the maximum acceptable loading, with a goal of reducing instream phosphorus concentrations as much as possible. Improvements in dissolved oxygen and biological communities are anticipated as a result of the reduced phosphorus loadings, and should be verified by monitoring.

Because the mouth of Arcola Creek harbors an outstanding natural wetland area, the biotic communities need to be assessed, including the nursery function it holds for Lake Erie fishes. Impacts to the wetlands from flow appropriations, and bypasses of sewage from the Lake County Madison WWTP holding basins need to be investigated.

Conneaut Creek

Status of Aquatic Life Uses

Conneaut Creek is designated Coldwater Habitat. Biological indicator performance demonstrate that this use is inappropriate; however, the performance does indicate that Exceptional Warmwater Habitat (EWH) is the appropriate designation. The seasonal salmonid use designation for Conneaut Creek is appropriate and should be continued.

Status of Non-aquatic Life Uses

All non-aquatic life uses should remain as presently designated in the Ohio Water Quality Standards.

Other Recommendations

The exceptional biological communities found in Conneaut Creek, including strong populations of several species with declining ranges in Ohio, in conjunction with the unique recreational opportunities afforded by the creek and the highly aesthetic pristine natural qualities of its surroundings, warrants protection. Riparian buffers, including those on the shale bluffs overlooking the creek, need to be maintained to protect the integrity of the aquatic communities. Comprehensive land use plans and zoning laws within the watershed should be drafted to protect the resource.

Future Monitoring Concerns

Because Conneaut Creek is an outstanding natural resource, developments and changes in land use practices within the watershed need to be monitored to identify potential threats to the quality of the resource.

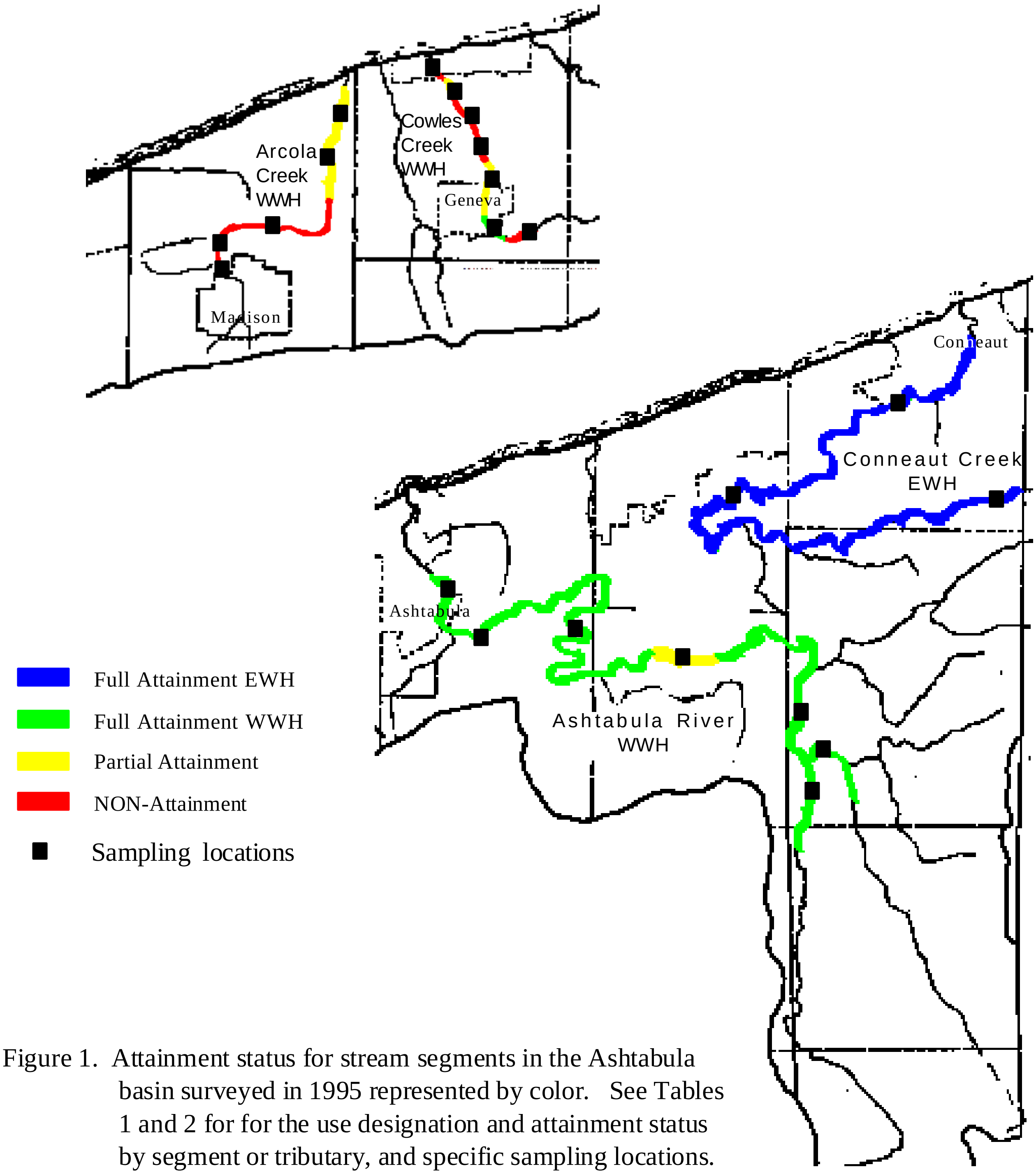


Figure 1. Attainment status for stream segments in the Ashtabula basin surveyed in 1995 represented by color. See Tables 1 and 2 for for the use designation and attainment status by segment or tributary, and specific sampling locations.

Table 1. Aquatic life use attainment status for stations sampled in the Ashtabula River basin based on data collected July-September, 1995. The Index of Biotic Integrity (IBI), Modified Index of well being (MIwb), and Invertebrate Community Index (ICI) are scores base on the performance of the biotic community. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biotic community.

River Mile Fish/Invertebrate	IBI	MIwb[a]	ICI[b]	QHEI	Attainment Status[c]	Comment
Ashtabula River (1995)			*WWH - existing*			
27.2/26.6	42	8.6	32[ns]	85	FULL	reference, low flows
19.1	47	7.1*	32[ns]	76	PARTIAL	low flows
12.1/11.9	41	7.9	MG[b]	78	FULL	low flows
6.3/--	42	8.1	--	73	FULL	suburban
3.5/3.6	36[ns]	7.6[ns]	46	64	FULL	urban
West Branch Ashtabula River			*WWH - existing*			
2.7/1.8	44	7.7[ns]	32[ns]	66	FULL	reference, low flows
East Branch Ashtabula River			*WWH - existing*			
1.4	44	8.2	MG[b]	73	FULL	nps livestock, low flows
Cowles Creek			*WWH - existing*			
7.2/7.1	29*	NA	MG[b]	63	Partial	reference, nonpoint
6.2/5.6	36[ns]	NA	MG[b]	63	FULL	upstream conditions
5.0/4.8	36[ns]	NA	14*	58	Partial	urban, unsewered
4.3	30*	NA	14*	63	**NON**	dst Geneva WWTP
3.3/3.6	31*	NA	16*	60	**NON**	impact/New London Rd.
1.1/1.4	36[ns]	NA	28*	56	Partial	partial recovery/Maple St.
0.3	<u>26</u>*	NA	18*	56	**NON**	impact/lake influenced
Arcola Creek			*WWH - existing*			
7.3/7.5	<u>23</u>*	NA	<u>12</u>*	44	**NON**	upstream WWTP/ channelized
7.0	<u>23</u>*	NA	26*	43	**NON**	dst Madison WWTP
5.0	<u>18</u>*	NA	34	34	**NON**	impact, channelized, adj US 20
2.0/2.1	28*	NA	26*	68	**NON**	recov./dewatering, Cunningham Rd
0.5/0.7	28*	NA	24*	60	**NON**	recovery/dewatering/Vrooman Rd.
onneaut Creek			*CWH - existing/EWH proposed*			
23.1/23.3	55	9.3[ns]	46	88	-- /FULL	Furnace Road
*C*12.1/12.6	48[ns]	9.5	46	86	-- /FULL	Dst Kingsville
--/5.4	--	--	50	--	-- /(FULL)	unassessed/Grant Road

Table 1. Continued.

Ecoregion Biocriteria: Erie-Ontario Lake Plain

	IBI			MIwb		
Site Type	WWH	EWH	MWH[d]	WWH	EWH	MWH[d]
Headwaters	40	50	20	NA	AN	NA
Wading	38	50	22	7.9	9.4	5.6
Boat	40	48	24	8.7	9.6	5.7

a - MIwb is not applicable to headwater streams with drainage areas≤ 20 mi^2.
b - A qualitative narrative evaluation based on best professional judgement and sample attributes such as community composition, EPT taxa richness, and QCTV scores was used when quantitative data were not available or considered unreliable due to current velocities less than 0.3 fps flowing over the artificial substrates.
c - Attainment status is given for both existing and proposed use designations.
d - Modified Warmwater Habitat criteria for channel modified habitats.
ns - Nonsignificant departure from biocriteria (≤4 IBI units or ≤0.5 MIwb units).
* - Indicates significan departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

STUDY AREA

The Ashtabula River study area encompassed the Ashtabula River watershed basin, Conneaut Creek (within Ohio), plus two Lake Erie tributaries, Arcola Creek, and Cowles Creek (Figure 1). Specific sampling locations are listed in Table 3. The Ashtabula River basin, (not including Conneaut Creek and Lake Erie tributaries), drains an area of 137.14 square miles or 87,770 square acres. The Ashtabula River mainstem originates in eastern Ashtabula County. In general the Ashtabula River flows in a northwesterly direction, to the City of Ashtabula, where it discharges to Lake Erie. The mainstem is 39.7 river miles in length (including West Branch). The Ashtabula River mainstem falls an average gradient of 11.6 feet per mile, (from an elevation of 1033 to 573 feet above mean sea level). Principal tributaries to the Ashtabula River include Ashtabula Creek, Hubbard Run, West Branch and East Branch. The Conneaut Creek basin drains an area of 37.7 square miles in Ohio (24,128 square acres). The Conneaut Creek mainstem originates south of Conneautville in Crawford County, Pennsylvania. In general Conneaut Creek flows in a northwesterly direction, to the town of Conneaut, where it enters Lake Erie. The mainstem is 56.8 river miles in length, (22.3 in miles in Ohio). Conneaut Creek mainstem falls an average gradient of 11.3 feet per mile, (from an elevation of 1215 to 573 feet above mean sea level). All the principal tributaries to Conneaut Creek are located in Pennsylvania. No significant surface water impoundments are located within the Conneaut Creek watershed or the Ashtabula River watershed.

Table 2. Waterbody use designations for the Ashtabula River Basin. Changes to existing use designations appear in ***bold italics***, or designations based on the 1978 water quality standards for which results of biological field assessments are now available apear as plus signs to the right of existing markers. See Ohio Water Quality Standards for explanation of symbols.

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Arcola Creek - estuary zone		*			o			*	*			*	
- all other segments		*/+						*	*			*	
Wheeler Creek - estuary zone		*			o			*	*			*	
- all other segments		*						*	*			*	
Cowles Creek - estuary zone (RM 0.8 - 0.0)		+			+			+	+			+	
- all other segments		+						+	+			+	
Indian Creek		*						*	*			*	
Red Brook		*						*	*			*	
Ashtabula River - S.R. 11 (RM 5.8) to mouth		*/+			▲				*			*	
- all other segments		*/+						*	*			*	
Strong Brook							+		*			*	

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Fields Brook - S.R. 11 (RM 1.34) to confluence with Ashtabula River		oL							*			*	
- all other segments		oL							*			*	
West Brook							+		+				+
Hubbard Run		*						*	*			*	
Ashtabula Creek		*						*	*			*	
West Branch		*/+						*	*			*	
East Branch		*/+						*	*			*	
Conneaut Creek			▲		o	*		*	*			*	
Temple Creek		*						*	*			*	
Marsh Run		*						*	*			*	
West Branch		*						*	*			*	
East Branch		*						*	*			*	
Middle Branch		*						*	*			*	
Stone Run		*						*	*			*	
Fish Creek		*						*	*			*	
Turkey Creek					o	*		*	*			*	

The Ashtabula River and Conneaut Creek watersheds are situated within the gently rolling dissected glacial plateau of the Erie/Ontario Lake Plain ecoregion. During the Pleistocene era varying thickness of glacial drift were deposited over Devonian shales. The majority ofthese two watersheds exist in ground moraines and end moraines. Sediments deposited by former beach ridges, arranged parallel to the existing Lake Erie shoreline, are composed of sand, gravel and cobble. The preglacial valleys within the underlying bedrock shale were buriedby glacial clays, sands and gravels down to depths of 200 feet from ground surface. Both watersheds are primarily woodland and agricultural in the upper basins. Both estuaries are impacted from urbanized municipal and industrial activities. Both estuaries have major coal handling operations which have resulted in extensive layers of coal dust in the substrates.

An industrialized area, located on Fields Brook, (tributary to the Ashtabula River), has heavily contaminated the bottom sediments of the Ashtabula estuary. A fish tissue consumption advisory exists for all species in the estuary and harbor area due to elevated levels of PCB, hexachlorobenzene, pentachlorobenzene and tetrachlorobenzene. The lowest 0.7 mile of the Ashtabula River has been modified for international freighter traffic by dredging and installation of vertical bulkheads. Marina development exists on about 50% of the river's shoreline between river mile 0.7 and 2.2, with some undisturbed shoreline still present along the east banks. In Conneaut Creek the lowest 0.5 mile, has also been channelized for freighter traffic. The waterway has been dredged to an approximate depth of 25 feet and the shoreline reinforced with concrete, steel an vertical railroad tie bulkheads. There are no marinas along Conneaut Creek, however, the west shore has been bulkheaded adjacent to the railroad tracks and embankment reshaping has occurred along the eastern embankment, between river mile 1.0 and 1.5. The harbor areas of Conneaut Creek and the Ashtabula River were not included in the present survey, but were sampled in a previous survey (*Biological Community Status of the Lower Ashtabula River and Harbor Within the Area of Concern (AoC)*). Undisturbed shorelines exist upstream from RM 2.0.

Ohio Water Quality Standards, (WQS; OAC 3745-1-25), list the current use designations for the Ashtabula River system as: agricultural and industrial water supply and primary contact recreation. The mainstem of the Ashtabula and conjoining tributaries have been designated warmwater habitat (WWH) . Conneaut Creek use designations are: agricultural and industrial water supply and primary contact recreation. Conneaut Creek mainstem has been designated Coldwater Habitat (CWH) and Seasonal Salmonid. No municipal or public drinking waters come from the Ashtabula River, Conneaut Creek or their tributaries. Groundwater yields in the Ashtabula and Conneaut watershed basins are very low. The yields can range from less than 3 gallons per minute, up to 10 gallons per minute, this may not provide enough water during peak domestic usage.

The upper sections of both watersheds are primarily rural due to limited groundwater supplies. The major urban industrialized areas near the mouth of the Ashtabula River and Conneaut Creek obtain their water from Lake Erie. The major environmental threats to the Ashtabula River include Detrex, SCM, Acme Scrap, Oxychem, RMI, a coal handling facility, numerous marinas and channelization/bulkheading for shipping. The major threats to Conneaut Creek include a coal handling facility and channelization/bulkheading of the mouth of this waterway.

NONPOINT SOURCES

The quality of surface waters in Ohio have generally improved over the past 25 years. Credit must go to private industries and government entities who have improved point source discharges and upgraded sewage treatment facilities. Now Ohio's major water pollutants primarily come from nonpoint sources; specifically agricultural and storm water run-off, and construction activities. Uncontrolled storm water discharge from construction activities such as individual houses, residential developments, commercial properties and industrial sites runoff can carry tons of soil into local streams leading to impairment of aquatic communities. If the excavated area is to exceed 5 acres an NPDES permit must be filed with the Ohio EPA and a storm water plan developed. Each of the local Soil and Water Conservation Districts are to work with the Ohio EPA and developer to minimize soil losses from these properties.

Farms/Orchards/Nurseries

The Ashtabula River is primarily agricultural. In the past year national grain reserves have become depleted, which has forced the price of grains up. The Ashtabula SWCD has noted an increase of hayfields being converted to row crops. Tilling can increase the amount of loss into local streams. Sudden sediment loads can totally change a stream bottom habitat, which directly impacts on the entire aquatic community. Over application or untimely application of herbicides/pesticides can stress or eliminate aquatic organisms. Fertilizer run-off can cause aquatic plants to grow at uncontrollable rates, creating an imbalance in the ecosystem.

Local Soil and Water Conservation Districts have been working with these operations on conservation practices. The districts have encouraged practices such as no-till farming, animal waste storage structures, minimal usage of chemicals, filter stripping, livestock exclusion fencing, etc.. Many of these operators have discovered that new techniques may not only improve the environment, they often save time and money. Continuing education throughout the watershed is imperative.

Failing Septic Systems

The Ashtabula River watershed is primarily rural and most areas are not serviced by sanitary sewers. A high percentage of septic systems in the watershed are well beyond 20 years in age, (the expected life of a system). Additionally, high percentages of clay content in the local soils further contribute to high failure rates of septic systems. Inadequately treated sewage can impact on the water quality of roadside ditches, wetlands, streams and lakes. This can cause health hazards in drinking and recreational waters, decreased oxygen levels, excessive aquatic plant growth and offensive odors. Areas identified in Ashtabula County Ohio with large concentrations of failing septic systems include Kelloggsvile and North Kingsville Data indicating how many failing systems are within this watershed is currently not available.

Urban Runoff
The city of Ashtabula is currently phasing out their combined sewer overflows in Ashtabula Harbor and plan to have a segregated system by 1998. Urbanized pollutants such as road salts, vehicle fluids, litter/debris, lawn chemical, pet wastes etc. can be detrimental to local water quality. City ordinances and programs which help control these concerns are important. Education of the community is very important.

Sanitary Landfills
Up to the mid 1970's it was common for every community and township to have at least one garbage dump. Many of these dumps closed when state regulations required licensing and daily cover. Some of these abandoned garbage dumps presumably degrade surface or groundwater quality through leachate. The locations of these abandoned garbage dumps are not contained in this report.

Many industries have established operations in Ashtabula because of the close proximity to Lake Erie and major interstate highways. The following industries have major documented industrial releases to surface or groundwater:

Reserve Environmental Services
Neutralizes hazardous waste materials, stores in impoundments and discharges into a permitted deep well. The facility has documented the presence of trichloroethylene in groundwater and in Whitmans Creek, a treatment system has been installed.

RMI-Extrusion Services
Facility has closed, however, it is undergoing a long-term RCRA cleanup of trichloroethylene, uranium and technetium 99. The Nuclear Regulatory Commission is also involved due to the presence of low level radioactive materials.

Detrex
This facility has contaminated local groundwater with chlorinated organics, a treatment system to pump and treat the groundwater and surface water has been installed. This facility is adjacent to Fields Brook (tributary to the Ashtabula River).

SCM Facilities
These plants have released PCB’s and are cleaning up under Superfund orders.

Acme Scrap
This scrap yard accepted old electrical capacitors and dumped PCB contaminated oils onto the ground. Fields Brook flows near this facility.

Oxychem
This facility had documented groundwater contamination. Several years ago they installed a slurry wall around the contamination plume.

RMI-Sodium
This facility is currently undergoing corrective actions for an on-site industrial landfill.

Timber Harvesting Operations
This watershed has numerous timber harvesting sites. Poor road layout and construction can contribute large volumes of sediment during active operations. If the timber has been over harvested, erosion will continue until a natural vegetative cover becomes reestablished. Professional foresters are available to monitor and educate timber harvesting operations.

Oil and Gas Extraction
Many oil and gas wells have been developed within the watershed. Oil and brine spills from a well or tank can devastate a local waterway. The Ohio Department of Natural Resources has jurisdiction over spills and disposal.

Riparian Corridor Protection
Vegetation along the embankments of streams and lakes offers many benefits; stream bank stabilization, filtration of run-off waters, food source, cooler water temperatures and habitat enhancement. Protection of existing riparian corridors is as critical as areas that need vegetation established. Conservation easements, land trusts, education and responsible legislation are valuable tools for riparian corridor protection.

These major nonpoint source activities all contribute to the water quality in this watershed basin. Educating public officials and local citizens about nonpoint source issues is essential to maintaining and improving existing water quality. Developing watershed plans and implementing best management practices is equally important. By establishing committed partnerships, improved water quality in Ohio can be accomplished.

Table 3. Sampling locations in the Ashtabula River study area for the 1995 survey (C - conventional water chemistry, C_p - conventional plus pesticide scan; S - sediment metals, additional scans noted by the following subscripts: v = volatile organic compounds, b = base neutral acid extractable compounds, p=pesticide/polychlorinated biphenyls; B - benthic macroinvertebrates, F - fish, D - Datasonde®, Fec - fecal coliform).

Stream/ River Mile	Type of Sampling	USGS 7.5 Minute Latitude/Longitude	Landmark	Quadrangle Map
Ashtabula River				
27.2	F	41 49 03 / 83 37 20	ust Hilldom Rd	Pierpont
25.6	B,S_o,C	41 50 06 / 83 37 20	dst Root Rd	Pierpont
19.1	F,B,C	41 50 55 / 80 41 21	Benetka Rd	Gageville
12.1	F,B,C	41 51 48 / 80 43 43	ust Dewey Rd	Gageville
11.9	B,C	41 51 47 / 80 43 09	dst Dewey Rd	Gageville
6.3	F,C	41 51 29 / 80 45 42	State Rd	Ashtabula South
3.6	B	41 52 23 / 80 46 43	dst Prospect (US 20)	Ashtabula North
3.5	F	41 52 24 / 80 46 47	Tannery Hill Rd	Ashtabula North
2.5	C,S_o	41 51 57 / 80 47 42	ust East 24th Street	Ashtabula North
2.3	B	41 52 56 / 80 47 40	ust East 24th Street	Ashtabula North
West Branch Ashtabula River				
2.7	F	41 46 54 / 80 37 04	Graham Rd	Pierpont
1.8	B,C	41 47 24 / 80 37 01	dst Beckwith Rd	Pierpont
East Branch Ashtabula River				
1.4	F,B,C	41 48 40 / 80 35 49	Scribner Rd	Pierpont
Unnamed Tributary				
1.5	C	41 49 31 / 80 43 20	jct Carson and Beck Rds	Gageville
Cowles Creek				
7.24	C,D	41 47 52 / 80 55 21	ust Barnum Rd	Geneva
7.2	B,F	41 47 51 / 80 55 21	ust Barnum Rd	Geneva
7.1	B	41 47 53 / 80 55 31	dst Barnum Rd	Geneva
6.2	F	41 47 50 / 80 56 20	ust Eastwood Rd	Geneva
5.6	B	41 48 09 / 80 56 39	ust Eastwood Rd	Geneva
5.48	Fec	41 48 16 / 80 56 40	ust Eastwood Rd	Geneva
5.21	Fec	41 48 26 / 80 56 33	Main St (US 20)	Geneva
4.83	B,C,F,D	41 48 46 / 80 56 36	near Water street	Geneva
4.77	*C-effluent*	*41 48 50 / 80 56 32*	*at Geneva WWTP*	*Geneva*
4.67	D	41 48 52 / 80 56 29	dst WWTP	Geneva

Table 3. Continued.

Stream/ River Mile	Type of Sampling	Latitude/Longitude	Landmark	USGS 7.5 Minute Quadrangle Map
Cowles Creek - continued				
4.64	C,Fec	41 48 52 / 80 56 29	dst WWTP	Geneva
4.3	B,F	41 49 10 / 80 56 24	dst WWTP	Geneva
3.07	B,F,D	41 49 35 / 80 56 43	ust Maple Rd	Geneva
3.2	C,Fec	41 49 46 / 80 56 52	dst Maple Rd	Geneva
1.8	F	41 51 00 / 80 57 40	dst New London Rd	Geneva
1.4	B,C,Fec	41 50 42 / 80 57 31	dst New London Rd	Geneva
0.9	C,D	41 51 01 / 80 57 44	SR 534	Geneva
0.35	C,D	41 51 15 / 80 58 05	Lake Road	Geneva
0.30	B,F	41 51 15 / 80 58 11	Lake Road	Geneva
Arcola Creek				
7.5	B	41 47 15 / 81 03 53	@ Middle Ridge Rd	Madison
7.12	C_p,F	41 47 34 / 81 03 42	ust Madison WWTP	Madison
7.09	*C-effluent*	*41 47 33 / 81 03 41*	*Madison WWTP*	*Madison*
7.05	C_p,B,F	41 47 37 / 81 03 38	dst Madison WWTP	Madison
6.92	C	41 47 40 / 81 03 50	dst Feedlot	Madison
6.09	C	41 47 60 / 81 02 56	SR 528	Madison
5.04	B,C_p,F	41 47 53 / 81 01 39	nursery road W of Bennet Rd	Madison
2.02	B,C,F	41 49 37 / 81 00 52	@ Cunningham Rd	Madison
0.5	B,F	41 50 34 / 81 00 24	dst Vrooman Rd	Madison
Conneaut Creek				
23.3	B,C	41 54 14 / 80 31 40	ust Furnace Rd	Conneaut
23.1	F	41 54 12 / 80 31 55	dst Furnace Rd	Conneaut
12.6	B,C	41 53 59 / 80 39 32	dst Kingsville	N. Kingsville
12.1	F	41 54 05 / 80 39 20	ust old landfill	N. Kingsville
5.7	B	41 55 58 / 80 35 21	Grant Rd	Conneaut

Pollutant Loadings

Cowles Creek - Geneva WWTP: 1980-1995

Initially constructed in 1937, the Geneva WWTP was expanded to provide nitrification and chlorination/dechlorination in 1988 with a permitted flow of 1 MGD. Rapid sand filters were added to the plant through an upgrade which was completed in 1990. A second nitrification tower was added to the plant in 1994. The NPDES permit for the plant was modified to allow an increase in flow to 1.4 MGD in November 1994 and was subsequently modified in May 1995 to allow a flow of 2.0 MGD following the installation of the second nitrification tower. The Geneva WWTP currently employs tertiary treatment which includes aerated grit chambers, primary settling, trickling filters, secondary clarification, nitrification, tertiary filtering via rapid sand filters, and chlorination-dechlorination. Phosphorus removal is accomplished through the addition of alum during the treatment process. The facility discharges to Cowles Creek at RM 4.73. The latest census estimated the city's population at 6,200, approximately 3,088 of whom were served by the WWTP. The sewer service area has been expanded in recent years through sewer extensions approved by the Ohio EPA. The sewer system includes two lift stations and is a separate system with no combined sewers or overflows. Inflow and infiltration has been a persistent problem with excessive flows (to 6.47 MGD) to the plant during heavy rainstorms.

The Ohio EPA has conducted three rounds of compliance sampling inspections (CSI's) at the Geneva WWTP. The CSI's were carried out in 1985-1986, 1991 and 1994-1995. Each CSI consists of two sampling events where an automatic sampler is used to collect a 24 hour composite sample of the effluent. Grab samples of the effluent are collected for the analysis of parameters for which composite sampling cannot be used (i.e. fecal coliform bacteria, oil and grease, volatile organic compounds, and cyanide). Grab samples are also taken from the receiving stream (Cowles Creek) upstream from the discharge point and within the mixing zone to quantify impacts of the discharge on the stream. In addition to chemical and bacteriological analyses, the Geneva WWTP effluent was also tested for acute toxicity to indicator organisms (*Ceriodaphnia* and fathead minnow) using bioassay techniques in 1991 and 1994-1995. No acute toxicity was observed in any of the samples taken for the 1991 or the 1994-1995 CSI's.

Sampling conducted in 1985-1986 detected exceedances for oil and grease (22.0 mg/l, effluent vs. 10 mg/l, permit limit) in July 1985 and for fecal coliform bacteria (2,700 colonies/100ml, effluent vs. 2,000, maximum permit limit) in June of 1986. Sampling conducted in 1991 detected an exceedance for phosphorus (1.98 mg/l, effluent vs. 1.5 mg/l 7 day max in permit). No exceedances were detected during the 1994-1995 CSI.

Analyses for priority pollutant organic compounds for the 1991 and 1994-1995 CSI's detected no semi-volatile organic compounds. Volatile organic compounds detected in trace amounts were bromodichloromethane and chloroform in samples taken September 1991, October 1994 and June 1995 and dibromochloromethane which was detected in samples taken by Ohio EPA September 1994 and June 1995.

Annual median (50th percentile) daily flows to the plant have gradually increased over the last 15 years due to growth within in the service area. Flows from the WWTP have ranged from 0.63 to 1.13 MGD (Figure 2). Daily flows to the plant fluctuate widely during rain events as reflected by 95th percentile values which range from 0.98 to 2.11 MGD. Until the permitted flow value was increased to 2.0 MGD in 1995, these events contributed to several violations for daily loading for suspended solids and phosphorus. Maximum flows to the Geneva WWTP as high as 6.47 MGD have been reported.

The impacts of discharges of ammonia nitrogen (NH_3-N) from the Geneva WWTP on water quality in Cowles Creek were severe prior to the installation of nitrification processes in 1988 (Figures 2 and 3). Summertime in-stream NH_3-N concentrations downstream from the Geneva WWTP as reported by the city ranged as high as 26.8 mg/l during this period. Addition of the nitrification equipment has reduced the summertime NH_3-N concentrations in the effluent from the plant by over 90% (Figure 4). Annual median (50th percentile) daily loading values for NH_3-N from the plant for the period of 1980 to 1986 ranged from 11.4 to 61.9 kg/day (Figure 2). The range of the annual median (50th percentile) loading of NH_3-N from the plant has decreased to 0.25 to 1.00 kg/day during the period of 1989 through 1995.

Annual median (50th percentile) total suspended solids (TSS) loadings decreased markedly following the addition of rapid sand filters in 1990 (Figures 2). The average annual median TSS loading decreased from 54.9 kg/day for the period of 1980 through 1989 to 14.1 kg/day for the period since the installation of the tertiary sand filters. Although the median annual loadings have decreased since 1990, maximum annual daily loadings as reflected by 95th percentile data have not reflected the same decrease. However, maximum summertime daily concentrations reflected by 95th percentile data have decreased since the addition of the tertiary sand filters (Figure 3). These trends indicate that the fluctuations in flow are primarily responsible for peaks in TSS loading, and that the presence of the tertiary filtering equipment is mitigating the impacts of these fluctuations on the stream to some degree.

Concentrations of phosphorus and the loading of phosphorus to Cowles Creek have remained relatively stable over time (Figure 2). Marked differences between the median (50th percentile) and maximum (95th percentile) concentration and loading values are indicative of the stress placed upon the treatment system during high flow events.

The Genvea WWTP has consistently met the NPDES permit limit for fecal coliform bacteria. During the period of 1980 through 1995, self-monitoring has indicated only two instances where fecal coliform bacteria have exceeded the 1,000 colonies/100 ml permit limit. However, upstream and downstream monitoring within Cowles Creek conducted by the WWTP staff has detected persistently high summertime fecal coliform bacteria counts upstream from the WWTP which are 1 to 3 orders of magnitude higher than those found in the plant effluent (Figure 4). Although dilution from the WWTP effluent appears to reduce the in-stream fecal coliform count

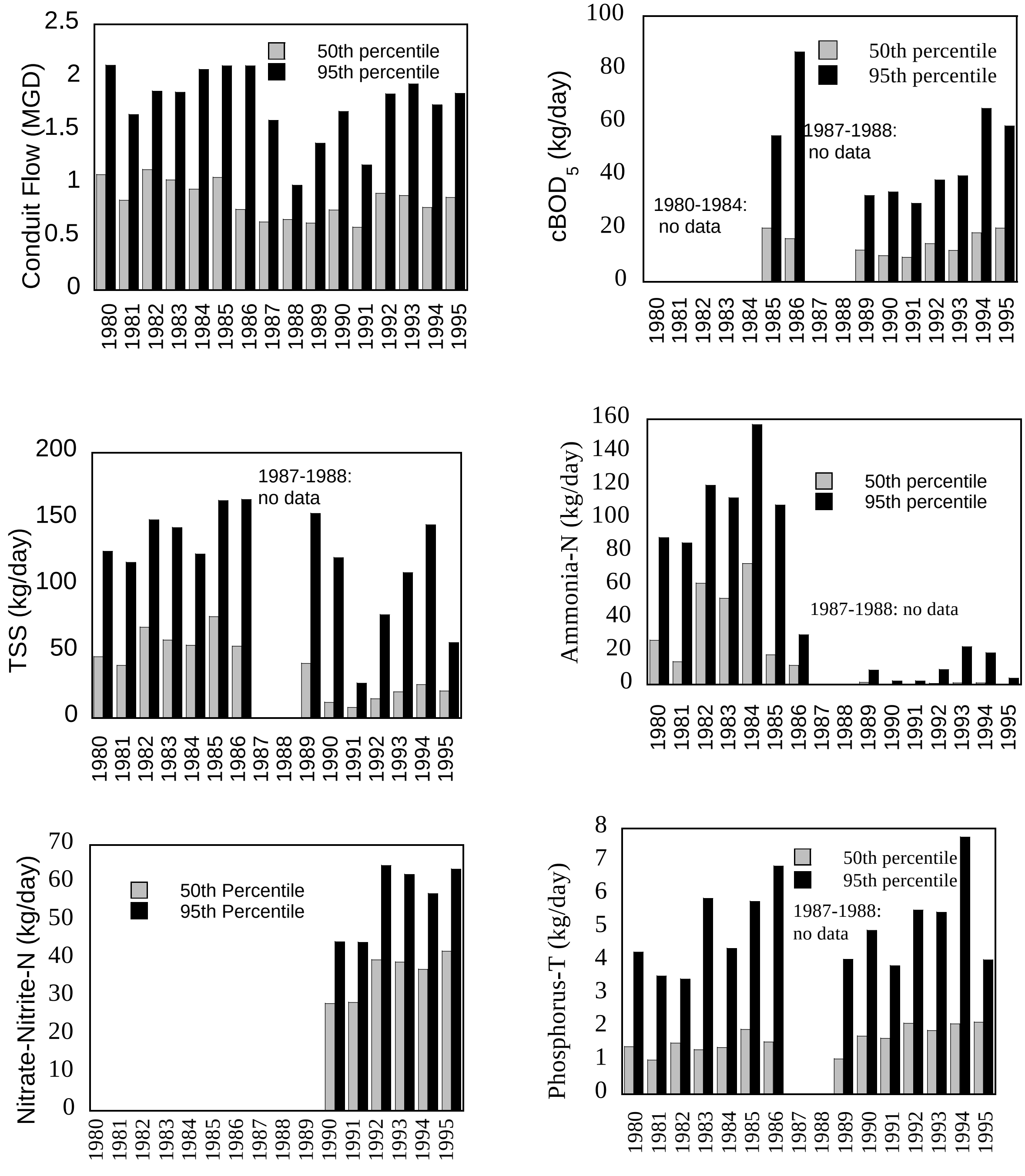
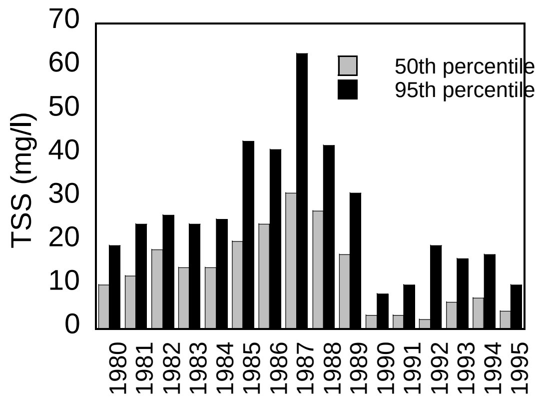
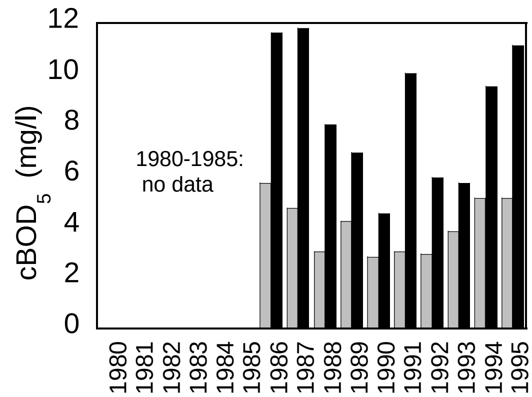


Figure 2. Median and 95th percentile annual loadings of selected pollutants to Cowles Creek by the Geneva WWTP, 1980 - 1995.





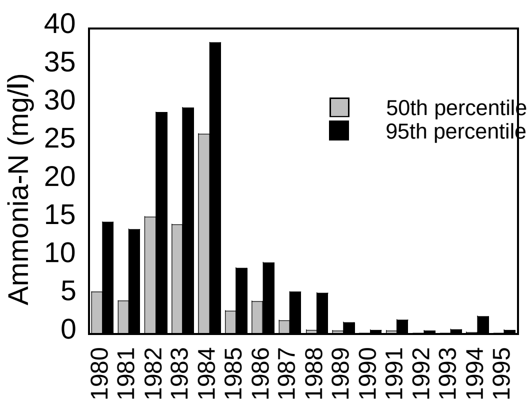
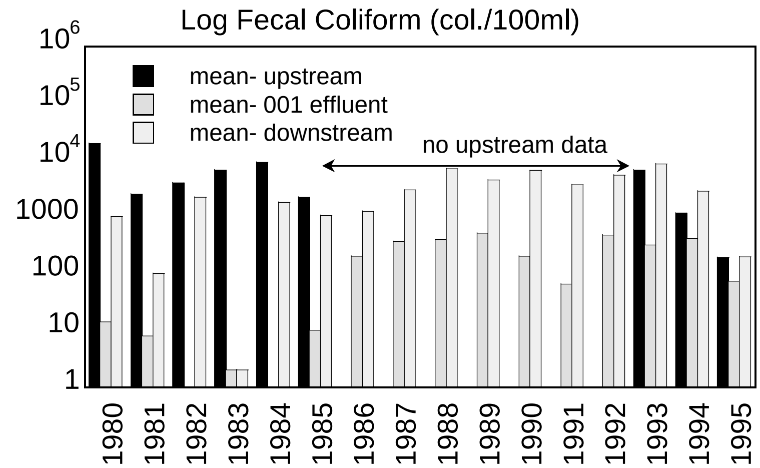


Figure 3. Median and 95th percentile third quarter loadings of selected pollutants by the Geneva WWTP, 1980 - 1995.

somewhat, the concentrations both upstream and downstream of the plant consistently exceed the Water Quality Standard for Primary Contact Recreation of 1,000 colonies/100 ml.

Arcola Creek - Madison Village WWTP: 1985-1995

Initially constructed in 1965, the Madison WWTP utilizes oxidation ditches for waste water treatment followed by clarification and chlorination/dechlorination. The plant was expanded in 1991 to provide for a total of four 100,000 gallon oxidation ditches and four clarifiers, the expansion of the chlorine contact tanks, the addition of stand-by power, new sludge holding ponds and a 240,000 gallon equalization basin to minimize the likelihood of bypasses during peak flows. The dechlorination and sludge handling equipment at the plant as well as the on-site laboratory were upgraded in 1994. The plant is currently permitted for the discharge of 0.3 MGD, although peak flows to 1.19 MGD have been reported. Current plant design is based upon



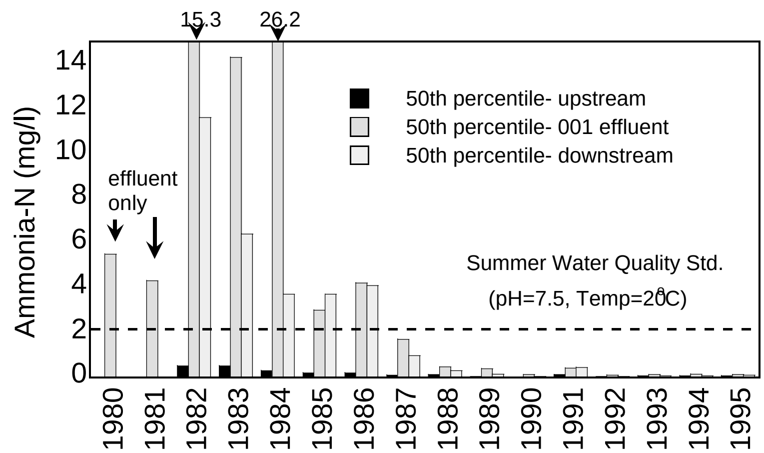


Figure 4. Fecal coliform counts (top) and ammonia-nitrogen concentrations (bottom) in the Geneva WWTP effluent (third quarter data) compared to the upstream and downstream receiving waters.

0.4 MGD average flow and peak flows to 1.13 MGD. Inflow and infiltration have been identified as the major source of excessive flows during storm events, but extensive smoke testing of the sewer system prior to 1987 did not detect any major sources. In 1994, the Village of Madison requested that the permit be modified to increase the allowable flow from the plant to 0.5 MGD. Estimates from 1991 indicate that the sewer district includes a population of approximately 2,600, 85% of whom are served by the sewer system.

Annual median (50th percentile) daily flows to the Madison WWTP have roughly doubled since the upgrade of the plant in 1991 (Figure 5). Median daily flows from the WWTP increased from an average of 0.19 MGD for the period of 1985-1991 to 0.42 MGD for the period of 1992-1995, indicating average flows in excess of plant design. Peaks in daily flows to the plant reflected by 95th percentile values ranged from 0.26 to 0.44 MGD for the period of 1985-1991, and from 0.67 to 0.81 MGD for 1992-1995. The maximum flow reported in monthly operating reports from the plant for the period of 1985 to 1995 was 1.11 MGD.

Upgrade of the WWTP in 1991 significantly reduced the loadings of total suspended solids (TSS), phosphorus and ammonia nitrogen (NH_3-N) (Figure 5) to Arcola Creek. However, loadings for all three pollutants have increased since 1993. Median (50th percentile) annual daily loadings of TSS have increased from 2.36 kg/day in 1991 to an average of 9.19 kg/day during the period of 1993-1995. Similarly, median annual loadings for phosphorus have increased from 0.75 kg/day in 1991 to an average of 2.59 kg/day for 1993-1995, and NH_3-N loadings have increased from 0.36 kg/day in 1991 to an average of 2.38 kg/day for 1993-1995.

The increase in loadings for TSS and phosphorus during the period 1993-1995 appears to be caused primarily by the increase in flow from the plant. Increased loadings of NH_3-N appear to be caused by a combination of increased flow and concentration in the effluent, although the increase in plant flow appears to be the dominant factor. Total suspended solids concentrations have remained relatively constant throughout this period (Figure 6), with median (50th percentile) summertime TSS concentrations averaging 2.4 mg/l for the years 1991-1995. Median summertime phosphorus concentrations (Figure 6) declined from 4.6 mg/l in 1987 to an average of 0.82 mg/l for the period 1991-1994. Median (50th percentile) summertime NH_3-N concentrations in the plant effluent declined following the upgrade to the plant in 1991 from an average of 2.2 mg/l for the years 1988-1990 to an average of 0.5 mg/l for the years 1991-1993. Summertime NH_3-N concentrations in the effluent increased in 1994 and 1995, with median (50th percentile) concentrations equaling 1.7 and 1.2 mg/l, respectively; concentrations exceeding water quality standards for a typical range of pH and temperatures in found in summer.

Loadings of $cBOD_5$ have increased steadily since the upgrade of the plant in 1991 (Figure 5). Annual median (50th percentile) $cBOD_5$ loadings have increased from a minimum of 0.94 kg/day in 1991 to 6.24 kg/day in 1995. Loadings in 1995 exceed those observed prior to the plant upgrade, when median annual $cBOD_5$ loadings averaged 5.2 kg/day (1989-1990 data). The increase in $cBOD_5$ loading during the period of 1992 through 1994 was primarily caused by increased flow, since concentrations of $cBOD_5$ in the effluent were decreasing during this period (Figure 5). Median (50th percentile) summertime $cBOD_5$ concentrations in the effluent averaged 1.4 mg/l for the years 1991-1994. However, the summertime median $cBOD_5$ concentration in the effluent increased sharply in 1995 to 5.7 mg/l, which is equivalent to the summertime median concentrations observed prior to the plant upgrade in 1991. This increase may have been caused

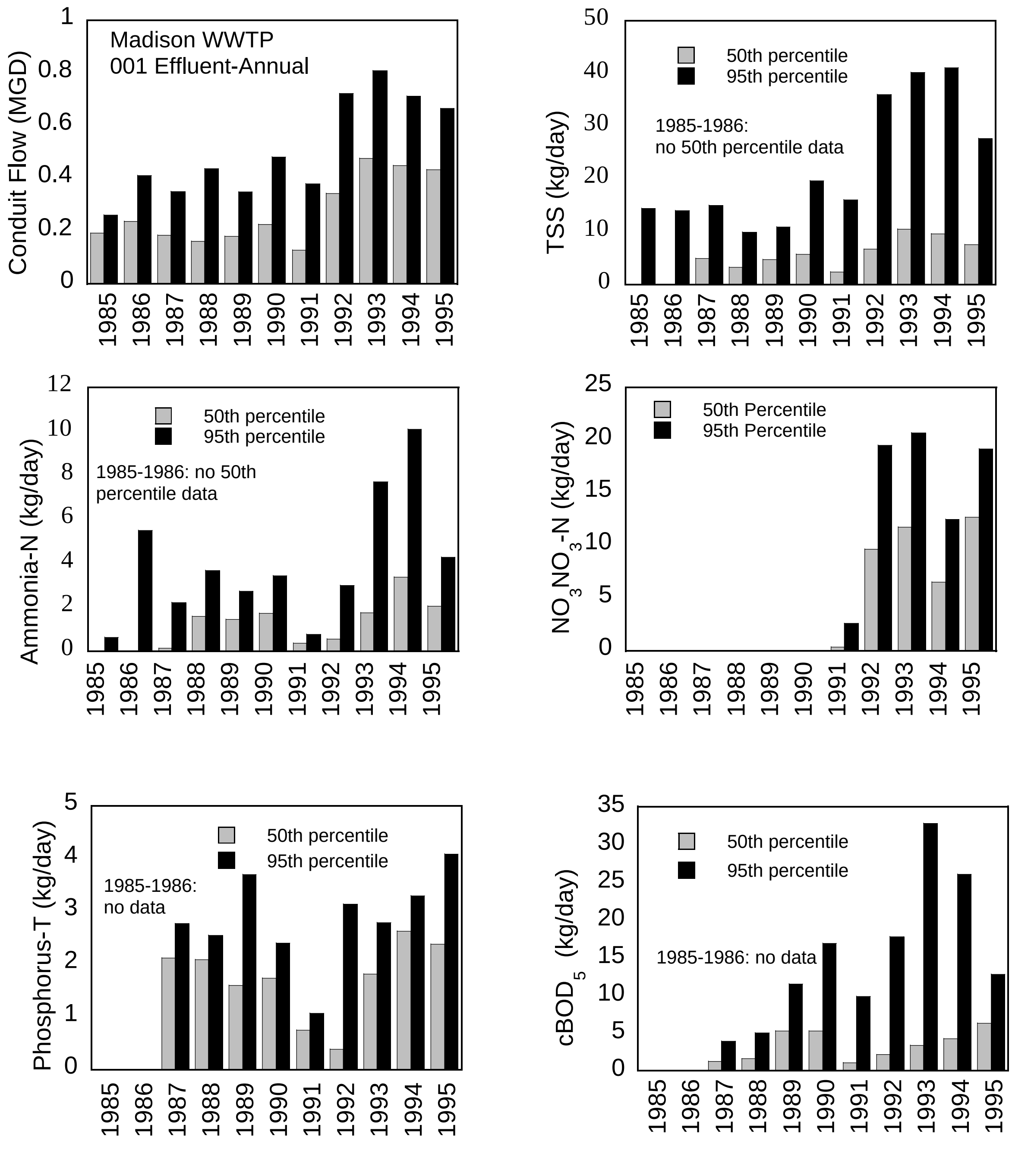


Figure 5. Median and 95th percentile annual loadings of select pollutant parameters by the Madison WWTP to Arcola Creek, 1985 - 1995.

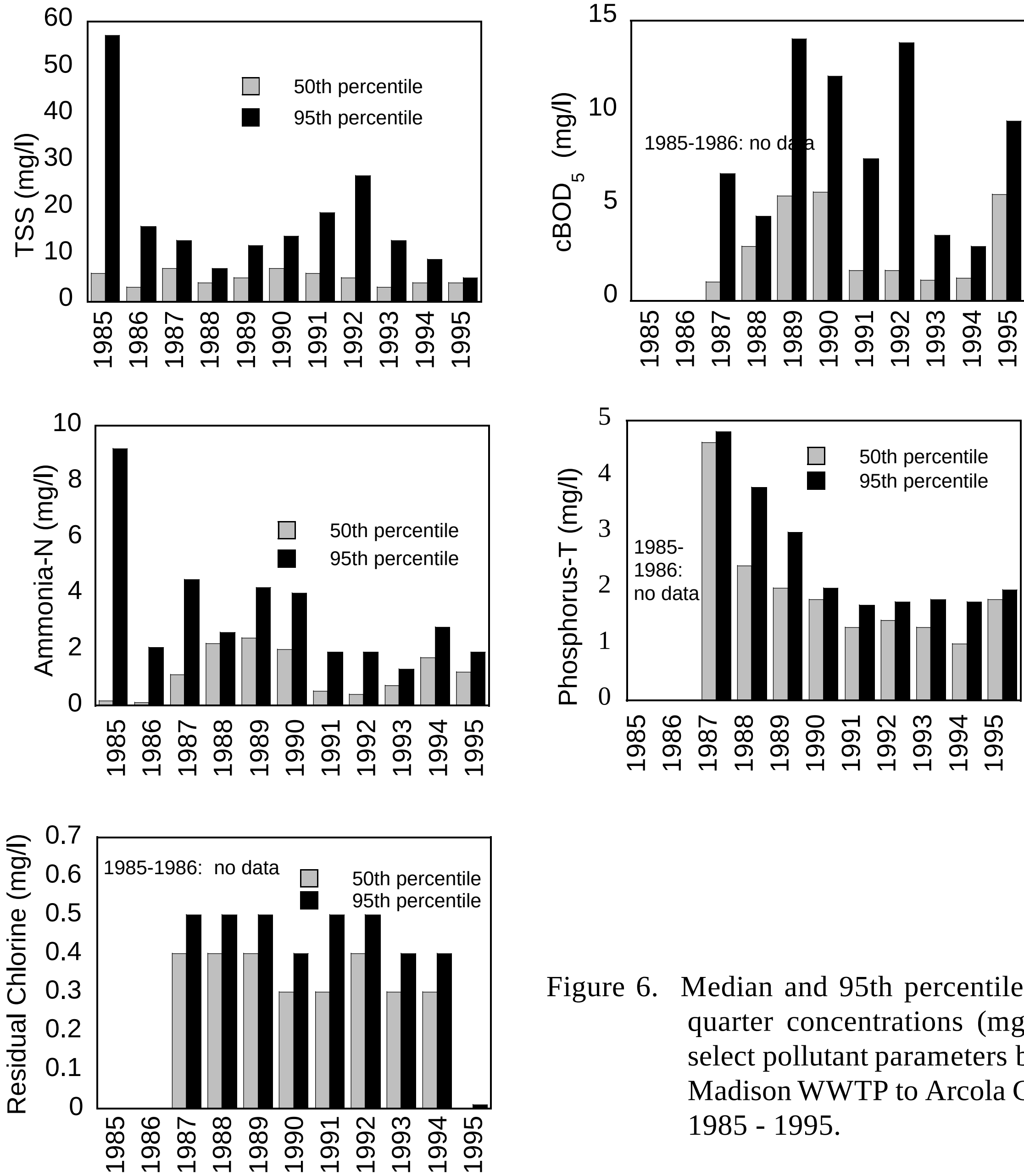


Figure 6. Median and 95th percentile third quarter concentrations (mg/l) of select pollutant parameters by the Madison WWTP to Arcola Creek, 1985 - 1995.

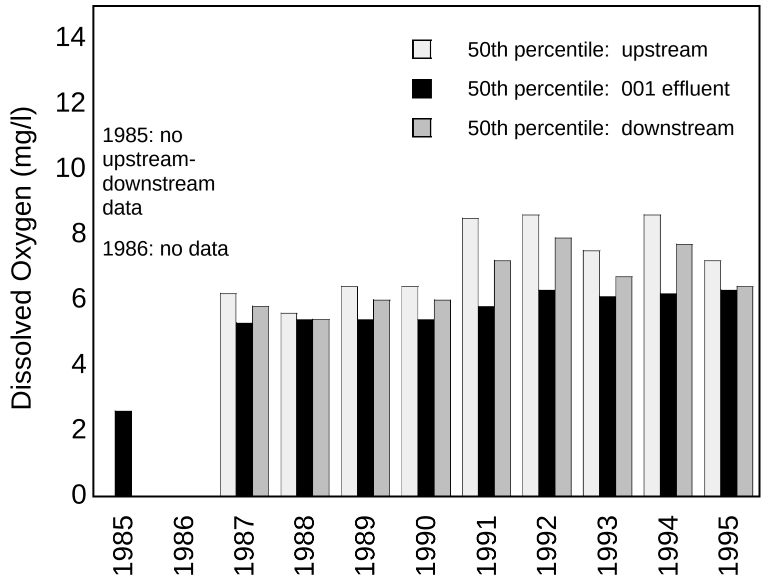


Figure 7. Concentrations of dissolved oxygen in the Madison WWTP effluent (third quarter) in relation to the upstream and downstream receiving waters.

by increased concentrations in the influent caused by the extremely dry weather which prevailed during the summer of 1995. Hydraulic contributions due to inflow and infiltration were likely to have been non-existent during this period.

The upgrade of the dechlorination equipment within the plant in 1994 has significantly reduced the concentration of residual chlorine in the plant effluent (Figure 6). Prior to installation of the new dechlorination equipment, summertime median (50th percentile) residual chlorine concentrations averaged 0.35 mg/l. In 1995, the median residual chlorine concentration was at the non-detect level for the test procedure.

In-stream monitoring of dissolved oxygen concentrations in Arcola Creek by WWTP staff did not detect any violations of the Water Quality Standards during the summers of 1987 through 1995 (Figure 7). However, a comparison of the upstream and downstream monitoring data with that of the plant effluent does indicate that the discharge reduces the median summertime in-stream dissolved oxygen concentrations at the downstream monitoring station by an average of 0.6 mg/l The downstream station is located approximately 0.1 river miles downstream of the WWTP outfall.

Spills, Overflows and Unauthorized Releases

Cowles Creek

The discharge of approximately 619,000 gallons of untreated wastewater from the Geneva WWTP on January 15 and 16, 1995 was the largest documented spill to Cowles Creek reported to the Ohio EPA Division of Emergency and Remedial Response (DERR) in 1995. Reports submitted to the Ohio EPA Division of Surface Water (DSW) regarding this incident indicate that the bypass was caused by a storm event which increased flows beyond the hydraulic capacity of the WWTP. The report from the Geneva WWTP to the DSW indicated that approximately 3,500 gal of untreated wastewater was bypassed on January 15, 1995 and that approximately 619,500 gallons was bypassed to the stream on January 16, 1995. The characteristics of the bypassed wastewater are included in Table 4. One other spill was reported to the DERR during 1995. The report alleged that an unknown quantity of oil had been released to a tributary of Cowles Creek. This release was not verified in the field.

For the period 1990-1995, the Geneva WWTP has reported ten bypasses resulting in discharges of untreated or partially treated wastewater to Cowles Creek (Table 4). Although there are no documented violations of the WQS in Cowles Creek associated with these bypasses, it is likely that they have had an impact on downstream water quality due to the characteristics of the bypassed effluent. High flows during storm events were the cause of five of the ten reported bypasses, electrical problems contributed to three, and pump malfunctions caused two bypasses. Discharges of untreated effluent from bypasses caused by rain events resulted in much larger releases than those caused by other reasons. The bypasses caused by rain events resulted in an average discharge of 373,500 gallons, while bypasses resulting from other causes resulted in an average discharge of 26,400 gallons.

Arcola Creek

Only one spill to Arcola Creek was reported to the Ohio EPA DERR in 1995. The report concerned an oily sheen believed to be caused by the release of diesel fuel to the stream. This release was not verified in the field.

Fish Kills

Three fish kills were recorded from Cowles creek between 1983 and 1988 due to either discharges of raw or poorly treated sewage (see Table 4 for examples) from the Geneva WWTP or toxic levels of ammonium in their effluent. No fish kills have been reported subsequent to the plant upgrades. Only three other fish kills were reported from the study area since 1983, reflecting the relatively undeveloped nature of the watershed.

Table 4. Summary of effluent bypass events from the Geneva WWTP, 1990-1995.

Date	Duration	Quantity Released	Cause	Characteristics of Bypassed Effluent	Comments
7/17/90	~2 hours	1,000-5,000 gal.	Pump malfunction	??	
7/30/90	~2 hours	400,000-500,000 gal.	Heavy rain	??	
8/7/90	??	60,000 gal.	Pump malfunction	??	Bypass after primary treatment
12/28/91-12/29/91	????		Heavy rain	$cBOD_5$=142 mg/l TSS=92 mg/l	Bypass flow meter malfunction. Instream $cBOD_5$ dst of bypass=14mg/l
8/4/92	3 hrs, 41 min.	371,000 gal.	Heavy rain	$cBOD_5$=21.3 mg/l TSS=292 mg/l	
9/9/92	21 min.	10,000 gal.	Loss of electricity	$cBOD_5$=25 mg/l TSS=60 mg/l	
11/19/93	65 min.	50,000 gal.	Loss of electricity	$cBOD_5$=112.5 mg/l TSS=110 mg/l	
8/14/95	??	7,000 gal.	Electrical surge TSS=40 mg/l	$cBOD_5$=17.5mg/l	
1/15/95	??	3,500 gal.	Heavy rain	$cBOD_5$=14.6 mg/l TSS=76.0 mg/l	
1/16/95	??	619,500 gal.	Heavy rain	$cBOD_5$=157.5 mg/l TSS=596 mg/l	

Surface Water and Sediment Quality

Ashtabula River

Concentrations of phosphorus and oxidized nitrogen (nitrate-nitrite), measured in water quality grab samples collected from the Ashtabula River were at or near detection levels in most samples (Figure 8) reflecting the lack of point sources and relatively low intensity land use within the watershed. Ammonia nitrogen levels, while generally low were elevated in several samples, especially from those collected at Benetka Road (RM 19.1) and East 24th Street (RM 2.5). The highest ammonia-nitrogen levels were recorded during rain event sampling (see plot of fecal coliform - Figure 8), and likely represent runoff from livestock waste in the upper and middle reaches, and unsewered inputs in the lower reach (*i.e.*, RM 2.5). Similarly, fecal coliform bacterial levels were also elevated in rain event samples (Figure 8, Table 7). Correspondingly, chemical oxygen demand was higher in the headwater reaches compared with downstream. Other parameters indicative of organic enrichment (*i.e.*, TKN and TDS - see Appendix Table 3) were not elevated, suggesting the enrichment was not acute. Mean dissolved oxygen (DO) concentrations measured in grab samples from the Ashtabula River were above the twenty-four hour average minimum Warmwater Habitat Water Quality Standard of 5.0 mg/l (Figure 8). However, DO concentrations at or below the minimum Water Quality Standard of 4.0 mg/l were detected at RM 19.1 of the mainstem and in both branches. The low concentrations were caused primarily by the very low and intermittent flows observed in late summer, but may have been exacerbated by organic loadings.

The unnammed tributary sampled near the junction of Carson and Beck Roads had elevated levels of ammonia nitrogen, and mean fecal coliform bacteria counts ($\bar{x}$ = 3230/100ml) exceeding secondary contact Water Quality Standard of 2000/100ml (Figure 8, Table 7). The high levels were likely caused by livestock access to the stream.

Concentrations of water column metals in the Ashtabula River were low and well within the WWH water quality criteria. Arsenic, lead, copper and zinc were detected at concentrations very close to their analytical detection limits (maximum observed concentrations: As=6 ug/l at West Branch Ashtabula @ Beckwith Road, Pb=8 ug/l at West Branch Ashtabula @ Beckwith Road, Cu=15 ug/l at RM 6.3, Zn=73 ug/l at Beckwith Road).

Sediment metal concentrations in the Ashtabula River were elevated compared to background concentrations described by Kelly and Hite (1984) for Illinois streams and exceeded the lowest effect level described by Persaud et al. (1994) for arsenic, chromium, copper, lead and mercury. The levels do not indicate contamination from point sources, but are more likely due to the parent bedrock and glacial deposits. Concentrations of all metals, excluding cadmium, were higher at RM 2.5 than RM 27.1, reflecting the increased contamination from urban runoff.

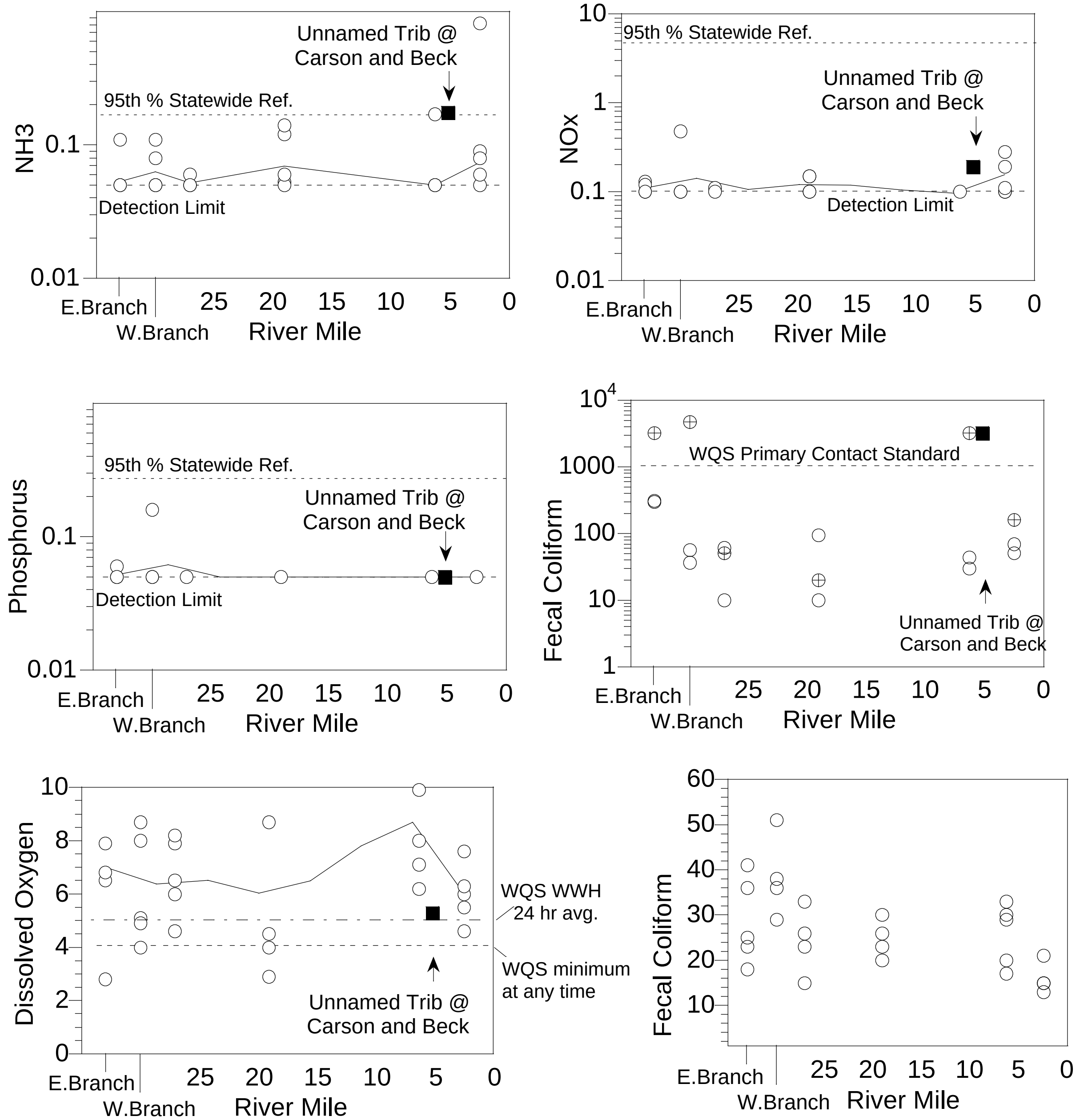


Figure 8. Select water quality parameters measured in grab samples collected from the Ashtabula River, 1995. Solid lines conjoin means. 95th percentile values are for wadeable statewide reference sites. Marked data points in the fecal coliform plot show rain event samples. Dection limits and Water Quality Standards (WQS) are shown where appropriate.

Table 5. Concentrations of heavy metals in sediments in the Ashtabula study area collected in 1995. All parameter concentrations except nickel were ranked based on a stream sediment classification system described by Kelly and Hite (1984). All values are mg/kg.

River Mile	As	Cd	Cr	Cu	Pb	Hg	Zn
27.1	12.9[c†]	0.563[b]	**52.0**[d†]	16.5[a†]	<26[a]	0.069[a]	100[c]
2.5	14.2[c†]	0.537[b]	**69.8**[d†]	33.5[a†]	46.0[c†]	0.167[c]	**180**[d†]

[a] Non-elevated [b] *Slightly elevated* [c] *Elevated* [d] **Highly elevated** [e] **Extremely elevated**

"<" - indicates the concentration is less than the stated detection limit for that sample. Evaluations based upon the Kelly and Hite (1984) criteria for the "<" samples assume the concentration of the sediment sample is at the stated detection limit.

† Exceeds the Lowest Effect Level given by Persaud et al. (1993).

No concentration exceeded the Ontario Severe Effect Level (Persaud et al. 1993).

Table 6. Dry weight concentrations of volatile and semi-volatile organic and pesticide/PCB pollutants detected in the sediments of the Ashtabula River, 1995.

Astabula River	RM 27.1	RM 2.5
Parameter		
Volatiles / Semi-Volatiles (mg/kg or ppm)		
Number of compounds analyzed	163	163
Number of compounds below detection limits	163	157
List of Semi Volatiles found		
BENZP [B & K] FLUORANTHENE	1.4	0.7
BIS (2-ETHYLHEXYL) PHTHALATE	1.1	0.7
CHRYSENE	0.9	0.7
FLUORANTHENE	1.8	0.7
PHENANTHRENE	0.7	0.7
Pesticides and PCBs (ug/kg or ppb)		
Number of compounds analyzed	26	26
Number below detection limits	26	26

Cowles Creek

Dissolved oxygen (D.O.) concentrations in Cowles Creek measured during day time sampling events were consistently above levels necessary to support the Warm Water Habitat (WWH) aquatic life use designation (Figure 9). Dissolved oxygen concentrations were highest in Cowles Creek downstream from the Geneva Waste Water Treatment Plant (WWTP), where they averaged 8.15 mg/l. Dissolved oxygen concentrations measured during day time sampling events in the Creek ranged from 5.6 to 9.5 mg/l during the study period.

Measurement of diurnal D.O. concentrations in Cowles Creek using Data Sonde continuous monitors during the period of July 25-July 26, 1995 did not detect any violations of the water quality standards (WQS). However, monitoring did detect reduced DO concentrations at night in the upper reaches of the stream (RM 7.2) and near the mouth (RM 0.3) (Figure 9). Dissolved oxygen concentrations at Barnum Road (RM 7.2) ranged from 4.15 to 7.3 mg/l. This site had extremely low flows during June and July, and had no detectable flow in August and September. Concentrations measured near the mouth of the Creek (RM 0.3) ranged from 4.2 to 7.4 mg/l over a 24 hour period, and averaged 5.45 mg/l. This segment of the stream is deeper and slower moving that the remainder of the sites assessed upstream. The diurnal D.O. regime within the middle segment downstream from the Geneva WWTP (RM 4.51 to 0.9) was very good, with concentrations ranging from 5.5 to 8.7 mg/l at the four sites assessed.

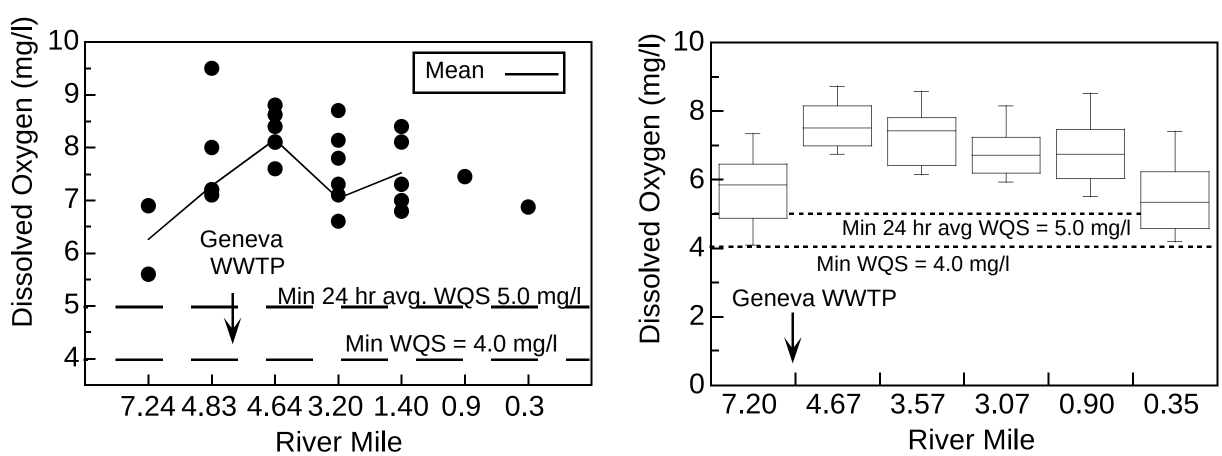


Figure 9. Dissolved oxygen concentrations (mg/l) measured in Cowles Creek in routine water quality grab samples (left) and from hourly Datasonde records collected over a 48 period, July 25 - July 26, 1995 (left).

Concentrations of carbonaceous five day biochemical oxygen demand ($cBOD_5$) were low (2.4 and 2.3 mg/l) in samples taken from the Geneva WWTP effluent. In-stream $cBOD_5$ concentrations were similarly low, with $cBOD_5$ concentrations ranging from less than the analytical detection limit (2.0 mg/l) to 2.3 mg/l upstream from the WWTP, and from less than the analytical detection limit to 3.7 mg/l downstream from the plant.

Chemical oxygen demand (COD) concentrations in Cowles Creek were elevated by the discharge from the Geneva WWTP (Figure 10). In-stream COD concentrations increased from an average of 19 mg/l upstream from the WWTP (RM 4.83) to an average of 31.6 mg/l downstream from the plant (RM 4.64). Samples taken from the WWTP effluent during the study period had an average COD concentration of 27.3 mg/l. Concentrations of COD declined steadily downstream from the WWTP, averaging 23.6 mg/l at RM 3.2 and 16.4 mg/l at RM 1.4.

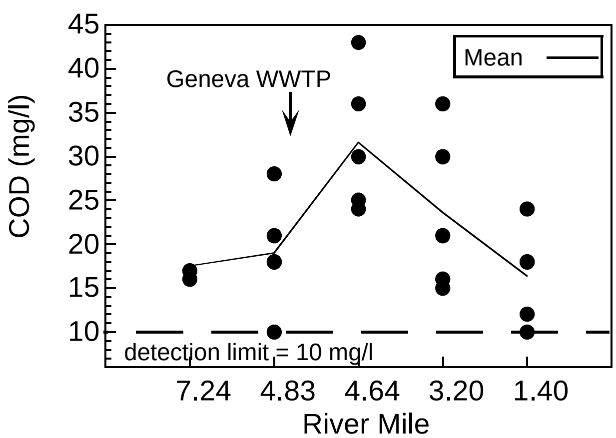


Figure 10. Chemical oxygen demand (COD) measured in routine water quality grab samples collected from Cowles Creek, 1995.

Ammonia nitrogen (NH_3-N) concentrations were only slightly elevated downstream from the Geneva WWTP, and were significantly below the WQS (Figure 11). Average NH_3-N concentrations in Cowles Creek increased from an average of 0.05 mg/l upstream from the WWTP (RM 4.83) to an average of 0.15 mg/l at the downstream monitoring station (RM 4.64). The WWTP effluent samples had NH_3-N concentrations ranging from 0.06 to 0.15 mg/l, while NH_3-N concentrations for samples taken in Cowles Creek downstream from the WWTP (RM 6.64 to RM 0.3) ranged from less than the analytical detection limit of 0.05 mg/l to 0.39 mg/l.

Discharges of nitrate-nitrite nitrogen (NO_3-NO_2-N) from the Geneva WWTP dominated the nutrient dynamics of Cowles Creek during the study period. Effluent NO_3-NO_2-N concentrations ranged from 11.0 to 16.4 mg/l, resulting in an increase in average in-stream NO_3-NO_2-N

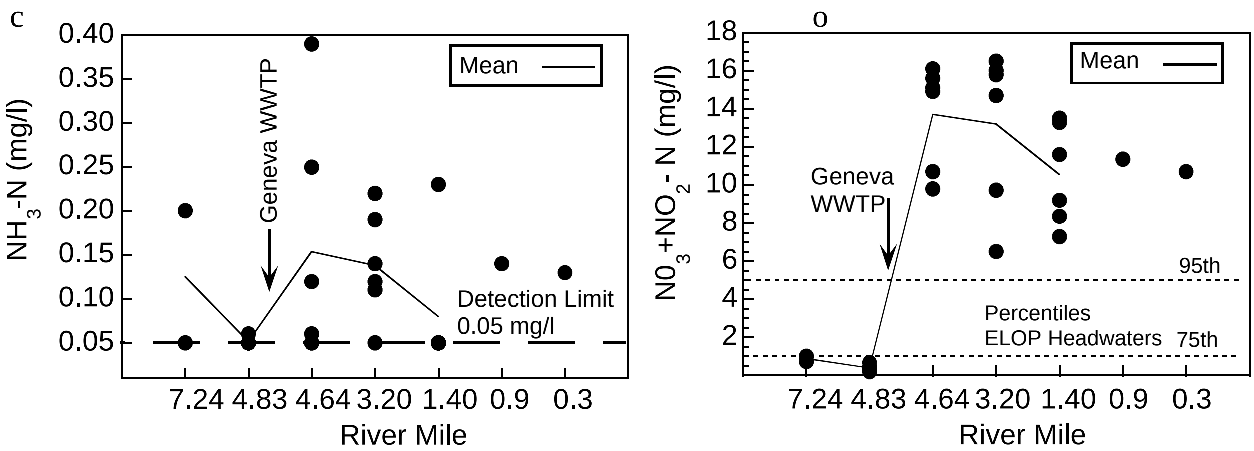


Figure 11. Concentrations of ammonia-nitrogen (left) and nitrate/nitrite-nitrogen (right)measured in water quality grab samples collected from Cowles Creek, 1995.

from 0.38 mg/l upstream from the WWTP (RM 4.83) to 13.7 mg/l at the site downstream from the plant (RM 4.64) (Figure 11). Concentrations of NO_3-NO_2-N in the stream remained elevated throughout the study period for all of the downstream sampling sites, averaging 13.2 mg/l at RM 3.2 and 10.5 mg/l at RM 1.4. Results from analysis of samples taken on July 26, 1995 indicate that these elevated NO_3-NO_2-N concentrations persist to the mouth of the stream. Concentrations of NO_3-NO_2-N at RM 0.9 and RM 0.3 on that date were 11.2 mg/l and 10.7 mg/l respectively.

Total Kjeldahl nitrogen (TKN), a measure of organically-bound nitrogen, displayed the same pattern with respect to concentrations in Cowles Creek as NO_3-NO_2-N. Discharges of TKN from the Geneva WWTP (average effluent concentration = 1.5 mg/l) increased the average in-stream TKN concentration from 0.5mg/l upstream (RM 4.83) to 1.6 mg/l downstream from the WWTP (RM 4.64). As with NO_3-NO_2-N, TKN concentrations remained elevated at all sites downstream from the WWTP to the mouth of the stream, ranging from 0.9 to 1.5 mg/l throughout the study period.

The data from the survey indicate that although some of the NO_3-NO_2-N and TKN discharged to the stream is assimilated downstream from the WWTP, most of the load is conserved and exported to Lake Erie. Average concentrations of NO_3-NO_2-N were 28 times higher at RM 1.4 than those found upstream from the WWTP (RM 4.83) and average TKN concentrations were 2.1 times higher. Results from sampling at stations farther downstream from the WWTP (RM 09 and 0.3) on July 26, 1995 indicate that this condition persists to the mouth of the stream.

Phosphorus concentrations in Cowles Creek were slightly elevated downstream from the Geneva WWTP (Figure 12). Concentrations of phosphorus upstream from the WWTP at RMs 7.24 and RM 4.83 ranged from less than the analytical detection limit of 0.05 mg/l to 0.11 mg/l during the study. Discharges from the WWTP (average effluent concentration during the study = 0.50 mg/l) increased the phosphorus concentrations downstream (RM 4.64) to an averaged 0.42 mg/l. Phosphorus was quickly assimilated in the stream, with average concentrations declining to 0.30 mg/l at RM 3.2 and 0.20 mg/l at RM 1.4.

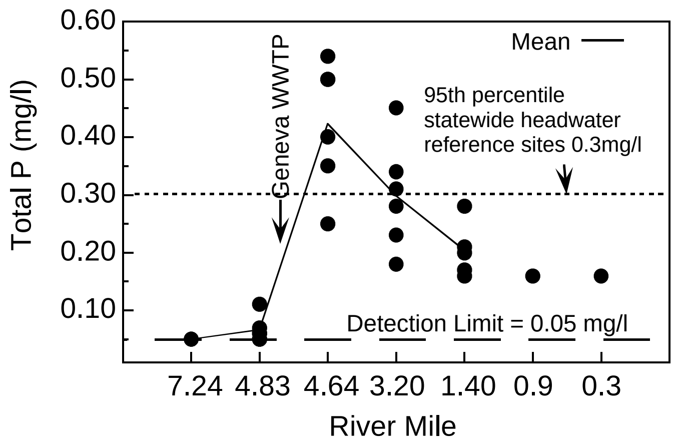


Figure 12. Total Phosphorus concentrations in water quality grab samples collected from Cowles Creek, 1995, in relation to the Geneva WWTP.

Concentrations of metals in Cowles Creek were low and well within the WQS for all stream use designations. Cadmium, copper and lead were detected in only three, one, and three samples, respectively, at concentrations very close to their analytical detection limits (maximum observed concentrations: Cd = 0.3 μg/l at RM 1.4, Cu = 17 μg/l at RM 1.4, and Pb = 5 μg/l at RM 4.83). Zinc was detected in all but three samples, but concentrations were well below the WQS both upstream and downstream from the Geneva WWTP.

Contamination of Cowles Creek within the City of Geneva upstream from the Geneva WWTP from fecal coliform bacteria was identified as a significant problem (Table 7, Figure 13). Although one sample taken from the Barnum Rd. sampling site (RM 7.24) exceeded the primary contact 30 day geometric mean WQS (30- day WQS) of 1,000 colonies/100ml (col./ml), densities of fecal coliform increased dramatically within the City of Geneva. Fecal coliform bacteria densities ranged from 2,300 to 5,600 at Eastwood Ave. (RM 5.48), exceeding the maximum WQS for primary contact recreation on all three sampling dates and that for secondary contact recreation on two of the three dates. Fecal coliform densities were found to be even higher at East Main St. (RM 5.2), where densities ranged from 4,600 to 25,000 col./ml. The geometric mean fecal coliform bacteria count was 12,504 col/ml at RM 5.2. Densities of fecal coliform bacteria declined downstream from RM 5.2 but remained elevated to at least RM 3.2, with values ranging from 800 to 10,000 col./ml at RM 4.83, 67 to 4,300 col./ml at RM 4.64, and from 800 to

3,100 col./ml at RM 3.2. There were no detected exceedences for fecal coliform bacteria at RM 1.4, where densities ranged from 430 to 900 col./ml.

Two surveys conducted by walking the stream upstream from East Main St. failed to locate an obvious source for the bacterial contamination detected in the stream. Failure to also detect elevated nutrient (phosphorus and/or nitrogen) concentrations as well as the lack of any observed oxygen deficiency in the Creek upstream from the Geneva WWTP indicate that a sewer break is not the likely cause of the problem. Additional surveys should be conducted in Cowles Creek to identify and correct the cause of the contamination to ensure that recreational uses of the stream are protected.

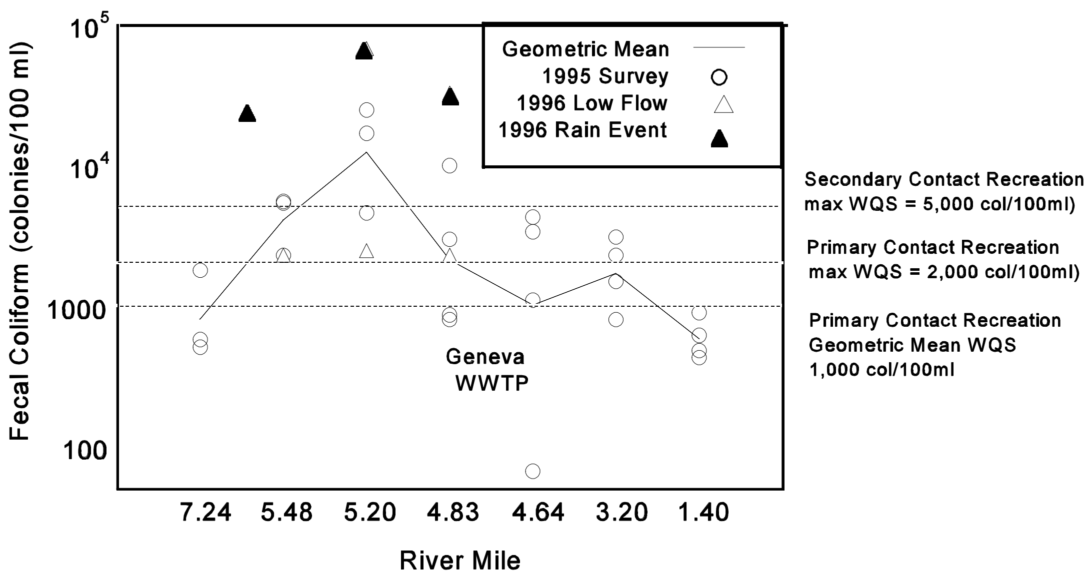
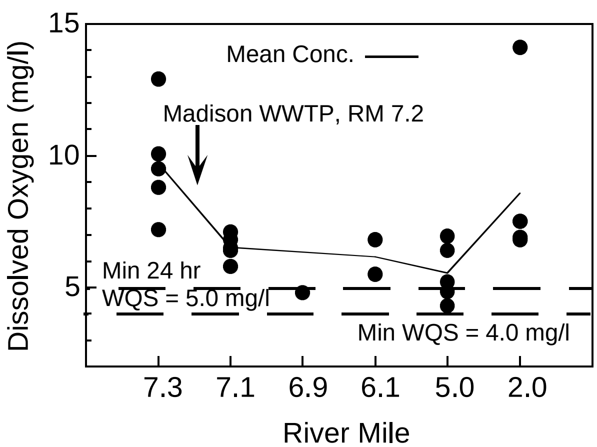


Figure 13. Number of fecal coliform colonies in grab samples collected from Cowles Creek, 1995, and in follow-up samples collected in 1996.

Arcola Creek

Daytime D.O. concentrations in the middle segment of Arcola Creek downstream from the Madison Village WWTP (RM 7.1 to RM 5.0) were depressed compared to the upstream sampling location (RM 7.3), and the sampling station downstream from U.S. Route 20 (RM 2.0) (Figure14). Average daytime D.O. concentrations in the reach were 3.2 to 4.9 mg/l less than those measured at the upstream location (RM 7.3), and six of sixteen (38%) measurements were below the WWH 24-hour average minimum WQS concentration of 5.0 mg/l (Table 7). Dissolved oxygen concentrations recovered downstream from U.S. Route 20, averaging 8.6mg/l at RM 2.0.

Results from a diurnal survey conducted on August 15, 1995 indicate that the sag in D.O. concentrations in Arcola Creek is more pronounced at night (Figure 14). A severe depression in D.O. concentration was observed at all of the sites upstream from U.S. Route 20, including the site upstream from the Madison Village WWTP (RM 4.73). Night time D.O. concentrations ranged from 2.6 to 4.5 mg/l upstream from U.S. Route 20, with concentrations at both the RM 6.1 and 5.0 sampling sites falling below the minimum WWH WQS of 4.0 mg/l (Table 7). Only the site downstream from U.S. Route 20 at RM 2.0 maintained a D.O. concentration above the minimum WWH WQS throughout the night time hours.



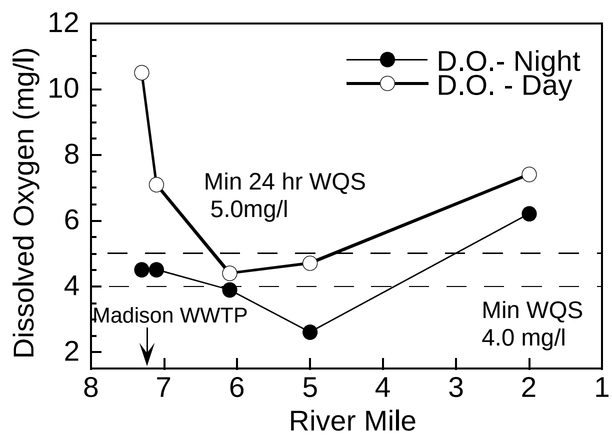


Figure 14. Dissolved oxygen concentrations (mg/l) in Arcola Creek measured in routine water quality grab samples (left), and from samples collected in a diurnal survey (right)

Flow within the stream was extremely low throughout the study period, with no flow conditions occurring at the downstream sampling site (RM 2.0) by the last sampling date on September 5, 1995. Due to the characteristics of the middle segment of the stream (deeper channels, few riffle areas), aeration within the stream due to natural flow was probably minimal during the study period. Although dissolved oxygen averaged 5.6 mg/l in the WWTP effluent during the study, it appears that little surplus oxygen was being supplied to the stream from the WWTP, and that the current permit limit of 5.0 mg/l is insufficient for the needs within the stream. Reaeration of the WWTP effluent to provide DO in excess of the current minimum of 5.0 mg/l D.O. in the plant effluent specified in the N.P.D.E.S. permit should be strongly considered as a mechanism for improving in-stream D.O. concentrations.

Carbonaceous five day biochemical oxygen demand ($cBOD_5$) concentrations in the Madison

Village WWTP were low (2.1 mg/l) for both samples taken during the study. In-stream $cBOD_5$ concentrations were similarly low, with only two samples found to have $cBOD_5$ concentrations slightly above the analytical detection limit of 2.0 mg/l. Although chemical oxygen demand (COD) concentrations in Arcola Creek were variable downstream from the WWTP, the average detected concentrations at the downstream stations were very similar (Figure 15). The average COD concentration in the WWTP effluent was 19.7 mg/l during the study, and in-stream average COD concentrations ranged from 9.6 to 15.2 mg/l downstream from the WWTP.

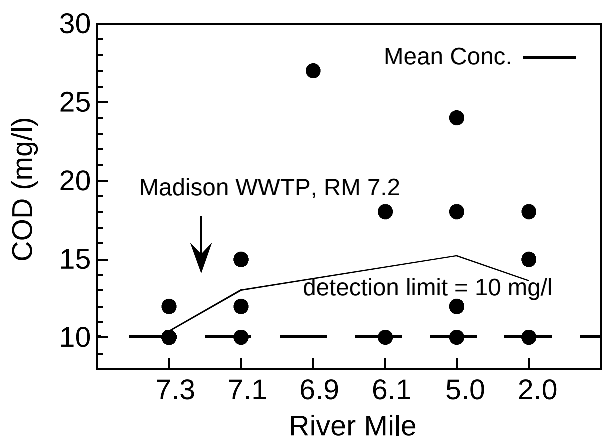


Figure 15. Chemical oxygen demand (COD mg/l) measured in water quality grab samples collected from Arcola Creek, 1995, in relation to the Madison Village WWTP.

There were no exceedences of any of the water quality criteria for nitrogen compounds in Arcola Creek detected during the study period. However, concentrations of nitrogen compounds were highest in the stream below the Madison Village WWTP (Figure 16). Average NH_3-N concentrations increased from less than the limits of detection (0.05 mg/l) upstream from the WWTP to 0.46 mg/l downstream. Ammonia nitrogen was quickly assimilated in the stream, and ranged from 0.06 to 0.15 mg/l from RM 6.1 to the downstream station at RM 2.0. NH_3-N concentrations in the WWTP effluent averaged 0.51 mg/l. Concentrations of NO_3-NO_2-N were highest at State Route 528 (RM 6.1), possibly reflecting the assimilation and conversion of NH_3-N discharged by the WWTP to NO_3-NO_2-N. As compared to the upstream sampling location,

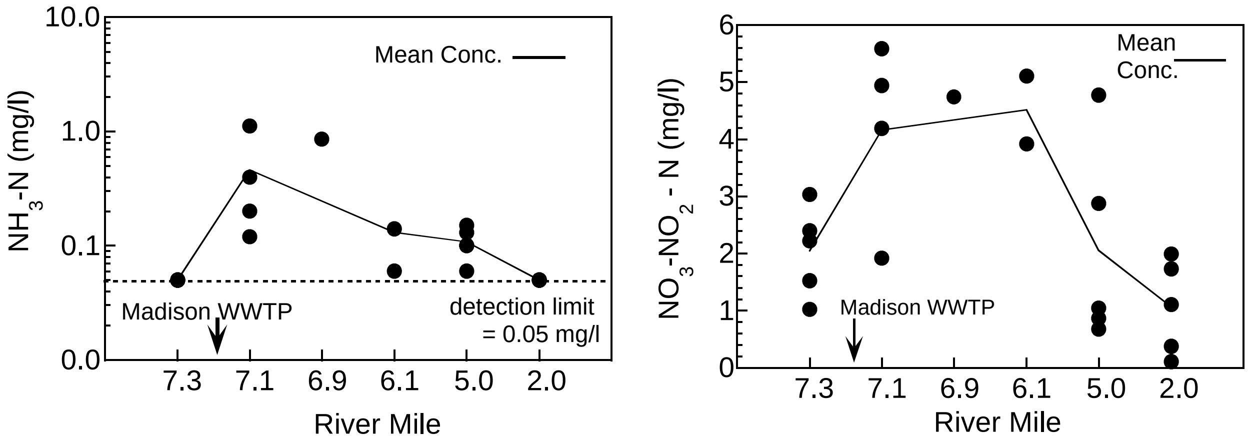
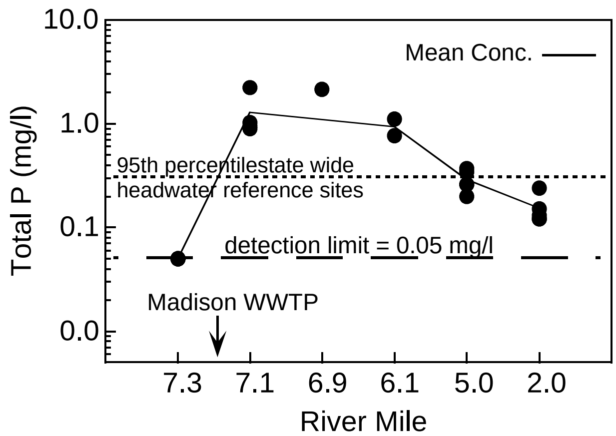


Figure 16. Concentrations of ammonia-nitrogen (left) and nitrified-nitrogen (right) in water quality grab samples collected from Arcola Creek, 1995 in relation to the Madison WWTP.

NO_3-NO_2-N concentrations downstream from the WWTP were elevated by an average of 2.4 mg/l in the segment from RM 7.2 to RM 6.1, ranging from 1.92 to 5.58 mg/l. Effluent from the WWTP averaged 5.34 mg/l of NO_3-NO_2-N during the study period. Concentrations of NO_3-NO_2-N returned to levels comparable to upstream conditions by RM 5.0, and were markedly lower at RM 2.0, with concentrations there ranging from less than the detection limit (0.10 mg/l) to 1.99 mg/l. Concentrations of TKN averaged 1.0 mg/l just downstream from the WWTP, but were highly similar at the remainder of the downstream stations, with average concentrations of 0.5 to 0.6 mg/l from RM 6.1 to RM 2.0.

Phosphorus concentrations in the Madison Village WWTP effluent ranged from 1.36 to 2.73 mg/l during the study period. The effluent discharge increased the average in-stream concentration of phosphorus from <0.05 mg/l at the upstream sampling site (RM 7.3) to 1.27 mg/l at the downstream site (RM 7.2). Phosphorus concentrations declined but remained elevated further downstream from the WWTP, averaging 0.93 mg/l at RM 6.1, 0.29 mg/l at RM 5.0, and 0.15 at RM 2.0. Concentrations of phosphorus in the stream exceeded the WQS guideline of 1.0 mg/l in four of the seven samples taken downstream from the WWTP between RM 7.1 and RM 6.1 (Figure 17, Table 7).

Biological productivity of aquatic systems has been found to be limited by the availability of nitrogen and phosphorus (for discussions see Wetzel 1975). A significant relationship exists between average in-stream nutrient concentrations and fish community indices. Existing data indicate that when average in-stream phosphorus concentrations exceed 0.1 mg/l, changes in the



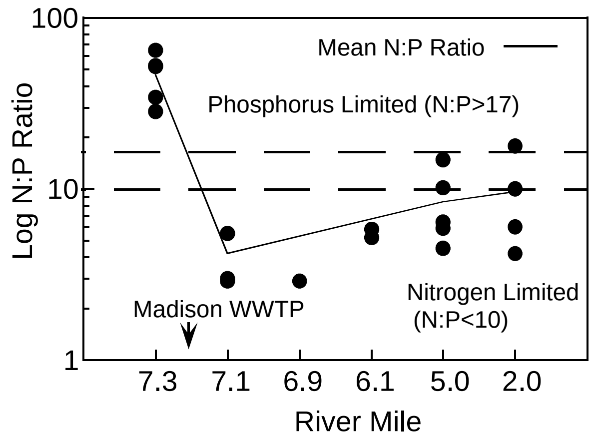


Figure 17. Total phosphorus concentration in water quality grab samples collected from Arcola Creek, 1995 (left), and their respective nitrogen:phosphorus ratios (right).

fish community become evident which result in lower IBI scores. A similar relationship also has been observed in Ohio streams when nitrate-nitrogen concentrations exceed 8.0 mg/l. Ultimately, the nutrient which will limit biological activity is dependant upon the ratio of nitrogen to phosphorus (N:P). Studies show that phosphorus is the exclusive limiting nutrient at N:P > 37.7:1, and that nitrogen is exclusively limiting at N:P < 4.1:1 (Smith, 1982). At intermediate N:P values, the availability of both nutrients impacts productivity (Hecky and Killiam 1988). Systems where N:P values are less than 10:1 are typically characterized as predominantly nitrogen limited, while systems with N:P values greater than 17:1 are characterized as predominantly phosphorus limited .

Using the data collected during the 1995 survey, it is estimated that the WWTP effluent averages approximately 65% of the stream flow in Arcola Creek downstream from the Madison Village WWTP during low flow conditions. Analysis of the ratios of total nitrogen (TKN + NO_3-NO_2-N) to phosphorus in Arcola Creek indicates that the stream is enriched with phosphorus at all of the sampling sites downstream from the Madison Village WWTP (Figure 17), while biological productivity at the upstream (RM 7.3) sampling location was found to be exclusively limited by phosphorus (average N:P = 46.4:1). Nitrogen to phosphorus ratios downstream from the WWTP (RM 7.1) decreased to an average of 4.2:1, indicating that loadings of phosphorus from the WWTP had significantly enriched the stream. Average N:P ratios in the WWTP effluent during the study period were 3.3:1. It is apparent that loadings of phosphorus to the stream from the WWTP dominated the nutrient dynamics within the stream during the study and that nutrient enrichment of the stream was the major factor in the observed decline in DO concentrations in the middle reach (RM 7.1 to RM 5.0).

Using an average in-stream phosphorus concentration of 0.5 mg/l as a target for water quality below the Madison Village WWTP and data from the 1995 survey, it is estimated that the effluent phosphorus concentration should be reduced to an average of 0.73 mg/l under the proposed plant expansion to 0.5 MGD. Assuming that total nitrogen loadings from the WWTP remain the same, this would result in an N:P ratio of approximately 10:1, the lower limit for phosphorus limitation of biological activity as found in the literature. Therefore, this proposed limit should be considered the maximum acceptable loading, with a goal of reducing in-stream phosphorus concentrations even lower than 0.5 mg/l. Data from the 1995 survey indicate that a reduction of phosphorus loadings to Arcola Creek, through additional treatment at the Madison Village WWTP, will have beneficial impacts on the downstream biological community. Although the approach used to determine an appropriate target concentration for phosphorus in the stream results in an estimate below the 1.0 mg/l WQS guideline, it must be noted that the guideline is based upon strategies for the reduction of phosphorus loadings to the Great Lakes and not upon maintaining in-stream biological integrity. It is therefore recommended that permit requirements for the Madison WWTP be established to reduce average in-stream phosphorus concentrations to 0.5 mg/l by setting an average effluent limit for phosphorus of 0.73 mg/l.

Concentrations of zinc were elevated downstream from the Madison Village WWTP, though they were well within the WQS. The average zinc concentration upstream from the WWTP (RM 7.3) was 12 μg/l, while the average concentration downstream from it (RM 7.1) was 29 μg/l. The average concentration in the WWTP effluent was 41 μg/l. Discussion with DSW staff in the Ohio EPA Northeast District Office indicates that a single industrial discharger may be responsible for the majority of the zinc in the WWTP influent. Additional pretreatment oversight has already begun for this discharger.

Fecal coliform bacteria levels in Arcola Creek were well within the range acceptable for primary contact recreation except for two instances where the levels exceeded the 30 day WQS (Table 7, Figure 18). Feedlot activities along the stream in the area of RM 6.9 may have been responsible for these events.

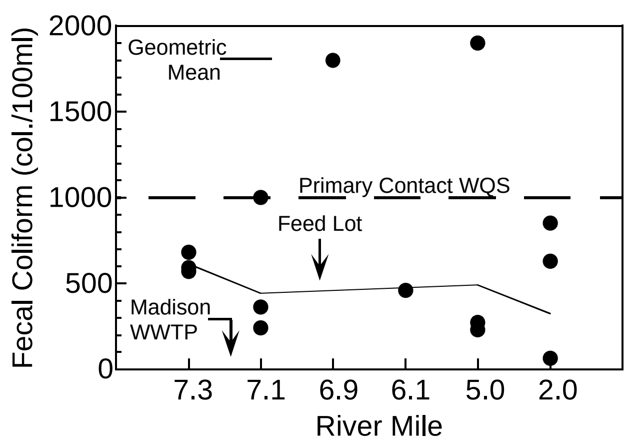


Figure 18. Fecal coliform colonies (#/100ml) in water quality grab samples collected from Arcola Creek, 1995.

The herbicide dieldrin was detected in a grab sample taken upstream from the WWTP (RM 7.3) at a concentration (0.010 μg/l) exceeding the numerical criteria for the outside mixing zone 30-day average. Dieldrin, endrin and heptachlor epoxide were all detected at 0.003 μg/l at RM 5.0 (Table 7). Run off from the extensive acreage used for the nursery industry in the Arcola Creek watershed is the likely source for these organic compounds.

Conneaut Creek

During the 1995 survey season, Ohio EPA sampled one site in Conneaut Creek at Furnace Road (River Mile 23.1) for Water Quality. The site was sampled five times during the study period. Results of individual grab samples are presented in Appendix Table X.

The survey data indicated good water quality with no exceedances of any of Ohio's Water Quality Criteria with the exception of one dissolved oxygen value recorded on August 16, 1995 @ 7:43 AM. The dissolved oxygen concentration was 5.0 mg/l, which is an exceedence of the Exceptional Warmwater Habitat Water Quality Standard of 6.0 mg/l at any time. Dissolved oxygen concentrations measured during day time sampling events at Furnace Road ranged from 5.0 to 8.8 mg/l during the study period. The low dissolved oxygen reading does not necessarily indicate water quality impacts associated with non-point pollution sources, rather it is likely attributable to low flow conditions observed throughout the study period.

Nutrient concentrations in Conneaut Creek were very low. Nitrate-nitrite nitrogen concentrations were generally below 0.50 mg/l and ammonia-nitrogen concentrations were present below or near method detection limits. Phosphorus concentrations were below the detection limit in all samples. Chemical Oxygen Demand concentrations at the Furnace Road site ranged from <10 to 18 mg/l. Concentrations of metals in the Conneaut Creek were also low during the study and well within the Water Quality Criteria for the stream's use designation.

Fecal coliform bacteria levels in the Conneaut Creek were within the acceptable range for primary contact recreation.

Table 7. Instances of exceedences from the Ohio EPA Warmwater Habitat criteria (OAC 3745-1) for chemical/physical water parameters measured in grab samples taken from the Cowles Creek and Arcola Creek study areas during 1995 (units are μg/l for organics, # colonies/100ml for fecal coliform bacteria, and mg/l for all other parameters).

Stream	River Mile	Parameter (value)
Ashtabula River		
	27.1	Dissolved Oxygen (4.6[‡])
	19.1	Dissolved Oxygen (4.5[‡])
	6.3	Fecal Coliform (3200[**])
East Branch	1.4	Fecal Coliform (3200[**])
West Branch	1.8	Fecal Coliform (4700[**])
Unnamed Trib		
	1.5	Fecal Coliform (3230[**])
Cowles Creek		
	7.24	Dissolved Oxygen (*4.08*)
		Fecal coliform (1,800[*])
	5.48	Fecal coliform (5,400[***]; 5,600[***]; 2,300[**])
	5.20	Fecal coliform (25,000[***]; 4,600[**]; 17,000[***])
	4.83	Fecal coliform (10,000[***]; 3,000[**])
	4.64	Fecal coliform (4,300[**]; 3,400[**]; 1,100[*])
	3.20	Fecal coliform (3,100[**]; 2,300[**]; 1,500[*])
	0.30	Dissolved oxygen (4.19[‡])
Arcola Creek		
	7.3	Dieldrin (0.010[#, ##])
		Dissolved oxygen (4.5[‡])
	7.1	Dissolved oxygen (4.5[‡])
		Phosphorus (1.02[†]; 2.23[†])

Table x. Continued.

Stream	River Mile	Parameter (value)
Arcola Creek - Continued.		
	6.9	Dissolved oxygen (4.8‡)
		Phosphorus (2.13†)
		Fecal coliform (1,800*)
	6.1	Dissolved oxygen (3.9‡ ‡; 4.4‡)
		Phosphorus (1.10†)
	5.0	Dieldrin (0.003##)
		Endrin (0.003##)
		Dissolved oxygen (4.3‡; 2.6‡‡; 4.7‡; 4.85‡)
		Fecal coliform (1,900*)

Concentrations exceeding the numerical criteria for outside the mixing zone 30-day average.

Concentrations exceeding the numerical criteria for human health 30-day average.

Dissolved Oxygen concentrations noted in italics are minimum readings obtained by use of Datasondes.

‡ Concentrations below the average warmwater habitat dissolved oxygen criterion (5.0 mg/l).

‡‡ Concentrations below the minimum warmwater habitat dissolved oxygen criterion (4.0 mg/l).

* Data exceeding the average Primary Contact Recreation criterion for fecal coliform bacteria (1,000 colonies/100 ml).

** Data exceeding the maximum Primary Contact Recreation criterion for fecal coliform bacteria (2,000 colonies/100 ml).

*** Data exceeding the maximum Secondary Contact Recreation criterion for fecal coliform bacteria (5,000 colonies/100 ml).

† Data exceeding the Water Quality Standards guideline for daily average total phosphorus (1.0 mg/l).

Physical Habitat for Aquatic Life

Ashtabula River

The quality of the macro habitats at five locations sampled for fish in the Ashtabula River, and at the sites sampled in the East and West Branches (Table 8), were assessed using the Qualitative Habitat Evaluation Index (QHEI - Rankin 1989). The mean QHEI score for the basin was 73.2 ± 5.93 s.d., indicating generally good to excellent habitat quality and the capability of supporting a diverse aquatic fauna. The absence of anthropogenic modifications to the river is demonstrated by the low ratio(<0.5) of modified habitat attributes to warmwater habitat attributes. The postive warmwater habitat attributes encountered in the Ashtabula River is largely ascribed to a lack of channelization, wide mature riparian areas, and small acreage farms using conservative practices in the basin. Riffle and channel substrates were unembedded and generally silt free. Glacial till and fractured bedrock provided a variety of substrate sizes and habitat complexity, especially in the upper watershed. Although the physical habitat is very good, extremely low or intermittent flows occur every summer in the Ashtabula River (USGS reference) limiting the amount of habitat available to aquatic fauna. The low flows in summer are due to the limited ground water capacity of the shale bedrock aquifers. High volumes of stream discharge (>5000 cfs, max ~ 11,100 cfs in 1959), emanating from snow melt, scours and denudes the lower reach of the Ashtabula River. Consequently, QHEI scores decreased with proximity to Ashtabula mainly because of the increased prevalence of unbroken shale bedrock and less cover.

Cowles Creek

Macro habitats in Cowles Creek were evaluated at seven fish sampling locations (Table 8). The average QHEI score was 59.6 ± 3.23 s.d., reflecting fair to good habitat quality overall, and the ability to support a fish fauna consistent with expectations of WWH criteria. However, ratios of modified habitat characteristics to warmwater habitat characteristics exceeded 1 at 4 of 7 locations reflecting modifications to the stream. Modified habitat attributes limiting to biological communities identified at most locations include moderate to heavy siltation, poor channel development, no fast current, embedded substrates, and sparse cover. Two segments had been previously channelized, RMs 5.0 and 1.1. The reach flowing through the city of Geneva has been confined with revetments, although the creek had recovered free flowing characteristics within the confines of the revetments at RM 5.0. The channel at RM 1.1, previously straightened for road construction, was starting to meander, and riparian vegetation was recovering. Stream dewatering for nursery irrigation upstream from Geneva appeared to have altered the natural flow. Reduced flows contributed to the generally poor quality of the riffle habitat by reducing the downstream transport of silt, and reducing available habitat. The habitat was limited by natural factors, specifically poor in-stream cover due to shale bedrock in the lower reaches. Positive warmwater habitat attributes common to most sites were no past channel modifications, the presence of glacial till adding habitat complexity and in-stream cover, and deep pools.

Table 8. QHEI matrix for sites sampled in the Ashtabula River basin, 1995.

Key QHEI Components

WWH Attributes

River Mile	QHEI	Gradient (ft/mile)	No channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max. Depth > 40cm	Low/No Riffle Embeddedness	**Total WWH Attributes**
(07 -001) AshtabulaRiver													
27.2	84.5	8.6	■			■	■	■		■	■		7
19.1	75.5	9.4	■	■		■	■	■		■	■		8
12.1	77.5	11.4	■	■		■	■	■	■	■	■		9
6.3	72.5	17.5	■	■		■	■	■		■	■		8
3.5	64.0	12.5	■	■		■	■		■	■	■		8
(07-004) West Branch Ashtabula River													
2.7	65.5	19.6	■	■		■	■	■		■	■		8
(07-005) East Branch Ashtabula River													
1.4	73.0	12.5	■	■		■	■	■		■	■		8
(07-007) Cowles Creek													
7.2	62.5	13.7	■	■		■	■	■		■	■		7
6.2	63.0	14.3	■	■		■	■	■			■		7
5.0	57.5	21.7	■	■						■	■		4
4.2	62.5	20.8	■	■		■	■			■	■	■	7
3.3	60.0	15.9	■	■		■	■	■			■		6
1.1	55.5	22.7	■	■							■		3
0.3	56.0	0.1	■					■			■		3
(07-011) Arcola Creek													
7.4	44.0	8.9		■				■	■		■		4
7.2	43.0	13.2		■							■		2
5.0	34.0	6.2											0
2.0	67.5	20.8	■			■	■	■		■	■	■	7
0.5	60.0	29.4	■	■		■	■			■			6
(07-100) Conneaut Creek													
23.1	88.0	8.9	■	■		■	■	■	■	■	■	■	9
12.1	85.5	5.6	■	■		■	■	■	■	■	■	■	9

MWH Attributes

High Influence

River Mile	Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max. Depth < 40 cm (WD/HW)	**Total H.I. MWH Attributes**
(07 -001) AshtabulaRiver						
27.2						0
19.1						0
12.1						0
6.3				●		1
3.5				●		1
(07-004) West Branch Ashtabula River						
2.7						0
(07-005) East Branch Ashtabula River						
1.4						0
(07-007) Cowles Creek						
7.2				●		1
6.2				●		1
5.0			●	●		2
4.2				●		1
3.3				●		1
1.1			●	●		2
0.3			●			1
(07-011) Arcola Creek						
7.4	●		●	●		3
7.2	●		●	●		3
5.0	●	●	●	●	●	5
2.0				●		1
0.5				●	●	2
(07-100) Conneaut Creek						
23.1						0
12.1						0

Moderate Influence

River Mile	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**MWH H.I./WWH Ratio**	**MWH M.I. WWH Ratio**
(07 -001) AshtabulaRiver															
27.2									▲				1	0.13	0.25
19.1									▲				1	0.11	0.22
12.1													0	0.10	0.10
6.3									▲				1	0.22	0.33
3.5							▲		▲				2	0.22	0.44
(07-004) West Branch Ashtabula River															
2.7									▲				1	0.11	0.22
(07-005) East Branch Ashtabula River															
1.4									▲				1	0.11	0.22
(07-007) Cowles Creek															
7.2		▲							▲	▲		▲	4	0.25	0.75
6.2					▲				▲	▲	▲		4	0.25	0.75
5.0	▲				▲	▲			▲		▲		5	0.60	1.60
4.2		▲			▲				▲				3	0.25	0.63
3.3		▲			▲				▲	▲	▲		5	0.29	1.00
1.1	▲	▲			▲	▲			▲	▲	▲		7	0.75	2.50
0.3		▲			▲	▲			▲	▲		▲	6	0.50	2.00
(07-011) Arcola Creek															
7.4	▲	▲			▲	▲			▲	▲		▲	7	0.80	2.20
7.2	▲	▲			▲	▲			▲	▲		▲	7	1.33	3.67
5.0	▲	▲			▲	▲			▲	▲		▲	7	6.00	9.99
2.0									▲				1	0.25	0.38
0.5									▲				1	0.43	0.57
(07-100) Conneaut Creek															
23.1													0	0.10	0.10
12.1													0	0.10	0.10

Arcola Creek

Macrohabitats were evaluated at five locations in Arcola Creek (Table 8). The three upper sites were recently channelized, and consequently had severely degraded habitats (QHEI < 45). The ratio of modified habitat attributes to warmwater habitat attributes at these sites ranged from 2.20 at RM 7.3 to >10 (*i.e.*, no warmwater habitat attributes) at RM 5.0. Of the three channelized sites, RM 5.0 had the most degraded habitat, as it was the most recently channelized, and consequently was completely lacking in any warmwater habitat attributes. Redeposition of sand and silt, and sediment runoff from nurseries had completely covered the channel to the point that it was difficult to wade in, cover was lacking, and depth was uniformly shallow. Habitat degradation was less severe at the upstream sites bracketing the WWTP, as the channel had recovered several warmwater habitat attributes. Original substrates were present, channel development was higher and cover was more abundant. The two sites downstream from U.S. Rt. 20 had not been previously channelized (or were recovered), as reflected by QHEI scores (67.5 and 60.0 at RMs 5.0 and 0.5, respectively) and the relatively low ratio of modified habitat attributes to warmwater habitat attributes (<0.6 at both sites). Habitat attributes favoring WWH fish communities common to both sites were unembedded substrates, and a well developed and sinuous channel containing gravel, cobbles and bedrock slabs. Water withdrawal for irrigation, however, had rendered flows intermittent at the two downstream sites, and significantly reduced available habitat. Collectively, anthropogenic modifications to the physical habitat and hydrologic budget are serious limitations to the fish community of Arcola Creek.

Conneaut Creek

Excellent habitat quality was noted at the two sites evaluated in Conneaut Creek (Table 8). Fractured bedrock and glacial tills provided substrates with a variety of sizes and high complexity, and channel development was excellent. Riffles were free of embedding silt, and silt in the slower channels was confined to depositional areas. Wide mature riparian vegetation covered the undeveloped flood plain at both locations, providing woody debris for in-stream cover. Small acreage farms using conservation tillage practices, paired with wide riparian buffers, helped reduce the amount of sediment entering the stream.

Biological Assessment: Macroinvertebrate Community

Artificial substrate samplers were collected from 19 of 20 stations in the Ashtabula River, Cowles Creek, Arcola Creek, and Conneaut Creek during the summer of 1995 (Table 9). Narrative evaluations ranged from poor in the upper reaches of Arcola Creek to exceptional at three Conneaut Creek stations and one Ashtabula River station. Eighteen of the twenty artificial substrate sets were affected by inadequate current velocities (< 0.3 ft./sec.) or no detectable current in the location where they were placed. Also, stream flows were intermittent or nearly intermittent at eight of the twenty sites, in the Ashtabula River, Arcola Creek and the upper section of Cowles Creek. Because the lack of current could result in lower ICI scores by limiting the presence of flow-dependent taxa on the artificial substrates, these sites were also evaluated based on the qualitative (natural substrate) collections. This analysis overrides the ICI scores at four locations where the evaluation was raised from "fair" to "marginally good" (Table 9).

Ashtabula River

Artificial substrate sampling in the Ashtabula River basin included four mainstem sites from RM 25.6 to 3.6 (upstream from the estuary) and a site in the West Branch at RM 1.8. The samplers were lost in the East Branch at RM 1.4 and only qualitative sampling was performed. A total of 160 taxa were collected from the six sites in the basin, with an average of 11 EPT taxa collected from natural substrates per site. At the five locations where both quantitative and qualitative data were collected, an average of 71 total taxa were found per site. Narrative evaluations were consistently in the marginally good range; however, RM 3.6 was rated excellent (Table 9, Figure 19).

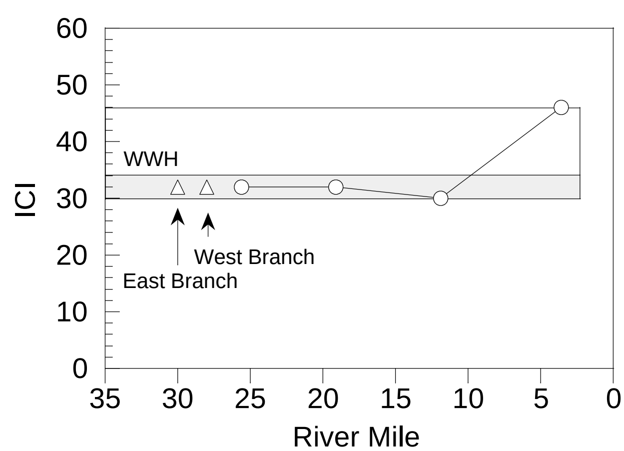


Figure 19. Longitudinal performance of the Invertebrate Community Index (ICI) for the Ashtabula River, 1995.

Stream flow in the branches and mainstem was very low during the late summer collection period. All sites were intermittent or nearly intermittent except the mainstem at RM 3.6. Marginally good macroinvertebrate communities were found in both the West Branch of the Ashtabula River (ICI=32 at RM 1.8) and the East Branch based on the qualitative collections. ICI scores in the upper mainstem were also in the marginally good range at RMs 25.6 and 19.1. A slight drop into the fair range at RM 11.9 (ICI=28) was considered primarily a result of stream intermittence and not a significant change in water quality; the community was also evaluated as marginally good. Communities improved to an exceptional condition (ICI=46) at RM 3.6 where flow conditions improved. With the exception of RM 3.6, communities throughout the Ashtabula River basin reflected moderate stresses from the late summer-low flow conditions.

Cowles Creek

Artificial substrates were collected at seven sites from RM 7.2 (upstream from Geneva) to RM 0.3 in the Lake Erie estuary. Narrative evaluations ranged from fair at sites between Geneva and Lake Erie, to marginally good at two sites upstream from the village. A total of 133 taxa were collected from the seven mainstem sites.

Flow conditions upstream from Geneva were intermittent or nearly intermittent at RM 7.1 and 5.6. Both sites had low ICI scores (fair range) but relatively good communities were collected from the natural substrates (Table 9, Figure 20). Numbers of EPT taxa collected from the natural substrates exceeded or were near ecoregional expectations, and the QCTV scores were in the high range. Based on the qualitative collections, both sites were considered marginally good.

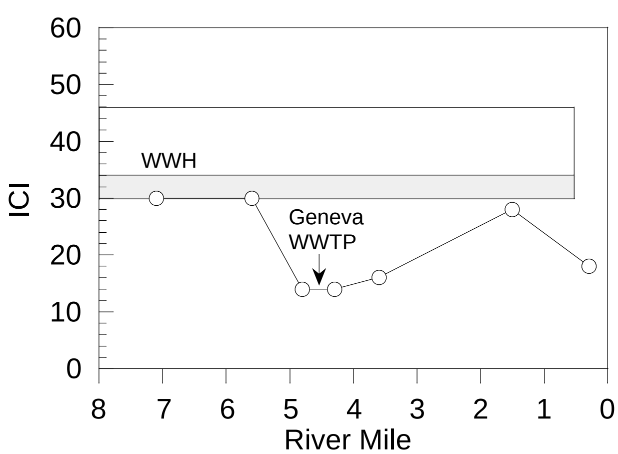


Figure 20. Longitudinal performance of the Invertebrate Community Index (ICI) for Cowles Creek in relation to the Geneva WWTP, 1995.

Community health declined at RM 4.8, downstream from the city of Geneva and immediately upstream from the Geneva WWTP. Despite a lack of current flowing over the artificial substrates, the ICI of 14 (low fair range) was considered indicative of water quality impacts. Pollution tolerant oligochaetes and snails accounted for over fifty percent of total organisms obtained from the artificial substrates, and declines in the QCTV score and qualitative EPT taxa were recorded based on the natural substrate collection.

Habitat conditions improved and current velocities increased downstream from the Geneva WWTP as stream flow was augmented by the effluent discharge. However, macroinvertebrate communities remained in the fair range at three sites between the WWTP and Lake Erie. ICI scores ranged from 14 at RM 4.3 to 28 at RM 1.5 before declining again in the estuary at RM 0.3. Oligochaetes, snails and midges (excluding the Tanytarsini fraction) accounted for up to 95% of the organisms from the free flowing sites. A gradual decrease in tolerant taxa and subsequent increase in Tanytarsini midges characterized the improving trend from upstream to downstream. An odor of ammonia was detected at RM 4.3 (nearest to the Geneva WWTP) and several septic tank discharges were observed at additional sites downstream.

Arcola Creek

Artificial substrates were collected at five sites from RM 7.5 (upstream from the Madison WWTP) to RM 0.6 (upstream from the Lake Erie estuary). A total of 106 taxa were collected from the five mainstem sites with an average 44 total taxa and 4 qualitative EPT taxa per site. Narrative evaluations ranged from poor at RM 7.5 to good at RM 5.0.

A degraded communities (ICI=12) was encountered upstream from the Madison WWTP at RM 7.5 (Figure 21). Foul smelling muck was deposited on the artificial substrates and along stream margins. Only one mayfly and one caddisfly taxon were collected while nutrient tolerant oligochaetes and flatworms predominated the quantitative and qualitative samples, respectively. Immediately downstream from the Madison WWTP at RM 7.1, the ICI increased to 26 (fair range). Improvement in the ICI score probably resulted from the augmented flow downstream from the discharge. High densities of hemoglobin utilizing midges (*Chironomus decorus* group) collected from the natural substrates and oligochaetes gathered from the artificial substrates reflected highly enriched conditions. However, the presence of numerous midges of the Tribe Tanytarsini, a toxics intolerant group, indicated a lack of toxicity associated with the effluent.

Further downstream, continued improvement in the ICI (34) was noted at RM 5.0. However, the poor quality of the qualitative sample (i.e., only three EPT taxa and low QCTV score [26.4]) indicated continued water quality impacts. Mayflies were entirely lacking on the artificial substrates and the ICI metric scoring was very erratic with five of the ten metrics receiving a "0" and four receiving a "6" on the 0 to 6 scoring scale. This scoring pattern is quite unusual for an undisturbed sampler set under adequate current conditions. Data from RM 5.0 shows that significant aspects of the macroinvertebrate community performed well below ecoregional expectations and, despite the ICI score, the site was considered impacted from enrichment sources upstream.

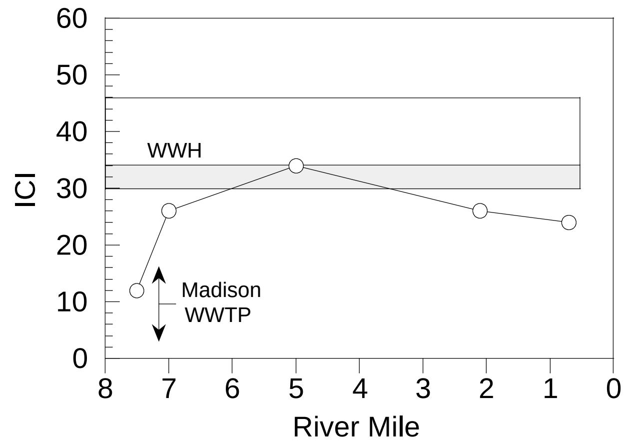


Figure 21. Longitudinal performance of the Invertebrate Community Index (ICI) for Arcola Creek in relation to the Madison WWTP, 1995.

Artificial substrates at RMs 2.1 and 0.7 were collected from areas with no detectable current; consequently ICI scores dropped into the fair range. Based on analysis of the qualitative samples, communities appeared to gradually improve with increased distance downstream but recovery was considered incomplete prior to entering Lake Erie due to stream dewatering.

Conneaut Creek

Macroinvertebrate communities were consistently in the exceptional range at three sampling locations located between the state line and RM 5.4 near the city of Conneaut (Table 9). ICI scores, EPT taxa richness and QCTV scores were consistently among the highest in the survey. A total of 149 taxa were collected from the three mainstem sites with an average 99 total taxa and 23 qualitative EPT taxa per site. The RM 23.3 site yielded 110 total taxa, the highest number recorded from any station in the Ohio EPA data base (4610 samples).

Table 9. Summary of macroinvertebrate data collected from artificial substrates (quantitative evaluation) and natural substrates (qualitative evaluation) in the Ashtabula River basin, Cowles Creek, Arcola Creek and Conneaut Creek study area, 1979 to 1995.

Quantitative Evaluation

Stream River Mile	Density (No./Sq. Ft.)	Quant. Taxa	Qual. Taxa	Total Taxa	Qual. EPT[a]	QCTV[b]	ICI	Narrative Evaluation[c]
Ashtabula River (1995)								
25.6	589	45	52	81	10	35.6	32[ns]	Marg. Good
19.1	126	44	46	71	10	37.2	32[ns]	Marg. Good
11.9	550	40	38	63	9	38.5	28*	Marg. Good[c]
3.6	140	40	48	71	16	39.2	46	Exceptional
Ashtabula River (1989)								
10.0		29	42	57	18	39.3	42	Very Good
Ashtabula River (1983)								
25.6		43	49	71	20	40.0	34	Good
West Branch Ashtabula River (1995)								
1.8	780	30	59	71	11	34.1	32[ns]	Marg. Good
West Branch Ashtabula River (1984)								
1.8		32	40	61	11	39.0	40	Good
East Branch Ashtabula River (1995)								
1.4			46		9	35.3		Marg. Good
Cowles Creek (1995)								
7.1	23	22	36	47	9	35.6	24*	Marg. Good[c]
5.6	11	18	31	41	6	39.2	20*	Marg. Good[c]
4.8	96	25	35	46	5	35.3	14*	Fair
4.3	304	30	32	45	3	32.3	14*	Fair
3.6	380	23	32	40	2	35.6	16*	Fair
1.5	197	35	34	53	7	37.2	28*	Fair
0.3	694	27	31	52	2	29.6	18*	Fair
Arcola Creek (1995)								
7.5	824	31	43	48	2	26.4	12*	Poor

Table 9. (continued).

Quantitative Evaluation								
Stream River Mile	Density (No./Sq. Ft.)	Quant. Taxa	Qual. Taxa	Total Taxa	Qual. EPT[a]	QCTV[b]	ICI	Narrative Evaluation[c]
7.0	1541	32	38	41	3	31.3	26*	Fair
5.0	308	45	44	46	2	26.4	34	Good
2.1	160	22	31	45	6	37.5	26*	Fair
0.7	544	27	37	40	7	35.8	24*	Fair
Conneaut Creek (1995)								
23.3	819	68	80	110	23	39.1	46	Exceptional
12.6	1151	60	66	95	21	39.9	46	Exceptional
5.4	470	57	60	92	26	40.9	50	Exceptional
Conneaut Creek (1989)								
6.7		43	65	84	26	39.9	52	Exceptional
Conneaut Creek (1979)								
6.7		36	32	55	16	41.3	48	Exceptional

Qualitative Evaluation						
Stream River Mile	No. Qual. Taxa	QCTV[b]	Average Qual. EPT[a]	Relative Density	Predominant Organisms	Narrative Evaluation[c]
East Branch Ashtabula River (1995)						
1.4	46	35.3	9	High	Crayfish,Water Pennies, Mayflies	Marg.Good[c]

Ecoregion Biocriteria: Erie-Ontario Lake Plains (EOLP)

INDEX	WWH	EWH	MWH / Lake Erie Estuary[d]
ICI	34	46	22

[a] EPT= total Ephemeroptera (mayflies), Plectoptera (stoneflies) and Tricoptera (caddisflies).

[b] Qualitative Community Tolerance Values (QCTV) calculated as the median of the tolerance values determined for each qaulitative taxon colleted.

[c] A qualitative narrative evaluation based on best professional judgement and samplingattributes such as community composition, EPT taxa richness, and QCTV scores was used when quantitative data were not available or considered unreliable due to current velocities less than 0.3 fps flowing over the artificial substrates.

[d] Modified Warmwater Habitat for channel modified areas and Lake Erie river mouths.

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

[ns] Nonsignificant departure from ecoregion biocriterion (≤4 ICI units).

Biological Assessment - Fish Communities

Ashtabula River

Fish communities in the Ashtabula River, including the East and West Branches, achieved expectations for WWH as measured by the IBI at all locations, and at all locations except RM 19.1 as measured by the MIwb (Table 10, Figure 22). MIwb scores for the Ashtabula River were generally low, with nonsignificant departure at three locations and the previously noted significant departure. The marginal performance of the MIwb does not necessarily indicate poor water quality originating from anthropogenic stresses; it stems largely from stresses to the fish community imposed by intermittent flow experienced in most years (U.S.G.S. reference). Intermittent flows crowd fishes into pools, exposing them to predators and increasing competition for space and food. Through stagnation, intermittency can also result in wide diurnal fluctuations in dissolved oxygen. Combined, those stessors lower the carrying capacity of the steam. The MIwb is particularly sensitive to low numbers or biomass, hence the marginal scores. The good to very good IBI scores obtained, and the presence of pollution intolerant species at all locations further suggests that water quality is not significantly impaired by anthropogenic sources. However, anthropogenic stresses, namely septic discharge and livestock operations likely exacerbated effects of intermittency. High fecal coliform counts (>1000/100 ml) were detected at several locations sampled following a rain event, and over grazing and open cattle access to the stream was observed sporadically in the upper watershed. Dissolved oxygen levels below the 24 hr minimum average criteria of 5.0 mg/l were measured at two locations in the middle reach, possibly reflecting the loadings of organic wastes. The frequent intermittency, though not influencing the IBI as severely as the MIwb, also suppressed IBI scores and likely prevents the establishment of an exceptional fauna. This is born out by the lack of correlation between QHEI scores and the IBI ($t = 1.03$, $P = 0.3503$), especially in light of the excellent habitat. The MIwb was significantly influenced by habitat quality ($t = 2.94$, $P = 0.0321$) owing to its effect, especially that of deep pool habitat under low flows, on biomass.

A discernable decline in both the MIwb and IBI was noticed at RM 3.5. The IBI score was strongly influenced by the presence of bluntnose minnows in the second sampling pass (9/8/95), when they constituted 40% of the total catch by number. This may reflect urban impacts (*i.e.*, stormwater run-off, or unsewered inputs) on water quality.

The benefits of conservative farming practices paired with intact riparian vegetation were manifest, especially in the middle reaches, by the high relative abundance of mimic shiner and bigeye chub, species requiring clear, silt free habitats to thrive. Rosyface shiners, also intolerant of pollution and turbidity, were abundant at RM 3.5 (though only in the first pass). Bigeye chub is a species that has been extirpated throughout much of its former range in Ohio.

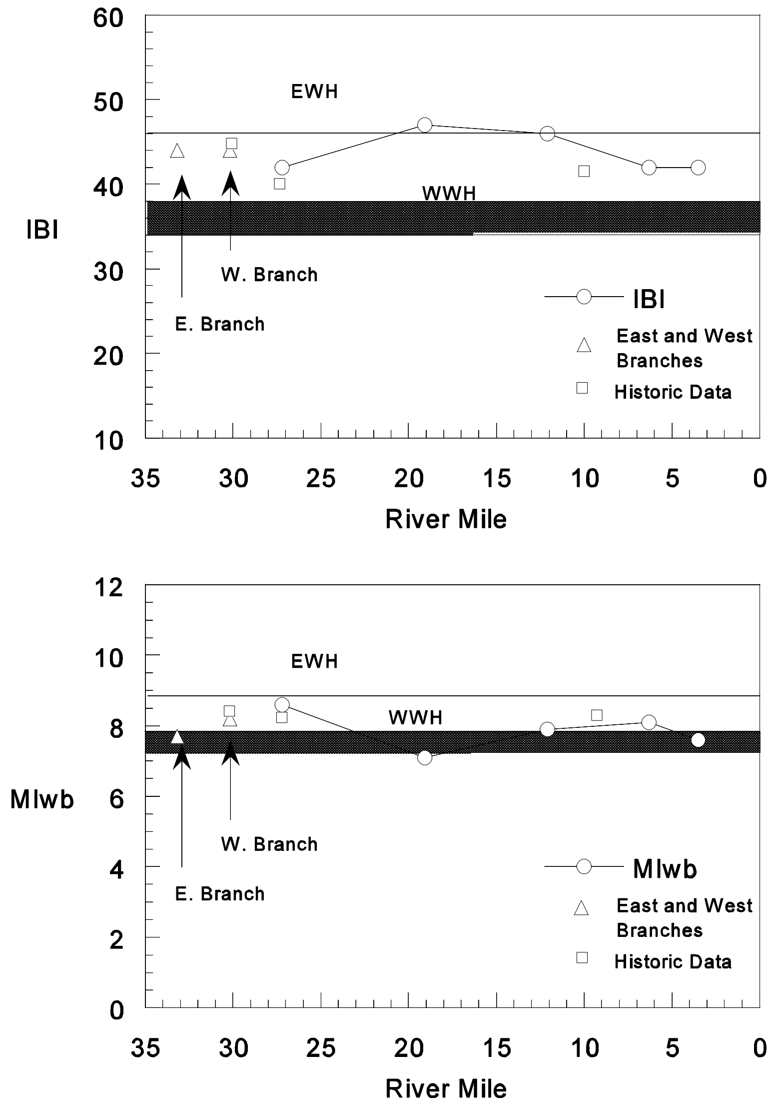


Figure 22. Biological performance of fish communities in the Ashtabula River, and East and West Branches, as measured by the IBI (top) and MIwb (bottom). Limited historical information is also presented - see Table xx for corresponding years. The shaded box shows the area of insignificant departure for EWH criteria. The solid horizontal line depicts the lower bounds of WWH.

Cowles Creek

Fish communities in Cowles Creek were generally degraded, and only marginally met WWH criterion at three locations (Table 10). A noticeable drop in IBI scores occurred downstream of the Geneva WWTP relative to upstream scores (Figure 23), corresponding to a decline in the number of darter species and an increase in the percentage of tolerant and pioneering fishes. Organic enrichment from the effluent was evident in its effect on the composition of the fauna. The relative number of fish, especially creek chubs and stonerollers, increased by nearly two orders of magnitude (Figure 24). The loss of darter species suggests a toxic impact associated with the effluent as opposed to organic enrichment alone, however, effluent toxicity tests revealed no acute toxicity and NH_3-N concentrations in the effluent have decreased to less than 1.0 mg/l. This suggests that impacts to the fish community may be linked to a combination of periodic upsets in the plant due to inflow and infiltration problems and stormwater runoff from the city of Geneva (see ***Pollutant Loadings*** section). Partial recovery of the fish community to that found upstream of the plant was observed at RM 1.1.

The sample collected in the estuarine portion at RM 0.3 did not meet the WWH criterion for headwaters. Interpretation of community indices in estuarine portions of streams is confounded by the slow current, and changes in habitat and species composition. Expectations of community performance have not been developed for estuarine portions of wadable streams, but have been established for boatable estuarine streams, and are lower than those for free flowing streams. Consequently, it can be reasonably expected that those for wadable estuarine stream should also be lower. However, the organic enrichment from the WWTP effluent appears to have exacerbated the effect of slow current on dissolved oxygen concentrations and impacted the fish community at RM 0.3, given that 9 of 12 species of fish sampled were either tolerant or moderately tolerant and composed 69.8% of the catch.

The fish community sampled at RM 7.2 did not achieve the headwater WWH criterion. Flows at this site were interstitial and the lack of sustained flow may have been responsible for the impaired fish community. The headwaters of Cowles Creek originate in the end moraines and old beach reaches left from the retreating glaciers and glacial lakes. These water bearing deposits are of consistent but low yield, and are susceptible to perturbations in the overlaying strata. Development or stream dewatering for irrigation may have contributed to the observed low flows.

Arcola Creek

The fish communities in Arcola Creek at the five locations sampled did not meet WWH criterion, due mainly to habitat limitations and partially to nutrient enrichment. The creek had recently been channelized at the three upper locations (RM 7.4, 7.2 and 5.0), and had severely degraded physical habitats ($\bar{x}$ QHEI = 40.3). Consequently, the fish fauna was composed primarily of tolerant and pioneering species, especially at the two upstream sites. Water appropriations by local nurseries for irrigation captured most of the stream flow on the first sampling pass, and all of the flow on the second pass, rendering extremely low or intermittent flows from RM 5.0 to the mouth, and severely limiting the amount of habitat available to aquatic life. Accordingly, fish communities at the downstream locations, while not limited by in-stream physical habitat, were heavily impacted by low flows.

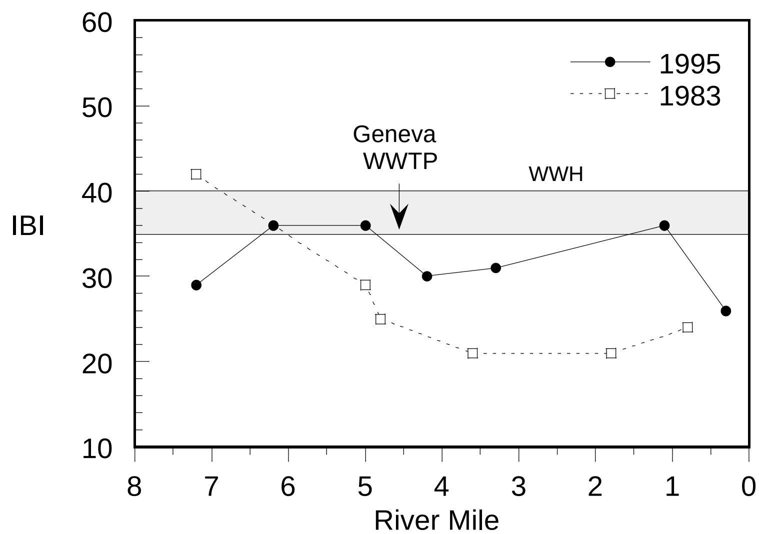


Figure 23. Longitudinal performance of the Index of Biotic Integrity (IBI) in relation to the Geneva WWTP for Cowles Creek, 1995 and 1981.

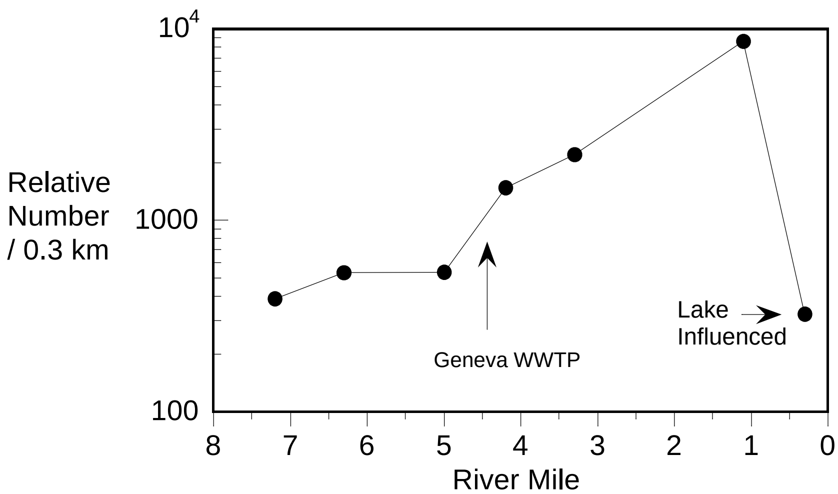


Figure 24. Relative number of fish by river mile in Cowles Creek in relation to the Geneva WWTP

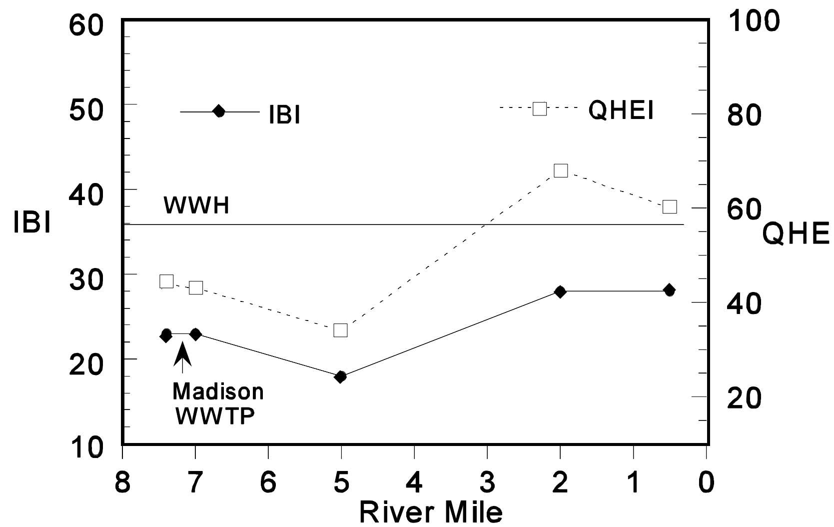


Figure 25. Longitudinal trends in the Index of Biotic Integrity (IBI) in relation to the Madison WWTP, and available habitat as measured by the Qualitative Habitat Evaluation Index (QHEI) for Arcola Creek. The solid horizontal line represents the lower bounds of nonsignificant departure from WWH criterion.

The Madison WWTP did not appear to significantly impact the fish communities in Arcola Creek given the habitat limitations, but likely aggravated effects of the habitat alterations through nutrient enrichment. Although a significant drop in community performance was noted in the far field sampling zone (RM 5.0) relative to the upstream sites, the QHEI score at RM 5.0 also declined relative to the upstream sites (Figure 25). Furthermore, the mean IBI score obtained immediately downstream of the plant was identical to that obtained upstream, and no avoidance was noted in the near-field sample.

Conneaut Creek

Exceptional fish communities were found at both locations sampled on Conneaut Creek. Bigeye chub constituted nearly 10% of the total catch by number at both locations, and black redhorse, river chub, mimic shiner and rosyface shiner were also abundant. These species have declining populations or a shrinking range across the state.

Although the MIwb scores were similar at both locations, the mean IBI score at RM 12.1 was significantly less than the score at RM 23.1 due mainly to the presence of large numbers of stonerollers at RM 12.1. Unbroken shale bedrock, conducive to the growth of diatoms and periphyton, was more prevalent at the downstream location, and thus supported high populations of stonerollers. Also, the watershed surrounding the downstream location was more developed, and likely received a higher load of anthropogenically derived nutrients. Because the IBI at the downstream site was marginally meeting exceptional warmwater habitat (EWH) criteria, no further nutrient loads should be added to the creek, and the excellent riparian buffers present should be maintained.

Table 10. Fish community indices from samples collected in the Ashtabula study area, 1995, 1989, 1984, 1983 and 1981.

River Mile	Mean Number Species	Cumulative Species	Mean Rel. No (No./0.3 km)	Mean Rel. Wt. (wt./0.3 km)	QHEI	Mean Miwb[a]	Mean IBI	Narrative Evaluation
Ashtabula River (1995)								
27.2	20.0	22	1037.3	8.1	85	8.6	42	Good
19.1	14.0	17	375.8	5.1	76	7.1*	47	Fair/V.Good
12.1	16.0	20	606.8	7.8	78	7.9	46	Good/V.Good
6.3	20.0	26	417.8	4.2	73	8.1	42	Good
3.5	18.5	22	754.6	2.1	64	7.6[ns]	36[ns]	M.Good
Ashtabula River (1989)								
9.9	23.0		877.0		47	8.2	42	Good
Ashtabula River (1983)								
27.2	20.5		1127.0		73	8.0	40	Good
West Branch Ashtabula River (1995)								
2.7	18.0	18	590.0	2.7	66	7.7[ns]	44	M.Good/Good
West Branch Ashtabula River (1983)								
1.9	21.0		317.0		74	8.2	45	Good
East Branch Ashtabula River (1995)								
1.5	18.0	18	1202.0	2.4	73	8.2	44	Good
Conneaut Creek (1995)								
23.1	24.0	26	1004.3	14.0	88	9.3[ns]	55	V.Good/Except
12.1	24.5	27	1805.3	14.4	86	9.5	48[ns]	Except/V.Good
Conneaut Creek (1989)								
6.7	19.0		525.0		56	8.5*	47[ns]	Good/V.Good

Table 10. Continued.

River Mile	Mean Number Species	Cumulative Species	Mean Rel. No (No./0.3 km)	Mean Rel. Wt. (wt./0.3 km)	QHEI	Mean Miwb[a]	Mean IBI	Narrative Evaluation
Cowles Creek (1995)								
7.2	9.0	10	388.0	4.7	63	NA	29*	Fair
6.2	9.5	10	532.0	2.7	63	NA	36ns	M.Good
5.0	11.0	12	537.0	2.1	58	NA	36ns	M.Good
4.2	10.0	11	1484.6	6.5	63	NA	30*	Fair
3.3	9.0	10	2207.3	5.0	60	NA	31*	Fair
1.1	10.5	13	8608.0	14.7	56	NA	36ns	M.Good
0.3	11.0	12	322.5	9.1	56	NA	<u>26</u>*	Poor
Cowles Creek (1981)								
7.2	12.0		233.0		60	NA	42	Good
4.8	11.0		375.0		66	NA	29*	Fair
3.6	6.5		474.0		79	NA	<u>25</u>*	Poor
1.8	5.5		235.0		73	NA	<u>21</u>*	Poor
0.8	11.0		202.0		66	NA	<u>24</u>*	Poor
Arcola Creek (1995)								
7.4	9.5	11	1791.0	9.9	44	NA	<u>23</u>*	Poor
7.0	8.0	11	2443.0	17.4	43	NA	<u>23</u>*	Poor
5.0	5.5	8	166.0	0.5	34	NA	<u>18</u>*	Poor
2.0	8.0	9	1758.5	3.2	68	NA	28*	Fair
0.5	12.0	15	2193.0	3.3	60	NA	28*	Fair

Ecoregion Biocriteria: Erie-Ontario Lake Plain

Site Type	IBI WWH	IBI EWH	IBI MWH[c]	MIwb WWH	MIwb EWH	MIwb MWH[c]
Headwaters	40	50	24			
Wading	38	50	24	7.9	9.4	5.6
Boat	40	48	24	8.7	9.6	5.7

a - MIwb is not applicable to headwater streams with drainage areas ≤ 20 mi².
ns - Nonsignificant departure from biocriteria (≤4 IBI units or ≤0.5 MIwb units).
* - Indicates significant departure from applicable biocriteria (>4 IBI units or >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.

Chemical Water Quality Changes

Cowles Creek 1975-1995

Comparison of D.O. profiles from Cowles Creek taken over the last twenty years demonstrates the water quality improvements attained through the provision of adequate wastewater treatment (Figure 26). Although the stream was sampled only once during 1975, depletions of D.O.

downstream of the Geneva WWTP and especially downstream of the Geneva-on-the-Lake WWTP, which at that time discharged at approximately RM 0.4, were evident. Another round of sampling in 1979 found that depletions below the Geneva WWTP (at RM 3.2) were still evident, with the D.O. concentration at RM 3.2 of 4.9 mg/l. The in-stream D.O. concentration recovered by RM 0.9 in 1975 (8.7 mg/l). Sampling was not conducted near the mouth (RM 0.3) in 1979 or 1981 because the outfall for the Geneva-on-the-Lake WWTP had been moved to Lake Erie. Dissolved oxygen concentrations in Cowles Creek were much improved in 1981, when they ranged from 6.5 to 12.8 mg/l downstream of the Geneva WWTP. Concentrations measured in 1995 followed a similar longitudinal pattern to that observed in 1981; however, 1981 values were uniformly higher, possibly due to higher flows.

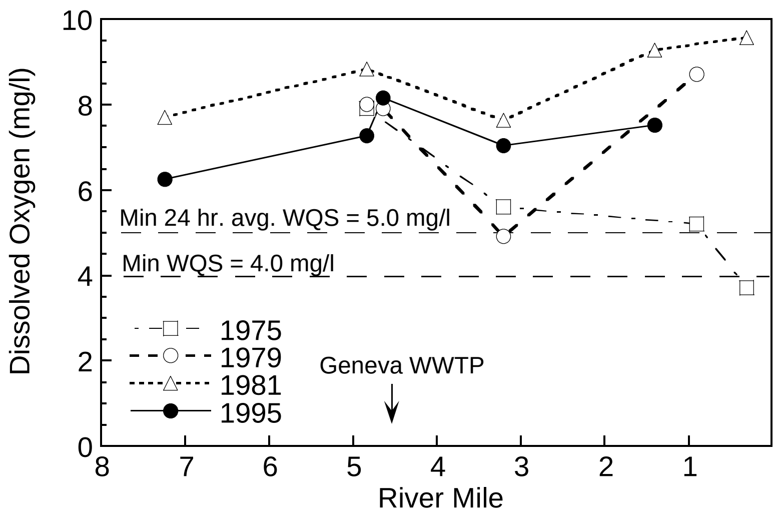
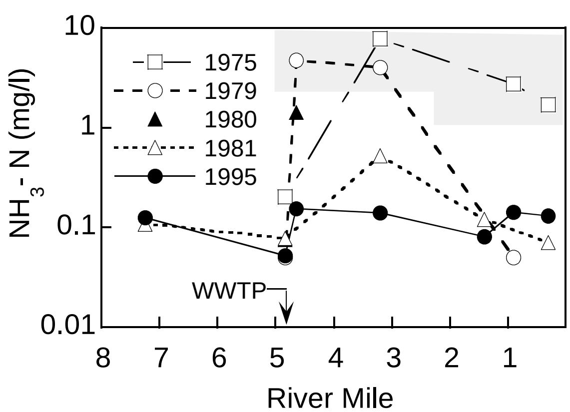


Figure 26. Trends in mean dissolved oxygen concentrations measured in water quality grab samples collected from Cowles Creek, 1975 - 1995.

Water quality degradation in Cowles Creek during the 1970's can be largely attributed to the discharge of NH_3-N from the Geneva WWTP. Sampling conducted once in 1975 and 1979 found Concentrations of NH_3-N downstream of the WWTP ranged as high as 7.73 mg/l in 1975 and 4.02 mg/l in 1979 (Figure 27). Average concentrations of NH_3-N downstream of the WWTP decreased to 0.37 to 0.8 mg/l during the survey of Cowles Creek conducted in 1981 (3 sampling visits per site). The observed decrease can be attributed to better operation and maintenance at the Geneva WWTP. Effluent NH_3-N concentrations decreased from 22.4 mg/l (50th percentile data averaged over annual periods) during the period of 1976-1979 to 10.1 mg/l during the years 1980 to 1988.

The concentrations of NH_3-N in Cowles Creek downstream of the Geneva WWTP have been reduced by 73 percent in 1995 as compared to 1981 (reduction in average concentration from 0.52 mg/l to 0.14 mg/l at RM 3.2) through the addition the nitrification towers in 1988 and 1994. Water quality problems due to the presence of NH_3-N in Cowles Creek appear to have been eliminated through this facility upgrade. However, from a nutrient loadings standpoint, NH_3-N has been supplanted by Nitrate-Nitrite nitrogen (NO_X). Concentrations of NO_X in Cowles Creek have increased by an average of 342 percent at the stations downstream of the Geneva WWTP between 1981 and 1995 (Figure 27). The increase in NO_X concentrations reflects increased loadings from the service area coupled with the addition of nitrification. From a biological standpoint, the stream can be assumed to be saturated with respect to nutrient availability for NO_X since little assimilation of these nutrients (as would be evidenced by decreasing concentrations farther downstream from the source) is observable based on the 1995 data. Concentrations of TKN at stations downstream of the Geneva WWTP have remained relatively constant between 1981 (average = 1.14 mg/l) and 1995 (average = 1.33 mg/l). Conditions have improved markedly since the 1970's when concentrations as high as 9.2 mg/l (RM 3.2 in 1975) were observed.

The installation of phosphorus removal treatment processes at the Geneva WWTP in the late 1970's has significantly reduced concentrations of phosphorus in Cowles Creek. Concentrations of total phosphorus as high as 3.8 mg/l were observed downstream of the WWTP (RM 3.2) in 1975. Downstream phosphorus concentrations averaged 0.15 mg/l in 1979, 0.19 mg/l in 1981



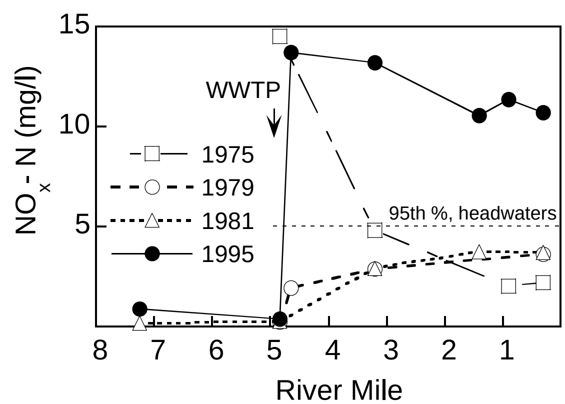


Figure 27. Trends in concentrations of ammonia-nitrogen (left) and nitrate-nitrite nitrogen (right) in Cowles Creek in relation to the Geneva WWTP, 1975 - 1995. Values inside the shaded region in the plot of ammonia-nitrogen represent WQS violations.

and 0.33 in 1995. The increasing trend reflects increasing influent volume. Continued effort to maintain phosphorus concentrations at low levels (i.e. < 0.5 mg/l) is critical as the stream is over-enriched with nitrogen nutrients, and any increase in phosphorus concentrations would be expected to cause water quality degradation through increased biological productivity.

Arcola Creek
The Ohio EPA has not conducted any water quality surveys of Arcola Creek prior to the 1995 intensive survey.

Changes in Biological Community Performance: Macroinvertebrate Communities

Ashtabula River
Artificial substrate samples were collected from the West Branch of the Ashtabula River in 1984 and from two sites in the mainstem in 1983 and 1989. Narrative evaluations at the sites range from marginally good to very good. Like the 1995 collections, all the artificial substrates were collected from slow or no detectable current velocities. Variation in the communities between sampling years appeared primarily related to the severity of flow conditions during each late summer sampling period.

Cowles Creek
Cowles Creek was previously surveyed in 1981 using qualitative techniques. Impact trends were similar to those observed in 1995 with the highest quality communities found upstream from Geneva, and degraded communities downstream from Geneva to Lake Erie. Evaluations in the vicinity of the Geneva WWTP were confounded by the relative lack of organisms immediately upstream and several miles downstream from the discharge. A high water event a few days prior to sampling coupled with marginal substrate conditions (sand and soft shale) were considered the primary reason for the poor collections upstream from the discharge in 1981.

Conneaut Creek
Previous sampling in Conneaut Creek in 1989 and 1979 reflected exceptional quality macroinvertebrate communities over the past 16 years. Conneaut Creek has consistently been among the highest quality streams in the state of Ohio with regards to macroinvertebrate community performance.

Changes in Biological Performance: Fish Communities

Ashtabula River
Limited historical information exists for the Ashtabula River basin. The community scores in this survey compared favorably with scores obtained previously in similar locations or reaches (Table 10), suggesting water and habitat quality has not diminished in the intervening period.

Cowles Creek

Cowles Creek was previously surveyed in 1981. Results of that survey revealed significant impairment downstream from the city of Geneva, especially downstream from the WWTP (Figure 23). Upgrades to the plant implemented over the last decade have resulted in improvements to the fish community with the fish recovering to nonsignificant departure downstream of the plant. Area of Degradation (ADV) scores illustrate the difference. The ADV/mile in 1981 was 81.5, but in 1995 it was 29.4, a 36% reduction (Table 11). An exception to the trend toward improvement was at RM 7.2 where the IBI dropped to 29 in 1995 from 42 in to 1981. No causes for the decline were apparent other than possibly stream dewatering for irrigation.

Table 11. Area of Degradation (ADV) statistics for similar segments of Cowles Creek sampled in 1995 and 1981.

	Biological Index Scores					Area of Degradation Values			Attainment Status (Miles)			
Year Index	Upper RM	Lower RM	Mini- mum	Maxi- mum	Mean	ADV	ADV/ Mile	Neg. % of Criteria	Full	Partial	NON	POOR/VP
Cowles Creek												
1995												
IBI			26	32	36	203	29.4	14.8				
MIwb	7.2	0.3	--	--	--	--	--	--	1.4	0.1	5.4	0.0
ICI			--	--	--	--	--	--				
1981												
IBI			21	42	28	522	81.5	41.1				
MIwb	7.2	0.8	--	--	--	--	--	--	1.3	0.0	5.1	2.8
ICI			--	--	--	--	--	--				

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Appendices to:

Biological and Water Quality Study of the Grand and Ashtabula River Basins including Arcola Creek, Cowles Creek and Conneaut Creek

Ashtabula, Geauga, Lake and Trumbull Counties

Volume II

January 7, 1997

P.O. Box 1094, 1800 WaterMark Drive, Columbus, Ohio 43216-1049

Table A-1. NPDES permitted dischargers to the Grand River and select tributaries.

Entity	Stream	County	Permit No.	Design Flow MGD	Type[1] (industrial)
Sanitary Discharges					
Auburn Voc. School Dist	Ellison Creek	Lake	3PT00058	0.012	
Painesville WWTP	Grand River	Lake	3PD00029	6.0	
Lake Co. Heatherstone	Grand River	Lake	3PH00054	0.400	
Lake Co. Far Hills	Grand River	Lake	(Abandoned 1994)	0.040	
River Pine Resorts, Inc.	Grand River	Geauga	3PR00135	0.025	
Rustic Pine MHP	Mill Creek	Geauga	3PV00076	0.030	
Orwell Village	Trib to Grand River	Ashtabula	3PB00041	0.0260	
Nelson Ledges Estates MHP		Trib to Grand River		Portage	
	3PV00009	0.03			
Lake Co. Rio Grande	Big Creek	Lake	3PG00130	0.0215	
Lake Co. Sunshine Acres	East Creek Trib	Lake	3PG00063	0.020	
Lake Co. Park Estates	Red Creek	Lake	(Abandoned 1994)	0.055	
Lake Co.Kellogg	Kellogg Creek	Lake	3PG00129	0.037	
Chardon Village	Big Creek	Geauga	3PB00010	1.10	
Terrace Glen Estates	Cutts Creek to Big Creek	Geauga	3PR00156	0.020	
Geauga Wintergreen Hills	Trib to Big Creek	Geauga	3PG00055	0.015	
Leroy Schools	East Creek	Lake	3PT00055	0.008	
Grennan Mobile Village	Jenks Creek to Big Creek	Geauga	3PV00077	0.025	
Thunderhill Golf Course	Trib to Griswold Creek	Lake	3PR00143	0.0125	
Ashtabula JVS	Mill Creek	Ashtabula	3PT00029	0.04	
Jefferson Village	Cemetery Crk to Mill Crk	Ashtabula	3PC00021	1.0	
Rock Creek Village	Rock Creek	Ashtabula	3PA00029	0.070	
Roaming Shores Village	Rock Creek	Ashtabula	3PB00068	0.120	
Middlefield MHP	Trib to Swine Creek	Geauga	3PV00053	0.020	
Southington Pk Estates	Trib to Dead Branch	Trumbull	3PV00066	0.030	
Industrial Discharges					
Avery Dennison Bldg 7	SS. to Grand R	Lake	3IN00196		NC
Avery Dennison Bldg 5	SS. to Grand R	Lake	3IN00195		NC
Avery Dennison Bldg 3	SS. to Grand R	Lake	3IN00194		NC
Avery International (Fasson)	Grand R	Lake	3IN00125		
Structural Fibers, Inc.	Trib to Big Creek	Geauga	3IE00058	0.031	P
Chardon Rubber Co.	Trib to Big Creek	Geauga	3II00003		ST
Waste Mgmt. Ohio W. Resrv	Cutts Creek	Geauga	3IN00177		ST
Ricerca Inc.	Trib to Ellison Creek	Lake	3IE00004		NC, ST
Aluminum Smelting	Trib to Griggs Creek		3IN00194		
Worthington Cylinder	Trib to Cemetery Creek		Ashtabula	3II00037	
Village of Roaming Shores	Rock Creek	Ashtabula	3IV00100		
PET Processors, Inc.	Silver Creek		3IF00009		
Mercury Plastics	Trib to Swine Creek	Geauga	3IQ00027	0.09	S,P, NC,
ST					
Polymer/Raymond	Trib to Swine Creek	Geauga	3IR00046		S
Venture Plastics	Trib		3IQ00033		
Vari-seal	Grand River	Geauga	3IR00051		NC

Table A-1. Continued.

Entity	Stream	County	Permit No.	Design Flow MGD	Type[1] (industrial)
Fairport Harbor Water Plt	Grand River	Lake	3IV00230		P
Louza, Inc.	Trib to Grand R	Lake	3IJ00007		NC
LTV Steel Lime Plant	Grand River	Lake	3IJ00021		NC, ST
Lyden Oil	Grand River	Ashtabula	3IN00107		
Morton Salt	Grand River	Lake	3IE00030		P, CS
Painesville City Muni Elec	SS to Grand R	Lake	3IB00015		P
Obron Atlantic Corp.	Grand River	Lake	3II00194		ST
Chem Land Holdings Site 2	Grand River	Lake	3II00070		ST
Lonza, Inc.	Grand River	Lake	3II00169		ST
Euclid Chemical	Grand River	Lake	3II00040		ST
Uniroyal	Grand River	Lake	3II00080		ST
Zeneca	Red Creek	Lake	3IF00001		S,P

1 C = COOLING WATER NC = NON-CONTACT COOLING WATER B = BOILER BLOWDOWN
P = PROCESS WASTEWATER CS = CONTAMINATED STORM WATER S =SANITARY
ST = STORM WATER

Table A-2. Water quality parameters by sampling location and collection date for sites sampled in the Grand River basin, 1995.

LOCATION	RIVER MILE	DATE	TEMP C	pH S.U.	D.O. mg/l	COND µmho/cm	COD mg/l	NOx mg/l	NH3 mg/l	TKN mg/l	PHOS mg/l	TDS mg/l	TSS mg/l	F.C. BACT Col/100 ml
Grand River	95.4	July 12, 1995	18	7.97	8.4	418	12	0.15	0.05K	0.3	0.05K	280	5K	
UST U.S. 422	95.4	July 19, 1995	20											
	95.4	July 25, 1995	24	8.4	8.6	455	13	0.1K	0.06	0.3	0.05K	278	5K	110
	95.4	August 09, 1995	19.9	8.2	7.7	326	19	0.2	0.05K	0.2	0.05K	302	5	
	95.4	August 23, 1995	18	8.1	7.6	390	12	0.1K	0.05K	0.3	0.05K	310	5K	
	95.4	September 06, 1995	16.6	7.95	9.3	382	10K	0.24	0.05K	0.3	0.05K	334	5K	
Grand River	83.5	July 12, 1995	20	7.9	7.8	398	21	0.1K	0.05K	0.2	0.05K	278	11	
near Hyde Rd	83.5	July 19, 1995	100											
(Wildlife area)	83.5	July 25, 1995	24.1	7.8	6.4	470	13	0.1K	0.08	0.3	0.05K	288	14	200
	83.5	August 09, 1995	20.9	7.9	5.3	462	16	0.1K	0.05K	0.2	0.06	294	37	
	83.5	August 23, 1995	20.5	7.8	4.8	432	20	0.1K	0.05K	0.2	0.05K	295	44	
	83.5	September 06, 1995	18	7.6	8.2	393	306	27						
Baughman Crk	80.76/3.3	July 12, 1995	20	7.86	10.4	530	12	0.93	0.05K	0.2	0.05K	402	5K	
Messic Rd	80.76/3.3	July 25, 1995	22	7.7	7.2	550	10K	0.85	0.11	0.4	0.05K	390	5K	
	80.76/3.3	July 26, 1995	1000											
	80.76/3.3	August 09, 1995	18.3	7.7	6.5	545	10K	0.96	0.05K	0.2K	0.05K	409	5K	
	80.76/3.3	August 23, 1995	16.8	7.7	5.4	520	10K	0.92	0.05K	0.2K	0.05K	400	5	200
	80.76/3.3	September 06, 1995	16	7.65	7.65	465	10K	0.91	0.05K	0.2K	0.05K	378	5K	
Swine Creek	75.17/5.2	July 12, 1995	18.5	7.96	7.9	500	10K	0.1K	0.05K	0.2K	0.05K	374	5K	
S.R. 534	75.17/5.2	July 25, 1995	23.5	7.9	7.7	550	10K	0.1K	0.05K	0.2K	0.05K	368	5K	
	75.17/5.2	July 26, 1995	11000											
	75.17/5.2	August 09, 1995	19.9	8	7.1	515	22	0.1K	0.05K	0.2K	0.05K	382	5K	
	75.17/5.2	August 23, 1995	19.2	7.8	6.6	555	10K	0.1K	0.05K	0.2K	0.05K	406	5	1100
	75.17/5.2	September 06, 1995	18	7.7	8.1	498	13	0.1K	0.05K	0.2K	0.05K	376	5	
Phelps Creek	72.02/5.3	July 12, 1995	19	8.14	8.5	326	12	0.12	0.05K	0.4	0.05K	216	5K	
Wiswell Rd	72.02/5.3	July 25, 1995	23	7.9	7.2	380	19	0.1K	0.05K	0.4	0.05K	256	5K	
	72.02/5.3	July 26, 1995	120											
	72.02/5.3	August 09, 1995	19.9	8	7	389	16	0.1K	0.05K	0.3	0.05K	252	5K	
	72.02/5.3	August 23, 1995	17.8	7.7	4.4	370	12	0.3	0.05K	0.4	0.05K	256	6	27
	72.02/5.3	September 06, 1995	17.1	7.7	8.4	380	13	0.23	0.05K	0.2	0.05K	272	5K	
Grand River	65.9	July 12, 1995	20.5	7.82	6.6	408	24	0.2	0.05K	0.2	0.1	296	37	

Table A-2. Continued.

LOCATION	RIVER MILE	DATE	TEMP C	pH S.U.	D.O. mg/l	COND µmho/cm	COD mg/l	NOx mg/l	NH3 mg/l	TKN mg/l	PHOS mg/l	TDS mg/l	TSS mg/l	F.C. BACT Col/100 ml
UST U.S. 322	65.9	July 19, 1995	90											
	65.9	July 25, 1995	23.3	7.7	4.6	475	16	0.1K	0.08	0.4	0.08	302	32	
	65.9	August 09, 1995	21.5	7.8	4.7	462	19	0.11	0.05	0.3	0.08	298	37	
	65.9	August 23, 1995	20.8	7.7	5.1	449	20	0.1K	5K	0.3	0.05K	300	34	
	65.9	September 06, 1995	18.9	7.8	7	418	13	0.1K	0.05K	0.3	0.05	314	26	
Rock Creek	50.59/0.8	July 12, 1995	26.7	8.77	11.4	273	24	0.72	0.09	0.7	0.18	178	5K	
Union Cemetery	50.59/0.8	July 25, 1995	23.6	8	8.3	320	32	1.87	0.11	1	0.48	214	5	
	50.59/0.8	July 26, 1995	220											
	50.59/0.8	August 09, 1995	22.3	8.6	9.6	256	19	0.43	0.05K	0.5	0.08	172	5K	
	50.59/0.8	August 23, 1995	19.5	8.5	6.9	280	23	0.96	0.05K	0.6	0.24	206	5K	200
	50.59/0.8	September 06, 1995	20.5	8.1	9.9	465	33	7.56	0.05	1.1	1.12	348	5K	
Grand River	42.4	July 12, 1995												
Schweitzer Rd	42.4	July 12, 1995	22.5	7.8	6.7	350	89	0.13	0.05K	0.4	0.05K	186	26	
	42.4	July 19, 1995	70											
	42.4	July 25, 1995	24	7.6	4.3	462	22	0.1K	0.1	0.4	0.05K	274	34	140
	42.4	August 09, 1995	23	7.6	4	275	22	0.15	0.09	0.4	0.21	198	13	
	42.4	August 23, 1995	23.9	7.2	5.9	438	21	0.1K	0.05K	0.3	0.05K	268	18	
	42.4	September 06, 1995	19.7	7.6	4.7	410	20	0.1K	0.05K	0.2K	0.05K	268	16	
Mill Creek	41.28/18.2	July 12, 1995	25.5	7.63	7.15	385	35	0.93	0.19	1	0.05K	244	5K	
Netcher Rd	41.28/18.2	July 25, 1995	22	7.5	6.1	255	32	1.07	0.09	0.8	0.08	182	34	
	41.28/18.2	July 26, 1995	25000											
	41.28/18.2 K	August 23, 1995	23.8	7.8	7.2	288	32	0.1K	0.05K	0.9	0.06	208	14	100
	41.28/18.2	September 06, 1995	22.9	7.5	7.1	277	30	0.1K	0.05K	0.8	0.05K	194	6	
Mill Creek	41.28/12.1	July 12, 1995	27.1	8.35	10	1008	21	0.12	0.05K	0.8	0.05K	242	5K	
S.R. 46	41.28/12.1	July 25, 1995	23.9	7.6	6.3	380	29	0.24	0.13	0.9	0.06	248	20	
	41.28/12.1	July 26, 1995	2400											
	41.28/12.1	August 09, 1995	21.5	7.9	7.3	276	37	1.08	0.05K	0.9	0.06	220	5K	
	41.28/12.1	August 23, 1995												
	41.28/12.1	August 23, 1995	22.3	7.8	5	302	32	0.1K	0.05K	1	0.06	198	14	33
	41.28/12.1	September 06, 1995	23	7.35	6.5	315	36	0.1K	0.05K	0.8	0.05K	204	14	

Table A-2. Continued.

LOCATION	RIVER MILE	DATE	TEMP C	pH S.U.	D.O. mg/l	COND µmho/cm	COD mg/l	NOx mg/l	NH3 mg/l	TKN mg/l	PHOS mg/l	TDS mg/l	TSS mg/l	F.C. BACT Col/100 ml
Cemetery Creek	41.28/8.42/2.5	July 12, 1995	23	7.6	3.45	826	24	0.12	0.28	0.8	0.12	548	8	
Market St														
Cemetery Crk	41.28/8.42/2.1	July 12, 1995	23.2	8.53	8.6	1173	18	1.47	0.2	1	0.2	686	18	
UST WWTP	41.28/8.42/2.1	July 25, 1995	21.9	7.6	7.2	350	32	1.18	0.05K	0.7	0.1	256	42	
	41.28/8.42/2.1	August 09, 1995	80.4	8	8.2	874	19	0.5	0.05K	0.4	0.05K	552	5K	
	41.28/8.42/2.1	August 23, 1995	19.8	7.7	4	750	26	0.1K	0.05K	0.6	0.05K	484	20	
Cemetery Crk	41.28/8.42/1.25	July 12, 1995	24	7.66	7.6	877	15	12	0.07	1.1	2.01	528	5K	
DST Poplar St	41.28/8.42/1.25	July 25, 1995	22	7.7	6.9	425	38	2.5	0.33	1.2	0.54	288	44	
	41.28/8.42/1.25	July 26, 1995	840											
	41.28/8.42/1.25	August 09, 1995	20.5	7.6	6.4	824	25	14.7	0.25	1.1	2.99	542	5K	
	41.28/8.42/1.25	August 23, 1995	20.7	7.9	8.7	780	20	11	0.2	1.1	0.72	522	5K	240
	41.28/8.42/1.25	September 06, 1995	21.5	7.4	8.6	760	10	13	0.56	1.3	0.47	408	5K	
Grand River	36.3	July 12, 1995	25	8.7	11.6	350	24	0.1K	0.05K	0.5	0.05K	200	14	
Tote Rd	36.3	July 19, 1995	30											
	36.3	July 25, 1995	24.5	7.9	7.6	432	22	0.1K	0.05K	0.5	0.05K	238	5K	20
	36.3	August 09, 1995	23.9	7.9	7.6	285	40	0.6	0.05K	0.9	0.06	196	14	
	36.3	August 23, 1995	27.7	7.6	7.6	418	18	0.1K	0.05K	0.4	0.05K	252	9	
	36.3	September 06, 1995	21.1	7.9	4.4	380	23	0.1K	0.05K	0.3	0.05K	246	18	
Grand River	34	July 12, 1995	25	8.5	10.5	350	21	0.1K	0.05K	0.6	198	15		
Sexton Rd	34	July 19, 1995	40											
	34	July 25, 1995	25	7.8	6.3	400	22	0.1K	0.06	0.5	0.05K	250	5K	180
	34	August 09, 1995	23.9	8	7.6	290	31	0.69	0.05K	0.3	0.19	206	12	
	34	August 23, 1995	29.1	7.4	8.1	406	23	0.1K	0.05K	0.6	0.05K	238	9	
	34	September 06, 1995	19.5	7.9	5	360	16	0.1K	0.05K	0.4	0.05K	244	9	
Grand River	28.4	July 12, 1995	25	8.6	9.1	350	24	0.1K	0.05K	0.6	0.08	201	6	
Brandt Rd	28.4	July 19, 1995	50											

Table A-2. Continued.

LOCATION	RIVER MILE	DATE	TEMP C	pH S.U.	D.O. mg/l	COND µmho/cm	COD mg/l	NOx mg/l	NH3 mg/l	TKN mg/l	PHOS mg/l	TDS mg/l	TSS mg/l	F.C. BACT Col/100 ml
	28.4	July 25, 1995	25.4	7.9	7.6	399	22	0.1K	0.05K	0.4	0.14	210	5K	40
	28.4	August 09, 1995	22.5	8.1	7.9	280	28	0.8	0.05K	0.5	0.05K	216	8	
	28.4	August 23, 1995	25.4	8	9.7	355	24	0.1K	0.05K	0.5	0.05K	220	6	
	28.4	September 06, 1995	19.9	8.1	7	340	23	0.1K	0.05K	0.5	0.05K	230	5	
Grand River	22.1	July 12, 1995	24.5	8.4	8.9	350	24	0.1K	0.05K	0.5	0.05K	194	8	
S.R. 528	22.1	July 19, 1995	10											
	22.1	July 25, 1995	26	7.9	7.7	400	24	0.1K	0.05	0.4	0.05K	218	5K	100
	22.1	August 09, 1995	22.9	8.1	7.9	275	22	0.52	0.05K	0.4	0.05K	154	10	
	22.1	August 23, 1995	25.2	7.9	9.3	349	18	0.1K	0.05K	0.4	0.05K	218	14	
	22.1	September 06, 1995	20.4	8.1	6.6	355	16	0.1K	0.05K	0.5	0.05K	236	8	
Paine Creek	14.31/0.5	July 12, 1995	22.8	8.2	8.4	380	10K	0.1K	0.05K	0.2K	0.05K	210	5K	
Seely Rd	14.31/0.5	July 25, 1995	24.4	8.1	7.8	276	10K	0.2	0.05	0.3	0.05K	170	34	
	14.31/0.5	July 26, 1995	200											
	14.31/0.5	August 09, 1995	19.3	8.1	8.2	300	10K	0.1K	0.05K	0.2K	0.05K	222	26	
	14.31/0.5	August 23, 1995	23	8.1	8.5	382	10K	0.1K	0.05K	0.2K	0.05K	242	5K	33
	14.31/0.5	September 06, 1995	18	8.2	7.9	510	16	0.1K	0.05K	0.2	0.05K	326	5K	
Grand River	13.6	July 12, 1995	24	8.1	7.2	350	24	0.1K	0.05K	0.5	0.05K	212	17	
Vrooman Rd	13.6	July 19, 1995	20											
	13.6	July 25, 1995	26	7.9	7.3	359	22	0.12	0.06	0.3	0.05K	206	24	520
	13.6	August 09, 1995	22.1	8	7.3	300	20	0.35	0.05K	0.2	0.05	226	60	
	13.6	August 23, 1995	25.4	7.7	7.9	350	29	0.1K	0.05K	0.5	0.05K	218	10	
	13.6	September 06, 1995	23	8	6.6	395	23	0.1K	0.05K	0.4	0.05K	254	30	
Chardon WWTP	9.32/16.1	July 12, 1995	20	7.5	80	1025	18	15.6	0.05K	0.8	0.1	862	5K	
Effluent	9.32/16.1	July 25, 1995	22	7.5	8.3	1339	10K	10.6	0.06	0.7	0.07	804	5K	
	9.32/16.1	July 26, 1995	10	K										
	9.32/16.1	August 09, 1995	21.8	7.7	7.9	1030	25	13.2	0.15	1	0.05	870	5K	
	9.32/16.1	August 23, 1995	21.5	7.5	7.9	1275	29	11.6	0.05K	1	0.1	782	5K	960
	9.32/16.1	September 06, 1995	22.1	7.7	7.9	1210	20	13.1	0.05K	1	0.16	778	5K	
Big Creek	9.32/15.8	July 12, 1995	19.8	7.7	8	1020	28	14.6	0.05K	1	0.08	914	5K	
DST Chardon	9.32/15.8	July 25, 1995	22.4	7.8	8.6	1286	10K	9.5	0.06	0.6	0.12	796	5K	10K
WWTP	9.32/15.8	July 26, 1995	90											

Table A-2. Continued.

LOCATION	RIVER MILE	DATE	TEMP C	pH S.U.	D.O. mg/l	COND µmho/cm	COD mg/l	NOx mg/l	NH3 mg/l	TKN mg/l	PHOS mg/l	TDS mg/l	TSS mg/l	F.C. BACT Col/100 ml
	9.32/15.8	July 26, 1995	10	K										
	9.32/15.8	August 09, 1995	21	7.8	7.6	1200	25	11.4	0.16	1	0.05	820	5K	
	9.32/15.8	August 23, 1995	26	7.6	8.1	1224	30	11	0.05K	0.9	0.09	754	5K	1000
	9.32/15.8	August 23, 1995	21.5	7.5	7.9	1275	29	11.6	0.05K	1	0.1	782	5K	960
	9.32/15.8	September 06, 1995	22.1	8	8.7	1180	28	11.2	0.05K	1	0.14	726	5K	
	9.32/15.8	September 06, 1995	22.1	7.7	7.9	1210	20	13.1	0.05K	1	0.16	778	5K	
Big Creek	9.32/14.2	July 12, 1995	17.5	7.7	7	900	12	6.72	0.05K	0.6	0.06	704	5K	
Woodin Rd	9.32/14.2	July 25, 1995	23	8.1	8.2	914	10K	4.49	0.06	0.6	0.06	526	5K	
	9.32/14.2	July 26, 1995	610											
	9.32/14.2	August 09, 1995	19.6	8	6.8	850	12	5.11	0.05K	0.7	0.05K	598	5K	
	9.32/14.2	August 23, 1995	18	7.7	7.2	1060	15	6.81	0.05K	0.4	0.05	716	5K	250
	9.32/14.2	September 06, 1995	19.5	8.3	9.5	1100	20	8.83	0.05K	0.6	0.1	678	5K	
Jenks Creek	9.32/11.52/0.4	July 12, 1995	16	8	7.5	320	10K	0.13	0.05K	0.2K	0.05K	234	5K	
Robinson Rd	9.32/11.52/0.4	July 25, 1995	21	8	8	309	10K	0.1K	0.05K	0.2K	0.05K	204	5K	
	9.32/11.52/0.4	July 26, 1995	300											
	9.32/11.52/0.4	August 09, 1995	18.8	8	7.1	350	10K	0.13	0.05K	0.2K	0.05K	262	5K	
	9.32/11.52/0.4	August 23, 1995	17	7.8	7.9	388	10K	0.2	0.05K	0.2K	0.05K	272	5K	11
	9.32/11.52/0.4	September 06, 1995	16.4	8.2	8.1	390	10K	0.16	0.05K	0.2K	0.05K	264	5K	
Big Creek	9.32/16.3	July 12, 1995	18.5	7.3	4.9	800	24	0.1K	1.99	2.6	0.08	697	6	
U.S. 6	9.32/16.3	July 25, 1995	23.4	7.4	3.4	618	16	0.1K	0.74	1.3	0.13	346	5K	
	9.32/16.3	July 26, 1995	67											
	9.32/16.3	August 09, 1995	20.5	7.6	3.8	570	40	0.1K	0.71	1.4	0.13	414	5K	
	9.32/16.3	August 23, 1995	18.8	7.4	6.4	1610	35	0.1	1.14	0.13	1700	18		
	9.32/16.3	September 06, 1995	21.8	7.9	1.2	2550	60	0.1K	1.39	2.2	0.19	1750		8
Big Creek	9.32/4.9	July 25, 1995	26.4	8.7	9.7	462	10K	0.15	0.05K	0.2	0.05K	280	5K	
Williams Rd	9.32/4.9	July 26, 1995	100											
	9.32/4.9	August 09, 1995	19.2	8.3	8.2	500	12	0.1K	0.05K	0.2K	0.05K	347	5K	
	9.32/4.9	August 23, 1995	18	7.7	9.4	612	10K	0.24	0.05K	0.2K	0.05K	406	5K	53
	9.32/4.9	September 06, 1995	21.5	8.6	11	700	10K	0.64	0.05K	0.2K	0.05K	430	6	
Big Creek	9.32/2.5	July 12, 1995	18.8	8.2	8.8	525	10K	0.1K	0.05K	0.2K	0.05K	384	5K	
Fay Road	9.32/2.5	July 26, 1995	400											

Table A-2. Continued.

LOCATION	RIVER MILE	DATE	TEMP C	pH S.U.	D.O. mg/l	COND µmho/cm	COD mg/l	NOx mg/l	NH3 mg/l	TKN mg/l	PHOS mg/l	TDS mg/l	TSS mg/l	F.C. BACT Col/100 ml
	9.32/2.5	August 09, 1995	19.4	8.3	8	500	10K	0.1K	0.05K	0.2K	0.05K	352	5K	400
	9.32/2.5	August 23, 1995	19.5	7.9	9.1	612	10K	0.1K	0.05K	0.2K	0.05K	432	5K	40
	9.32/2.5	September 06, 1995	22.5	8.5	9.5	700	10K	0.18	0.05K	0.2K	0.05K	452	5K	
	9.32/2.5	July 25, 1995	26.5	8.5	9.2	618	13	0.26	0.05K	0.2K	0.05K	332	5K	
Grand River	8.6	July 12, 1995	23.2	8	7.3	370	21	0.16	0.05	0.4	0.05K	230	22	
S.R. 84	8.6	July 19, 1995	90											
	8.6	July 25, 1995	27.5	8.1	8.2	472	10K	0.11	0.06	0.4	0.05K	288	14	410
	8.6	August 09, 1995	22.5	8.2	7.2	310	25	0.21	0.05K	0.3	0.05K	242	20	
	8.6	August 23, 1995	23.4	7.8	7.6	397	18	0.22	0.05K	0.4	0.05K	246	20	
	8.6	September 06, 1995	24	8.2	7.1	490	20	0.68	0.05K	0.3	0.06	297	12	
Grand River	6.1	July 12, 1995	24.5	8.3	8.8	400	24	0.1	0.05K	0.6	0.05K	224	22	
Kiwanis Park	6.1	July 19, 1995	60											
	6.1	July 25, 1995	28.6	8.4	9.6	402	10K	0.1K	0.05	0.4	0.05K	268	5K	60
	6.1	August 09, 1995	22.4	8.2	7.9	350	25	0.12	0.05K	0.2	0.05K	280	28	
	6.1	August 23, 1995	24.5	7.8	8.7	395	18	0.12	0.05K	0.5	0.05K	227	16	
	6.1	September 06, 1995	23	8.2	8.8	500	16	0.22	0.05K	0.4	0.05K	306	10	

Table A-3. Results of water quality grab samples by location and date collected from the Ashtabula River, 1995.

ID	Location	Date	Temp C	pH s.u.	D.O. mg/l	CaCO3 mg/l	COD mg/l	Sp.Cond. umhos	NOx mg/l	NH3 mg/l	TKN mg/l	P665 mg/l	TDS mg/l	TSS mg/l	Fecal Col. #/100ml
Ashtabula River		10-Jul-95	21	8.42	11.5	129	17		0.1K	0.05K	0.4	0.05K	254	8	
502760	State Road	18-Jul-95	27	8.5	8	154	20		0.1K	0.05K	0.4	0.05K	296	14	30
502760	Rm 6.3	16-Aug-95	26	8.18	6.2	110	29		0.1K	0.05K	0.7	0.05K	194	5	44
502760		14-Sep-95	19	7.92	7.1	227	30	690	0.1K	0.17	0.8	0.05K	458	16	3200
502760		26-Sep-95	16	8.32	9.9	336	33		0.1K	0.05K	1	0.05K	576	14	
502790	Ust E. 24th Street	10-Jul-95	21	8.42	5.5	294	15		0.01K	0.09	0.6	0.05K	682	6	
502790	Rm 2.5	18-Jul-95	27	8.2	6	151	15		0.19	0.05K	0.3	0.05K	206	5K	70
502790		16-Aug-95	28.5	7.8	4.6	362	13		0.1K	0.82	0.7	0.05K	860	6	51
502790		14-Sep-95	21	7.82	6.3	385	21	1280	0.28	0.06	0.6	0.05K	922	12	160
502790		26-Sep-95	15	7.75	7.6	443	15		0.11	0.08	0.5	0.05K	1070	10	
A01S02	Dst Root Road	10-Jul-95	19	8.47	7.9	119	15		0.11	0.05K	0.6	0.05K	214	5K	
A01S02	Rm 25.6	18-Jul-95	26	8	4.6	122	26		0.1K	0.05K	0.7	0.05K	170	10	10
A01S02		16-Aug-95	26.5	7.82	6	96	23		0.1K	0.06	0.7	0.05K	134	5K	61
A01S02		14-Sep-95	20	7.65	6.5	110	33	262	0.1K	0.05K	0.9	0.05K	146	15	51
A01S02		26-Sep-95				113	33	277	0.1K	0.05K	0.8	0.05K	174	10	
A01S03	West Branch	10-Jul-95	19	8.3	8	119	29		0.1K	0.05K	0.7	0.05K	188	10	
A01S03	Dst Beckwith Rd.	18-Jul-95	23	8.3	5.1	113	38		0.1K	0.05K	0.7	0.05K	174	38	37
A01S03	Rm 1.8	16-Aug-95	25.5	7.84	4	99	38		10K	0.08	0.9	0.05K	166	5K	57
A01S03		14-Sep-95	17.5	8	4.9	110	51	236	0.48	0.11	1.2	0.16	175	171	4700
A01S03		14-Sep-95													
A01S03		26-Sep-95	9	8	8.7	144	36	314	0.1K	0.05K	0.5	0.05K	208	28	
A01W19	East Branch	10-Jul-95	19	8.8	11	129	18		0.1	0.05K	0.4	0.05K	190	7	
A01W19	@ Scribner Road	18-Jul-95	23	8.4	7.9	134	25		0.1K	0.05K	0.7	0.05K	198	5K	310
A01W19	Rm 1.4	16-Aug-95	24	7.92	6.5	110	23		0.13	0.05K	0.7	0.05K	164	5K	300
A01W19		14-Sep-95	19.5	8	2.8	144	36	322	0.12	0.11	1.2	0.06	202	8	3200
A01W19		26-Sep-95	10	7.7	6.8	158	41	376	0.1K	0.05K	1	0.05K	236	6	
A01W20	Dst Root Road	10-Jul-95	20	8.76	10.1	94	20		0.01K	0.053K	0.4	0.05K	438	5K	
A01W20	Rm 19.1	18-Jul-95	26	8	4.5	100	23		0.1K	0.05K	0.6	0.05K	160	6	10
A01W20		16-Aug-95	26	7.7	4	89	26		0.1K	0.12	0.8	0.05K	178	10	94
A01W20	14-Sep-95	19	7.5	2.9	84	30	221		0.15	0.14	1	0.05K	146	5K	20

Table A-3. Continued.

ID	Location	Date	Temp C	pH s.u.	D.O. mg/l	CaCO3 mg/l	COD mg/l	Sp.Cond. umhos	NOx mg/l	NH3 mg/l	TKN mg/l	P665 mg/l	TDS mg/l	TSS mg/l	Fecal Col. #/100ml
A01W20	26-Sep-95		10	7.7	8.7	86	30	226	0.1	0.06	0.7	0.05K	158	8	
A01W21	Unnamed Tributary	10-Jul-95	17	8.22	5.5	500	38		0.17	0.08	0.9	0.05K	956	8	
A01W21	@ Carson and Beck	18-Jul-95	22	7.74	5.5	545	26		0.1K	0.05K	0.6	0.05K	1060	5K	290
A01W21	Rm 1.5	16-Aug-95	24	7.93	3.8	350	50		0.16	0.22	1.1	0.05K	626	5K	6400
A01W21		14-Sep-95	17.5	7.6	3.7	336	42		0.23	0.29	1.2	0.05K	662	47	3000
A01W21	26-Sep-95		13	7.9	7.9	362	41		0.29	0.23	1.1	0.05K	684	29	
Cowles Creek															
	7.24	June 29, 1995	22.3	7.6	6.9	202	16	520	0.74	<0.05	0.4	<0.05	392	55	580
	7.24	July 20, 1995	21	7.19	5.6	285	17	714	1.01	0.2	0.8	<0.05	510	18	510
	7.24	Aug. 15, 1995													1800
	5.48	July 20, 1995													5400
	5.48	Aug. 15, 1995													5600
	5.48	Sept. 05, 1995													2300
	5.2	July 20, 1995													25000
	5.2	Aug. 15, 1995													4600
	5.2	Sept. 05, 1995													17000
	4.83	June 29, 1995	22	7.3	7.2	197	28	581	0.46	<0.05	0.5	<0.05	392	12	10000
	4.83	July 20, 1995	22.2	7.93	8	243	18	805	0.23	0.06	0.6	<0.05	500	<5	870
	4.83	July 26, 1995	24.8	7.92	4.59	2.3	0.66	784	0.05	0.6	0.11	374	18		
	4.83	Aug. 03, 1995	25.2	8.1	7.2	237	18	600	0.4	0.05	0.5	0.06	446	<5	
	4.83	Aug. 15, 1995													3000
	4.83	Aug. 24, 1995	20.5	7.7	7.1	246	<10	816	0.33	<0.05	0.4	0.07	494	<5	
	4.83	Sept. 05, 1995	20.1	7.3	9.5	241	<2	741	21	0.21	<0.05	0.4	0.06	444	8
	800														
	4.73	June 29, 1995	24	7.6	8.7	181	16	826	14.5	0.06	1.2	0.38	576	<5	60
	4.73	Aug. 03, 1995	28	8	7.3	176	36	918	16.4	0.15	1.6	0.55	556	<5	
	4.73	Sept. 05, 1995	21.1	7.1	8.6	164	2.3	690	11	0.09	1.7	0.56	444	<5	90

Table A-3. Continued.

ID	Location	Date	Temp C	pH s.u.	D.O. mg/l	CaCO3 mg/l	COD mg/l	Sp.Cond. umhos	NOx mg/l	NH3 mg/l	TKN mg/l	P665 mg/l	TDS mg/l	TSS mg/l	Fecal Col. #/100ml
Cowles Creek - continued															
	4.64	June 29, 1995	22.1	7.5	8.1	179	25	765	9.78	<0.05	1.2	0.25	510	<5	4300
	4.64	July 20, 1995	21.2	7.6	8.1	164	24	856	16.1	0.25	1.8	0.5	564	<5	3400
	4.64	July 26, 1995	24.5	7.9	3.7			890	15.6	0.39	2	0.35	384	23	
	4.64	Aug. 03, 1995	24.5	7.9	8.4	181	36	905	15.1	0.12	1.8	0.5			
	4.64	Aug. 15, 1995							1100						
	4.64	Aug. 24, 1995	21.9	7.2	7.6	164	43	816	14.9	<0.05	1.5	0.4	530	<5	
	4.64	Sept. 05, 1995	20.9	7.7	8.8	167	30	713	10.7	0.06	1.5	0.54	442	<5	67
	3.2	June 29, 1995	21.1	7.5	7.8	196	16	795	9.73	0.12	1.4	0.23	518	6	3100
	3.2	July 20, 1995	22.8	7.92	7.3	181	15	868	16.5	0.22	1.4	0.28	524	<5	2300
	3.2	July 26, 1995	28.7	7.16	4.67		2.2		6.5	0.19	1.1	0.18	338	17	
	3.2	Aug. 03, 1995	24	7.8	6.6	183	30	905	15.8	0.14	1.4	0.34	532	6	
	3.2	Aug. 15, 1995							1500						
	3.2	Aug. 24, 1995	20.1	7.1	7.1	167	21	818	16	<0.05	1.5	0.31	544	<5	
	3.2	Sept. 05, 1995	19.1	7.4	8.7	167	36	693	14.7	0.11	1.4	0.45	460	<5	800
	1.4	June 29, 1995	22	7.3	7	202	12	734	7.28	<0.05	0.9	0.16	504	43	430
	1.4	July 20, 1995	23.2	8.12	8.1	169	<10	794	9.21	0.05	0.9	0.17	530	<5	620
	1.4	July 26, 1995	23.6	7.76			2.4	870	11.6	0.23	1.5	0.21	492		
	1.4	Aug. 03, 1995	25	7.9	7.3	168	18	764	8.35	<0.05	1	0.2	424	<5	
	1.4	Aug. 15, 1995													900
	1.4	Aug. 24, 1995	20.5	7.2	6.8	183	18	816	13.3	<0.05	1.1		540	<5	
	1.4	Sept. 05, 1995	18.2	7.58	8.4	169	24	694	13.5	0.05	1	0.28	490	<5	480
	0.9	July 26, 1995	28.26	7.82	7.45		2.2	750	11.2	0.13	1.3	0.16		<0.2	
	0.3	July 26, 1995	25.5	7.58	6.88		<2	810	10.7	0.13	1.3	0.16	482	22	

Table A-3. Continued.

ID	Location	Date	Temp C	pH s.u.	D.O. mg/l	SpecC umhos	CaCO3 mg/l	COD mg/l	NOx mg/l	NH3 mg/l	TKN mg/l	P665 mg/l	TDS mg/l	TSS mg/l	Fecal Col. #/100ml
Arcola Creek															
	7.3	June 29, 1995	19.9	7.4	7.2	530	257	<10	1.02	<0.05	0.4	<0.05	396	8	570
	7.3	July 20, 1995	22.6	9.01	12.9	595	253	<10	2.22	<0.05	0.4	<0.05	390	<5	590
	7.3	Aug. 03, 1995	22	8	8.8	615	287	12	1.52	<0.05	0.2	<0.05	374	<5	
	7.3	Aug. 15, 1995	22	4.5											
	7.3	Aug. 15, 1995	26	10.5											
	7.3	Aug. 24, 1995	20.3	7.5	10.05	602	254	<10	2.4	<0.05	<0.2	<0.05	380	<5	
	7.3	Sept. 05, 1995	15.9	7.75	9.5	656	276	<10	3.03	<0.05	<0.2	<0.05	378	16	680
	7.2	June 29, 1995	21	6.9	4.7	765	226	19	2.42	0.17	0.9	1.36	510	<5	940
	7.2	Aug. 03, 1995	22	7.5	6.5	816	242	16	8.28	0.07	0.9	1.7	492	<5	
	7.2	Sept. 05, 1995	19.4	7.35	5.5	694	214	24	5.32	1.3	2	2.73	452	<5	60
	7.1	June 29, 1995	20	7	5.8	714	243	12	1.92	0.12	0.8	0.94	478	5	1000
	7.1	July 20, 1995	21	8.21	7.1	804	246	<10	4.19	0.2	0.8	0.9	504	6	360
	7.1	Aug. 03, 1995	22	7.7	6.5	715	253	15	5.58	0.4	0.6	1.02	496	<5	
	7.1	Aug. 15, 1995	22.5	4.5											
	7.1	Aug. 15, 1995	24	7.1											
	7.1	Aug. 24, 1995	20.8	7	6.4	745							480	<5	
	7.1	Sept. 05, 1995	19.3	7.3	6.8	770	220	15	4.94	1.11	1.7	2.23	436	<5	240
	6.9	Sept. 05, 1995	18.4	7.4	4.8	713	2	27	4.74	0.86	1.5	2.13	452	26	1800
	6.1	Aug. 15, 1995	24	3.9											
	6.1	Aug. 15, 1995	25	4.4											
	6.1	Aug. 24, 1995	20.3	7.1	5.5	724	227	<2	<10	3.92	0.06	0.5	0.76	480	10
	6.1	Sept. 05, 1995	18.1	7.5	6.8	665	222	<2	18	5.11	0.14	0.6	1.1	434	14
	460														
	5	June 29, 1995	21	7.3	5.2	612	244	12	0.87	0.15	0.4	0.2	430	<5	1900
	5	July 20, 1995	21.9	8.22	6.95	714	242	<10	0.68	0.06	0.5	0.26	430	<5	270

Table A-3. Continued.

ID	Location	Date Temp C	pH s.u.	D.O. mg/l	SpecC umhos	CaCO3 mg/l	COD mg/l	NOx mg/l	NH3 mg/l	TKN mg/l	P665 mg/l	TDS mg/l	TSS mg/l	Fecal Col. #/100ml	
Arcola Creek - continued															
	5	Aug. 03, 1995	23.1	7.7	4.3	612	263	18	1.04	0.1	0.5	0.26	398	8	
	5	Aug. 15, 1995	23.3	2.6											
	5	Aug. 15, 1995	25	4.7											
	5	Aug. 24, 1995	20.8	6.9	4.85	687	227	12	2.88	0.1	0.6	0.34	410	6	
	5	Sept. 05, 1995	17.9	7.4	6.4	618	201	24	4.77	0.13	0.7	0.37	394	7	230
	2	June 29, 1995	22.2	7.6	7.5	663	258	<10	1.73	<0.05	0.4	0.12	454	<5	850
	2	July 20, 1995	22.8	8.55	6.9	682	242	<10	0.38	<0.05	0.4	0.13	420	<5	630
	2	Aug. 03, 1995	24	8	7.5	672	254	15	1.1	<0.05	0.4	0.15	412	<5	
	2	Aug. 15, 1995	24.5	6.2											
	2	Aug. 15, 1995	25.5	7.4											
	2	Aug. 24, 1995	20.7	7.2	6.8	765	299	18	1.99	<0.05	1.2	0.24	528	11	
	2	Sept. 05, 1995	20.8	8.3	14.1	646	256	15	<0.10	<0.05	0.4	0.12	402	<5	63
	2.0 (Dup)	Aug. 03, 1995	24	8	7.5	672	235	15	1.36	<0.05	0.4	0.15	406	<5	
	2.0 (Dup)	Aug. 24, 1995	20.7	7.2	6.8	765	290	24	1.97	<0.05	1.2	556	11		

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 95.50

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
08240	*Orconectes (Crokerinus) propinquus*	+
11010	*Acentrella sp*	+
11130	*Baetis intercalaris*	+
11150	*Labiobaetis propinquus*	+
11650	*Procloeon sp (w/ hindwing pads)*	+
12200	*Isonychia sp*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
14950	*Leptophlebia sp or Paraleptophebia sp*	+
15501	*Ephemerellidae*	+
17200	*Caenis sp*	+
21200	*Calopteryx sp*	+
22300	*Argia sp*	+
23909	*Boyeria vinosa*	+
24900	*Gomphus sp*	+
47600	*Sialis sp*	+
48620	*Nigronia serricornis*	+
50301	*Chimarra aterrima*	+
50315	*Chimarra obscura*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52530	*Hydropsyche depravata group*	+
52540	*Hydropsyche dicantha*	+
54000	*Leucotrichia pictipes*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	+
59300	*Mystacides sp*	+
60300	*Dineutus sp*	+
68075	*Psephenus herricki*	+
68707	*Dubiraphia quadrinotata*	+
69400	*Stenelmis sp*	+
71910	*Tipula abdominalis*	+
77120	*Ablabesmyia mallochi*	+
77800	*Helopelopia sp*	+
78140	*Labrundinia pilosella*	+
80310	*Cardiocladius obscurus*	+
81650	*Parametriocnemus sp*	+
82141	*Thienemanniella xena*	+
82710	*Chironomus (C.) sp*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84300	*Phaenopsectra obediens group*	+
84440	*Polypedilum (P.) aviceps*	+
84480	*Polypedilum (P.) laetum group*	+
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	+
85800	*Tanytarsus sp*	+
85814	*Tanytarsus glabrescens group*	+
86100	*Chrysops sp*	+
86401	*Atherix lantha*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	+

No. Quantitative Taxa: 0 Total Taxa: 56

No. Qualitative Taxa: 56 ICI:

Number of Organisms: 0 Qual EPT: 20

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 83.30

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	23 +
01801	*Turbellaria*	32
03600	*Oligochaeta*	65
04685	*Placobdella ornata*	+
04686	*Placobdella papillifera*	+
06201	*Hyalella azteca*	5 +
08200	*Orconectes sp*	1 +
11020	*Acerpenna pygmaeus*	+
11150	*Labiobaetis propinquus*	+
11650	*Procloeon sp (w/ hindwing pads)*	1 +
13400	*Stenacron sp*	65 +
13521	*Stenonema femoratum*	3
13561	*Stenonema pulchellum*	8
14950	*Leptophlebia sp or Paraleptophebia sp*	350
17200	*Caenis sp*	31 +
21200	*Calopteryx sp*	3 +
22300	*Argia sp*	18 +
23909	*Boyeria vinosa*	1
25010	*Hagenius brevistylus*	+
34130	*Acroneuria frisoni*	+
45300	*Sigara sp*	+
45900	*Notonecta sp*	+
47600	*Sialis sp*	1 +
48620	*Nigronia serricornis*	3 +
50301	*Chimarra aterrima*	+
50315	*Chimarra obscura*	+
50804	*Lype diversa*	+
51400	*Nyctiophylax sp*	1 +
51600	*Polycentropus sp*	6
52200	*Cheumatopsyche sp*	6 +
53800	*Hydroptila sp*	1
57900	*Pycnopsyche sp*	+
60300	*Dineutus sp*	+
60400	*Gyrinus sp*	1
68130	*Helichus sp*	1
68601	*Ancyronyx variegata*	1 +
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	35 +
69400	*Stenelmis sp*	2 +
74501	*Ceratopogonidae*	2
77120	*Ablabesmyia mallochi*	16
77130	*Ablabesmyia rhamphe group*	22 +
77740	*Hayesomyia senata*	33 +
78140	*Labrundinia pilosella*	41
78650	*Procladius sp*	22 +
79010	*Tanypus carinatus*	5 +
80370	*Corynoneura lobata*	33 +
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	5
82121	*Thienemanniella n.sp 3*	61
82730	*Chironomus (C.) decorus group*	+
82880	*Cryptotendipes sp*	27
83040	*Dicrotendipes neomodestus*	16
83050	*Dicrotendipes lucifer*	22
83840	*Microtendipes pedellus group*	5
84300	*Phaenopsectra obediens group*	38 +
84302	*Phaenopsectra punctipes*	5
84460	*Polypedilum (P.) fallax group*	38 +
84520	*Polypedilum (Tripodura) halterale group*	5
84540	*Polypedilum (Tripodura) scalaenum group*	11
84790	*Tribelos fuscicorne*	11
84800	*Tribelos jucundum*	5
85500	*Paratanytarsus sp*	5
85625	*Rheotanytarsus exiguus group*	115
85720	*Stempellinella n.sp nr. flavidula*	5
85800	*Tanytarsus sp*	71
85802	*Tanytarsus curticornis group*	22
85814	*Tanytarsus glabrescens group*	66
86100	*Chrysops sp*	+
93200	*Hydrobiidae*	+
94400	*Fossaria sp*	+
95100	*Physella sp*	+
96002	*Helisoma anceps anceps*	+
96900	*Ferrissia sp*	28 +
99100	*Pyganodon grandis*	+
99280	*Lasmigona costata*	+
99420	*Amblema plicata plicata*	+
99440	*Fusconaia flava*	+
99540	*Elliptio dilatata*	+
99600	*Actinonaias ligamentina carinata*	+
99820	*Villosa iris iris*	+
99860	*Lampsilis radiata luteola*	+
99880	*Lampsilis ventricosa*	+

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 83.30

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	53	Total Taxa:	82
No. Qualitative Taxa:	52	ICI:	**46**
Number of Organisms:	1399	Qual EPT:	12

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 65.80

Taxa Code	Taxa	Quant	Qual
01320	*Hydra sp*	4	
03600	*Oligochaeta*	8	+
06201	*Hyalella azteca*	1	+
08240	*Orconectes (Crokerinus) propinquus*	1	+
08601	*Hydracarina*	16	
11020	*Acerpenna pygmaeus*	4	+
11130	*Baetis intercalaris*	231	+
11650	*Procloeon sp (w/ hindwing pads)*	5	+
11670	*Procloeon irrubrum*		+
13400	*Stenacron sp*	161	+
13521	*Stenonema femoratum*	1	
13561	*Stenonema pulchellum*	140	+
14950	*Leptophlebia sp or Paraleptophebia sp*	8	
16700	*Tricorythodes sp*	2	
18750	*Hexagenia limbata*		+
21200	*Calopteryx sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*		+
23909	*Boyeria vinosa*		+
34130	*Acroneuria frisoni*	1	
42700	*Belostoma sp*		+
43570	*Neoplea sp*		+
44300	*Pelocoris sp*		+
45100	*Palmacorixa sp*		+
45300	*Sigara sp*		+
45400	*Trichocorixa sp*		+
45900	*Notonecta sp*		+
47600	*Sialis sp*	2	+
50804	*Lype diversa*	4	+
51400	*Nyctiophylax sp*		+
52200	*Cheumatopsyche sp*	96	+
57900	*Pycnopsyche sp*		+
60300	*Dineutus sp*	2	+
68130	*Helichus sp*		+
68601	*Ancyronyx variegata*		+
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	70	+
77500	*Conchapelopia sp*	11	
77750	*Hayesomyia senata or Thienemannimyia norena*	22	
77800	*Helopelopia sp*		+
78140	*Labrundinia pilosella*	8	
78450	*Nilotanypus fimbriatus*	12	+
78650	*Procladius sp*		+
80370	*Corynoneura lobata*	20	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	5	
81632	*Parakiefferiella n.sp 2*	5	
81825	*Rheocricotopus (Psilocricotopus) robacki*	5	
82880	*Cryptotendipes sp*		+
82900	*Demicryptochironomus sp*		+
83300	*Glyptotendipes (G.) sp*	11	+
84300	*Phaenopsectra obediens group*	11	
84450	*Polypedilum (P.) convictum*	44	
84460	*Polypedilum (P.) fallax group*	22	
84540	*Polypedilum (Tripodura) scalaenum group*		+
84700	*Stenochironomus sp*	5	
84800	*Tribelos jucundum*	5	
85500	*Paratanytarsus sp*	11	
85615	*Rheotanytarsus distinctissimus group*	11	
85625	*Rheotanytarsus exiguus group*	376	+
85800	*Tanytarsus sp*		+
85802	*Tanytarsus curticornis group*	5	
85814	*Tanytarsus glabrescens group*	22	
86100	*Chrysops sp*		+
86401	*Atherix lantha*		+
87540	*Hemerodromia sp*		+
93200	*Hydrobiidae*		+
96900	*Ferrissia sp*	1	
98200	*Pisidium sp*		+
98600	*Sphaerium sp*		+
99100	*Pyganodon grandis*		+
99280	*Lasmigona costata*		+
99440	*Fusconaia flava*		+
99600	*Actinonaias ligamentina carinata*		+
99860	*Lampsilis radiata luteola*		+
99880	*Lampsilis ventricosa*		+

No. Quantitative Taxa: 39 Total Taxa: 75

No. Qualitative Taxa: 52 ICI: **46**

Number of Organisms: 1369 Qual EPT: 11

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-001 River: Grand River RM: 56.00

Taxa Code	Taxa	Quant	Qual
01320	*Hydra sp*	3336	+
01801	*Turbellaria*	2	
03121	*Paludicella articulata*	1	
03364	*Plumatella emarginata*	1	
03369	*Plumatella repens*	6	+
03451	*Urnatella gracilis*	72	+
03600	*Oligochaeta*	9	+
04666	*Helobdella triserialis*		+
06201	*Hyalella azteca*		+
08240	*Orconectes (Crokerinus) propinquus*	1	+
13400	*Stenacron sp*	111	+
13561	*Stenonema pulchellum*	18	
16700	*Tricorythodes sp*	1	
17200	*Caenis sp*	18	+
21200	*Calopteryx sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	2	+
23804	*Basiaeschna janata*		+
23909	*Boyeria vinosa*	1	
24107	*Nasiaeschna pentacantha*		+
34130	*Acroneuria frisoni*		+
45100	*Palmacorixa sp*		+
45400	*Trichocorixa sp*		+
45900	*Notonecta sp*		+
47600	*Sialis sp*	2	+
50315	*Chimarra obscura*		+
51206	*Cyrnellus fraternus*	10	
52200	*Cheumatopsyche sp*	46	+
53501	*Hydroptilidae*	2	
57900	*Pycnopsyche sp*	1	
59100	*Ceraclea sp*	1	
59110	*Ceraclea ancylus*		+
59145			+
63300	*Hydroporus sp*		+
68601	*Ancyronyx variegata*		+
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	52	+
69400	*Stenelmis sp*	8	+
71100	*Hexatoma sp*		+
77740	*Hayesomyia senata*	521	+
77800	*Helopelopia sp*		+
78650	*Procladius sp*		+
79085	*Telopelopia okoboji*		+
80410	*Cricotopus (C.) sp*		+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	27	
81240	*Nanocladius (N.) distinctus*	55	+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	165	+
83050	*Dicrotendipes lucifer*	55	
83158	*Endochironomus nigricans*		+
83300	*Glyptotendipes (G.) sp*	302	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	27	+
83840	*Microtendipes pedellus group*		+
84060	*Parachironomus pectinatellae*	55	
84210	*Paratendipes albimanus or P. duplicatus*	27	
84300	*Phaenopsectra obediens group*	55	
84450	*Polypedilum (P.) convictum*		+
84470	*Polypedilum (P.) illinoense*		+
84540	*Polypedilum (Tripodura) scalaenum group*	27	+
84800	*Tribelos jucundum*	55	
85265	*Cladotanytarsus vanderwulpi group Type 5*		+
85625	*Rheotanytarsus exiguus group*	247	+
85800	*Tanytarsus sp*	411	
85814	*Tanytarsus glabrescens group*	1042	
86100	*Chrysops sp*		+
87540	*Hemerodromia sp*	24	
93200	*Hydrobiidae*		+
95100	*Physella sp*	24	+
96900	*Ferrissia sp*	92	+
98200	*Pisidium sp*		+
98600	*Sphaerium sp*		+
99230	*Simpsonaias ambigua*		+
99440	*Fusconaia flava*		+
99540	*Elliptio dilatata*		+
99600	*Actinonaias ligamentina carinata*		+

No. Quantitative Taxa: 40 Total Taxa: 75
No. Qualitative Taxa: 55 ICI: **34**
Number of Organisms: 6912 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 44.70

Taxa Code	Taxa	Quant	Qual
00401	*Spongillidae*		+
01320	*Hydra sp*	144	
01801	*Turbellaria*	70	
03121	*Paludicella articulata*	1	+
03360	*Plumatella sp*	1	
03451	*Urnatella gracilis*	1	
03600	*Oligochaeta*	96	+
06201	*Hyalella azteca*		+
06700	*Crangonyx sp*		+
08240	*Orconectes (Crokerinus) propinquus*		+
08601	*Hydracarina*	20	
11020	*Acerpenna pygmaeus*	23	
11130	*Baetis intercalaris*	61	+
12200	*Isonychia sp*	13	+
13400	*Stenacron sp*	131	+
13561	*Stenonema pulchellum*	151	+
14950	*Leptophlebia sp or Paraleptophebia sp*	16	
17200	*Caenis sp*	4	+
21200	*Calopteryx sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	1	+
24900	*Gomphus sp*		+
25010	*Hagenius brevistylus*		+
25510	*Stylogomphus albistylus*		+
34130	*Acroneuria frisoni*	2	+
47600	*Sialis sp*		+
48620	*Nigronia serricornis*		+
50315	*Chimarra obscura*	2	
50804	*Lype diversa*	4	
51300	*Neureclipsis sp*	7	
52200	*Cheumatopsyche sp*	797	+
57900	*Pycnopsyche sp*		+
59500	*Oecetis sp*	16	
68601	*Ancyronyx variegata*		+
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	95	+
69400	*Stenelmis sp*	6	+
72700	*Anopheles sp*		+
77130	*Ablabesmyia rhamphe group*	28	
77500	*Conchapelopia sp*	28	+
77740	*Hayesomyia senata*	28	+
77800	*Helopelopia sp*		+
78140	*Labrundinia pilosella*	32	
78450	*Nilotanypus fimbriatus*	53	
80370	*Corynoneura lobata*	155	
81229	*Nanocladius (N.) crassicornus*	28	
81250	*Nanocladius (N.) minimus*	28	
81825	*Rheocricotopus (Psilocricotopus) robacki*	28	
82121	*Thienemanniella n.sp 3*	37	
82141	*Thienemanniella xena*	16	
82820	*Cryptochironomus sp*		+
82880	*Cryptotendipes sp*		+
83300	*Glyptotendipes (G.) sp*	28	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*		+
84420	*Polypedilum (P.) Type 1*	2	
84450	*Polypedilum (P.) convictum*	369	
84460	*Polypedilum (P.) fallax group*	28	+
84470	*Polypedilum (P.) illinoense*	57	+
84540	*Polypedilum (Tripodura) scalaenum group*		+
84651	*Stelechomyia perpulchra*	16	
84700	*Stenochironomus sp*		+
85265	*Cladotanytarsus vanderwulpi group Type 5*	28	
85625	*Rheotanytarsus exiguus group*	2044	+
85720	*Stempellinella n.sp nr. flavidula*	16	
85802	*Tanytarsus curticornis group*	28	
85814	*Tanytarsus glabrescens group*	28	
85840	*Tanytarsus guerlus group*	28	
86401	*Atherix lantha*	1	
87540	*Hemerodromia sp*	8	
95100	*Physella sp*		+
96900	*Ferrissia sp*	4	
98600	*Sphaerium sp*		+

No. Quantitative Taxa: 49 Total Taxa: 72

No. Qualitative Taxa: 41 ICI: **42**

Number of Organisms: 4808 Qual EPT: 8

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-001 River: Grand River RM: 32.90

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
01801	*Turbellaria*	+
03040	*Fredericella sp*	+
03121	*Paludicella articulata*	+
03451	*Urnatella gracilis*	+
03600	*Oligochaeta*	+
06201	*Hyalella azteca*	+
08240	*Orconectes (Crokerinus) propinquus*	+
11130	*Baetis intercalaris*	+
13400	*Stenacron sp*	+
13561	*Stenonema pulchellum*	+
16700	*Tricorythodes sp*	+
17200	*Caenis sp*	+
18100	*Anthopotamus sp*	+
18600	*Ephemera sp*	+
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
23804	*Basiaeschna janata*	+
23909	*Boyeria vinosa*	+
24900	*Gomphus sp*	+
27406	*Neurocordulia obsoleta*	+
34130	*Acroneuria frisoni*	+
34700	*Agnetina capitata complex*	+
43300	*Ranatra sp*	+
47600	*Sialis sp*	+
48410	*Corydalus cornutus*	+
49200	*Climacia sp*	+
50315	*Chimarra obscura*	+
52200	*Cheumatopsyche sp*	+
52540	*Hydropsyche dicantha*	+
52550	*Hydropsyche frisoni*	+
52620	*Macrostemum zebratum*	+
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	+
59110	*Ceraclea ancylus*	+
59500	*Oecetis sp*	+
59970	*Petrophila sp*	+
68075	*Psephenus herricki*	+
68601	*Ancyronyx variegata*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	+
77130	*Ablabesmyia rhamphe group*	+
77355	*Clinotanypus pinguis*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	+
78140	*Labrundinia pilosella*	+
78650	*Procladius sp*	+
78750	*Rheopelopia paramaculipennis*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	+
82880	*Cryptotendipes sp*	+
83040	*Dicrotendipes neomodestus*	+
83158	*Endochironomus nigricans*	+
83300	*Glyptotendipes (G.) sp*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
84155	*Paralauterborniella nigrohalteralis*	+
84300	*Phaenopsectra obediens group*	+
84420	*Polypedilum (P.) Type 1*	+
84450	*Polypedilum (P.) convictum*	+
84470	*Polypedilum (P.) illinoense*	+
84800	*Tribelos jucundum*	+
85720	*Stempellinella n.sp nr. flavidula*	+
92615	*Cipangopaludina japonica*	+
93200	*Hydrobiidae*	+
93900	*Elimia sp*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	+
98600	*Sphaerium sp*	+
99100	*Pyganodon grandis*	+
99260	*Lasmigona compressa*	+
99280	*Lasmigona costata*	+

No. Quantitative Taxa: 0 Total Taxa: 74

No. Qualitative Taxa: 74 ICI:

Number of Organisms: 0 Qual EPT: 19

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 28.40

Taxa Code	Taxa	Quant/Qual	
00700	*Radiospongilla crateriformis*		+
01801	*Turbellaria*		+
03040	*Fredericella sp*	1	
03121	*Paludicella articulata*	1	+
03360	*Plumatella sp*	1	
03451	*Urnatella gracilis*	1	+
03600	*Oligochaeta*	40	+
08240	*Orconectes (Crokerinus) propinquus*		+
08601	*Hydracarina*		+
11020	*Acerpenna pygmaeus*	25	
11130	*Baetis intercalaris*	19	+
11650	*Procloeon sp (w/ hindwing pads)*	2	
12200	*Isonychia sp*	10	+
13000	*Leucrocuta sp*	2	
13400	*Stenacron sp*	428	+
13540	*Stenonema mediopunctatum*	70	+
13561	*Stenonema pulchellum*	1362	+
16324	*Serratella deficiens*	17	+
16700	*Tricorythodes sp*	87	+
17200	*Caenis sp*	294	+
18600	*Ephemera sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	1	+
24700	*Dromogomphus sp*		+
24900	*Gomphus sp*		+
26700	*Macromia sp*		+
27406	*Neurocordulia obsoleta*		+
34130	*Acroneuria frisoni*		+
34140	*Acroneuria internata*	3	+
34700	*Agnetina capitata complex*		+
43300	*Ranatra sp*		+
43570	*Neoplea sp*		+
44300	*Pelocoris sp*		+
47600	*Sialis sp*		+
48410	*Corydalus cornutus*	8	+
50315	*Chimarra obscura*	150	+
51400	*Nyctiophylax sp*	25	
51600	*Polycentropus sp*	34	+
52200	*Cheumatopsyche sp*	34	+
52430	*Ceratopsyche morosa group*	23	
52540	*Hydropsyche dicantha*	18	+
52550	*Hydropsyche frisoni*	42	
52620	*Macrostemum zebratum*	8	+
53800	*Hydroptila sp*	13	+
57900	*Pycnopsyche sp*		+
59110	*Ceraclea ancylus*		+
59120	*Ceraclea flava complex*		+
59150	*Ceraclea resurgens group*		+
59500	*Oecetis sp*	9	+
59970	*Petrophila sp*		+
65800	*Berosus sp*		+
68708	*Dubiraphia vittata group*	1	+
68901	*Macronychus glabratus*	31	+
69400	*Stenelmis sp*	3	+
70600	*Antocha sp*	1	
77120	*Ablabesmyia mallochi*	49	+
77750	*Hayesomyia senata or Thienemannimyia norena*	147	+
77800	*Helopelopia sp*		+
78140	*Labrundinia pilosella*	48	
78450	*Nilotanypus fimbriatus*	304	
78650	*Procladius sp*		+
78750	*Rheopelopia paramaculipennis*	147	+
80310	*Cardiocladius obscurus*		+
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	112	
80370	*Corynoneura lobata*	16	
80410	*Cricotopus (C.) sp*		+
80420	*Cricotopus (C.) bicinctus*		+
81280	*Nanocladius (Plecopteracoluthus) n. sp*		+
82070	*Synorthocladius semivirens*	8	
82101	*Thienemanniella n.sp 1*	49	+
82121	*Thienemanniella n.sp 3*	32	
82600	*Axarus sp*		+
82730	*Chironomus (C.) decorus group*		+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	196	+
83300	*Glyptotendipes (G.) sp*		+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*		+
83900	*Nilothauma sp*	49	
84450	*Polypedilum (P.) convictum*	490	+
84470	*Polypedilum (P.) illinoense*		+
85210	*Cladotanytarsus species group B*	49	
85615	*Rheotanytarsus distinctissimus group*	392	+
85625	*Rheotanytarsus exiguus group*	2010	+

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 28.40

Taxa Code	Taxa	Quant/Qual
85720	*Stempellinella n.sp nr. flavidula*	+
85814	*Tanytarsus glabrescens group*	932 +
85840	*Tanytarsus guerlus group*	49
86401	*Atherix lantha*	+
87540	*Hemerodromia sp*	8
93200	*Hydrobiidae*	+
93900	*Elimia sp*	+
94400	*Fossaria sp*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	1 +
98600	*Sphaerium sp*	+
99180	*Strophitus undulatus undulatus*	+
99200	*Alasmidonta marginata*	+
99540	*Elliptio dilatata*	+

No. Quantitative Taxa: 53 Total Taxa: 97

No. Qualitative Taxa: 78 ICI: **54**

Number of Organisms: 7852 Qual EPT: 23

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 22.60

Taxa Code	Taxa	Quant	Qual
00401	*Spongillidae*		+
01320	*Hydra sp*	78	
01801	*Turbellaria*	1	
03451	*Urnatella gracilis*	19	
03600	*Oligochaeta*	17	+
04680	*Placobdella sp*	1	
08240	*Orconectes (Crokerinus) propinquus*		+
11130	*Baetis intercalaris*	123	+
11150	*Labiobaetis propinquus*		+
11650	*Procloeon sp (w/ hindwing pads)*	6	
12200	*Isonychia sp*	11	+
13000	*Leucrocuta sp*		+
13400	*Stenacron sp*	91	+
13540	*Stenonema mediopunctatum*	183	
13561	*Stenonema pulchellum*	176	+
15501	*Ephemerellidae*	18	
16700	*Tricorythodes sp*	105	
17200	*Caenis sp*	99	+
21300	*Hetaerina sp*	4	
22001	*Coenagrionidae*		+
22300	*Argia sp*	10	+
24800	*Gomphurus sp*		+
25010	*Hagenius brevistylus*		+
25300	*Ophiogomphus sp*		+
25510	*Stylogomphus albistylus*		+
26700	*Macromia sp*		+
27409	*Neurocordulia yamaskanensis*		+
34110	*Acroneuria abnormis*		+
34120	*Acroneuria carolinensis*	1	+
34140	*Acroneuria internata*	9	+
34300	*Neoperla clymene complex*		+
34700	*Agnetina capitata complex*	2	+
43300	*Ranatra sp*		+
47600	*Sialis sp*		+
48410	*Corydalus cornutus*	1	+
50315	*Chimarra obscura*	1	+
51300	*Neureclipsis sp*	1	
51600	*Polycentropus sp*	1	
52200	*Cheumatopsyche sp*	14	+
52430	*Ceratopsyche morosa group*	17	+
52540	*Hydropsyche dicantha*	9	+
52550	*Hydropsyche frisoni*	24	
52620	*Macrostemum zebratum*		+
53800	*Hydroptila sp*	19	+
58505	*Helicopsyche borealis*	1	+
59100	*Ceraclea sp*	1	
59110	*Ceraclea ancylus*		+
59120	*Ceraclea flava complex*		+
59500	*Oecetis sp*	12	+
59510	*Oecetis avara*	4	
62200	*Copelatus sp*		+
65800	*Berosus sp*		+
66500	*Enochrus sp*		+
67800	*Tropisternus sp*		+
68075	*Psephenus herricki*		+
68130	*Helichus sp*		+
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	2	+
69400	*Stenelmis sp*	1	
71100	*Hexatoma sp*		+
77120	*Ablabesmyia mallochi*	137	+
77500	*Conchapelopia sp*	20	
77750	*Hayesomyia senata or Thienemannimyia norena*	39	
77800	*Helopelopia sp*		+
78450	*Nilotanypus fimbriatus*	20	
78750	*Rheopelopia paramaculipennis*	98	
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	40	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	20	+
81280	*Nanocladius (Plecopteracoluthus) n. sp*		+
82070	*Synorthocladius semivirens*	20	
82121	*Thienemanniella n.sp 3*		+
82141	*Thienemanniella xena*	24	
82730	*Chironomus (C.) decorus group*		+
83040	*Dicrotendipes neomodestus*	312	+
83900	*Nilothauma sp*	20	
84450	*Polypedilum (P.) convictum*	137	+
84460	*Polypedilum (P.) fallax group*		+
84470	*Polypedilum (P.) illinoense*		+
84700	*Stenochironomus sp*		+
84888	*Xenochironomus xenolabis*		+
84960	*Pseudochironomus sp*	20	
85615	*Rheotanytarsus distinctissimus group*	293	
85625	*Rheotanytarsus exiguus group*	273	+

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 22.60

Taxa Code	Taxa	Quant/Qual	
85720	*Stempellinella n.sp nr. flavidula*	20	
85800	*Tanytarsus sp*	39	
85814	*Tanytarsus glabrescens group*	351	+
85840	*Tanytarsus guerlus group*		+
87540	*Hemerodromia sp*	48	
93900	*Elimia sp*	9	+
95100	*Physella sp*	1	+
96900	*Ferrissia sp*	1	
98600	*Sphaerium sp*		+
99180	*Strophitus undulatus undulatus*		+
99280	*Lasmigona costata*		+

No. Quantitative Taxa: 56 Total Taxa: 94

No. Qualitative Taxa: 65 ICI: **50**

Number of Organisms: 3004 Qual EPT: 22

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 03-001 River: Grand River RM: 13.60

Taxa Code	Taxa	Quant	Qual
01320	*Hydra sp*	34	
01900	*Nemertea*		+
03360	*Plumatella sp*	1	
03451	*Urnatella gracilis*	8	
03600	*Oligochaeta*	16	
04964	*Mooreobdella microstoma*		+
08240	*Orconectes (Crokerinus) propinquus*		+
11110	*Baetis armillatus*	3	
11118	*Baetis dubius*	1	
11130	*Baetis intercalaris*	502	
12200	*Isonychia sp*	78	+
13000	*Leucrocuta sp*	39	
13400	*Stenacron sp*	137	+
13540	*Stenonema mediopunctatum*	647	+
13561	*Stenonema pulchellum*	39	+
13590	*Stenonema vicarium*	39	
16324	*Serratella deficiens*	2	
16700	*Tricorythodes sp*	36	
17200	*Caenis sp*	34	+
18600	*Ephemera sp*	1	
22001	*Coenagrionidae*		+
22300	*Argia sp*	12	+
24710	*Dromogomphus spinosis*		+
24900	*Gomphus sp*		+
25510	*Stylogomphus albistylus*		+
27400	*Neurocordulia sp*	1	
34110	*Acroneuria abnormis*		+
34130	*Acroneuria frisoni*	2	+
34140	*Acroneuria internata*	6	
34300	*Neoperla clymene complex*		+
34700	*Agnetina capitata complex*	1	+
43300	*Ranatra sp*		+
47600	*Sialis sp*		+
48410	*Corydalus cornutus*	10	+
50315	*Chimarra obscura*	31	+
51300	*Neureclipsis sp*	3	
51600	*Polycentropus sp*	1	
52200	*Cheumatopsyche sp*	130	+
52430	*Ceratopsyche morosa group*	42	
52540	*Hydropsyche dicantha*	77	+
52550	*Hydropsyche frisoni*	91	+
52620	*Macrostemum zebratum*	7	+
53800	*Hydroptila sp*	16	
59110	*Ceraclea ancylus*		+
59120	*Ceraclea flava complex*		+
59500	*Oecetis sp*	8	
59970	*Petrophila sp*		+
65800	*Berosus sp*		+
67500	*Laccobius sp*		+
68075	*Psephenus herricki*		+
68601	*Ancyronyx variegata*		+
68901	*Macronychus glabratus*	6	
69400	*Stenelmis sp*	5	+
71100	*Hexatoma sp*		+
74100	*Simulium sp*		+
77130	*Ablabesmyia rhamphe group*		+
78450	*Nilotanypus fimbriatus*	208	+
78650	*Procladius sp*		+
78750	*Rheopelopia paramaculipennis*	148	+
80410	*Cricotopus (C.) sp*		+
81250	*Nanocladius (N.) minimus*	30	
81270	*Nanocladius (N.) spiniplenus*		+
82730	*Chironomus (C.) decorus group*		+
82770	*Chironomus (C.) riparius group*		+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	30	+
84450	*Polypedilum (P.) convictum*	445	+
84651	*Stelechomyia perpulchra*	30	
85615	*Rheotanytarsus distinctissimus group*	296	
85625	*Rheotanytarsus exiguus group*	2019	+
85800	*Tanytarsus sp*		+
85814	*Tanytarsus glabrescens group*	178	
85840	*Tanytarsus guerlus group*	119	
87540	*Hemerodromia sp*	1	
93900	*Elimia sp*	3	+
95100	*Physella sp*		+
96900	*Ferrissia sp*	2	+
98600	*Sphaerium sp*		+
99180	*Strophitus undulatus undulatus*		+
99560	*Ptychobranchus fasciolaris*		+
99600	*Actinonaias ligamentina carinata*		+

No. Quantitative Taxa: 48 Total Taxa: 81

No. Qualitative Taxa: 55 ICI: **52**

Number of Organisms: 5575 Qual EPT: 16

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-001 River: Grand River RM: 8.50

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
08240	*Orconectes (Crokerinus) propinquus*	+
11118	*Baetis dubius*	+
11130	*Baetis intercalaris*	+
11650	*Procloeon sp (w/ hindwing pads)*	+
13000	*Leucrocuta sp*	+
13400	*Stenacron sp*	+
13561	*Stenonema pulchellum*	+
17200	*Caenis sp*	+
18100	*Anthopotamus sp*	+
18600	*Ephemera sp*	+
18750	*Hexagenia limbata*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
24900	*Gomphus sp*	+
27409	*Neurocordulia yamaskanensis*	+
34110	*Acroneuria abnormis*	+
34140	*Acroneuria internata*	+
34700	*Agnetina capitata complex*	+
47600	*Sialis sp*	+
48410	*Corydalus cornutus*	+
50301	*Chimarra aterrima*	+
50315	*Chimarra obscura*	+
51300	*Neureclipsis sp*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52540	*Hydropsyche dicantha*	+
52620	*Macrostemum zebratum*	+
53800	*Hydroptila sp*	+
59110	*Ceraclea ancylus*	+
59120	*Ceraclea flava complex*	+
60900	*Peltodytes sp*	+
68075	*Psephenus herricki*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	+
71100	*Hexatoma sp*	+
74100	*Simulium sp*	+
77800	*Helopelopia sp*	+
78450	*Nilotanypus fimbriatus*	+
78650	*Procladius sp*	+
80310	*Cardiocladius obscurus*	+
80420	*Cricotopus (C.) bicinctus*	+
81280	*Nanocladius (Plecopteracoluthus) n. sp*	+
82220	*Tvetenia discoloripes group*	+
82600	*Axarus sp*	+
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
84450	*Polypedilum (P.) convictum*	+
85263	*Cladotanytarsus vanderwulpi group Type 3*	+
85615	*Rheotanytarsus distinctissimus group*	+
85625	*Rheotanytarsus exiguus group*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	+
99600	*Actinonaias ligamentina carinata*	+

No. Quantitative Taxa: 0 Total Taxa: 55

No. Qualitative Taxa: 55 ICI:

Number of Organisms: 0 Qual EPT: 23

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 03-001 River: Grand River RM: 6.20

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	32	
01801	*Turbellaria*	24	+
03451	*Urnatella gracilis*	32	
03600	*Oligochaeta*	432	+
11118	*Baetis dubius*	90	
11130	*Baetis intercalaris*	1331	+
12200	*Isonychia sp*		+
13000	*Leucrocuta sp*		+
13400	*Stenacron sp*	258	+
13540	*Stenonema mediopunctatum*	190	
13561	*Stenonema pulchellum*	432	+
16700	*Tricorythodes sp*	107	+
17200	*Caenis sp*	303	+
18100	*Anthopotamus sp*		+
18600	*Ephemera sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	9	+
23909	*Boyeria vinosa*		+
25510	*Stylogomphus albistylus*		+
27409	*Neurocordulia yamaskanensis*		+
34140	*Acroneuria internata*		+
34700	*Agnetina capitata complex*		+
47600	*Sialis sp*		+
48410	*Corydalus cornutus*	5	
50315	*Chimarra obscura*	536	+
51300	*Neureclipsis sp*	3	+
51600	*Polycentropus sp*		+
52200	*Cheumatopsyche sp*	1433	+
52430	*Ceratopsyche morosa group*	677	
52540	*Hydropsyche dicantha*	954	+
52550	*Hydropsyche frisoni*	348	
52620	*Macrostemum zebratum*	1425	+
53800	*Hydroptila sp*	66	+
58505	*Helicopsyche borealis*		+
59110	*Ceraclea ancylus*		+
59500	*Oecetis sp*	3	
60300	*Dineutus sp*		+
68075	*Psephenus herricki*		+
68130	*Helichus sp*		+
68601	*Ancyronyx variegata*		+
68700	*Dubiraphia sp*	1	
68901	*Macronychus glabratus*		+
69400	*Stenelmis sp*	4	+

Taxa Code	Taxa	Quant/Qual	
74100	*Simulium sp*	33	
77500	*Conchapelopia sp*	112	+
77750	*Hayesomyia senata or Thienemannimyia norena*	223	+
77800	*Helopelopia sp*		+
78450	*Nilotanypus fimbriatus*	781	
78750	*Rheopelopia paramaculipennis*	893	+
80370	*Corynoneura lobata*		+
80410	*Cricotopus (C.) sp*		+
80420	*Cricotopus (C.) bicinctus*	223	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*		+
82101	*Thienemanniella n.sp 1*		+
82141	*Thienemanniella xena*	112	
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*		+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*		+
84450	*Polypedilum (P.) convictum*	2902	+
84470	*Polypedilum (P.) illinoense*		+
85261	*Cladotanytarsus vanderwulpi group Type 1*		+
85615	*Rheotanytarsus distinctissimus group*	781	
85625	*Rheotanytarsus exiguus group*	3907	+
85814	*Tanytarsus glabrescens group*	112	
87540	*Hemerodromia sp*	64	
89501	*Ephydridae*		+
93900	*Elimia sp*	10	+
95100	*Physella sp*		+
96900	*Ferrissia sp*	76	+
99240	*Lasmigona complanata*		+
99700	*Potamilus alatus*		+

No. Quantitative Taxa: 38 Total Taxa: 71

No. Qualitative Taxa: 55 ICI: **44**

Number of Organisms: 18924 Qual EPT: 20

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-022 River: Baughman Creek RM: 4.10

Taxa Code	Taxa	Quant/Qual
00675	*Heteromeyenia latitenta*	+
01801	*Turbellaria*	12 +
03600	*Oligochaeta*	1
08240	*Orconectes (Crokerinus) propinquus*	+
08601	*Hydracarina*	+
11020	*Acerpenna pygmaeus*	9 +
11120	*Baetis flavistriga*	1
11130	*Baetis intercalaris*	3 +
11651	*Procloeon sp (w/o hindwing pads)*	1
13400	*Stenacron sp*	29 +
13521	*Stenonema femoratum*	3 +
13590	*Stenonema vicarium*	22 +
14950	*Leptophlebia sp or Paraleptophebia sp*	379 +
17200	*Caenis sp*	+
21200	*Calopteryx sp*	12 +
22001	*Coenagrionidae*	3
45100	*Palmacorixa sp*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
48620	*Nigronia serricornis*	1 +
50301	*Chimarra aterrima*	1 +
50315	*Chimarra obscura*	+
50804	*Lype diversa*	6
51300	*Neureclipsis sp*	1 +
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	2 +
52430	*Ceratopsyche morosa group*	+
52530	*Hydropsyche depravata group*	4 +
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	+
60300	*Dineutus sp*	+
64800	*Uvarus sp*	+
66150	*Crenitis sp*	+
67100	*Hydrobius sp*	+
68075	*Psephenus herricki*	+
68130	*Helichus sp*	1
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	3 +
69400	*Stenelmis sp*	5 +
71100	*Hexatoma sp*	+
71910	*Tipula abdominalis*	+
74100	*Simulium sp*	+
77500	*Conchapelopia sp*	15 +
77750	*Hayesomyia senata or Thienemannimyia norena*	+
77800	*Helopelopia sp*	5
78402	*Natarsia baltimoreus*	5
78450	*Nilotanypus fimbriatus*	56
79400	*Zavrelimyia sp*	19
80370	*Corynoneura lobata*	90
81650	*Parametriocnemus sp*	+
82121	*Thienemanniella n.sp 3*	10
82200	*Tvetenia bavarica group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	5
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	10
83840	*Microtendipes pedellus group*	160 +
84210	*Paratendipes albimanus or P. duplicatus*	29
84300	*Phaenopsectra obediens group*	24
84440	*Polypedilum (P.) aviceps*	+
84450	*Polypedilum (P.) convictum*	+
84460	*Polypedilum (P.) fallax group*	34 +
84480	*Polypedilum (P.) laetum group*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
84700	*Stenochironomus sp*	5
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	83 +
85800	*Tanytarsus sp*	39
85802	*Tanytarsus curticornis group*	10
85814	*Tanytarsus glabrescens group*	68 +
86100	*Chrysops sp*	+
87540	*Hemerodromia sp*	14 +
96900	*Ferrissia sp*	10
98200	*Pisidium sp*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 41 Total Taxa: 75

No. Qualitative Taxa: 55 ICI: **50**

Number of Organisms: 1190 Qual EPT: 17

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-100 River: Big Creek RM: 16.10

Taxa Code	Taxa	Quant/Qual	
03600	*Oligochaeta*	156	+
04653	*Glossiphonia complanata*		+
04935	*Erpobdella punctata punctata*	1	+
08240	*Orconectes (Crokerinus) propinquus*		+
11120	*Baetis flavistriga*		+
14950	*Leptophlebia sp or Paraleptophebia sp*	4	
21200	*Calopteryx sp*	4	+
22001	*Coenagrionidae*	4	+
22300	*Argia sp*		+
23905	*Boyeria grafiana*		+
23909	*Boyeria vinosa*		+
42700	*Belostoma sp*		+
52200	*Cheumatopsyche sp*		+
52530	*Hydropsyche depravata group*		+
53800	*Hydroptila sp*		+
66500	*Enochrus sp*		+
74100	*Simulium sp*		+
74501	*Ceratopogonidae*	12	
77500	*Conchapelopia sp*	26	
77750	*Hayesomyia senata or Thienemannimyia norena*	77	+
77800	*Helopelopia sp*	109	+
78450	*Nilotanypus fimbriatus*	6	+
80370	*Corynoneura lobata*	4	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	32	
81650	*Parametriocnemus sp*	13	
84315	*Phaenopsectra flavipes*	13	
84430	*Polypedilum (P.) albicorne*	96	+
84460	*Polypedilum (P.) fallax group*	148	
84470	*Polypedilum (P.) illinoense*	13	
85500	*Paratanytarsus sp*	13	
85814	*Tanytarsus glabrescens group*	6	
86100	*Chrysops sp*		+
86401	*Atherix lantha*		+
95100	*Physella sp*	5	+
96002	*Helisoma anceps anceps*		+
96900	*Ferrissia sp*	138	+

No. Quantitative Taxa: 21 Total Taxa: 36

No. Qualitative Taxa: 25 ICI: **12**

Number of Organisms: 880 Qual EPT: 4

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-100 River: Big Creek RM: 16.00

Taxa Code	Taxa	Quant/Qual	
03600	*Oligochaeta*	426	+
08240	*Orconectes (Crokerinus) propinquus*		+
11120	*Baetis flavistriga*	136	+
16200	*Eurylophella sp*	1	
17200	*Caenis sp*	1	
21200	*Calopteryx sp*	5	+
22300	*Argia sp*	2	+
23618	*Aeshna umbrosa*		+
23905	*Boyeria grafiana*		+
26100	*Cordulegaster sp*		+
52530	*Hydropsyche depravata group*		+
53800	*Hydroptila sp*		+
66500	*Enochrus sp*		+
67800	*Tropisternus sp*		+
68130	*Helichus sp*		+
71910	*Tipula abdominalis*		+
74100	*Simulium sp*		+
74501	*Ceratopogonidae*		+
77500	*Conchapelopia sp*	102	+
77750	*Hayesomyia senata or Thienemannimyia norena*	66	+
77800	*Helopelopia sp*	46	
80410	*Cricotopus (C.) sp*		+
80420	*Cricotopus (C.) bicinctus*	244	+
80430	*Cricotopus (C.) tremulus group*	5	
81650	*Parametriocnemus sp*	10	
81825	*Rheocricotopus (Psilocricotopus) robacki*		+
82820	*Cryptochironomus sp*	10	+
84460	*Polypedilum (P.) fallax group*	10	
84470	*Polypedilum (P.) illinoense*	36	+
85625	*Rheotanytarsus exiguus group*	10	+
86100	*Chrysops sp*	5	
87540	*Hemerodromia sp*	4	
89501	*Ephydridae*		+
95100	*Physella sp*	4	+
96900	*Ferrissia sp*	2	
98200	*Pisidium sp*		+

No. Quantitative Taxa: 20 Total Taxa: 36

No. Qualitative Taxa: 27 ICI: **12**

Number of Organisms: 1125 Qual EPT: 3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-100 River: Big Creek RM: 14.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03360	*Plumatella sp*	+
08240	*Orconectes (Crokerinus) propinquus*	+
11120	*Baetis flavistriga*	105 +
11130	*Baetis intercalaris*	100 +
11651	*Procloeon sp (w/o hindwing pads)*	1 +
12200	*Isonychia sp*	5 +
13000	*Leucrocuta sp*	11 +
13400	*Stenacron sp*	23 +
13521	*Stenonema femoratum*	12 +
13590	*Stenonema vicarium*	2 +
17200	*Caenis sp*	5 +
21200	*Calopteryx sp*	26 +
22300	*Argia sp*	+
23618	*Aeshna umbrosa*	+
23909	*Boyeria vinosa*	+
24900	*Gomphus sp*	+
34700	*Agnetina capitata complex*	2 +
48620	*Nigronia serricornis*	+
50301	*Chimarra aterrima*	+
50804	*Lype diversa*	8 +
51400	*Nyctiophylax sp*	+
52200	*Cheumatopsyche sp*	+
52440	*Ceratopsyche slossonae*	+
52530	*Hydropsyche depravata group*	+
57900	*Pycnopsyche sp*	+
68075	*Psephenus herricki*	+
69400	*Stenelmis sp*	37 +
70600	*Antocha sp*	3 +
71100	*Hexatoma sp*	+
74100	*Simulium sp*	+
74501	*Ceratopogonidae*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	116 +
77800	*Helopelopia sp*	39
78450	*Nilotanypus fimbriatus*	40 +
80370	*Corynoneura lobata*	108 +
80410	*Cricotopus (C.) sp*	39
81465	*Orthocladius (O.) carlatus*	8
81650	*Parametriocnemus sp*	16 +
82101	*Thienemanniella n.sp 1*	16 +
82141	*Thienemanniella xena*	4
82300	*Xylotopus par*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	8
84300	*Phaenopsectra obediens group*	8
84315	*Phaenopsectra flavipes*	+
84450	*Polypedilum (P.) convictum*	31
84460	*Polypedilum (P.) fallax group*	47 +
84470	*Polypedilum (P.) illinoense*	16
84480	*Polypedilum (P.) laetum group*	+
84540	*Polypedilum (Tripodura) scalaenum group*	31
84700	*Stenochironomus sp*	8
84750	*Stictochironomus sp*	+
85501	*Paratanytarsus n.sp 1*	16 +
85625	*Rheotanytarsus exiguus group*	109 +
85800	*Tanytarsus sp*	23 +
85814	*Tanytarsus glabrescens group*	109
86401	*Atherix lantha*	1 +
87400	*Stratiomys sp*	+
87540	*Hemerodromia sp*	48
95100	*Physella sp*	12 +
96900	*Ferrissia sp*	15 +

No. Quantitative Taxa: 38 Total Taxa: 63

No. Qualitative Taxa: 51 ICI: **50**

Number of Organisms: 1208 Qual EPT: 17

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-100 River: Big Creek RM: 9.40

Taxa Code	Taxa	Quant	Qual
01801	*Turbellaria*		+
03360	*Plumatella sp*		+
03600	*Oligochaeta*	8	
08240	*Orconectes (Crokerinus) propinquus*		+
11130	*Baetis intercalaris*	10	+
11650	*Procloeon sp (w/ hindwing pads)*		+
11651	*Procloeon sp (w/o hindwing pads)*	3	+
11670	*Procloeon irrubrum*		+
12200	*Isonychia sp*		+
13000	*Leucrocuta sp*	9	+
13400	*Stenacron sp*		+
13521	*Stenonema femoratum*	2	+
13561	*Stenonema pulchellum*		+
13590	*Stenonema vicarium*	2	
17200	*Caenis sp*	22	+
18619	*Ephemera simulans*	1	+
21200	*Calopteryx sp*	4	+
23909	*Boyeria vinosa*	1	+
24900	*Gomphus sp*		+
25510	*Stylogomphus albistylus*		+
34120	*Acroneuria carolinensis*	1	+
34700	*Agnetina capitata complex*		+
47600	*Sialis sp*	1	
48620	*Nigronia serricornis*		+
50301	*Chimarra aterrima*		+
50315	*Chimarra obscura*		+
50804	*Lype diversa*		+
51400	*Nyctiophylax sp*		+
52430	*Ceratopsyche morosa group*		+
52440	*Ceratopsyche slossonae*		+
52530	*Hydropsyche depravata group*		+
52540	*Hydropsyche dicantha*		+
53800	*Hydroptila sp*		+
57400	*Neophylax sp*		+
57900	*Pycnopsyche sp*		+
58505	*Helicopsyche borealis*		+
65800	*Berosus sp*	3	
68075	*Psephenus herricki*		+
68708	*Dubiraphia vittata group*		+
69210	*Optioservus ampliatus*		+
69400	*Stenelmis sp*	5	+
70600	*Antocha sp*		+
74100	*Simulium sp*		+
74501	*Ceratopogonidae*		+
77120	*Ablabesmyia mallochi*	21	
77500	*Conchapelopia sp*		+
77800	*Helopelopia sp*	137	+
78140	*Labrundinia pilosella*	10	
78402	*Natarsia baltimoreus*	10	
80370	*Corynoneura lobata*	44	
80420	*Cricotopus (C.) bicinctus*		+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	21	+
82101	*Thienemanniella n.sp 1*	4	
82141	*Thienemanniella xena*		+
83040	*Dicrotendipes neomodestus*	42	
83840	*Microtendipes pedellus group*	10	
84210	*Paratendipes albimanus or P. duplicatus*	95	
84300	*Phaenopsectra obediens group*	10	+
84460	*Polypedilum (P.) fallax group*	127	
84480	*Polypedilum (P.) laetum group*		+
84540	*Polypedilum (Tripodura) scalaenum group*	137	+
85230	*Cladotanytarsus mancus group*		+
85500	*Paratanytarsus sp*	53	
85625	*Rheotanytarsus exiguus group*	53	+
85800	*Tanytarsus sp*	116	
85814	*Tanytarsus glabrescens group*	42	
86401	*Atherix lantha*		+
87540	*Hemerodromia sp*	8	+
95100	*Physella sp*	3	
96900	*Ferrissia sp*	21	+

No. Quantitative Taxa: 34 Total Taxa: 70
No. Qualitative Taxa: 53 ICI: **32**
Number of Organisms: 1036 Qual EPT: 25

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-100 River: Big Creek RM: 2.50

Taxa Code	Taxa	Quant/Qual
05800	*Caecidotea sp*	+
08240	*Orconectes (Crokerinus) propinquus*	+
11010	*Acentrella sp*	1 +
11120	*Baetis flavistriga*	5
11130	*Baetis intercalaris*	41 +
11650	*Procloeon sp (w/ hindwing pads)*	1
12200	*Isonychia sp*	24 +
13000	*Leucrocuta sp*	43 +
13400	*Stenacron sp*	12 +
13521	*Stenonema femoratum*	+
13561	*Stenonema pulchellum*	79 +
13590	*Stenonema vicarium*	9
16700	*Tricorythodes sp*	11 +
17200	*Caenis sp*	70 +
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
23905	*Boyeria grafiana*	+
24900	*Gomphus sp*	+
34120	*Acroneuria carolinensis*	2 +
34700	*Agnetina capitata complex*	+
36001	*Chloroperlidae*	+
48410	*Corydalus cornutus*	+
50301	*Chimarra aterrima*	1 +
50315	*Chimarra obscura*	2 +
51300	*Neureclipsis sp*	+
52200	*Cheumatopsyche sp*	9 +
52430	*Ceratopsyche morosa group*	1 +
52530	*Hydropsyche depravata group*	+
52540	*Hydropsyche dicantha*	22 +
57900	*Pycnopsyche sp*	+
59110	*Ceraclea ancylus*	+
59500	*Oecetis sp*	1
60300	*Dineutus sp*	+
67800	*Tropisternus sp*	+
68075	*Psephenus herricki*	+
69400	*Stenelmis sp*	1 +
70600	*Antocha sp*	4 +
71100	*Hexatoma sp*	+
74501	*Ceratopogonidae*	4
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	24
77750	*Hayesomyia senata or Thienemannimyia norena*	94 +
77800	*Helopelopia sp*	8
78450	*Nilotanypus fimbriatus*	28
78650	*Procladius sp*	+
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	12 +
80370	*Corynoneura lobata*	88
80410	*Cricotopus (C.) sp*	24
80420	*Cricotopus (C.) bicinctus*	8
80430	*Cricotopus (C.) tremulus group*	16
81060	*Lopescladius sp*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	8
82101	*Thienemanniella n.sp 1*	4
82141	*Thienemanniella xena*	16
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	16
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	16
84210	*Paratendipes albimanus or P. duplicatus*	+
84450	*Polypedilum (P.) convictum*	110 +
84470	*Polypedilum (P.) illinoense*	24
84540	*Polypedilum (Tripodura) scalaenum group*	8
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	353 +
85720	*Stempellinella n.sp nr. flavidula*	8 +
85752	*Sublettea coffmani*	8
85800	*Tanytarsus sp*	63 +
85802	*Tanytarsus curticornis group*	8
85814	*Tanytarsus glabrescens group*	39 +
86401	*Atherix lantha*	+
87540	*Hemerodromia sp*	20
96900	*Ferrissia sp*	+

No. Quantitative Taxa: 45   Total Taxa: 73

No. Qualitative Taxa: 51   ICI: **52**

Number of Organisms: 1346   Qual EPT: 21

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-104 River: Jenks Creek RM: 0.50

Taxa Code	Taxa	Quant/Qual
07860	*Cambarus (Puncticambarus) robustus*	+
11120	*Baetis flavistriga*	+
11650	*Procloeon sp (w/ hindwing pads)*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
16200	*Eurylophella sp*	+
21200	*Calopteryx sp*	+
23905	*Boyeria grafiana*	+
34120	*Acroneuria carolinensis*	+
34130	*Acroneuria frisoni*	+
34700	*Agnetina capitata complex*	+
48620	*Nigronia serricornis*	+
50410	*Dolophilodes distinctus*	+
50804	*Lype diversa*	+
50906	*Psychomyia flavida*	+
51400	*Nyctiophylax sp*	+
52440	*Ceratopsyche slossonae*	+
52530	*Hydropsyche depravata group*	+
53501	*Hydroptilidae*	+
56001	*Limnephilidae*	+
57400	*Neophylax sp*	+
68025	*Ectopria sp*	+
68075	*Psephenus herricki*	+
70700	*Dicranota sp*	+
71100	*Hexatoma sp*	+
71910	*Tipula abdominalis*	+
72340	*Dixella sp*	+
77500	*Conchapelopia sp*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	+
79300	*Trissopelopia ogemawi*	+
79400	*Zavrelimyia sp*	+
82200	*Tvetenia bavarica group*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
84470	*Polypedilum (P.) illinoense*	+
85501	*Paratanytarsus n.sp 1*	+
85615	*Rheotanytarsus distinctissimus group*	+
85625	*Rheotanytarsus exiguus group*	+
85800	*Tanytarsus sp*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 40

No. Qualitative Taxa: 40 ICI:

Number of Organisms: 0 Qual EPT: 17

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-110 River: Paine Creek RM: 0.50

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	+
08240	*Orconectes (Crokerinus) propinquus*	+
11010	*Acentrella sp*	+
12200	*Isonychia sp*	+
13000	*Leucrocuta sp*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
13561	*Stenonema pulchellum*	+
13590	*Stenonema vicarium*	+
17200	*Caenis sp*	+
18600	*Ephemera sp*	+
22300	*Argia sp*	+
25305	*Ophiogomphus aspersus*	+
25510	*Stylogomphus albistylus*	+
34130	*Acroneuria frisoni*	+
34140	*Acroneuria internata*	+
47600	*Sialis sp*	+
48620	*Nigronia serricornis*	+
50301	*Chimarra aterrima*	+
50315	*Chimarra obscura*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
57900	*Pycnopsyche sp*	+
68075	*Psephenus herricki*	+
68130	*Helichus sp*	+
69400	*Stenelmis sp*	+
74501	*Ceratopogonidae*	+
77120	*Ablabesmyia mallochi*	+
77800	*Helopelopia sp*	+
81631	*Parakiefferiella n.sp 1*	+
81650	*Parametriocnemus sp*	+
82730	*Chironomus (C.) decorus group*	+
82770	*Chironomus (C.) riparius group*	+
83840	*Microtendipes pedellus group*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84300	*Phaenopsectra obediens group*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 37

No. Qualitative Taxa: 37 ICI:

Number of Organisms: 0 Qual EPT: 16

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-120 River: Mill Creek (Grand R. RM 41.28) RM: 18.20

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	133	
01801	*Turbellaria*	4	+
03121	*Paludicella articulata*	1	+
03360	*Plumatella sp*	5	+
03600	*Oligochaeta*	283	+
04685	*Placobdella ornata*		+
04686	*Placobdella papillifera*	1	
06201	*Hyalella azteca*	2	+
08240	*Orconectes (Crokerinus) propinquus*	1	+
08601	*Hydracarina*		+
11130	*Baetis intercalaris*		+
11250	*Centroptilum sp (w/o hindwing pads)*		+
11651	*Procloeon sp (w/o hindwing pads)*	10	
12200	*Isonychia sp*		+
13400	*Stenacron sp*	12	+
13521	*Stenonema femoratum*		+
16200	*Eurylophella sp*		+
17200	*Caenis sp*	64	+
21200	*Calopteryx sp*	2	
22001	*Coenagrionidae*		+
22300	*Argia sp*		+
24501	*Gomphidae*		+
34130	*Acroneuria frisoni*	7	+
43300	*Ranatra sp*		+
47600	*Sialis sp*		+
50315	*Chimarra obscura*		+
51600	*Polycentropus sp*		+
52200	*Cheumatopsyche sp*	1	+
52430	*Ceratopsyche morosa group*		+
57400	*Neophylax sp*		+
57900	*Pycnopsyche sp*		+
59110	*Ceraclea ancylus*		+
59400	*Nectopsyche sp*		+
60400	*Gyrinus sp*		+
63300	*Hydroporus sp*	1	
65800	*Berosus sp*		+
66500	*Enochrus sp*	2	
67700	*Paracymus sp*		+
67800	*Tropisternus sp*		+
68025	*Ectopria sp*		+
68075	*Psephenus herricki*	8	+
68201	*Scirtidae*	8	
68601	*Ancyronyx variegata*		+

Taxa Code	Taxa	Quant/Qual	
68708	*Dubiraphia vittata group*	1	+
69400	*Stenelmis sp*	74	+
71900	*Tipula sp*		+
74501	*Ceratopogonidae*		+
77115	*Ablabesmyia janta*	16	
77500	*Conchapelopia sp*	48	+
77750	*Hayesomyia senata or Thienemannimyia norena*	32	
78101	*Labrundinia becki*	16	
78140	*Labrundinia pilosella*	32	
80370	*Corynoneura lobata*	96	+
80410	*Cricotopus (C.) sp*	587	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	16	
82820	*Cryptochironomus sp*		+
83300	*Glyptotendipes (G.) sp*	16	+
83840	*Microtendipes pedellus group*	95	+
84210	*Paratendipes albimanus or P. duplicatus*	16	
84450	*Polypedilum (P.) convictum*	127	+
84460	*Polypedilum (P.) fallax group*	79	+
84470	*Polypedilum (P.) illinoense*	16	
84540	*Polypedilum (Tripodura) scalaenum group*	79	+
84700	*Stenochironomus sp*	16	
84750	*Stictochironomus sp*		+
85625	*Rheotanytarsus exiguus group*	127	+
85800	*Tanytarsus sp*	429	+
85802	*Tanytarsus curticornis group*	254	
85814	*Tanytarsus glabrescens group*	175	+
86200	*Tabanus sp*		+
92516	*Campeloma decisum*		+
95100	*Physella sp*	1	+
96100	*Menetus (Micromenetus) sp*	6	
96264	*Planorbella (Pierosoma) pilsbryi*	8	+
96900	*Ferrissia sp*	12	+
98600	*Sphaerium sp*	3	+
99280	*Lasmigona costata*		+
99440	*Fusconaia flava*		+
99860	*Lampsilis radiata luteola*		+

No. Quantitative Taxa: 45 Total Taxa: 79

No. Qualitative Taxa: 61 ICI: **36**

Number of Organisms: 2922 Qual EPT: 16

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 03-120 River: Mill Creek (Grand R. RM 41.28) RM: 12.10

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	62	
01801	*Turbellaria*	42	+
03360	*Plumatella sp*	3	+
03600	*Oligochaeta*	2018	+
04666	*Helobdella triserialis*		+
06201	*Hyalella azteca*	31	+
08240	*Orconectes (Crokerinus) propinquus*		+
08601	*Hydracarina*		+
11651	*Procloeon sp (w/o hindwing pads)*	23	
11670	*Procloeon irrubrum*		+
13521	*Stenonema femoratum*	34	+
15000	*Paraleptophlebia sp*	63	
16200	*Eurylophella sp*	11	+
17200	*Caenis sp*	132	+
22001	*Coenagrionidae*	34	+
22300	*Argia sp*	10	
23804	*Basiaeschna janata*		+
27610	*Epitheca (Tetragoneuria) cynosura*		+
43300	*Ranatra sp*		+
47600	*Sialis sp*		+
50315	*Chimarra obscura*		+
51400	*Nyctiophylax sp*	24	+
51600	*Polycentropus sp*	1	
52200	*Cheumatopsyche sp*		+
57400	*Neophylax sp*		+
59100	*Ceraclea sp*	1	
59110	*Ceraclea ancylus*		+
60800	*Haliplus sp*		+
65800	*Berosus sp*	33	+
68075	*Psephenus herricki*		+
68601	*Ancyronyx variegata*	1	+
68708	*Dubiraphia vittata group*	4	+
68901	*Macronychus glabratus*		+
69400	*Stenelmis sp*	1	+
74501	*Ceratopogonidae*	8	
77115	*Ablabesmyia janta*	27	
77120	*Ablabesmyia mallochi*	33	+
77130	*Ablabesmyia rhamphe group*	6	
77500	*Conchapelopia sp*	11	
77750	*Hayesomyia senata or Thienemannimyia norena*	6	
77800	*Helopelopia sp*		+
78101	*Labrundinia becki*	6	

Taxa Code	Taxa	Quant/Qual	
78140	*Labrundinia pilosella*	16	
80370	*Corynoneura lobata*		+
80410	*Cricotopus (C.) sp*	16	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	6	
82820	*Cryptochironomus sp*		+
82880	*Cryptotendipes sp*		+
83040	*Dicrotendipes neomodestus*	71	+
83051	*Dicrotendipes simpsoni*	5	
83300	*Glyptotendipes (G.) sp*	44	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*		+
83840	*Microtendipes pedellus group*	27	+
83900	*Nilothauma sp*	11	
84010	*Parachironomus "abortivus" (sensu Simpson & Bode, 1980)*	6	
84060	*Parachironomus pectinatellae*	5	
84450	*Polypedilum (P.) convictum*		+
84460	*Polypedilum (P.) fallax group*	5	
84800	*Tribelos jucundum*	6	
84960	*Pseudochironomus sp*	11	
85201	*Cladotanytarsus species group A*	6	
85500	*Paratanytarsus sp*	16	
85720	*Stempellinella n.sp nr. flavidula*	5	
85800	*Tanytarsus sp*	60	+
85814	*Tanytarsus glabrescens group*	27	
86100	*Chrysops sp*		+
89560	*Hydrellia sp*		+
95100	*Physella sp*	55	
96120	*Menetus (Micromenetus) dilatatus*	556	
96900	*Ferrissia sp*	75	
98600	*Sphaerium sp*		+
99100	*Pyganodon grandis*		+
99820	*Villosa iris iris*		+

No. Quantitative Taxa: 47 Total Taxa: 73

No. Qualitative Taxa: 44 ICI: **26**

Number of Organisms: 3654 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 03-124 River: Cemetery Creek RM: 2.50

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03360	*Plumatella sp*	+
04664	*Helobdella stagnalis*	+
04685	*Placobdella ornata*	+
06201	*Hyalella azteca*	+
08240	*Orconectes (Crokerinus) propinquus*	+
13521	*Stenonema femoratum*	+
17200	*Caenis sp*	+
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
23700	*Anax sp*	+
28500	*Libellula sp*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
63900	*Laccophilus sp*	+
66500	*Enochrus sp*	+
67700	*Paracymus sp*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	+
78401	*Natarsia species A (sensu Roback, 1978)*	+
78650	*Procladius sp*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	+
82730	*Chironomus (C.) decorus group*	+
83040	*Dicrotendipes neomodestus*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84315	*Phaenopsectra flavipes*	+
84750	*Stictochironomus sp*	+
85500	*Paratanytarsus sp*	+
85800	*Tanytarsus sp*	+
85814	*Tanytarsus glabrescens group*	+
95100	*Physella sp*	+
96002	*Helisoma anceps anceps*	+
96408	*Promenetus umbilicatellus*	+
96900	*Ferrissia sp*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 35

No. Qualitative Taxa: 35 ICI:

Number of Organisms: 0 Qual EPT: 2

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 03-124 River: Cemetery Creek RM: 1.30

Taxa Code	Taxa	Quant/Qual
04664	*Helobdella stagnalis*	+
04960	*Mooreobdella sp*	+
06201	*Hyalella azteca*	+
08601	*Hydracarina*	+
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
25510	*Stylogomphus albistylus*	+
47600	*Sialis sp*	+
48620	*Nigronia serricornis*	+
52530	*Hydropsyche depravata group*	+
67700	*Paracymus sp*	+
69400	*Stenelmis sp*	+
71700	*Pilaria sp*	+
77500	*Conchapelopia sp*	+
80420	*Cricotopus (C.) bicinctus*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) convictum*	+
85625	*Rheotanytarsus exiguus group*	+
95100	*Physella sp*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 22

No. Qualitative Taxa: 22 ICI:

Number of Organisms: 0 Qual EPT: 1

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-130 River: Rock Creek RM: 0.80

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	34
01801	*Turbellaria*	59 +
03121	*Paludicella articulata*	1
03360	*Plumatella sp*	+
03600	*Oligochaeta*	108 +
04666	*Helobdella triserialis*	+
05800	*Caecidotea sp*	+
06201	*Hyalella azteca*	14 +
08240	*Orconectes (Crokerinus) propinquus*	2 +
08601	*Hydracarina*	+
11020	*Acerpenna pygmaeus*	3
11130	*Baetis intercalaris*	1 +
11250	*Centroptilum sp (w/o hindwing pads)*	+
13400	*Stenacron sp*	332 +
13521	*Stenonema femoratum*	23 +
13561	*Stenonema pulchellum*	126 +
14950	*Leptophlebia sp or Paraleptophebia sp*	2
17200	*Caenis sp*	97 +
21200	*Calopteryx sp*	1
22001	*Coenagrionidae*	+
22300	*Argia sp*	32 +
47600	*Sialis sp*	+
50315	*Chimarra obscura*	+
52200	*Cheumatopsyche sp*	3 +
52430	*Ceratopsyche morosa group*	+
52530	*Hydropsyche depravata group*	+
52540	*Hydropsyche dicantha*	+
57400	*Neophylax sp*	+
58505	*Helicopsyche borealis*	2 +
59100	*Ceraclea sp*	2 +
65800	*Berosus sp*	+
66500	*Enochrus sp*	+
67800	*Tropisternus sp*	+
68075	*Psephenus herricki*	2 +
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	9 +
72700	*Anopheles sp*	+
72900	*Culex sp*	+
77500	*Conchapelopia sp*	29 +
77800	*Helopelopia sp*	15 +
78450	*Nilotanypus fimbriatus*	8 +
78650	*Procladius sp*	7
80370	*Corynoneura lobata*	50 +
82070	*Synorthocladius semivirens*	7
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	59
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	7
83840	*Microtendipes pedellus group*	15
84010	*Parachironomus "abortivus" (sensu Simpson & Bode, 1980)*	7
84210	*Paratendipes albimanus or P. duplicatus*	22
84300	*Phaenopsectra obediens group*	7
84450	*Polypedilum (P.) convictum*	118 +
84470	*Polypedilum (P.) illinoense*	7 +
84520	*Polypedilum (Tripodura) halterale group*	+
84540	*Polypedilum (Tripodura) scalaenum group*	22 +
84700	*Stenochironomus sp*	7
85625	*Rheotanytarsus exiguus group*	110 +
85800	*Tanytarsus sp*	37
85814	*Tanytarsus glabrescens group*	81
87540	*Hemerodromia sp*	7
95100	*Physella sp*	+
96120	*Menetus (Micromenetus) dilatatus*	+
96900	*Ferrissia sp*	4

No. Quantitative Taxa: 41 Total Taxa: 64

No. Qualitative Taxa: 46 ICI: **46**

Number of Organisms: 1479 Qual EPT: 14

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 03-150 River: Phelps Creek RM: 4.90

Taxa Code	Taxa	Quant	Qual
00401	*Spongillidae*		+
01320	*Hydra sp*	2	
01801	*Turbellaria*		+
03600	*Oligochaeta*		+
08240	*Orconectes (Crokerinus) propinquus*		+
11120	*Baetis flavistriga*		+
11250	*Centroptilum sp (w/o hindwing pads)*	4	
11651	*Procloeon sp (w/o hindwing pads)*	11	
12200	*Isonychia sp*		+
13400	*Stenacron sp*	8	+
13521	*Stenonema femoratum*	22	+
13590	*Stenonema vicarium*	1	+
14950	*Leptophlebia sp or Paraleptophebia sp*	6	+
15501	*Ephemerellidae*	2	
17200	*Caenis sp*	4	+
18600	*Ephemera sp*		+
24900	*Gomphus sp*		+
25510	*Stylogomphus albistylus*		+
34130	*Acroneuria frisoni*		+
34300	*Neoperla clymene complex*		+
48620	*Nigronia serricornis*		+
50301	*Chimarra aterrima*		+
51600	*Polycentropus sp*		+
52200	*Cheumatopsyche sp*		+
52530	*Hydropsyche depravata group*		+
52540	*Hydropsyche dicantha*		+
59120	*Ceraclea flava complex*		+
63300	*Hydroporus sp*		+
68075	*Psephenus herricki*		+
69400	*Stenelmis sp*		+
71100	*Hexatoma sp*		+
74501	*Ceratopogonidae*		+
77120	*Ablabesmyia mallochi*	28	+
77500	*Conchapelopia sp*		+
77750	*Hayesomyia senata or Thienemannimyia norena*	7	
78140	*Labrundinia pilosella*	4	
79400	*Zavrelimyia sp*		+
80370	*Corynoneura lobata*	19	
81650	*Parametriocnemus sp*		+
81825	*Rheocricotopus (Psilocricotopus) robacki*		+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	49	
83840	*Microtendipes pedellus group*	85	+
84210	*Paratendipes albimanus or P. duplicatus*	4	
84300	*Phaenopsectra obediens group*	32	
84315	*Phaenopsectra flavipes*	4	
84420	*Polypedilum (P.) Type 1*		+
84440	*Polypedilum (P.) aviceps*		+
84460	*Polypedilum (P.) fallax group*	11	
84470	*Polypedilum (P.) illinoense*		+
84480	*Polypedilum (P.) laetum group*		+
84540	*Polypedilum (Tripodura) scalaenum group*	4	
84750	*Stictochironomus sp*		+
85262	*Cladotanytarsus vanderwulpi group Type 2*	4	
85500	*Paratanytarsus sp*	4	
85625	*Rheotanytarsus exiguus group*		+
85800	*Tanytarsus sp*	116	+
85814	*Tanytarsus glabrescens group*	74	
86401	*Atherix lantha*		+
87540	*Hemerodromia sp*	2	
96900	*Ferrissia sp*	4	+
98200	*Pisidium sp*		+
98600	*Sphaerium sp*		+
99180	*Strophitus undulatus undulatus*		+

No. Quantitative Taxa: 26 Total Taxa: 64

No. Qualitative Taxa: 47 ICI: **36**

Number of Organisms: 511 Qual EPT: 16

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 03-160 River: Swine Creek RM: 5.20

Taxa Code	Taxa	Quant/Qual	
03600	*Oligochaeta*	24	+
08240	*Orconectes (Crokerinus) propinquus*		+
11018	*Acerpenna macdunnoughi*	4	
11120	*Baetis flavistriga*	1	+
11130	*Baetis intercalaris*	27	+
11150	*Labiobaetis propinquus*	1	
11651	*Procloeon sp (w/o hindwing pads)*	2	+
11670	*Procloeon irrubrum*	3	
12200	*Isonychia sp*	32	+
13400	*Stenacron sp*	56	+
13521	*Stenonema femoratum*	13	+
13561	*Stenonema pulchellum*	340	
13590	*Stenonema vicarium*	110	+
14950	*Leptophlebia sp or Paraleptophebia sp*	826	+
16200	*Eurylophella sp*	123	+
17200	*Caenis sp*	58	+
18750	*Hexagenia limbata*		+
21200	*Calopteryx sp*	37	+
23909	*Boyeria vinosa*	4	+
24501	*Gomphidae*		+
26120	*Cordulegaster maculata*		+
47600	*Sialis sp*		+
48620	*Nigronia serricornis*	3	+
50315	*Chimarra obscura*	8	+
50804	*Lype diversa*		+
51600	*Polycentropus sp*	3	+
52200	*Cheumatopsyche sp*	38	+
52430	*Ceratopsyche morosa group*	8	+
52440	*Ceratopsyche slossonae*		+
52530	*Hydropsyche depravata group*		+
60300	*Dineutus sp*		+
67000	*Helophorus sp*		+
68130	*Helichus sp*	1	+
68700	*Dubiraphia sp*	1	+
68901	*Macronychus glabratus*	42	+
69210	*Optioservus ampliatus*		+
69400	*Stenelmis sp*	4	+
71100	*Hexatoma sp*		+
74501	*Ceratopogonidae*	1	
77120	*Ablabesmyia mallochi*	18	
77500	*Conchapelopia sp*	200	+
77800	*Helopelopia sp*	36	
78140	*Labrundinia pilosella*	18	
78450	*Nilotanypus fimbriatus*	127	
80410	*Cricotopus (C.) sp*	55	
80420	*Cricotopus (C.) bicinctus*	18	
81650	*Parametriocnemus sp*	18	
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	73	+
83840	*Microtendipes pedellus group*	127	
84460	*Polypedilum (P.) fallax group*	73	
84540	*Polypedilum (Tripodura) scalaenum group*	36	
85261	*Cladotanytarsus vanderwulpi group Type 1*	18	
85500	*Paratanytarsus sp*	91	
85625	*Rheotanytarsus exiguus group*	121	+
85720	*Stempellinella n.sp nr. flavidula*	55	
85800	*Tanytarsus sp*	55	
85802	*Tanytarsus curticornis group*	91	+
85814	*Tanytarsus glabrescens group*	310	
85840	*Tanytarsus guerlus group*	73	
86100	*Chrysops sp*		+
86401	*Atherix lantha*		+
95100	*Physella sp*		+
96900	*Ferrissia sp*	78	+
98200	*Pisidium sp*		+
98600	*Sphaerium sp*		+

No. Quantitative Taxa: 48 Total Taxa: 66

No. Qualitative Taxa: 45 ICI: **56**

Number of Organisms: 3461 Qual EPT: 18

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-001 River: Ashtabula River RM: 25.60

Taxa Code	Taxa	Quant	Qual
01320	*Hydra sp*	72	
01801	*Turbellaria*	9	+
03360	*Plumatella sp*	2	
03600	*Oligochaeta*	387	+
06201	*Hyalella azteca*		+
08240	*Orconectes (Crokerinus) propinquus*		+
08601	*Hydracarina*		+
11651	*Procloeon sp (w/o hindwing pads)*	2	
13400	*Stenacron sp*		+
13521	*Stenonema femoratum*	10	+
14600	*Choroterpes sp*		+
16200	*Eurylophella sp*	8	
17200	*Caenis sp*	223	+
18600	*Ephemera sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*		+
23909	*Boyeria vinosa*	1	
25510	*Stylogomphus albistylus*		+
34130	*Acroneuria frisoni*		+
43300	*Ranatra sp*		+
45300	*Sigara sp*		+
45900	*Notonecta sp*		+
47600	*Sialis sp*		+
51400	*Nyctiophylax sp*	2	+
51600	*Polycentropus sp*	1	
53800	*Hydroptila sp*	14	
54300	*Oxyethira sp*	2	
57400	*Neophylax sp*		+
57900	*Pycnopsyche sp*		+
58505	*Helicopsyche borealis*	20	+
59110	*Ceraclea ancylus*		+
60900	*Peltodytes sp*		+
63300	*Hydroporus sp*		+
65800	*Berosus sp*	9	+
67000	*Helophorus sp*		+
67800	*Tropisternus sp*		+
68025	*Ectopria sp*		+
68075	*Psephenus herricki*		+
68601	*Ancyronyx variegata*	9	+
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	13	+
69400	*Stenelmis sp*	2	+
77115	*Ablabesmyia janta*	84	
77120	*Ablabesmyia mallochi*	21	+
77130	*Ablabesmyia rhamphe group*		+
77750	*Hayesomyia senata or Thienemannimyia norena*	21	+
78101	*Labrundinia becki*	84	
78680	*Procladius (Psilotanypus) bellus*		+
80358	*Corynoneura n.sp 8*	8	
80370	*Corynoneura lobata*	37	
80410	*Cricotopus (C.) sp*	209	
81640	*Parakiefferiella poss. coronata*	42	
82121	*Thienemanniella n.sp 3*	29	
82710	*Chironomus (C.) sp*	21	
82820	*Cryptochironomus sp*		+
82880	*Cryptotendipes sp*	21	
83040	*Dicrotendipes neomodestus*	522	+
83051	*Dicrotendipes simpsoni*	21	
83300	*Glyptotendipes (G.) sp*	21	
83840	*Microtendipes pedellus group*	84	+
83900	*Nilothauma sp*	21	
84210	*Paratendipes albimanus or P. duplicatus*	63	
84300	*Phaenopsectra obediens group*		+
84302	*Phaenopsectra punctipes*	21	
84460	*Polypedilum (P.) fallax group*	42	
84470	*Polypedilum (P.) illinoense*		+
84700	*Stenochironomus sp*	21	
84750	*Stictochironomus sp*		+
84800	*Tribelos jucundum*	293	
85230	*Cladotanytarsus mancus group*		+
85500	*Paratanytarsus sp*	21	
85800	*Tanytarsus sp*		+
85802	*Tanytarsus curticornis group*	146	
85803	*Tanytarsus Type 3*	146	
85814	*Tanytarsus glabrescens group*	104	
85815	*Tanytarsus glabrescens group Type 1*	42	+
95100	*Physella sp*	14	+
96002	*Helisoma anceps anceps*		+
98600	*Sphaerium sp*		+
99100	*Pyganodon grandis*		+
99860	*Lampsilis radiata luteola*		+

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-001 River: Ashtabula River RM: 25.60

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa:	45	Total Taxa:	81
No. Qualitative Taxa:	52	ICI:	**32**
Number of Organisms:	2945	Qual EPT:	11

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-001 River: Ashtabula River RM: 19.10

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
01320	*Hydra sp*	78
01801	*Turbellaria*	6
03040	*Fredericella sp*	+
03360	*Plumatella sp*	11
03600	*Oligochaeta*	18 +
04687	*Placobdella parasitica*	+
07860	*Cambarus (Puncticambarus) robustus*	+
08240	*Orconectes (Crokerinus) propinquus*	+
08601	*Hydracarina*	2
11020	*Acerpenna pygmaeus*	2
11651	*Procloeon sp (w/o hindwing pads)*	8
13400	*Stenacron sp*	28 +
13521	*Stenonema femoratum*	21 +
13561	*Stenonema pulchellum*	9
14600	*Choroterpes sp*	+
14950	*Leptophlebia sp or Paraleptophebia sp*	4
16700	*Tricorythodes sp*	1
18600	*Ephemera sp*	+
22001	*Coenagrionidae*	1 +
22300	*Argia sp*	2 +
24900	*Gomphus sp*	+
30000	*Plecoptera*	1
34130	*Acroneuria frisoni*	8 +
43300	*Ranatra sp*	1 +
47600	*Sialis sp*	+
51400	*Nyctiophylax sp*	+
51600	*Polycentropus sp*	+
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	2
59110	*Ceraclea ancylus*	1 +
59970	*Petrophila sp*	1 +
60300	*Dineutus sp*	+
60900	*Peltodytes sp*	+
63300	*Hydroporus sp*	+
65700	*Anacaena sp*	+
68025	*Ectopria sp*	+
68075	*Psephenus herricki*	+
68601	*Ancyronyx variegata*	2 +
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	27 +
69400	*Stenelmis sp*	66 +
71100	*Hexatoma sp*	+
77120	*Ablabesmyia mallochi*	2
77130	*Ablabesmyia rhamphe group*	6
77750	*Hayesomyia senata or Thienemannimyia norena*	4 +
77800	*Helopelopia sp*	+
78140	*Labrundinia pilosella*	5
80370	*Corynoneura lobata*	19
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	4
82121	*Thienemanniella n.sp 3*	2
83310	*Glyptotendipes (Trichotendipes) amplus*	2
83840	*Microtendipes pedellus group*	31 +
84155	*Paralauterborniella nigrohalteralis*	+
84210	*Paratendipes albimanus or P. duplicatus*	2 +
84300	*Phaenopsectra obediens group*	4
84460	*Polypedilum (P.) fallax group*	12
84540	*Polypedilum (Tripodura) scalaenum group*	14 +
84750	*Stictochironomus sp*	+
84800	*Tribelos jucundum*	6 +
84888	*Xenochironomus xenolabis*	+
85625	*Rheotanytarsus exiguus group*	14
85802	*Tanytarsus curticornis group*	61
85814	*Tanytarsus glabrescens group*	14
86100	*Chrysops sp*	+
87540	*Hemerodromia sp*	4
93900	*Elimia sp*	74 +
95100	*Physella sp*	1 +
96900	*Ferrissia sp*	50
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 44 Total Taxa: 71
No. Qualitative Taxa: 46 ICI: **32**
Number of Organisms: 631 Qual EPT: 10

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-001 River: Ashtabula River RM: 11.90

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	224	
01801	*Turbellaria*	16	
03360	*Plumatella sp*	4	
03600	*Oligochaeta*	380	+
08240	*Orconectes (Crokerinus) propinquus*		+
11130	*Baetis intercalaris*		+
11650	*Procloeon sp (w/ hindwing pads)*		+
11651	*Procloeon sp (w/o hindwing pads)*	2	
13400	*Stenacron sp*	62	+
13521	*Stenonema femoratum*	14	+
13590	*Stenonema vicarium*	21	
14600	*Choroterpes sp*	1	
14950	*Leptophlebia sp or Paraleptophebia sp*	36	
16200	*Eurylophella sp*	4	
17200	*Caenis sp*	144	+
18600	*Ephemera sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	2	+
34130	*Acroneuria frisoni*	8	+
47600	*Sialis sp*		+
52540	*Hydropsyche dicantha*		+
54200	*Orthotrichia sp*	2	
59110	*Ceraclea ancylus*	1	+
59310	*Mystacides sepulchralis*	1	
59510	*Oecetis avara*	7	
60300	*Dineutus sp*		+
66500	*Enochrus sp*		+
67500	*Laccobius sp*		+
68075	*Psephenus herricki*		+
68901	*Macronychus glabratus*	28	
69400	*Stenelmis sp*	25	+
71900	*Tipula sp*		+
77120	*Ablabesmyia mallochi*	9	
77500	*Conchapelopia sp*	9	
77750	*Hayesomyia senata or Thienemannimyia norena*	26	
77800	*Helopelopia sp*		+
78140	*Labrundinia pilosella*	9	
78655	*Procladius (Holotanypus) sp*		+
80370	*Corynoneura lobata*	32	
80420	*Cricotopus (C.) bicinctus*		+
80646	*Epoicocladius sp 3 (sensu Jacobsen, 1992)*		+
81250	*Nanocladius (N.) minimus*	17	
82101	*Thienemanniella n.sp 1*		+
82730	*Chironomus (C.) decorus group*		+
82820	*Cryptochironomus sp*		+
82880	*Cryptotendipes sp*		+
83040	*Dicrotendipes neomodestus*	181	+
83840	*Microtendipes pedellus group*	9	+
84060	*Parachironomus pectinatellae*	9	
84300	*Phaenopsectra obediens group*	9	
84450	*Polypedilum (P.) convictum*	9	
84540	*Polypedilum (Tripodura) scalaenum group*	43	+
85625	*Rheotanytarsus exiguus group*	155	
85800	*Tanytarsus sp*		+
85802	*Tanytarsus curticornis group*	77	
85814	*Tanytarsus glabrescens group*	95	+
85840	*Tanytarsus guerlus group*	155	
86401	*Atherix lantha*		+
87540	*Hemerodromia sp*	60	
93900	*Elimia sp*	18	+
95100	*Physella sp*	843	+
96280	*Planorbella (Pierosoma) trivolvis*		+
96900	*Ferrissia sp*	4	+

No. Quantitative Taxa: 40 Total Taxa: 63

No. Qualitative Taxa: 38 ICI: **28**

Number of Organisms: 2751 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-001 River: Ashtabula River RM: 3.60

Taxa Code	Taxa	Quant	Qual
00401	*Spongillidae*		+
01320	*Hydra sp*	18	
01801	*Turbellaria*	58	+
03360	*Plumatella sp*	7	
03600	*Oligochaeta*	6	+
04935	*Erpobdella punctata punctata*		+
06810	*Gammarus fasciatus*	1	
08240	*Orconectes (Crokerinus) propinquus*		+
11020	*Acerpenna pygmaeus*	9	+
11101	*Baetis sp (w/o hindwing pads)*		+
11130	*Baetis intercalaris*		+
11651	*Procloeon sp (w/o hindwing pads)*	3	
12200	*Isonychia sp*		+
13000	*Leucrocuta sp*	1	
13400	*Stenacron sp*	39	+
13521	*Stenonema femoratum*		+
13590	*Stenonema vicarium*	4	
16700	*Tricorythodes sp*	32	+
17200	*Caenis sp*	14	+
18600	*Ephemera sp*		+
22300	*Argia sp*		+
25510	*Stylogomphus albistylus*		+
28955	*Libellula lydia*		+
34130	*Acroneuria frisoni*	1	+
42700	*Belostoma sp*		+
45300	*Sigara sp*		+
47600	*Sialis sp*		+
50315	*Chimarra obscura*		+
51600	*Polycentropus sp*	1	
52200	*Cheumatopsyche sp*	1	+
52430	*Ceratopsyche morosa group*		+
52540	*Hydropsyche dicantha*		+
59110	*Ceraclea ancylus*	1	+
59120	*Ceraclea flava complex*		+
59510	*Oecetis avara*	13	
60900	*Peltodytes sp*		+
63900	*Laccophilus sp*		+
65800	*Berosus sp*		+
68075	*Psephenus herricki*	7	+
68601	*Ancyronyx variegata*	1	
68700	*Dubiraphia sp*		+
69400	*Stenelmis sp*		+
74673	*Atrichopogon websteri*	1	
77120	*Ablabesmyia mallochi*	4	
77750	*Hayesomyia senata or Thienemannimyia norena*	4	
77800	*Helopelopia sp*	4	+
78140	*Labrundinia pilosella*	2	
78655	*Procladius (Holotanypus) sp*		+
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	4	
80370	*Corynoneura lobata*	26	+
80420	*Cricotopus (C.) bicinctus*		+
81250	*Nanocladius (N.) minimus*	11	
82121	*Thienemanniella n.sp 3*	6	
82220	*Tvetenia discoloripes group*		+
83040	*Dicrotendipes neomodestus*	45	+
83840	*Microtendipes pedellus group*	8	
84450	*Polypedilum (P.) convictum*		+
84460	*Polypedilum (P.) fallax group*	8	
84470	*Polypedilum (P.) illinoense*		+
84750	*Stictochironomus sp*		+
84888	*Xenochironomus xenolabis*		+
85210	*Cladotanytarsus species group B*	4	
85625	*Rheotanytarsus exiguus group*	53	+
85800	*Tanytarsus sp*	11	
85802	*Tanytarsus curticornis group*	23	
85814	*Tanytarsus glabrescens group*	233	
85840	*Tanytarsus guerlus group*	19	+
86401	*Atherix lantha*		+
87540	*Hemerodromia sp*	4	
95100	*Physella sp*	6	+
96900	*Ferrissia sp*	8	+

No. Quantitative Taxa: 40 Total Taxa: 71

No. Qualitative Taxa: 48 ICI: **46**

Number of Organisms: 701 Qual EPT: 16

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-001 River: Ashtabula River RM: 2.50

Taxa Code	Taxa	Quant	Qual
01200	*Cordylophora lacustris*		+
01320	*Hydra sp*	866	
01801	*Turbellaria*	190	+
03360	*Plumatella sp*	1	+
03451	*Urnatella gracilis*	8	
03600	*Oligochaeta*	1953	+
04686	*Placobdella papillifera*		+
05800	*Caecidotea sp*		+
06700	*Crangonyx sp*		+
06810	*Gammarus fasciatus*	88	+
11651	*Procloeon sp (w/o hindwing pads)*	2	
13400	*Stenacron sp*	5	+
13521	*Stenonema femoratum*	5	
15501	*Ephemerellidae*	16	
16700	*Tricorythodes sp*	19	
17200	*Caenis sp*	264	+
18600	*Ephemera sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	6	+
43300	*Ranatra sp*		+
45400	*Trichocorixa sp*		+
47600	*Sialis sp*	1	
51206	*Cyrnellus fraternus*	38	+
51600	*Polycentropus sp*	91	+
59001	*Leptoceridae*	1	
59310	*Mystacides sepulchralis*		+
60300	*Dineutus sp*		+
60400	*Gyrinus sp*		+
60900	*Peltodytes sp*		+
63300	*Hydroporus sp*		+
63900	*Laccophilus sp*		+
67000	*Helophorus sp*		+
68700	*Dubiraphia sp*	1	
68901	*Macronychus glabratus*	1	+
69400	*Stenelmis sp*		+
77115	*Ablabesmyia janta*	55	+
77120	*Ablabesmyia mallochi*	22	
77355	*Clinotanypus pinguis*		+
77750	*Hayesomyia senata or Thienemannimyia norena*		+
77800	*Helopelopia sp*	22	
78650	*Procladius sp*		+
80410	*Cricotopus (C.) sp*	11	
80500	*Cricotopus (Isocladius) reversus group*	11	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	11	
81240	*Nanocladius (N.) distinctus*	44	+
81250	*Nanocladius (N.) minimus*	11	
82820	*Cryptochironomus sp*		+
83002	*Dicrotendipes modestus*		+
83040	*Dicrotendipes neomodestus*	338	+
83050	*Dicrotendipes lucifer*	98	+
83051	*Dicrotendipes simpsoni*	164	
83158	*Endochironomus nigricans*	44	+
83300	*Glyptotendipes (G.) sp*	11	
83840	*Microtendipes pedellus group*	87	
84020	*Parachironomus carinatus*	55	
84030	*Parachironomus directus*	11	
84040	*Parachironomus frequens*	11	+
84450	*Polypedilum (P.) convictum*	11	
84470	*Polypedilum (P.) illinoense*		+
84520	*Polypedilum (Tripodura) halterale group*		+
85500	*Paratanytarsus sp*	11	
85720	*Stempellinella n.sp nr. flavidula*	11	
85800	*Tanytarsus sp*	33	+
85802	*Tanytarsus curticornis group*	22	
85814	*Tanytarsus glabrescens group*	65	+
85840	*Tanytarsus guerlus group*	11	
93900	*Elimia sp*		+
94400	*Fossaria sp*		+
95100	*Physella sp*	20	+
95907	*Gyraulus (Torquis) parvus*		+
96900	*Ferrissia sp*	15	
97710	*Dreissena polymorpha*	16	+

No. Quantitative Taxa: 46 Total Taxa: 72

No. Qualitative Taxa: 47 ICI: **34**

Number of Organisms: 4777 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-001 River: Ashtabula River RM: 2.30

Taxa Code	Taxa	Quant	Qual
00401	*Spongillidae*		+
01200	*Cordylophora lacustris*	1	
01320	*Hydra sp*	32	
01801	*Turbellaria*	250	+
03073	*Lophopodella carteri*		+
03337	*Hyalinella punctata*	8	+
03360	*Plumatella sp*		+
03600	*Oligochaeta*	1672	+
04664	*Helobdella stagnalis*		+
04687	*Placobdella parasitica*		+
05800	*Caecidotea sp*		+
06810	*Gammarus fasciatus*	70	+
13400	*Stenacron sp*	3	+
13521	*Stenonema femoratum*	5	+
16200	*Eurylophella sp*	16	
17200	*Caenis sp*	400	+
22001	*Coenagrionidae*	21	+
22300	*Argia sp*	6	+
23909	*Boyeria vinosa*		+
27610	*Epitheca (Tetragoneuria) cynosura*	1	
28908	*Perithemis tenera*		+
45400	*Trichocorixa sp*		+
51206	*Cyrnellus fraternus*	62	
51600	*Polycentropus sp*	9	+
53800	*Hydroptila sp*	16	
54200	*Orthotrichia sp*	8	
54300	*Oxyethira sp*	8	
59520	*Oecetis cinerascens*		+
59570	*Oecetis nocturna*		+
60900	*Peltodytes sp*		+
65800	*Berosus sp*	2	+
69400	*Stenelmis sp*	26	
74501	*Ceratopogonidae*	40	
77115	*Ablabesmyia janta*		+
77120	*Ablabesmyia mallochi*		+
77130	*Ablabesmyia rhamphe group*	21	+
77355	*Clinotanypus pinguis*		+
78655	*Procladius (Holotanypus) sp*		+
81250	*Nanocladius (N.) minimus*	21	+
82730	*Chironomus (C.) decorus group*	21	+
82820	*Cryptochironomus sp*		+
83002	*Dicrotendipes modestus*	21	
83040	*Dicrotendipes neomodestus*	210	
83050	*Dicrotendipes lucifer*	294	
83051	*Dicrotendipes simpsoni*	483	+
83158	*Endochironomus nigricans*	231	+
83300	*Glyptotendipes (G.) sp*	294	+
83310	*Glyptotendipes (Trichotendipes) amplus*	21	
84030	*Parachironomus directus*	21	+
84040	*Parachironomus frequens*	21	+
84470	*Polypedilum (P.) illinoense*		+
84520	*Polypedilum (Tripodura) halterale group*	42	+
84888	*Xenochironomus xenolabis*		+
85800	*Tanytarsus sp*	42	+
85814	*Tanytarsus glabrescens group*	42	
94400	*Fossaria sp*		+
95100	*Physella sp*	1	+
95907	*Gyraulus (Torquis) parvus*		+
96120	*Menetus (Micromenetus) dilatatus*	9	+
96900	*Ferrissia sp*		+
97710	*Dreissena polymorpha*	16	+

No. Quantitative Taxa: 39 Total Taxa: 61

No. Qualitative Taxa: 46 ICI: **26**

Number of Organisms: 4467 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-001 River: Ashtabula River RM: 1.30

Taxa Code	Taxa	Quant	Qual
00401	*Spongillidae*		+
01200	*Cordylophora lacustris*	1	
01801	*Turbellaria*	498	
03360	*Plumatella sp*		+
03600	*Oligochaeta*		+
05800	*Caecidotea sp*	1	+
06810	*Gammarus fasciatus*	52	+
08601	*Hydracarina*	8	
17200	*Caenis sp*	8	+
22001	*Coenagrionidae*	76	+
22300	*Argia sp*	83	+
23704	*Anax junius*	1	
27307	*Epitheca (Epicordulia) princeps*		+
27610	*Epitheca (Tetragoneuria) cynosura*		+
49200	*Climacia sp*		+
53600	*Agraylea sp*		+
59520	*Oecetis cinerascens*	9	+
69400	*Stenelmis sp*	8	
77130	*Ablabesmyia rhamphe group*	178	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	59	
81240	*Nanocladius (N.) distinctus*	59	
83000	*Dicrotendipes sp*	59	
83051	*Dicrotendipes simpsoni*	475	
83158	*Endochironomus nigricans*	119	+
83300	*Glyptotendipes (G.) sp*	4271	+
84030	*Parachironomus directus*		+
84050	*Parachironomus "hirtalatus" (sensu Simpson & Bode, 1980)*	59	
84450	*Polypedilum (P.) convictum*		+
84888	*Xenochironomus xenolabis*		+
93025	*Bithynia tentaculata*		+
95100	*Physella sp*	72	+
96120	*Menetus (Micromenetus) dilatatus*	34	+
96900	*Ferrissia sp*	58	
97710	*Dreissena polymorpha*	95	+

No. Quantitative Taxa: 23 Total Taxa: 34

No. Qualitative Taxa: 23 ICI: **12**

Number of Organisms: 6283 Qual EPT: 3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95   River Code: 07-001   River: Ashtabula River   RM: 0.80

Taxa Code	Taxa	Quant/Qual	
00653	*Eunapius fragilis*		+
01320	*Hydra sp*	24	
01801	*Turbellaria*	394	+
03600	*Oligochaeta*	2033	+
04935	*Erpobdella punctata punctata*		+
05800	*Caecidotea sp*	79	+
06810	*Gammarus fasciatus*	560	+
08601	*Hydracarina*	8	
17200	*Caenis sp*	16	
22001	*Coenagrionidae*	4	+
52410	*Ceratopsyche alternans*	2	
53600	*Agraylea sp*		+
53800	*Hydroptila sp*	12	+
59300	*Mystacides sp*		+
68901	*Macronychus glabratus*	1	+
77130	*Ablabesmyia rhamphe group*	15	
80500	*Cricotopus (Isocladius) reversus group*	22	
80510	*Cricotopus (Isocladius) sylvestris group*		+
82121	*Thienemanniella n.sp 3*	15	
83002	*Dicrotendipes modestus*	29	
83040	*Dicrotendipes neomodestus*	7	
83050	*Dicrotendipes lucifer*	7	
83051	*Dicrotendipes simpsoni*	196	
83158	*Endochironomus nigricans*	269	+
83300	*Glyptotendipes (G.) sp*	44	
83840	*Microtendipes pedellus group*	15	
84050	*Parachironomus "hirtalatus" (sensu Simpson & Bode, 1980)*	7	+
84470	*Polypedilum (P.) illinoense*	29	+
84520	*Polypedilum (Tripodura) halterale group*	29	
84960	*Pseudochironomus sp*	15	
85500	*Paratanytarsus sp*	15	
95100	*Physella sp*		+
96264	*Planorbella (Pierosoma) pilsbryi*		+
97710	*Dreissena polymorpha*	7712	+

No. Quantitative Taxa: 27   Total Taxa: 34

No. Qualitative Taxa: 18   ICI: **16**

Number of Organisms: 11559   Qual EPT: 3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-004 River: West Branch Ashtabula River RM: 1.80

Taxa Code	Taxa	Quant	Qual
01320	*Hydra sp*	365	
01801	*Turbellaria*	478	+
03600	*Oligochaeta*	219	+
04935	*Erpobdella punctata punctata*		+
06201	*Hyalella azteca*		+
08240	*Orconectes (Crokerinus) propinquus*		+
11200	*Callibaetis sp*		+
11651	*Procloeon sp (w/o hindwing pads)*	4	
12501	*Heptageniidae*	2	
13400	*Stenacron sp*	43	+
13521	*Stenonema femoratum*	189	+
17200	*Caenis sp*	98	+
22001	*Coenagrionidae*	1	+
22300	*Argia sp*		+
23804	*Basiaeschna janata*		+
24900	*Gomphus sp*		+
25510	*Stylogomphus albistylus*		+
27610	*Epitheca (Tetragoneuria) cynosura*		+
28500	*Libellula sp*		+
28955	*Libellula lydia*		+
34130	*Acroneuria frisoni*	1	+
43300	*Ranatra sp*		+
45300	*Sigara sp*		+
47600	*Sialis sp*		+
51400	*Nyctiophylax sp*	25	+
51600	*Polycentropus sp*	1	+
57400	*Neophylax sp*		+
57900	*Pycnopsyche sp*	1	+
58505	*Helicopsyche borealis*		+
59120	*Ceraclea flava complex*		+
59970	*Petrophila sp*		+
60900	*Peltodytes sp*		+
65800	*Berosus sp*	2	+
68025	*Ectopria sp*		+
68075	*Psephenus herricki*		+
68708	*Dubiraphia vittata group*		+
69400	*Stenelmis sp*		+
72700	*Anopheles sp*		+
74501	*Ceratopogonidae*		+
77120	*Ablabesmyia mallochi*	137	
77355	*Clinotanypus pinguis*		+
77750	*Hayesomyia senata or Thienemannimyia norena*	20	

Taxa Code	Taxa	Quant	Qual
77800	*Helopelopia sp*		+
78101	*Labrundinia becki*	20	
78140	*Labrundinia pilosella*	20	
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	48	
80370	*Corynoneura lobata*	309	+
81240	*Nanocladius (N.) distinctus*	20	
82121	*Thienemanniella n.sp 3*	137	
82730	*Chironomus (C.) decorus group*		+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	1466	+
83840	*Microtendipes pedellus group*		+
84010	*Parachironomus "abortivus" (sensu Simpson & Bode, 1980)*		+
84210	*Paratendipes albimanus or P. duplicatus*		+
84300	*Phaenopsectra obediens group*	20	+
84470	*Polypedilum (P.) illinoense*		+
84540	*Polypedilum (Tripodura) scalaenum group*		+
84750	*Stictochironomus sp*		+
84800	*Tribelos jucundum*		+
85230	*Cladotanytarsus mancus group*		+
85710	*Stempellinella sp*		+
85800	*Tanytarsus sp*	156	
85814	*Tanytarsus glabrescens group*	20	+
85840	*Tanytarsus guerlus group*	39	
95100	*Physella sp*	42	+
96002	*Helisoma anceps anceps*	11	+
96280	*Planorbella (Pierosoma) trivolvis*	6	+
96801	*Ancylidae*		+
98600	*Sphaerium sp*		+
99860	*Lampsilis radiata luteola*		+

No. Quantitative Taxa: 30 Total Taxa: 71

No. Qualitative Taxa: 59 ICI: **32**

Number of Organisms: 3900 Qual EPT: 11

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 07-005 River: East Branch Ashtabula River RM: 1.40

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03360	*Plumatella sp*	+
03600	*Oligochaeta*	+
06201	*Hyalella azteca*	+
08240	*Orconectes (Crokerinus) propinquus*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
14600	*Choroterpes sp*	+
17200	*Caenis sp*	+
22001	*Coenagrionidae*	+
23804	*Basiaeschna janata*	+
28511	*Libellula luctuosa*	+
28955	*Libellula lydia*	+
34130	*Acroneuria frisoni*	+
45100	*Palmacorixa sp*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	+
59110	*Ceraclea ancylus*	+
60900	*Peltodytes sp*	+
65800	*Berosus sp*	+
66500	*Enochrus sp*	+
67800	*Tropisternus sp*	+
68025	*Ectopria sp*	+
68075	*Psephenus herricki*	+
68601	*Ancyronyx variegata*	+
68700	*Dubiraphia sp*	+
69400	*Stenelmis sp*	+
77500	*Conchapelopia sp*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
83840	*Microtendipes pedellus group*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
84750	*Stictochironomus sp*	+
85230	*Cladotanytarsus mancus group*	+
85800	*Tanytarsus sp*	+
85802	*Tanytarsus curticornis group*	+
85814	*Tanytarsus glabrescens group*	+
96002	*Helisoma anceps anceps*	+
96280	*Planorbella (Pierosoma) trivolvis*	+
98200	*Pisidium sp*	+
98600	*Sphaerium sp*	+
99180	*Strophitus undulatus undulatus*	+

No. Quantitative Taxa: 0 Total Taxa: 46

No. Qualitative Taxa: 46 ICI:

Number of Organisms: 0 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 07-007 River: Cowles Creek RM: 7.10

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	+
03600	*Oligochaeta*	1 +
06201	*Hyalella azteca*	+
08240	*Orconectes (Crokerinus) propinquus*	4 +
11651	*Procloeon sp (w/o hindwing pads)*	+
13400	*Stenacron sp*	1 +
13521	*Stenonema femoratum*	1 +
14950	*Leptophlebia sp or Paraleptophebia sp*	13 +
17200	*Caenis sp*	3 +
18704	*Hexagenia atrocaudata*	+
18750	*Hexagenia limbata*	+
21200	*Calopteryx sp*	+
23909	*Boyeria vinosa*	+
27500	*Somatochlora sp*	+
45000	*Hesperocorixa sp*	+
47600	*Sialis sp*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	+
63300	*Hydroporus sp*	+
66500	*Enochrus sp*	+
67500	*Laccobius sp*	+
68025	*Ectopria sp*	+
68901	*Macronychus glabratus*	+
72420	*Chaoborus sp*	+
72501	*Culicidae*	+
77120	*Ablabesmyia mallochi*	7
78140	*Labrundinia pilosella*	1
78650	*Procladius sp*	+
80370	*Corynoneura lobata*	2
82730	*Chironomus (C.) decorus group*	4
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	2
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	2
83840	*Microtendipes pedellus group*	12 +
84210	*Paratendipes albimanus or P. duplicatus*	20 +
84460	*Polypedilum (P.) fallax group*	7
84750	*Stictochironomus sp*	1 +
84800	*Tribelos jucundum*	12
84960	*Pseudochironomus sp*	+
85500	*Paratanytarsus sp*	6 +
85501	*Paratanytarsus n.sp 1*	8
85800	*Tanytarsus sp*	4
85814	*Tanytarsus glabrescens group*	2
87400	*Stratiomys sp*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	2 +
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 22 Total Taxa: 47

No. Qualitative Taxa: 36 ICI: **24**

Number of Organisms: 115 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 07-007 River: Cowles Creek RM: 5.60

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
07860	*Cambarus (Puncticambarus) robustus*	+
08240	*Orconectes (Crokerinus) propinquus*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	1 +
17200	*Caenis sp*	1 +
18750	*Hexagenia limbata*	+
21200	*Calopteryx sp*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
50301	*Chimarra aterrima*	+
52200	*Cheumatopsyche sp*	+
68075	*Psephenus herricki*	+
69400	*Stenelmis sp*	+
70700	*Dicranota sp*	+
71100	*Hexatoma sp*	+
71900	*Tipula sp*	+
77120	*Ablabesmyia mallochi*	3 +
78401	*Natarsia species A (sensu Roback, 1978)*	+
79100	*Thienemannimyia group*	1
80370	*Corynoneura lobata*	7 +
81650	*Parametriocnemus sp*	+
82730	*Chironomus (C.) decorus group*	3
83003	*Dicrotendipes fumidus*	3
83040	*Dicrotendipes neomodestus*	4
83840	*Microtendipes pedellus group*	6
84210	*Paratendipes albimanus or P. duplicatus*	4
84300	*Phaenopsectra obediens group*	4
84450	*Polypedilum (P.) convictum*	1 +
84460	*Polypedilum (P.) fallax group*	4 +
84470	*Polypedilum (P.) illinoense*	+
84480	*Polypedilum (P.) laetum group*	+
84750	*Stictochironomus sp*	+
85501	*Paratanytarsus n.sp 1*	1
85625	*Rheotanytarsus exiguus group*	8 +
85800	*Tanytarsus sp*	1
85814	*Tanytarsus glabrescens group*	3
86401	*Atherix lantha*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	1 +
98600	*Sphaerium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 18 Total Taxa: 41
No. Qualitative Taxa: 31 ICI: **20**
Number of Organisms: 56 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 07-007 River: Cowles Creek RM: 4.80

Taxa Code	Taxa	Quant/Qual	
01801	*Turbellaria*	2	+
03600	*Oligochaeta*	103	+
04664	*Helobdella stagnalis*	32	
04682	*Placobdella montifera*		+
04687	*Placobdella parasitica*		+
06700	*Crangonyx sp*		+
08240	*Orconectes (Crokerinus) propinquus*	3	+
11120	*Baetis flavistriga*		+
11130	*Baetis intercalaris*		+
21200	*Calopteryx sp*	4	+
21300	*Hetaerina sp*	3	
22300	*Argia sp*		+
23905	*Boyeria grafiana*		+
23909	*Boyeria vinosa*		+
47600	*Sialis sp*	1	+
52200	*Cheumatopsyche sp*		+
52530	*Hydropsyche depravata group*		+
53800	*Hydroptila sp*		+
63300	*Hydroporus sp*		+
66500	*Enochrus sp*		+
67800	*Tropisternus sp*		+
68708	*Dubiraphia vittata group*		+
69400	*Stenelmis sp*	1	+
77120	*Ablabesmyia mallochi*	23	+
77500	*Conchapelopia sp*	8	+
77800	*Helopelopia sp*		+
78401	*Natarsia species A (sensu Roback, 1978)*	1	+
78450	*Nilotanypus fimbriatus*	1	
82730	*Chironomus (C.) decorus group*	3	
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	9	
84210	*Paratendipes albimanus or P. duplicatus*	41	+
84300	*Phaenopsectra obediens group*	35	+
84410	*Polypedilum (Pentapedilum) tritum*	1	
84450	*Polypedilum (P.) convictum*		+
84460	*Polypedilum (P.) fallax group*	4	
84540	*Polypedilum (Tripodura) scalaenum group*	3	+
84750	*Stictochironomus sp*		+
84790	*Tribelos fuscicorne*	1	
85500	*Paratanytarsus sp*	44	
85800	*Tanytarsus sp*	3	
85814	*Tanytarsus glabrescens group*	1	
95100	*Physella sp*	53	+
96900	*Ferrissia sp*	101	+
98200	*Pisidium sp*		+
98600	*Sphaerium sp*		+

No. Quantitative Taxa: 25 Total Taxa: 46

No. Qualitative Taxa: 35 ICI: **14**

Number of Organisms: 481 Qual EPT: 5

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 07-007 River: Cowles Creek RM: 4.30

Taxa Code	Taxa	Quant/Qual	
03000	*Ectoprocta*	1	
03600	*Oligochaeta*	223	+
04935	*Erpobdella punctata punctata*		+
07860	*Cambarus (Puncticambarus) robustus*		+
08240	*Orconectes (Crokerinus) propinquus*		+
11120	*Baetis flavistriga*		+
21200	*Calopteryx sp*	32	+
21300	*Hetaerina sp*		+
22001	*Coenagrionidae*	10	+
23600	*Aeshna sp*		+
24900	*Gomphus sp*		+
47600	*Sialis sp*	10	+
52200	*Cheumatopsyche sp*	7	+
52530	*Hydropsyche depravata group*		+
66500	*Enochrus sp*		+
68075	*Psephenus herricki*	1	
68700	*Dubiraphia sp*		+
69400	*Stenelmis sp*	3	+
71900	*Tipula sp*		+
72501	*Culicidae*	1	+
77500	*Conchapelopia sp*	216	+
77800	*Helopelopia sp*	225	
78401	*Natarsia species A (sensu Roback, 1978)*	4	+
78402	*Natarsia baltimoreus*	4	+
78650	*Procladius sp*		+
78750	*Rheopelopia paramaculipennis*		+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	92	
81270	*Nanocladius (N.) spiniplenus*	8	
82820	*Cryptochironomus sp*	8	+
83040	*Dicrotendipes neomodestus*	8	
84300	*Phaenopsectra obediens group*	100	+
84315	*Phaenopsectra flavipes*	8	
84450	*Polypedilum (P.) convictum*	8	
84460	*Polypedilum (P.) fallax group*	17	+
84470	*Polypedilum (P.) illinoense*	75	+
84480	*Polypedilum (P.) laetum group*		+
84750	*Stictochironomus sp*		+
84800	*Tribelos jucundum*	8	
85814	*Tanytarsus glabrescens group*	8	
85840	*Tanytarsus guerlus group*	8	
95100	*Physella sp*	194	+
95900	*Gyraulus sp*	2	
95904	*Gyraulus (G.) deflectus*	1	
96900	*Ferrissia sp*	193	+
98200	*Pisidium sp*	45	+

No. Quantitative Taxa: 30 Total Taxa: 45

No. Qualitative Taxa: 32 ICI: **14**

Number of Organisms: 1520 Qual EPT: 3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 07-007 River: Cowles Creek RM: 3.60

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	8 +
03039	*Fredericellidae*	1
03360	*Plumatella sp*	2 +
03600	*Oligochaeta*	120 +
08240	*Orconectes (Crokerinus) propinquus*	+
11120	*Baetis flavistriga*	+
21200	*Calopteryx sp*	42 +
23600	*Aeshna sp*	+
24900	*Gomphus sp*	+
27500	*Somatochlora sp*	+
47600	*Sialis sp*	+
52200	*Cheumatopsyche sp*	9 +
63300	*Hydroporus sp*	+
67000	*Helophorus sp*	+
68700	*Dubiraphia sp*	+
69400	*Stenelmis sp*	+
71910	*Tipula abdominalis*	+
77500	*Conchapelopia sp*	188 +
77800	*Helopelopia sp*	548
78350	*Meropelopia sp*	78
78401	*Natarsia species A (sensu Roback, 1978)*	+
78402	*Natarsia baltimoreus*	+
78450	*Nilotanypus fimbriatus*	8
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	47 +
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	31
84210	*Paratendipes albimanus or P. duplicatus*	47 +
84300	*Phaenopsectra obediens group*	188 +
84450	*Polypedilum (P.) convictum*	31 +
84470	*Polypedilum (P.) illinoense*	31 +
85500	*Paratanytarsus sp*	16
85625	*Rheotanytarsus exiguus group*	16
85800	*Tanytarsus sp*	31 +
85814	*Tanytarsus glabrescens group*	172 +
85840	*Tanytarsus guerlus group*	+
86200	*Tabanus sp*	+
94400	*Fossaria sp*	9
95100	*Physella sp*	37 +
96900	*Ferrissia sp*	240 +

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 23 Total Taxa: 40

No. Qualitative Taxa: 32 ICI: **16**

Number of Organisms: 1900 Qual EPT: 2

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 07-007 River: Cowles Creek RM: 1.50

Taxa Code	Taxa	Quant/Qual
00653	*Eunapius fragilis*	+
01801	*Turbellaria*	+
03040	*Fredericella sp*	+
03360	*Plumatella sp*	+
03600	*Oligochaeta*	4 +
04664	*Helobdella stagnalis*	2
05800	*Caecidotea sp*	+
06700	*Crangonyx sp*	+
07701	*Cambaridae*	1
08240	*Orconectes (Crokerinus) propinquus*	1 +
11120	*Baetis flavistriga*	5 +
11130	*Baetis intercalaris*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	1 +
21200	*Calopteryx sp*	9 +
21300	*Hetaerina sp*	2
23600	*Aeshna sp*	+
23909	*Boyeria vinosa*	1
24900	*Gomphus sp*	+
47600	*Sialis sp*	5 +
52200	*Cheumatopsyche sp*	10 +
52530	*Hydropsyche depravata group*	+
53501	*Hydroptilidae*	2
59100	*Ceraclea sp*	+
68025	*Ectopria sp*	+
69400	*Stenelmis sp*	7 +
71900	*Tipula sp*	+
77120	*Ablabesmyia mallochi*	37 +
77500	*Conchapelopia sp*	37
77750	*Hayesomyia senata or Thienemannimyia norena*	30
77800	*Helopelopia sp*	156 +
78402	*Natarsia baltimoreus*	15
78750	*Rheopelopia paramaculipennis*	+
80370	*Corynoneura lobata*	150
82141	*Thienemanniella xena*	6
83040	*Dicrotendipes neomodestus*	22
84210	*Paratendipes albimanus or P. duplicatus*	7
84300	*Phaenopsectra obediens group*	111 +
84450	*Polypedilum (P.) convictum*	7 +
84460	*Polypedilum (P.) fallax group*	30
84480	*Polypedilum (P.) laetum group*	+
84750	*Stictochironomus sp*	+
84790	*Tribelos fuscicorne*	7
85500	*Paratanytarsus sp*	30
85625	*Rheotanytarsus exiguus group*	37
85800	*Tanytarsus sp*	15
85814	*Tanytarsus glabrescens group*	141
85840	*Tanytarsus guerlus group*	7
87540	*Hemerodromia sp*	2
95100	*Physella sp*	12 +
96002	*Helisoma anceps anceps*	13 +
96900	*Ferrissia sp*	63 +
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 35 Total Taxa: 53

No. Qualitative Taxa: 33 ICI: **28**

Number of Organisms: 985 Qual EPT: 7

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 07-007 River: Cowles Creek RM: 0.30

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
01200	*Cordylophora lacustris*	1
01320	*Hydra sp*	93
01801	*Turbellaria*	1160 +
03600	*Oligochaeta*	106 +
04689	*Placobdella pediculata*	+
05800	*Caecidotea sp*	+
06201	*Hyalella azteca*	+
06810	*Gammarus fasciatus*	+
08240	*Orconectes (Crokerinus) propinquus*	+
11250	*Centroptilum sp (w/o hindwing pads)*	+
17200	*Caenis sp*	51
22001	*Coenagrionidae*	5
28705	*Pachydiplax longipennis*	+
28955	*Libellula lydia*	+
44501	*Corixidae*	19
45300	*Sigara sp*	+
45400	*Trichocorixa sp*	+
47600	*Sialis sp*	+
53600	*Agraylea sp*	6
53800	*Hydroptila sp*	36 +
60400	*Gyrinus sp*	+
60900	*Peltodytes sp*	+
67700	*Paracymus sp*	+
67800	*Tropisternus sp*	+
69400	*Stenelmis sp*	+
74501	*Ceratopogonidae*	17
77120	*Ablabesmyia mallochi*	17 +
77500	*Conchapelopia sp*	34
77750	*Hayesomyia senata or Thienemannimyia norena*	17
78650	*Procladius sp*	+
80370	*Corynoneura lobata*	8
80410	*Cricotopus (C.) sp*	+
82820	*Cryptochironomus sp*	+
83002	*Dicrotendipes modestus*	103 +
83040	*Dicrotendipes neomodestus*	525
83050	*Dicrotendipes lucifer*	41
83051	*Dicrotendipes simpsoni*	738
83158	*Endochironomus nigricans*	68
83300	*Glyptotendipes (G.) sp*	17
84300	*Phaenopsectra obediens group*	68
84315	*Phaenopsectra flavipes*	17
84460	*Polypedilum (P.) fallax group*	17
84470	*Polypedilum (P.) illinoense*	34 +
84540	*Polypedilum (Tripodura) scalaenum group*	+
84750	*Stictochironomus sp*	+
85230	*Cladotanytarsus mancus group*	+
85800	*Tanytarsus sp*	51
85814	*Tanytarsus glabrescens group*	135
85840	*Tanytarsus guerlus group*	85
95100	*Physella sp*	+
99180	*Strophitus undulatus undulatus*	+

No. Quantitative Taxa: 27 Total Taxa: 52

No. Qualitative Taxa: 31 ICI:

Number of Organisms: 3469 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 07-011 River: Arcola Creek RM: 7.50

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	16	
01801	*Turbellaria*	37	+
03360	*Plumatella sp*	9	+
03600	*Oligochaeta*	1864	+
04615	*Actinobdella inequiannulata*		+
04663	*Helobdella papillata*		+
04664	*Helobdella stagnalis*	2	+
04687	*Placobdella parasitica*	1	
04935	*Erpobdella punctata punctata*	1	+
05800	*Caecidotea sp*		+
06201	*Hyalella azteca*		+
17200	*Caenis sp*	17	+
21200	*Calopteryx sp*	9	+
22001	*Coenagrionidae*	22	+
22300	*Argia sp*	35	+
23909	*Boyeria vinosa*		+
26100	*Cordulegaster sp*		+
28500	*Libellula sp*		+
28955	*Libellula lydia*		+
45300	*Sigara sp*		+
47600	*Sialis sp*	1	
52200	*Cheumatopsyche sp*		+
60900	*Peltodytes sp*		+
65800	*Berosus sp*	46	+
66500	*Enochrus sp*		+
67800	*Tropisternus sp*		+
68708	*Dubiraphia vittata group*	52	+
69400	*Stenelmis sp*		+
71900	*Tipula sp*		+
74501	*Ceratopogonidae*	16	+
77355	*Clinotanypus pinguis*	25	
77500	*Conchapelopia sp*		+
77800	*Helopelopia sp*		+
78401	*Natarsia species A (sensu Roback, 1978)*		+
78650	*Procladius sp*		+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	25	
82730	*Chironomus (C.) decorus group*	25	+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	50	
83051	*Dicrotendipes simpsoni*	101	
83300	*Glyptotendipes (G.) sp*	980	+
83840	*Microtendipes pedellus group*	50	
84210	*Paratendipes albimanus or P. duplicatus*	402	+
84300	*Phaenopsectra obediens group*	50	
84450	*Polypedilum (P.) convictum*		+
84460	*Polypedilum (P.) fallax group*	25	
84470	*Polypedilum (P.) illinoense*		+
84750	*Stictochironomus sp*		+
85500	*Paratanytarsus sp*	101	
85800	*Tanytarsus sp*	50	
85814	*Tanytarsus glabrescens group*	50	
86100	*Chrysops sp*		+
95100	*Physella sp*	3	+
96002	*Helisoma anceps anceps*	22	+
96900	*Ferrissia sp*	33	
98200	*Pisidium sp*		+
98600	*Sphaerium sp*		+

No. Quantitative Taxa: 31 Total Taxa: 57

No. Qualitative Taxa: 43 ICI: **12**

Number of Organisms: 4120 Qual EPT: 2

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 07-011 River: Arcola Creek RM: 7.00

Taxa Code	Taxa	Quant	Qual
03600	*Oligochaeta*	1353	+
04602	*Glossiphoniidae sp 1*	1	
04663	*Helobdella papillata*	1	
04664	*Helobdella stagnalis*	21	+
04935	*Erpobdella punctata punctata*	6	+
05800	*Caecidotea sp*	1	
06201	*Hyalella azteca*		+
08601	*Hydracarina*	36	
17200	*Caenis sp*	32	+
21200	*Calopteryx sp*	19	+
22001	*Coenagrionidae*	6	+
22300	*Argia sp*	5	
23600	*Aeshna sp*		+
45300	*Sigara sp*		+
52200	*Cheumatopsyche sp*	239	+
52530	*Hydropsyche depravata group*		+
65800	*Berosus sp*	11	+
67800	*Tropisternus sp*		+
68708	*Dubiraphia vittata group*	64	+
69400	*Stenelmis sp*	1	+
71000	*Helius sp*		+
71900	*Tipula sp*		+
72700	*Anopheles sp*		+
77355	*Clinotanypus pinguis*		+
77500	*Conchapelopia sp*	43	+
78650	*Procladius sp*		+
80410	*Cricotopus (C.) sp*		+
80430	*Cricotopus (C.) tremulus group*		+
82730	*Chironomus (C.) decorus group*	87	+
82820	*Cryptochironomus sp*	43	+
83040	*Dicrotendipes neomodestus*	391	
83300	*Glyptotendipes (G.) sp*	1348	+
84210	*Paratendipes albimanus or P. duplicatus*	217	+
84300	*Phaenopsectra obediens group*	43	
84450	*Polypedilum (P.) convictum*	435	+
84470	*Polypedilum (P.) illinoense*		+
84750	*Stictochironomus sp*		+
85400	*Micropsectra sp*	87	+
85500	*Paratanytarsus sp*	783	+
85625	*Rheotanytarsus exiguus group*	783	+
85800	*Tanytarsus sp*	43	
86100	*Chrysops sp*		+
87540	*Hemerodromia sp*	17	+
95100	*Physella sp*		+
96002	*Helisoma anceps anceps*	5	+
96900	*Ferrissia sp*	40	+
98200	*Pisidium sp*	2	
98600	*Sphaerium sp*	1	

No. Quantitative Taxa: 32 Total Taxa: 48

No. Qualitative Taxa: 38 ICI: **26**

Number of Organisms: 6164 Qual EPT: 3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 07-011 River: Arcola Creek RM: 5.00

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	52
01801	*Turbellaria*	52 +
03600	*Oligochaeta*	117 +
04664	*Helobdella stagnalis*	20 +
04666	*Helobdella triserialis*	15
04685	*Placobdella ornata*	1 +
04935	*Erpobdella punctata punctata*	61 +
05800	*Caecidotea sp*	36 +
06201	*Hyalella azteca*	18 +
08240	*Orconectes (Crokerinus) propinquus*	+
11200	*Callibaetis sp*	+
21200	*Calopteryx sp*	8 +
22001	*Coenagrionidae*	40 +
22300	*Argia sp*	36
23710	*Anax longipes*	+
28955	*Libellula lydia*	+
45100	*Palmacorixa sp*	+
45300	*Sigara sp*	+
45900	*Notonecta sp*	+
52200	*Cheumatopsyche sp*	1 +
53800	*Hydroptila sp*	2
54300	*Oxyethira sp*	44
55300	*Ptilostomis sp*	+
60300	*Dineutus sp*	1
60800	*Haliplus sp*	+
60900	*Peltodytes sp*	+
63900	*Laccophilus sp*	+
65800	*Berosus sp*	+
67800	*Tropisternus sp*	+
68708	*Dubiraphia vittata group*	41 +
69400	*Stenelmis sp*	8
72700	*Anopheles sp*	+
74501	*Ceratopogonidae*	12 +
77130	*Ablabesmyia rhamphe group*	30
77355	*Clinotanypus pinguis*	10 +
77500	*Conchapelopia sp*	60 +
78650	*Procladius sp*	10 +
79030	*Tanypus punctipennis*	+
80410	*Cricotopus (C.) sp*	+
80420	*Cricotopus (C.) bicinctus*	10 +
82730	*Chironomus (C.) decorus group*	+
82800	*Cladopelma sp*	10
82820	*Cryptochironomus sp*	10 +
83002	*Dicrotendipes modestus*	89 +
83003	*Dicrotendipes fumidus*	10
83040	*Dicrotendipes neomodestus*	10
84210	*Paratendipes albimanus or P. duplicatus*	40 +
84300	*Phaenopsectra obediens group*	20
84450	*Polypedilum (P.) convictum*	139 +
84460	*Polypedilum (P.) fallax group*	10
84800	*Tribelos jucundum*	109
85500	*Paratanytarsus sp*	159
85625	*Rheotanytarsus exiguus group*	50
85800	*Tanytarsus sp*	30
85814	*Tanytarsus glabrescens group*	10
85840	*Tanytarsus guerlus group*	50 +
86100	*Chrysops sp*	+
89501	*Ephydridae*	8
95100	*Physella sp*	17 +
96002	*Helisoma anceps anceps*	57 +
96280	*Planorbella (Pierosoma) trivolvis*	19 +
96900	*Ferrissia sp*	8 +
98200	*Pisidium sp*	+
98600	*Sphaerium sp*	2 +

No. Quantitative Taxa: 45 Total Taxa: 64

No. Qualitative Taxa: 45 ICI: **34**

Number of Organisms: 1542 Qual EPT: 3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 07-011 River: Arcola Creek RM: 2.10

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
04664	*Helobdella stagnalis*	+
04685	*Placobdella ornata*	+
04935	*Erpobdella punctata punctata*	2 +
07860	*Cambarus (Puncticambarus) robustus*	+
08240	*Orconectes (Crokerinus) propinquus*	1 +
11120	*Baetis flavistriga*	+
13400	*Stenacron sp*	7 +
13521	*Stenonema femoratum*	+
21200	*Calopteryx sp*	5 +
22300	*Argia sp*	+
24900	*Gomphus sp*	+
45300	*Sigara sp*	+
52200	*Cheumatopsyche sp*	1 +
52530	*Hydropsyche depravata group*	+
53800	*Hydroptila sp*	+
60900	*Peltodytes sp*	+
68601	*Ancyronyx variegata*	+
68708	*Dubiraphia vittata group*	1 +
68901	*Macronychus glabratus*	1 +
69400	*Stenelmis sp*	+
77130	*Ablabesmyia rhamphe group*	+
77500	*Conchapelopia sp*	6
77800	*Helopelopia sp*	36
78350	*Meropelopia sp*	+
78650	*Procladius sp*	6
80370	*Corynoneura lobata*	32
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	47
83300	*Glyptotendipes (G.) sp*	18
84210	*Paratendipes albimanus or P. duplicatus*	214 +
84440	*Polypedilum (P.) aviceps*	+
84450	*Polypedilum (P.) convictum*	6
84460	*Polypedilum (P.) fallax group*	47
84750	*Stictochironomus sp*	+
85500	*Paratanytarsus sp*	77
85625	*Rheotanytarsus exiguus group*	6 +
85800	*Tanytarsus sp*	47
85814	*Tanytarsus glabrescens group*	119
85840	*Tanytarsus guerlus group*	59
87540	*Hemerodromia sp*	+
96900	*Ferrissia sp*	63 +
98600	*Sphaerium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 22 Total Taxa: 43

No. Qualitative Taxa: 31 ICI: **26**

Number of Organisms: 801 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 07-011 River: Arcola Creek RM: 0.70

Taxa Code	Taxa	Quant/Qual	
01801	*Turbellaria*	150	+
03360	*Plumatella sp*		+
03600	*Oligochaeta*	49	+
04664	*Helobdella stagnalis*		+
05800	*Caecidotea sp*	2	+
08240	*Orconectes (Crokerinus) propinquus*		+
11670	*Procloeon irrubrum*		+
13400	*Stenacron sp*	2	+
13521	*Stenonema femoratum*		+
17200	*Caenis sp*	294	+
18600	*Ephemera sp*		+
21200	*Calopteryx sp*	1	+
22001	*Coenagrionidae*	1	+
23909	*Boyeria vinosa*		+
24900	*Gomphus sp*		+
45300	*Sigara sp*		+
47600	*Sialis sp*		+
52200	*Cheumatopsyche sp*		+
52530	*Hydropsyche depravata group*		+
65800	*Berosus sp*	1	
68075	*Psephenus herricki*		+
68601	*Ancyronyx variegata*	1	+
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	20	+
69400	*Stenelmis sp*	5	+
77120	*Ablabesmyia mallochi*	49	+
77500	*Conchapelopia sp*		+
77800	*Helopelopia sp*	24	+
78650	*Procladius sp*		+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	24	
82730	*Chironomus (C.) decorus group*	49	
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	440	+
83051	*Dicrotendipes simpsoni*	73	
84210	*Paratendipes albimanus or P. duplicatus*	440	+
84300	*Phaenopsectra obediens group*	147	
84450	*Polypedilum (P.) convictum*	73	
84460	*Polypedilum (P.) fallax group*	49	
84540	*Polypedilum (Tripodura) scalaenum group*		+
84750	*Stictochironomus sp*		+
85500	*Paratanytarsus sp*	220	
85625	*Rheotanytarsus exiguus group*	49	
85814	*Tanytarsus glabrescens group*	489	+
85840	*Tanytarsus guerlus group*	49	
95100	*Physella sp*	2	+
96900	*Ferrissia sp*	17	+
98600	*Sphaerium sp*		+

No. Quantitative Taxa: 27 Total Taxa: 47

No. Qualitative Taxa: 37 ICI: **24**

Number of Organisms: 2720 Qual EPT: 7

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 06/21/95 River Code: 07-019 River: Trib. to Lake Erie (N. Kingsville) RM: 0.90

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
63300	*Hydroporus sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 1

No. Qualitative Taxa: 1 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 06/21/95 River Code: 07-019 River: Trib. to Lake Erie (N. Kingsville) RM: 0.60

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
06830	*Gammarus minus*	+			
47600	*Sialis sp*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 3

No. Qualitative Taxa: 3 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 06/22/95 River Code: 07-019 River: Trib. to Lake Erie (N. Kingsville) RM: 0.10

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
06830	*Gammarus minus*	+
07860	*Cambarus (Puncticambarus) robustus*	+
32205	*Amphinemura delosa*	+
74100	*Simulium sp*	+
80204	*Brillia flavifrons group*	+
81650	*Parametriocnemus sp*	+

No. Quantitative Taxa: 0 Total Taxa: 7

No. Qualitative Taxa: 7 ICI:

Number of Organisms: 0 Qual EPT: 1

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 06/22/95 River Code: 07-020 River: Trib. to Lake Erie (Berkshire Rd.) RM: 0.30

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
03360	*Plumatella sp*	+
06830	*Gammarus minus*	+
07860	*Cambarus (Puncticambarus) robustus*	+
50301	*Chimarra aterrima*	+
52200	*Cheumatopsyche sp*	+
52530	*Hydropsyche depravata group*	+
57900	*Pycnopsyche sp*	+
69400	*Stenelmis sp*	+
71900	*Tipula sp*	+
74100	*Simulium sp*	+
74501	*Ceratopogonidae*	+
77500	*Conchapelopia sp*	+
78350	*Meropelopia sp*	+
79880	*Prodiamesa olivacea*	+
81650	*Parametriocnemus sp*	+
82820	*Cryptochironomus sp*	+
84450	*Polypedilum (P.) convictum*	+
84888	*Xenochironomus xenolabis*	+
85501	*Paratanytarsus n.sp 1*	+
85625	*Rheotanytarsus exiguus group*	+
87515	*Clinocera (C.) sp*	+
95100	*Physella sp*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 24

No. Qualitative Taxa: 24 ICI:

Number of Organisms: 0 Qual EPT: 4

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 07-100 River: Conneaut Creek RM: 23.30

Taxa Code	Taxa	Quant	Qual
00650	*Eunapius sp*		+
01320	*Hydra sp*	120	
01801	*Turbellaria*		+
03045	*Fredericella indica*	1	
03360	*Plumatella sp*		+
03451	*Urnatella gracilis*	8	
03600	*Oligochaeta*	56	+
04664	*Helobdella stagnalis*		+
08240	*Orconectes (Crokerinus) propinquus*		+
11118	*Baetis dubius*	3	+
11130	*Baetis intercalaris*	2	
11650	*Procloeon sp (w/ hindwing pads)*	1	
11651	*Procloeon sp (w/o hindwing pads)*	2	
12200	*Isonychia sp*	5	+
13000	*Leucrocuta sp*	4	+
13400	*Stenacron sp*	84	+
13540	*Stenonema mediopunctatum*	16	+
13561	*Stenonema pulchellum*	160	
13570	*Stenonema terminatum*	52	
13590	*Stenonema vicarium*	4	
16324	*Serratella deficiens*	144	
16700	*Tricorythodes sp*	27	
17200	*Caenis sp*	94	+
18100	*Anthopotamus sp*		+
18600	*Ephemera sp*		+
21200	*Calopteryx sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	8	+
23909	*Boyeria vinosa*		+
24900	*Gomphus sp*		+
25510	*Stylogomphus albistylus*		+
34130	*Acroneuria frisoni*	1	+
34140	*Acroneuria internata*	21	+
34150	*Acroneuria lycorias*	4	
34300	*Neoperla clymene complex*		+
34700	*Agnetina capitata complex*	3	+
43300	*Ranatra sp*		+
47600	*Sialis sp*		+
48410	*Corydalus cornutus*	1	+
50315	*Chimarra obscura*		+
52200	*Cheumatopsyche sp*	58	+
52430	*Ceratopsyche morosa group*	99	+
52530	*Hydropsyche depravata group*	23	+
52540	*Hydropsyche dicantha*	110	+
52620	*Macrostemum zebratum*		+
53800	*Hydroptila sp*	18	+
57400	*Neophylax sp*		+
57900	*Pycnopsyche sp*		+
58505	*Helicopsyche borealis*		+
59100	*Ceraclea sp*		+
59110	*Ceraclea ancylus*		+
59510	*Oecetis avara*	26	
60300	*Dineutus sp*		+
60400	*Gyrinus sp*		+
60900	*Peltodytes sp*		+
65800	*Berosus sp*		+
66500	*Enochrus sp*		+
67800	*Tropisternus sp*		+
68075	*Psephenus herricki*	1	+
68601	*Ancyronyx variegata*	17	+
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	129	+
69000	*Microcylloepus pusillus*	9	
69200	*Optioservus sp*	56	+
69400	*Stenelmis sp*	37	+
71700	*Pilaria sp*		+
74501	*Ceratopogonidae*		+
77120	*Ablabesmyia mallochi*		+
77500	*Conchapelopia sp*	65	+
77750	*Hayesomyia senata or Thienemannimyia norena*	43	
77800	*Helopelopia sp*	22	+
78450	*Nilotanypus fimbriatus*	24	
78750	*Rheopelopia paramaculipennis*	43	
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	8	
80370	*Corynoneura lobata*	16	
80410	*Cricotopus (C.) sp*	65	+
80420	*Cricotopus (C.) bicinctus*	43	+
80430	*Cricotopus (C.) tremulus group*	43	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	22	
81250	*Nanocladius (N.) minimus*	22	
81650	*Parametriocnemus sp*	22	
82101	*Thienemanniella n.sp 1*	40	
82121	*Thienemanniella n.sp 3*	24	

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 07-100 River: Conneaut Creek RM: 23.30

Taxa Code	Taxa	Quant/Qual	
82130	*Thienemanniella similis*	8	
82730	*Chironomus (C.) decorus group*		+
82820	*Cryptochironomus sp*		+
83003	*Dicrotendipes fumidus*	86	
83040	*Dicrotendipes neomodestus*	194	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	86	+
83840	*Microtendipes pedellus group*		+
84450	*Polypedilum (P.) convictum*	862	+
84460	*Polypedilum (P.) fallax group*	22	
84540	*Polypedilum (Tripodura) scalaenum group*	43	+
84700	*Stenochironomus sp*	65	
84960	*Pseudochironomus sp*	43	+
85615	*Rheotanytarsus distinctissimus group*		+
85625	*Rheotanytarsus exiguus group*	474	+
85800	*Tanytarsus sp*	43	+
85814	*Tanytarsus glabrescens group*	86	+
85840	*Tanytarsus guerlus group*	129	+
86100	*Chrysops sp*		+
86401	*Atherix lantha*		+
87400	*Stratiomys sp*		+
87540	*Hemerodromia sp*		+
93900	*Elimia sp*	5	+
95100	*Physella sp*	4	+
96900	*Ferrissia sp*	1	+
96930	*Laevapex fuscus*	38	
98200	*Pisidium sp*		+
99860	*Lampsilis radiata luteola*		+

No. Quantitative Taxa: 68 Total Taxa: 110

No. Qualitative Taxa: 80 ICI: **46**

Number of Organisms: 4095 Qual EPT: 24

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 07-100 River: Conneaut Creek RM: 12.60

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	112
01418	*Craspedacusta sowerbyi*	32
01801	*Turbellaria*	10
01900	*Nemertea*	+
03040	*Fredericella sp*	1 +
03451	*Urnatella gracilis*	1
03600	*Oligochaeta*	464 +
04685	*Placobdella ornata*	+
04686	*Placobdella papillifera*	+
08240	*Orconectes (Crokerinus) propinquus*	+
08601	*Hydracarina*	+
11118	*Baetis dubius*	1
11130	*Baetis intercalaris*	+
11650	*Procloeon sp (w/ hindwing pads)*	+
11651	*Procloeon sp (w/o hindwing pads)*	12
13000	*Leucrocuta sp*	+
13400	*Stenacron sp*	520 +
13540	*Stenonema mediopunctatum*	115 +
13561	*Stenonema pulchellum*	164
13590	*Stenonema vicarium*	58
14950	*Leptophlebia sp or Paraleptophebia sp*	32
16700	*Tricorythodes sp*	+
17200	*Caenis sp*	606 +
18100	*Anthopotamus sp*	137 +
18619	*Ephemera simulans*	+
21200	*Calopteryx sp*	2 +
22001	*Coenagrionidae*	+
22300	*Argia sp*	33 +
23804	*Basiaeschna janata*	+
23909	*Boyeria vinosa*	1
24900	*Gomphus sp*	+
34140	*Acroneuria internata*	1 +
34150	*Acroneuria lycorias*	13 +
34300	*Neoperla clymene complex*	9 +
43300	*Ranatra sp*	+
47600	*Sialis sp*	+
50315	*Chimarra obscura*	+
51400	*Nyctiophylax sp*	8
51600	*Polycentropus sp*	2
52200	*Cheumatopsyche sp*	1
52430	*Ceratopsyche morosa group*	1 +
52540	*Hydropsyche dicantha*	6 +
52550	*Hydropsyche frisoni*	21
52620	*Macrostemum zebratum*	+
53800	*Hydroptila sp*	35 +
57400	*Neophylax sp*	+
58505	*Helicopsyche borealis*	+
59110	*Ceraclea ancylus*	+
59120	*Ceraclea flava complex*	+
59510	*Oecetis avara*	57
59970	*Petrophila sp*	+
60300	*Dineutus sp*	+
63300	*Hydroporus sp*	+
65800	*Berosus sp*	1
68075	*Psephenus herricki*	+
68601	*Ancyronyx variegata*	+
68708	*Dubiraphia vittata group*	1 +
68901	*Macronychus glabratus*	29 +
69400	*Stenelmis sp*	23 +
71100	*Hexatoma sp*	+
77120	*Ablabesmyia mallochi*	50 +
77800	*Helopelopia sp*	+
78650	*Procladius sp*	25 +
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	64
80370	*Corynoneura lobata*	40
80410	*Cricotopus (C.) sp*	25
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	25
81250	*Nanocladius (N.) minimus*	25 +
81280	*Nanocladius (Plecopteracoluthus) n. sp*	25 +
82121	*Thienemanniella n.sp 3*	32
82141	*Thienemanniella xena*	32
82220	*Tvetenia discoloripes group*	+
82730	*Chironomus (C.) decorus group*	25 +
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	349 +
83900	*Nilothauma sp*	25
84450	*Polypedilum (P.) convictum*	50 +
84470	*Polypedilum (P.) illinoense*	+
84960	*Pseudochironomus sp*	25
85230	*Cladotanytarsus mancus group*	25
85500	*Paratanytarsus sp*	50
85615	*Rheotanytarsus distinctissimus group*	+
85625	*Rheotanytarsus exiguus group*	299 +
85720	*Stempellinella n.sp nr. flavidula*	80 +

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 07-100 River: Conneaut Creek RM: 12.60

Taxa Code	Taxa	Quant/Qual
85800	*Tanytarsus sp*	50
85802	*Tanytarsus curticornis group*	199
85814	*Tanytarsus glabrescens group*	747 +
85840	*Tanytarsus guerlus group*	623 +
86100	*Chrysops sp*	+
86200	*Tabanus sp*	+
87540	*Hemerodromia sp*	48
93900	*Elimia sp*	9 +
95100	*Physella sp*	39 +
96900	*Ferrissia sp*	262 +
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 60 Total Taxa: 95

No. Qualitative Taxa: 66 ICI: **46**

Number of Organisms: 5757 Qual EPT: 21

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 07-100 River: Conneaut Creek RM: 5.40

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	3	
01801	*Turbellaria*	29	+
03360	*Plumatella sp*	4	
03451	*Urnatella gracilis*		+
03600	*Oligochaeta*	112	+
11118	*Baetis dubius*	1	+
11120	*Baetis flavistriga*		+
11130	*Baetis intercalaris*		+
11651	*Procloeon sp (w/o hindwing pads)*	1	
12200	*Isonychia sp*		+
13000	*Leucrocuta sp*		+
13400	*Stenacron sp*	75	+
13540	*Stenonema mediopunctatum*	20	+
13561	*Stenonema pulchellum*	108	+
13590	*Stenonema vicarium*	8	
16324	*Serratella deficiens*	9	+
16700	*Tricorythodes sp*	12	+
17200	*Caenis sp*	193	+
18100	*Anthopotamus sp*		+
18600	*Ephemera sp*		+
21200	*Calopteryx sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	29	+
24900	*Gomphus sp*		+
26700	*Macromia sp*	1	
34130	*Acroneuria frisoni*		+
34140	*Acroneuria internata*	1	+
34150	*Acroneuria lycorias*	10	
34300	*Neoperla clymene complex*		+
34700	*Agnetina capitata complex*		+
43300	*Ranatra sp*		+
47600	*Sialis sp*		+
50315	*Chimarra obscura*	2	+
50319	*Chimarra socia*	1	+
51400	*Nyctiophylax sp*	18	
51600	*Polycentropus sp*	12	
52200	*Cheumatopsyche sp*	2	+
52430	*Ceratopsyche morosa group*	4	
52540	*Hydropsyche dicantha*	4	+
52550	*Hydropsyche frisoni*	43	+
52620	*Macrostemum zebratum*		+
53800	*Hydroptila sp*	1	+
58505	*Helicopsyche borealis*		+
59110	*Ceraclea ancylus*		+
59500	*Oecetis sp*	25	
59970	*Petrophila sp*	1	
60300	*Dineutus sp*		+
65700	*Anacaena sp*		+
65800	*Berosus sp*	1	
68075	*Psephenus herricki*	1	+
68601	*Ancyronyx variegata*	12	
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	8	+
69275	*Optioservus trivittatus*		+
69400	*Stenelmis sp*	7	+
71100	*Hexatoma sp*		+
77130	*Ablabesmyia rhamphe group*	14	
77750	*Hayesomyia senata or Thienemannimyia norena*	56	
77800	*Helopelopia sp*	14	
78401	*Natarsia species A (sensu Roback, 1978)*		+
78450	*Nilotanypus fimbriatus*	42	
80370	*Corynoneura lobata*	32	
80410	*Cricotopus (C.) sp*	98	+
80420	*Cricotopus (C.) bicinctus*		+
81250	*Nanocladius (N.) minimus*	126	
81280	*Nanocladius (Plecopteracoluthus) n. sp*		+
81631	*Parakiefferiella n.sp 1*	14	
82130	*Thienemanniella similis*		+
82600	*Axarus sp*		+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	42	
83840	*Microtendipes pedellus group*	14	
84155	*Paralauterborniella nigrohalteralis*	14	
84300	*Phaenopsectra obediens group*	84	+
84450	*Polypedilum (P.) convictum*	56	+
84460	*Polypedilum (P.) fallax group*	14	
84470	*Polypedilum (P.) illinoense*	14	
85210	*Cladotanytarsus species group B*	28	
85230	*Cladotanytarsus mancus group*		+
85615	*Rheotanytarsus distinctissimus group*	70	
85625	*Rheotanytarsus exiguus group*	419	+
85802	*Tanytarsus curticornis group*	28	
85814	*Tanytarsus glabrescens group*	293	+
85840	*Tanytarsus guerlus group*	42	+
86401	*Atherix lantha*		+

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 07-100 River: Conneaut Creek RM: 5.40

Taxa Code	Taxa	Quant/Qual
93900	*Elimia sp*	1 +
95100	*Physella sp*	+
96900	*Ferrissia sp*	1 +
96930	*Laevapex fuscus*	77
98200	*Pisidium sp*	+
98600	*Sphaerium sp*	+
99860	*Lampsilis radiata luteola*	+

No. Quantitative Taxa: 57 Total Taxa: 92

No. Qualitative Taxa: 63 ICI: **50**

Number of Organisms: 2351 Qual EPT: 26

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/15/95 River Code: 07-100 River: Conneaut Creek RM: 2.20

Taxa Code	Taxa	Quant/Qual	
00401	*Spongillidae*	1	
00653	*Eunapius fragilis*		+
01200	*Cordylophora lacustris*	1	
01320	*Hydra sp*	5	
01801	*Turbellaria*	33	+
03121	*Paludicella articulata*		+
03600	*Oligochaeta*	213	+
04666	*Helobdella triserialis*	3	
06201	*Hyalella azteca*	10	
08601	*Hydracarina*	5	
11650	*Procloeon sp (w/ hindwing pads)*	2	+
13400	*Stenacron sp*	6	+
17200	*Caenis sp*	24	+
18100	*Anthopotamus sp*		+
22001	*Coenagrionidae*	8	+
22300	*Argia sp*	37	+
23704	*Anax junius*		+
24900	*Gomphus sp*		+
47600	*Sialis sp*		+
51206	*Cyrnellus fraternus*		+
51400	*Nyctiophylax sp*		+
51600	*Polycentropus sp*	4	+
53800	*Hydroptila sp*	5	+
54200	*Orthotrichia sp*	6	
54300	*Oxyethira sp*	19	+
57400	*Neophylax sp*		+
59500	*Oecetis sp*		+
60900	*Peltodytes sp*		+
65800	*Berosus sp*	3	
68075	*Psephenus herricki*		+
68700	*Dubiraphia sp*	4	
68901	*Macronychus glabratus*	2	
69000	*Microcylloepus pusillus*	1	
69400	*Stenelmis sp*	9	
74501	*Ceratopogonidae*	6	
77115	*Ablabesmyia janta*	47	+
77120	*Ablabesmyia mallochi*		+
78650	*Procladius sp*		+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	5	
81650	*Parametriocnemus sp*	5	
82121	*Thienemanniella n.sp 3*	5	
83002	*Dicrotendipes modestus*	5	+
83040	*Dicrotendipes neomodestus*	5	
83050	*Dicrotendipes lucifer*	33	+
83158	*Endochironomus nigricans*	24	+
83840	*Microtendipes pedellus group*	57	+
84020	*Parachironomus carinatus*	5	
84470	*Polypedilum (P.) illinoense*	85	
84750	*Stictochironomus sp*		+
84790	*Tribelos fuscicorne*	76	
85500	*Paratanytarsus sp*	9	+
85814	*Tanytarsus glabrescens group*	14	
95100	*Physella sp*	35	+
96120	*Menetus (Micromenetus) dilatatus*	47	+
96900	*Ferrissia sp*	1	+
98600	*Sphaerium sp*	1	

No. Quantitative Taxa: 41 Total Taxa: 56

No. Qualitative Taxa: 34 ICI: **28**

Number of Organisms: 866 Qual EPT: 11

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/15/95 River Code: 07-100 River: Conneaut Creek RM: 1.10

Taxa Code	Taxa	Quant/Qual
00700	*Radiospongilla crateriformis*	+
01801	*Turbellaria*	93
03121	*Paludicella articulata*	+
03221	*Pectinatella magnifica*	3 +
03600	*Oligochaeta*	104 +
04637	*Batracobdella phalera*	1
04664	*Helobdella stagnalis*	+
04666	*Helobdella triserialis*	12 +
05800	*Caecidotea sp*	+
06201	*Hyalella azteca*	28
06700	*Crangonyx sp*	4 +
06810	*Gammarus fasciatus*	4
08240	*Orconectes (Crokerinus) propinquus*	+
08601	*Hydracarina*	4
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
17200	*Caenis sp*	32
22001	*Coenagrionidae*	17 +
22300	*Argia sp*	19 +
51206	*Cyrnellus fraternus*	1
51600	*Polycentropus sp*	8
53600	*Agraylea sp*	25
54160	*Ochrotrichia sp*	10
54200	*Orthotrichia sp*	189
54300	*Oxyethira sp*	4
59500	*Oecetis sp*	14
63300	*Hydroporus sp*	+
68708	*Dubiraphia vittata group*	+
77115	*Ablabesmyia janta*	3
77130	*Ablabesmyia rhamphe group*	13
80370	*Corynoneura lobata*	3
82121	*Thienemanniella n.sp 3*	3
83002	*Dicrotendipes modestus*	19
83040	*Dicrotendipes neomodestus*	19
83050	*Dicrotendipes lucifer*	16
83051	*Dicrotendipes simpsoni*	3
83158	*Endochironomus nigricans*	49
83300	*Glyptotendipes (G.) sp*	3
83310	*Glyptotendipes (Trichotendipes) amplus*	3
84030	*Parachironomus directus*	3
84040	*Parachironomus frequens*	10 +
84050	*Parachironomus "hirtalatus" (sensu Simpson & Bode, 1980)*	26
84060	*Parachironomus pectinatellae*	36
84470	*Polypedilum (P.) illinoense*	29
84960	*Pseudochironomus sp*	6
85840	*Tanytarsus guerlus group*	3
95100	*Physella sp*	28 +
95907	*Gyraulus (Torquis) parvus*	41
96120	*Menetus (Micromenetus) dilatatus*	224 +
96930	*Laevapex fuscus*	38 +
97710	*Dreissena polymorpha*	23 +
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 42 Total Taxa: 52

No. Qualitative Taxa: 21 ICI: **22**

Number of Organisms: 1173 Qual EPT: 2

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/15/95 River Code: 07-100 River: Conneaut Creek RM: 0.50

Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	1
01801	*Turbellaria*	53
03360	*Plumatella sp*	1
03600	*Oligochaeta*	2344
05800	*Caecidotea sp*	1
06810	*Gammarus fasciatus*	58 +
51206	*Cyrnellus fraternus*	97
68901	*Macronychus glabratus*	2 +
77750	*Hayesomyia senata or Thienemannimyia norena*	6
80410	*Cricotopus (C.) sp*	36
80420	*Cricotopus (C.) bicinctus*	11
80430	*Cricotopus (C.) tremulus group*	2 +
80500	*Cricotopus (Isocladius) reversus group*	2
81240	*Nanocladius (N.) distinctus*	4
81631	*Parakiefferiella n.sp 1*	4
82121	*Thienemanniella n.sp 3*	4
83040	*Dicrotendipes neomodestus*	29
83051	*Dicrotendipes simpsoni*	6
83840	*Microtendipes pedellus group*	15
84888	*Xenochironomus xenolabis*	+
85625	*Rheotanytarsus exiguus group*	4
85814	*Tanytarsus glabrescens group*	2
87540	*Hemerodromia sp*	1
95100	*Physella sp*	108
96120	*Menetus (Micromenetus) dilatatus*	192
96900	*Ferrissia sp*	63
97710	*Dreissena polymorpha*	622 +

No. Quantitative Taxa: 26 Total Taxa: 27

No. Qualitative Taxa: 5 ICI: **12**

Number of Organisms: 3668 Qual EPT: 0

Macroinvertebrate data for the Grand and Ashtabula River Basins

River Mile	Drainage Area (sq mi)	Number of Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Percent: Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Taxa	Qual. EPT	Eco-region	ICI
GRAND RIVER (03-001)													
Year: 95													
83.30	85.0	53(6)	6(4)	4(6)	27(6)	32.7(6)	1.0(2)	20.3(4)	41.2(4)	9.4(4)	12(4)	3	46
65.80	212.0	39(6)	8(4)	2(2)	19(6)	40.3(6)	7.3(2)	31.0(4)	15.9(6)	2.3(6)	11(4)	3	46
56.00	251.0	40(6)	4(2)	5(6)	16(4)	2.1(2)	0.9(2)	24.6(4)	71.5(0)	2.6(6)	7(2)	3	34
44.70	405.0	49(6)	7(4)	5(4)	25(6)	8.3(2)	17.2(4)	45.2(6)	27.2(4)	3.8(4)	8(2)	3	42
28.40	554.0	53(6)	11(6)	10(6)	20(6)	29.5(6)	4.5(2)	43.7(6)	21.7(4)	0.5(6)	23(6)	3	54
22.60	581.0	56(6)	9(6)	12(6)	19(6)	27.0(4)	3.5(2)	32.5(6)	36.1(2)	0.6(6)	22(6)	3	50
13.60	630.0	48(6)	13(6)	10(6)	11(4)	27.9(6)	7.3(2)	46.9(6)	17.1(6)	0.3(6)	16(4)	3	52
6.20	687.0	38(6)	7(4)	9(6)	12(4)	14.3(4)	28.8(4)	25.4(4)	31.4(2)	3.9(4)	20(6)	3	44
BAUGHMAN CREEK (03-022)													
Year: 95													
4.10	17.8	41(6)	8(6)	5(6)	19(4)	37.6(6)	1.2(2)	16.8(4)	42.3(4)	3.8(6)	17(6)	3	50
BIG CREEK (03-100)													
Year: 95													
16.10	1.2	21(2)	1(0)	0(0)	14(4)	0.5(2)	0.0(0)	2.1(2)	96.5(0)	52.3(0)	4(2)	3	12
16.00	1.2	20(2)	3(2)	0(0)	12(2)	12.3(4)	0.0(0)	0.9(2)	86.2(0)	64.2(0)	3(0)	3	12
14.20	4.5	38(6)	9(6)	1(4)	23(6)	21.9(4)	0.7(4)	21.3(6)	50.8(2)	7.5(6)	17(6)	3	50
9.40	14.9	34(4)	7(6)	0(0)	18(4)	4.7(2)	0.0(0)	25.5(6)	68.3(0)	15.3(4)	25(6)	3	32
2.50	35.0	45(6)	11(6)	6(6)	26(6)	22.0(4)	2.7(2)	35.6(6)	39.5(4)	2.4(6)	21(6)	3	52
MILL CREEK (03-120)													
Year: 95													
18.20	69.0	45(6)	3(2)	1(2)	20(6)	2.9(2)	0.1(2)	33.7(6)	59.8(2)	13.4(2)	16(6)	3	36
12.10	82.0	47(6)	5(2)	3(4)	25(6)	7.2(2)	0.7(2)	3.1(2)	86.7(0)	59.1(0)	9(2)	3	26
ROCK CREEK (03-130)													
Year: 95													
0.80	57.6	41(6)	7(4)	3(4)	20(6)	39.5(6)	0.5(2)	15.4(4)	41.7(4)	8.1(4)	14(6)	3	46
PHELPS CREEK (03-150)													
Year: 95													
4.90	23.6	26(4)	8(6)	0(0)	16(4)	11.4(2)	0.0(0)	38.7(6)	49.9(2)	2.9(6)	16(6)	3	36
SWINE CREEK (03-160)													
Year: 95													
5.20	15.7	48(6)	14(6)	4(6)	21(6)	46.1(6)	1.6(2)	23.5(6)	26.1(6)	5.6(6)	18(6)	3	56
ASHTABULA RIVER (07-001)													
Year: 95													
25.60	66.1	45(6)	4(2)	5(6)	26(6)	8.3(2)	1.3(2)	15.6(2)	73.7(0)	16.5(2)	11(4)	3	32

Macroinvertebrate data for the Grand and Ashtabula River Basins

River Mile	Drainage Area (sq mi)	Number of Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Percent: Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Taxa	Qual. EPT	Eco-region	ICI
19.10	93.0	44(6)	7(4)	2(4)	18(4)	11.6(2)	0.5(2)	14.1(2)	56.6(2)	12.8(2)	10(4)	3	32
11.90	107.0	40(6)	8(4)	4(4)	17(4)	10.3(2)	0.4(2)	17.5(4)	69.5(0)	44.6(0)	9(2)	3	28
3.60	128.0	40(6)	7(4)	4(4)	19(6)	14.5(2)	2.3(2)	48.9(6)	32.9(4)	4.0(6)	16(6)	3	46
2.30	132.0	39(6)	4(2)	5(4)	16(6)	9.5(4)	2.3(0)	1.9(2)	85.1(0)	48.7(0)	6(2)	3	26
W. BR. ASHTABULA R. (07-004)													
Year: 95													
1.80	27.0	30(4)	5(4)	3(6)	13(2)	8.6(2)	0.7(2)	5.5(2)	85.1(0)	7.2(6)	11(4)	3	32
COWLES CREEK (07-007)													
Year: 95													
7.10	6.8	22(2)	4(2)	0(0)	15(4)	15.7(4)	0.0(0)	17.4(4)	66.9(0)	12.1(4)	9(4)	3	24
5.60	9.9	18(2)	2(0)	0(0)	15(4)	3.6(2)	0.0(0)	23.2(6)	73.2(0)	14.3(4)	6(2)	3	20
4.80	11.5	25(4)	0(0)	0(0)	15(4)	0.0(0)	0.0(0)	10.0(4)	88.1(0)	55.1(0)	5(2)	3	14
4.30	11.7	30(4)	0(0)	1(2)	17(4)	0.0(0)	0.5(2)	1.1(2)	94.8(0)	46.2(0)	3(0)	3	14
3.60	12.9	23(2)	0(0)	1(2)	14(4)	0.0(0)	0.5(2)	12.4(4)	84.9(0)	22.5(2)	2(0)	3	16
1.50	14.7	35(4)	2(0)	2(4)	19(4)	0.6(2)	1.2(2)	23.3(6)	72.4(0)	11.1(4)	7(2)	3	28
0.30	15.2	27(4)	1(0)	2(2)	18(6)	1.5(2)	1.2(0)	7.8(4)	88.8(0)	25.8(0)	2(0)	3	18
ARCOLA CREEK (07-011)													
Year: 95													
7.50	7.8	31(4)	1(0)	0(0)	14(4)	0.4(2)	0.0(0)	4.9(2)	90.7(0)	49.8(0)	2(0)	3	12
7.00	7.9	32(4)	1(0)	1(4)	13(2)	0.5(2)	3.9(6)	27.5(6)	66.4(0)	24.0(2)	3(0)	3	26
5.00	11.0	45(6)	0(0)	3(6)	22(6)	0.0(0)	3.0(6)	19.4(6)	68.9(0)	10.5(4)	3(0)	3	34
2.10	19.0	22(2)	1(0)	1(2)	14(4)	0.9(2)	0.1(2)	38.5(6)	59.7(2)	13.7(4)	6(2)	3	26
0.70	19.5	27(4)	2(0)	0(0)	14(4)	10.9(2)	0.0(0)	29.7(6)	58.4(2)	8.8(4)	7(2)	3	24
CONNEAUT CREEK (07-100)													
Year: 95													
23.30	152.0	68(6)	14(6)	6(6)	28(6)	14.6(2)	8.2(2)	17.9(4)	52.3(2)	3.1(6)	24(6)	3	46
12.60	169.0	60(6)	9(6)	8(6)	24(6)	28.6(4)	2.3(2)	36.0(6)	31.2(4)	13.7(0)	21(6)	3	46
5.40	176.0	57(6)	9(6)	10(6)	21(6)	18.2(4)	4.8(2)	37.4(6)	36.6(4)	6.0(4)	26(6)	3	50

Species List

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **94.30**	Basin: Grand River		Date Range: 07/25/95
	Time Fished: 3600 sec	Drain Area: 15.2 sq mi	Thru: 08/30/95
	Dist Fished: 0.40 km	No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GRASS PICKEREL		P	M	P	1	0.75	0.09	0.02	0.47	29.00
GOLDEN REDHORSE	R	I	S	M	1	0.75	0.09	0.01	0.13	8.00
NORTHERN HOG SUCKER	R	I	S	M	72	54.00	6.72	1.06	22.73	19.64
WHITE SUCKER	W	O	S	T	58	43.50	5.41	0.13	2.80	3.00
RIVER CHUB	N	I	N	I	52	39.00	4.85	0.48	10.38	12.41
BLACKNOSE DACE	N	G	S	T	15	11.25	1.40	0.01	0.29	1.21
CREEK CHUB	N	G	N	T	68	51.00	6.34	0.55	11.85	10.85
ROSYFACE SHINER	N	I	S	I	12	9.00	1.12	0.03	0.54	2.75
STRIPED SHINER	N	I	S		93	69.75	8.68	0.41	8.69	5.81
SAND SHINER	N	I	M	M	2	1.50	0.19	0.00	0.05	1.50
SILVERJAW MINNOW	N	I	M		97	72.75	9.05	0.27	5.79	3.71
BLUNTNOSE MINNOW	N	O	C	T	136	102.00	12.69	0.27	5.84	2.67
CENTRAL STONEROLLER	N	H	N		305	228.75	28.45	0.91	19.40	3.96
YELLOW BULLHEAD		I	C	T	1	0.75	0.09	0.00	0.10	6.00
STONECAT MADTOM		I	C	I	5	3.75	0.47	0.04	0.95	11.80
ROCK BASS	S	C	C		5	3.75	0.47	0.31	6.68	83.00
LARGEMOUTH BASS	F	C	C		1	0.75	0.09	0.01	0.28	17.00
GREEN SUNFISH	S	I	C	T	1	0.75	0.09	0.01	0.21	13.00
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.09	0.00	0.06	4.00
PUMPKINSEED SUNFISH	S	I	C	P	1	0.75	0.09	0.01	0.15	9.00
BLACKSIDE DARTER	D	I	S		1	0.75	0.09	0.00	0.03	2.00
JOHNNY DARTER	D	I	C		61	45.75	5.69	0.05	1.00	1.02
GREENSIDE DARTER	D	I	S	M	2	1.50	0.19	0.01	0.23	7.00
RAINBOW DARTER	D	I	S	M	16	12.00	1.49	0.01	0.26	1.00
FANTAIL DARTER	D	I	C		65	48.75	6.06	0.05	1.14	1.08
	Mile Total				1,072	804.00		4.67		
	Number of Species				25					
	Number of Hybrids				0					

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **83.50**	Basin: Grand River		Date Range: 08/03/95
	Time Fished: 4658 sec	Drain Area: 85.0 sq mi	Thru: 10/11/95
	Dist Fished: 0.40 km	No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GRASS PICKEREL		P	M	P	11	8.25	6.40	0.12	3.84	14.09
SILVER REDHORSE	R	I	S	M	1	0.75	0.58	0.17	5.70	231.00
GOLDEN REDHORSE	R	I	S	M	2	1.50	1.16	0.20	6.45	131.00
NORTHERN HOG SUCKER	R	I	S	M	1	0.75	0.58	0.08	2.76	112.00
WHITE SUCKER	W	O	S	T	7	5.25	4.07	0.27	9.01	52.29
SPOTTED SUCKER	R	I	S		1	0.75	0.58	0.04	1.23	50.00
GOLDEN SHINER	N	I	M	T	2	1.50	1.16	0.02	0.62	12.50
RIVER CHUB	N	I	N	I	1	0.75	0.58	0.02	0.62	25.00
CREEK CHUB	N	G	N	T	1	0.75	0.58	0.04	1.28	52.00
STRIPED SHINER	N	I	S		5	3.75	2.91	0.04	1.18	9.60
SPOTFIN SHINER	N	I	M		4	3.00	2.33	0.03	0.82	8.25
BLUNTNOSE MINNOW	N	O	C	T	19	14.25	11.05	0.04	1.17	2.47
YELLOW BULLHEAD		I	C	T	16	12.00	9.30	0.45	14.62	37.13
BLACK BULLHEAD		I	C	P	1	0.75	0.58	0.03	0.87	35.00
BRINDLED MADTOM		I	C	I	7	5.25	4.07	0.02	0.72	4.14
TROUT-PERCH		I	M		7	5.25	4.07	0.06	1.92	11.14
BLACK CRAPPIE	S	I	C		6	4.50	3.49	0.06	2.12	14.33
ROCK BASS	S	C	C		4	3.00	2.33	0.08	2.58	26.00
LARGEMOUTH BASS	F	C	C		1	0.75	0.58	0.01	0.34	14.00
WARMOUTH SF	S	C	C		17	12.75	9.88	0.21	6.86	16.35
GREEN SUNFISH	S	I	C	T	17	12.75	9.88	0.11	3.73	8.88
BLUEGILL SUNFISH	S	I	C	P	8	6.00	4.65	0.19	6.29	31.88
PUMPKINSEED SUNFISH	S	I	C	P	4	3.00	2.33	0.05	1.66	16.75
WALLEYE	F	P	S		1	0.75	0.58	0.61	19.94	810.00
BLACKSIDE DARTER	D	I	S		25	18.75	14.53	0.11	3.59	5.84
JOHNNY DARTER	D	I	C		2	1.50	1.16	0.00	0.10	2.00
GREENSIDE DARTER	D	I	S	M	1	0.75	0.58	0.00	0.13	5.00
Mile Total					172	129.00		3.05		
Number of Species					27					
Number of Hybrids					0					

Species List

River Code: **03-001**	Stream: **Grand River**	Sample Date: **1995**
River Mile: **65.90**	Basin: Grand River	Date Range: 07/25/95
	Time Fished: 4451 sec Drain Area: 212.0 sq mi	Thru: 09/07/95
	Dist Fished: 1.00 km No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GRASS PICKEREL		P	M	P	4	4.00	1.89	0.03	0.07	8.00
SILVER REDHORSE	R	I	S	M	21	21.00	9.91	18.15	37.26	864.19
BLACK REDHORSE	R	I	S	I	1	1.00	0.47	0.88	1.81	880.00
GOLDEN REDHORSE	R	I	S	M	68	68.00	32.08	16.18	33.21	237.89
NORTHERN HOG SUCKER	R	I	S	M	12	12.00	5.66	0.78	1.60	64.93
WHITE SUCKER	W	O	S	T	24	24.00	11.32	9.60	19.71	399.92
RIVER CHUB	N	I	N	I	1	1.00	0.47	0.09	0.19	92.00
REDFIN SHINER	N	I	N		1	1.00	0.47	0.00	0.01	3.00
STRIPED SHINER	N	I	S		7	7.00	3.30	0.13	0.27	18.79
SPOTFIN SHINER	N	I	M		17	17.00	8.02	0.06	0.12	3.53
BLUNTNOSE MINNOW	N	O	C	T	4	4.00	1.89	0.01	0.02	3.00
BRINDLED MADTOM		I	C	I	1	1.00	0.47	0.01	0.01	6.00
TROUT-PERCH		I	M		27	27.00	12.74	0.23	0.47	8.41
BLACK CRAPPIE	S	I	C		1	1.00	0.47	0.03	0.06	30.00
ROCK BASS	S	C	C		10	10.00	4.72	1.27	2.60	126.50
BLUEGILL SUNFISH	S	I	C	P	2	2.00	0.94	0.13	0.26	63.00
PUMPKINSEED SUNFISH	S	I	C	P	1	1.00	0.47	0.02	0.04	19.00
WALLEYE	F	P	S		1	1.00	0.47	1.05	2.16	1,050.00
YELLOW PERCH			M		1	1.00	0.47	0.04	0.08	39.00
BLACKSIDE DARTER	D	I	S		5	5.00	2.36	0.03	0.06	5.47
JOHNNY DARTER	D	I	C		2	2.00	0.94	0.00	0.01	1.50
GREENSIDE DARTER	D	I	S	M	1	1.00	0.47	0.00	0.00	1.00
Mile Total					212	212.00		48.71		
Number of Species					22					
Number of Hybrids					0					

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **52.70**	Basin: Grand River		Date Range: 07/25/95
	Time Fished: 5681 sec	Drain Area: 289.0 sq mi	Thru: 09/07/95
	Dist Fished: 1.00 km	No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GRASS PICKEREL		P	M	P	3	3.00	1.69	0.01	0.01	3.67
SILVER REDHORSE	R	I	S	M	46	46.00	25.99	29.74	35.07	646.56
GOLDEN REDHORSE	R	I	S	M	25	25.00	14.12	3.24	3.81	129.40
RIVER REDHORSE [S]	R	I	S	I	1	1.00	0.56	2.75	3.24	2,750.00
WHITE SUCKER	W	O	S	T	8	8.00	4.52	2.16	2.54	269.50
COMMON CARP	G	O	M	T	9	9.00	5.08	28.60	33.72	3,177.78
GOLDEN SHINER	N	I	M	T	2	2.00	1.13	0.02	0.03	11.00
REDFIN SHINER	N	I	N		2	2.00	1.13	0.00	0.00	1.50
SPOTFIN SHINER	N	I	M		6	6.00	3.39	0.03	0.03	4.67
SAND SHINER	N	I	M	M	1	1.00	0.56	0.00	0.00	1.00
BLUNTNOSE MINNOW	N	O	C	T	5	5.00	2.82	0.01	0.01	1.20
GRASS CARP	E		M		1	1.00	0.56	5.60	6.60	5,600.00
YELLOW BULLHEAD		I	C	T	5	5.00	2.82	1.53	1.81	306.60
TROUT-PERCH		I	M		9	9.00	5.08	0.09	0.11	10.11
WHITE CRAPPIE	S	I	C		5	5.00	2.82	0.91	1.07	181.80
BLACK CRAPPIE	S	I	C		5	5.00	2.82	0.66	0.78	132.80
ROCK BASS	S	C	C		8	8.00	4.52	1.05	1.24	131.13
SMALLMOUTH BASS	F	C	C	M	1	1.00	0.56	0.46	0.54	456.00
LARGEMOUTH BASS	F	C	C		2	2.00	1.13	0.04	0.04	18.00
WARMOUTH SF	S	C	C		1	1.00	0.56	0.06	0.07	56.00
GREEN SUNFISH	S	I	C	T	1	1.00	0.56	0.02	0.03	22.00
BLUEGILL SUNFISH	S	I	C	P	6	6.00	3.39	0.28	0.33	47.00
LONGEAR SUNFISH	S	I	C	M	2	2.00	1.13	0.02	0.03	12.00
PUMPKINSEED SUNFISH	S	I	C	P	4	4.00	2.26	0.11	0.13	28.00
B'GILL X PUMPKINSEED					1	1.00	0.56	0.06	0.08	64.00
HYBRID X SUNFISH					1	1.00	0.56	0.03	0.03	27.00
WALLEYE	F	P	S		9	9.00	5.08	6.72	7.92	746.44
YELLOW PERCH			M		4	4.00	2.26	0.59	0.70	148.50
BLACKSIDE DARTER	D	I	S		2	2.00	1.13	0.01	0.01	5.00
LOGPERCH	D	I	S	M	1	1.00	0.56	0.00	0.00	3.00
JOHNNY DARTER	D	I	C		1	1.00	0.56	0.00	0.00	3.00
Mile Total					177	177.00		84.81		
Number of Species					29					
Number of Hybrids					2					

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **40.90**	Basin: Grand River		Date Range: 07/25/95
	Time Fished: 4975 sec	Drain Area: 521.0 sq mi	Thru: 09/07/95
	Dist Fished: 1.00 km	No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN PIKE	F	P	M		3	3.00	0.68	0.71	1.35	237.00
SILVER REDHORSE	R	I	S	M	32	32.00	7.21	15.90	30.25	497.02
BLACK REDHORSE	R	I	S	I	10	10.00	2.25	2.81	5.34	280.90
GOLDEN REDHORSE	R	I	S	M	94	94.00	21.17	17.46	33.21	185.72
RIVER REDHORSE [S]	R	I	S	I	1	1.00	0.23	0.48	0.92	482.00
NORTHERN HOG SUCKER	R	I	S	M	25	25.00	5.63	0.86	1.64	34.52
COMMON CARP	G	O	M	T	1	1.00	0.23	2.90	5.52	2,900.00
HORNYHEAD CHUB	N	I	N	I	2	2.00	0.45	0.01	0.02	4.00
RIVER CHUB	N	I	N	I	6	6.00	1.35	0.10	0.19	16.67
ROSYFACE SHINER	N	I	S	I	1	1.00	0.23	0.00	0.00	1.00
REDFIN SHINER	N	I	N		18	18.00	4.05	0.02	0.03	1.00
STRIPED SHINER	N	I	S		19	19.00	4.28	0.17	0.33	9.05
SPOTFIN SHINER	N	I	M		13	13.00	2.93	0.05	0.10	3.85
SAND SHINER	N	I	M	M	4	4.00	0.90	0.01	0.01	1.25
MIMIC SHINER	N	I	M	I	78	78.00	17.57	0.13	0.25	1.65
BLUNTNOSE MINNOW	N	O	C	T	51	51.00	11.49	0.16	0.31	3.20
CENTRAL STONEROLLER	N	H	N		8	8.00	1.80	0.04	0.07	4.38
CHANNEL CATFISH	F		C		2	2.00	0.45	4.35	8.27	2,175.00
STONECAT MADTOM		I	C	I	1	1.00	0.23	0.00	0.00	1.00
BRINDLED MADTOM		I	C	I	1	1.00	0.23	0.01	0.01	5.00
TROUT-PERCH		I	M		25	25.00	5.63	0.17	0.31	6.60
BLACK CRAPPIE	S	I	C		1	1.00	0.23	0.20	0.38	198.00
ROCK BASS	S	C	C		3	3.00	0.68	0.03	0.05	8.67
SMALLMOUTH BASS	F	C	C	M	8	8.00	1.80	2.17	4.12	271.00
LARGEMOUTH BASS	F	C	C		2	2.00	0.45	0.04	0.07	17.50
GREEN SUNFISH	S	I	C	T	1	1.00	0.23	0.02	0.04	20.00
BLUEGILL SUNFISH	S	I	C	P	5	5.00	1.13	0.04	0.07	7.00
LONGEAR SUNFISH	S	I	C	M	1	1.00	0.23	0.01	0.02	12.00
WALLEYE	F	P	S		5	5.00	1.13	3.68	7.00	735.80
BLACKSIDE DARTER	D	I	S		12	12.00	2.70	0.03	0.06	2.50
LOGPERCH	D	I	S	M	3	3.00	0.68	0.03	0.05	9.00
JOHNNY DARTER	D	I	C		1	1.00	0.23	0.00	0.00	1.00
GREENSIDE DARTER	D	I	S	M	4	4.00	0.90	0.01	0.01	1.75
FANTAIL DARTER	D	I	C		3	3.00	0.68	0.01	0.01	1.67
Mile Total					444	444.00		52.57		
Number of Species					34					
Number of Hybrids					0					

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **36.30**	Basin: Grand River		Date Range: 07/17/95
	Time Fished: 5570 sec	Drain Area: 543.0 sq mi	Thru: 09/07/95
	Dist Fished: 1.00 km	No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN PIKE	F	P	M		1	1.00	0.43	0.10	0.21	95.00
MUSKELLUNGE [S]	F	P	M		2	2.00	0.86	4.07	8.89	2,035.00
SILVER REDHORSE	R	I	S	M	40	40.00	17.17	16.49	36.01	412.25
BLACK REDHORSE	R	I	S	I	1	1.00	0.43	0.28	0.61	278.00
GOLDEN REDHORSE	R	I	S	M	56	56.00	24.03	7.98	17.43	142.58
WHITE SUCKER	W	O	S	T	1	1.00	0.43	0.14	0.31	141.00
COMMON CARP	G	O	M	T	4	4.00	1.72	10.46	22.83	2,614.25
GOLDEN SHINER	N	I	M	T	4	4.00	1.72	0.03	0.06	7.25
REDFIN SHINER	N	I	N		1	1.00	0.43	0.00	0.00	1.00
STRIPED SHINER	N	I	S		6	6.00	2.58	0.05	0.11	8.17
SPOTFIN SHINER	N	I	M		5	5.00	2.15	0.02	0.04	3.60
MIMIC SHINER	N	I	M	I	11	11.00	4.72	0.01	0.03	1.27
BLUNTNOSE MINNOW	N	O	C	T	19	19.00	8.15	0.02	0.05	1.11
TROUT-PERCH		I	M		15	15.00	6.44	0.09	0.20	6.13
WHITE CRAPPIE	S	I	C		4	4.00	1.72	0.20	0.44	50.50
BLACK CRAPPIE	S	I	C		2	2.00	0.86	0.01	0.02	5.00
ROCK BASS	S	C	C		11	11.00	4.72	0.62	1.36	56.45
SMALLMOUTH BASS	F	C	C	M	5	5.00	2.15	1.40	3.05	279.60
LARGEMOUTH BASS	F	C	C		8	8.00	3.43	0.12	0.25	14.38
BLUEGILL SUNFISH	S	I	C	P	6	6.00	2.58	0.11	0.23	17.50
PUMPKINSEED SUNFISH	S	I	C	P	14	14.00	6.01	0.25	0.54	17.79
WALLEYE	F	P	S		6	6.00	2.58	3.26	7.12	543.67
YELLOW PERCH			M		2	2.00	0.86	0.07	0.16	35.50
BLACKSIDE DARTER	D	I	S		7	7.00	3.00	0.01	0.03	1.86
LOGPERCH	D	I	S	M	2	2.00	0.86	0.01	0.02	5.50
Mile Total					233	233.00		45.80		
Number of Species					25					
Number of Hybrids					0					

Species List

River Code: **03-001**	Stream: **Grand River**	Sample Date: **1995**
River Mile: **34.00**	Basin: Grand River	Date Range: 07/18/95
	Time Fished: 4078 sec Drain Area: 548.0 sq mi	Thru: 08/24/95
	Dist Fished: 0.95 km No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
SILVER REDHORSE	R	I	S	M	10	10.56	2.70	3.40	6.19	311.30
BLACK REDHORSE	R	I	S	I	33	36.22	9.28	4.13	7.52	115.30
GOLDEN REDHORSE	R	I	S	M	38	39.89	10.22	4.91	8.95	121.03
RIVER REDHORSE [S]	R	I	S	I	2	2.22	0.57	6.00	10.93	2,700.00
NORTHERN HOG SUCKER	R	I	S	M	12	12.22	3.13	1.07	1.96	86.50
WHITE SUCKER	W	O	S	T	1	1.11	0.28	0.03	0.05	24.00
COMMON CARP	G	O	M	T	8	8.78	2.25	29.67	54.05	3,393.75
RIVER CHUB	N	I	N	I	7	7.00	1.79	0.10	0.19	14.57
ROSYFACE SHINER	N	I	S	I	2	2.00	0.51	0.01	0.02	5.50
REDFIN SHINER	N	I	N		3	3.00	0.77	0.00	0.01	1.33
STRIPED SHINER	N	I	S		29	30.11	7.71	0.24	0.43	7.90
SPOTFIN SHINER	N	I	M		6	6.11	1.57	0.02	0.04	3.83
MIMIC SHINER	N	I	M	I	111	111.78	28.63	0.17	0.30	1.48
BLUNTNOSE MINNOW	N	O	C	T	30	30.44	7.80	0.10	0.18	3.30
CENTRAL STONEROLLER	N	H	N		2	2.00	0.51	0.00	0.01	1.50
STONECAT MADTOM		I	C	I	1	1.00	0.26	0.03	0.06	32.00
TROUT-PERCH		I	M		15	16.11	4.13	0.14	0.26	8.80
BLACK CRAPPIE	S	I	C		2	2.22	0.57	0.64	1.17	288.50
ROCK BASS	S	C	C		22	23.22	5.95	1.17	2.14	49.68
SMALLMOUTH BASS	F	C	C	M	12	12.67	3.24	2.67	4.87	210.08
GREEN SUNFISH	S	I	C	T	1	1.11	0.28	0.00	0.00	1.00
LONGEAR SUNFISH	S	I	C	M	2	2.22	0.57	0.02	0.04	10.50
PUMPKINSEED SUNFISH	S	I	C	P	1	1.11	0.28	0.02	0.04	19.00
WALLEYE	F	P	S		3	3.11	0.80	0.22	0.41	67.33
BLACKSIDE DARTER	D	I	S		11	11.22	2.87	0.04	0.07	3.36
LOGPERCH	D	I	S	M	6	6.00	1.54	0.04	0.07	6.67
GREENSIDE DARTER	D	I	S	M	6	6.00	1.54	0.03	0.05	4.33
FANTAIL DARTER	D	I	C		1	1.00	0.26	0.00	0.00	1.00
Mile Total					377	390.44		54.88		
Number of Species					28					
Number of Hybrids					0					

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **28.40**	Basin: Grand River		Date Range: 07/18/95
	Time Fished: 3119 sec	Drain Area: 554.0 sq mi	Thru: 08/23/95
	Dist Fished: 0.70 km	No of Passes: 2	Sampler Type: A 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	8	8.00	1.18	0.72	1.80	89.63
BLACK REDHORSE	R	I	S	I	61	55.00	8.13	11.90	29.88	211.13
GOLDEN REDHORSE	R	I	S	M	29	28.00	4.14	5.45	13.69	188.47
NORTHERN HOG SUCKER	R	I	S	M	97	87.50	12.93	8.48	21.28	92.92
COMMON CARP	G	O	M	T	2	2.00	0.30	1.94	4.88	971.00
RIVER CHUB	N	I	N	I	67	58.50	8.64	1.65	4.15	26.90
SILVER SHINER	N	I	S	I	10	9.25	1.37	0.06	0.16	6.80
ROSYFACE SHINER	N	I	S	I	56	45.00	6.65	0.09	0.23	1.96
REDFIN SHINER	N	I	N		1	1.00	0.15	0.01	0.02	6.00
STRIPED SHINER	N	I	S		95	84.50	12.49	0.83	2.08	9.53
SPOTFIN SHINER	N	I	M		5	5.00	0.74	0.03	0.08	6.00
SAND SHINER	N	I	M	M	8	7.75	1.15	0.02	0.06	2.88
MIMIC SHINER	N	I	M	I	44	41.50	6.13	0.06	0.16	1.49
BLUNTNOSE MINNOW	N	O	C	T	37	31.00	4.58	0.12	0.29	3.81
CENTRAL STONEROLLER	N	H	N		29	22.50	3.32	0.18	0.44	7.76
STRIPED SH X ROSYFACE SH		I			1	0.75	0.11	0.01	0.02	9.00
STONECAT MADTOM		I	C	I	7	6.00	0.89	0.25	0.63	40.86
ROCK BASS	S	C	C		57	51.25	7.57	4.71	11.83	89.96
SMALLMOUTH BASS	F	C	C	M	18	17.50	2.59	2.67	6.70	148.48
LONGEAR SUNFISH	S	I	C	M	1	1.00	0.15	0.05	0.13	52.00
WALLEYE	F	P	S		1	1.00	0.15	0.21	0.51	205.00
BLACKSIDE DARTER	D	I	S		8	6.25	0.92	0.02	0.06	3.75
LOGPERCH	D	I	S	M	17	13.75	2.03	0.13	0.32	9.53
GREENSIDE DARTER	D	I	S	M	59	48.75	7.20	0.17	0.42	3.43
RAINBOW DARTER	D	I	S	M	12	10.75	1.59	0.03	0.09	3.25
FANTAIL DARTER	D	I	C		41	33.25	4.91	0.05	0.13	1.50
Mile Total					771	676.75		39.83		
Number of Species					25					
Number of Hybrids					1					

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **22.10**	Basin: Grand River		Date Range: 07/19/95
	Time Fished: 5400 sec	Drain Area: 581.0 sq mi	Thru: 08/23/95
	Dist Fished: 0.40 km	No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BLACK REDHORSE	R	I	S	I	11	8.25	1.13	1.37	6.63	165.59
GOLDEN REDHORSE	R	I	S	M	9	6.75	0.92	0.04	0.18	5.44
NORTHERN HOG SUCKER	R	I	S	M	63	47.25	6.47	6.06	29.36	128.17
WHITE SUCKER	W	O	S	T	2	1.50	0.21	0.02	0.07	10.00
RIVER CHUB	N	I	N	I	86	64.50	8.84	4.27	20.70	66.21
SILVER SHINER	N	I	S	I	26	19.50	2.67	0.10	0.47	4.93
ROSYFACE SHINER	N	I	S	I	86	64.50	8.84	0.14	0.68	2.17
STRIPED SHINER	N	I	S		77	57.75	7.91	1.06	5.12	18.29
SPOTFIN SHINER	N	I	M		7	5.25	0.72	0.02	0.10	3.86
SAND SHINER	N	I	M	M	9	6.75	0.92	0.01	0.04	1.22
MIMIC SHINER	N	I	M	I	32	24.00	3.29	0.05	0.23	1.93
BLUNTNOSE MINNOW	N	O	C	T	79	59.25	8.12	0.26	1.25	4.35
CENTRAL STONEROLLER	N	H	N		86	64.50	8.84	1.36	6.59	21.07
STRIPED SH X ROSYFACE SH		I			1	0.75	0.10	0.01	0.06	17.00
YELLOW BULLHEAD		I	C	T	1	0.75	0.10	0.10	0.50	138.00
STONECAT MADTOM		I	C	I	21	15.75	2.16	0.35	1.68	21.94
ROCK BASS	S	C	C		77	57.75	7.91	2.82	13.65	48.75
SMALLMOUTH BASS	F	C	C	M	23	17.25	2.36	1.84	8.94	106.83
BLACKSIDE DARTER	D	I	S		19	14.25	1.95	0.02	0.09	1.37
LOGPERCH	D	I	S	M	38	28.50	3.91	0.36	1.76	12.71
JOHNNY DARTER	D	I	C		3	2.25	0.31	0.00	0.01	1.00
GREENSIDE DARTER	D	I	S	M	108	81.00	11.10	0.24	1.16	2.96
RAINBOW DARTER	D	I	S	M	28	21.00	2.88	0.05	0.25	2.46
FANTAIL DARTER	D	I	C		81	60.75	8.32	0.10	0.49	1.68
Mile Total					973	729.75		20.63		
Number of Species					23					
Number of Hybrids					1					

River Code: **03-001**	Stream: **Grand River**	Sample Date: **1995**
River Mile: **13.40**	Basin: Grand River	Date Range: 07/19/95
	Time Fished: 4024 sec Drain Area: 630.0 sq mi	Thru: 09/07/95
	Dist Fished: 1.00 km No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
SILVER REDHORSE	R	I	S	M	2	2.00	0.36	2.83	6.40	1,412.50
BLACK REDHORSE	R	I	S	I	85	85.00	15.45	23.01	52.13	270.67
GOLDEN REDHORSE	R	I	S	M	42	42.00	7.64	5.97	13.52	142.11
RIVER REDHORSE [S]	R	I	S	I	2	2.00	0.36	2.62	5.94	1,310.00
NORTHERN HOG SUCKER	R	I	S	M	79	79.00	14.36	5.02	11.36	63.49
RIVER CHUB	N	I	N	I	15	15.00	2.73	0.34	0.77	22.67
BIGEYE CHUB	N	I	S	I	1	1.00	0.18	0.00	0.00	1.00
SILVER SHINER	N	I	S	I	41	41.00	7.45	0.18	0.40	4.32
ROSYFACE SHINER	N	I	S	I	39	39.00	7.09	0.09	0.19	2.20
STRIPED SHINER	N	I	S		59	59.00	10.73	0.67	1.52	11.35
SPOTFIN SHINER	N	I	M		6	6.00	1.09	0.02	0.05	3.50
SAND SHINER	N	I	M	M	5	5.00	0.91	0.01	0.03	2.60
MIMIC SHINER	N	I	M	I	47	47.00	8.55	0.07	0.16	1.53
BLUNTNOSE MINNOW	N	O	C	T	30	30.00	5.45	0.09	0.21	3.09
CENTRAL STONEROLLER	N	H	N		11	11.00	2.00	0.10	0.23	9.27
STONECAT MADTOM		I	C	I	2	2.00	0.36	0.04	0.08	18.00
BRINDLED MADTOM		I	C	I	2	2.00	0.36	0.01	0.03	6.00
ROCK BASS	S	C	C		19	19.00	3.45	1.26	2.85	66.21
SMALLMOUTH BASS	F	C	C	M	20	20.00	3.64	1.55	3.50	77.30
BLUEGILL SUNFISH	S	I	C	P	3	3.00	0.55	0.09	0.20	30.00
BLACKSIDE DARTER	D	I	S		4	4.00	0.73	0.01	0.02	2.50
LOGPERCH	D	I	S	M	20	20.00	3.64	0.15	0.34	7.40
JOHNNY DARTER	D	I	C		1	1.00	0.18	0.00	0.00	1.00
GREENSIDE DARTER	D	I	S	M	8	8.00	1.45	0.01	0.03	1.75
RAINBOW DARTER	D	I	S	M	4	4.00	0.73	0.01	0.02	1.75
FANTAIL DARTER	D	I	C		3	3.00	0.55	0.01	0.01	1.67
Mile Total					550	550.00		44.14		
Number of Species					26					
Number of Hybrids					0					

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **8.00**	Basin: Grand River		Date Range: 07/19/95
	Time Fished: 4276 sec	Drain Area: 686.0 sq mi	Thru: 09/06/95
	Dist Fished: 1.00 km	No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		1	1.00	0.28	0.16	0.21	156.00
QUILLBACK CARPSUCKER	C	O	M		2	2.00	0.55	1.51	2.02	752.50
SILVER REDHORSE	R	I	S	M	11	11.00	3.04	9.38	12.57	852.27
BLACK REDHORSE	R	I	S	I	39	39.00	10.77	9.75	13.07	250.04
GOLDEN REDHORSE	R	I	S	M	29	29.00	8.01	5.75	7.71	198.33
NORTHERN HOG SUCKER	R	I	S	M	45	45.00	12.43	5.35	7.17	118.82
WHITE SUCKER	W	O	S	T	2	2.00	0.55	0.24	0.32	120.00
SPOTTED SUCKER	R	I	S		2	2.00	0.55	0.55	0.74	276.00
COMMON CARP	G	O	M	T	15	15.00	4.14	36.40	48.79	2,426.67
RIVER CHUB	N	I	N	I	8	8.00	2.21	0.11	0.14	13.50
SILVER SHINER	N	I	S	I	10	10.00	2.76	0.05	0.07	5.10
ROSYFACE SHINER	N	I	S	I	16	16.00	4.42	0.07	0.09	4.19
STRIPED SHINER	N	I	S		35	35.00	9.67	0.44	0.59	12.49
SPOTFIN SHINER	N	I	M		10	10.00	2.76	0.05	0.07	5.10
SAND SHINER	N	I	M	M	5	5.00	1.38	0.01	0.01	1.40
MIMIC SHINER	N	I	M	I	12	12.00	3.31	0.03	0.04	2.42
BLUNTNOSE MINNOW	N	O	C	T	7	7.00	1.93	0.03	0.04	4.57
CENTRAL STONEROLLER	N	H	N		25	25.00	6.91	0.41	0.55	16.40
BRINDLED MADTOM		I	C	I	3	3.00	0.83	0.01	0.01	3.67
ROCK BASS	S	C	C		15	15.00	4.14	1.14	1.52	75.83
SMALLMOUTH BASS	F	C	C	M	23	23.00	6.35	1.45	1.94	63.09
LARGEMOUTH BASS	F	C	C		2	2.00	0.55	0.05	0.06	23.00
BLUEGILL SUNFISH	S	I	C	P	7	7.00	1.93	0.17	0.23	24.86
LONGEAR SUNFISH	S	I	C	M	6	6.00	1.66	0.14	0.19	23.33
WALLEYE	F	P	S		1	1.00	0.28	0.01	0.01	11.00
BLACKSIDE DARTER	D	I	S		1	1.00	0.28	0.01	0.01	5.00
LOGPERCH	D	I	S	M	2	2.00	0.55	0.02	0.02	7.50
JOHNNY DARTER	D	I	C		1	1.00	0.28	0.00	0.00	1.00
GREENSIDE DARTER	D	I	S	M	9	9.00	2.49	0.04	0.05	3.89
RAINBOW DARTER	D	I	S	M	8	8.00	2.21	0.01	0.01	0.63
FANTAIL DARTER	D	I	C		9	9.00	2.49	0.01	0.01	0.75
FRESHWATER DRUM			M	P	1	1.00	0.28	1.30	1.74	1,300.00
Mile Total					362	362.00		74.61		
Number of Species					32					
Number of Hybrids					0					

River Code: **03-001**	Stream: **Grand River**		Sample Date: **1995**
River Mile: **6.20**	Basin: Grand River		Date Range: 07/19/95
	Time Fished: 3533 sec	Drain Area: 687.0 sq mi	Thru: 09/06/95
	Dist Fished: 1.00 km	No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		14	14.00	2.93	1.75	4.34	124.93
SILVER REDHORSE	R	I	S	M	4	4.00	0.84	1.65	4.10	412.75
BLACK REDHORSE	R	I	S	I	55	55.00	11.51	13.52	33.58	245.88
GOLDEN REDHORSE	R	I	S	M	19	19.00	3.97	3.68	9.15	193.89
SHORTHEAD REDHORSE	R	I	S	M	2	2.00	0.42	0.52	1.29	260.00
NORTHERN HOG SUCKER	R	I	S	M	126	126.00	26.36	8.89	22.07	70.52
COMMON CARP	G	O	M	T	1	1.00	0.21	1.95	4.84	1,950.00
RIVER CHUB	N	I	N	I	30	30.00	6.28	0.63	1.57	21.03
EMERALD SHINER	N	I	S		1	1.00	0.21	0.00	0.00	2.00
SILVER SHINER	N	I	S	I	8	8.00	1.67	0.03	0.08	4.13
ROSYFACE SHINER	N	I	S	I	13	13.00	2.72	0.02	0.06	1.85
STRIPED SHINER	N	I	S		23	23.00	4.81	0.36	0.89	15.65
SPOTFIN SHINER	N	I	M		3	3.00	0.63	0.01	0.03	4.67
MIMIC SHINER	N	I	M	I	31	31.00	6.49	0.03	0.07	0.97
SILVERJAW MINNOW	N	I	M		1	1.00	0.21	0.00	0.00	2.00
BLUNTNOSE MINNOW	N	O	C	T	38	38.00	7.95	0.08	0.19	2.05
CENTRAL STONEROLLER	N	H	N		16	16.00	3.35	0.13	0.32	7.94
CHANNEL CATFISH	F		C		4	4.00	0.84	3.21	7.98	803.25
STONECAT MADTOM		I	C	I	3	3.00	0.63	0.07	0.17	22.33
WHITE BASS	F	P	M		1	1.00	0.21	0.09	0.21	85.00
WHITE PERCH	E		M		2	2.00	0.42	0.03	0.08	16.50
ROCK BASS	S	C	C		9	9.00	1.88	0.60	1.50	67.00
SMALLMOUTH BASS	F	C	C	M	20	20.00	4.18	1.80	4.46	89.90
LARGEMOUTH BASS	F	C	C		1	1.00	0.21	0.07	0.18	72.00
BLUEGILL SUNFISH	S	I	C	P	1	1.00	0.21	0.02	0.04	17.00
WALLEYE	F	P	S		1	1.00	0.21	0.10	0.26	103.00
BLACKSIDE DARTER	D	I	S		1	1.00	0.21	0.00	0.01	3.00
LOGPERCH	D	I	S	M	8	8.00	1.67	0.06	0.15	7.63
GREENSIDE DARTER	D	I	S	M	19	19.00	3.97	0.07	0.16	3.47
RAINBOW DARTER	D	I	S	M	4	4.00	0.84	0.01	0.01	1.25
FANTAIL DARTER	D	I	C		12	12.00	2.51	0.01	0.03	1.17
FRESHWATER DRUM			M	P	7	7.00	1.46	0.87	2.15	123.86
	Mile Total				478	478.00		40.27		
	Number of Species				32					
	Number of Hybrids				0					

River Code: **03-100**	Stream: **Big Creek**		Sample Date: **1995**
River Mile: **16.30**	Basin: Grand River		Date Range: 07/12/95
	Time Fished: 4040 sec	Drain Area: 1.0 sq mi	Thru: 08/22/95
	Dist Fished: 0.36 km	No of Passes: 2	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	905	754.17	77.48	2.94	61.82	3.90
WHITE SUCKER	W	O	S	T	27	22.50	2.31	0.27	5.73	12.11
CREEK CHUB	N	G	N	T	190	158.33	16.27	1.25	26.21	7.87
SOUTH. REDBELLY DACE	N	H	S		1	0.83	0.09	0.00	0.05	3.00
COMMON SHINER	N	I	S		6	5.00	0.51	0.04	0.82	7.83
CENTRAL STONEROLLER	N	H	N		28	23.33	2.40	0.13	2.79	5.68
BLACK BULLHEAD		I	C	P	1	0.83	0.09	0.03	0.63	36.00
LARGEMOUTH BASS	F	C	C		2	1.67	0.17	0.08	1.68	48.00
BROOK STICKLEBACK		I	C		8	6.67	0.68	0.01	0.26	1.88
Mile Total					1,168	973.33		4.76		
Number of Species					9					
Number of Hybrids					0					

River Code: **03-100**	Stream: **Big Creek**		Sample Date: **1995**
River Mile: **15.90**	Basin: Grand River		Date Range: 07/12/95
	Time Fished: 3600 sec	Drain Area: 1.3 sq mi	Thru: 08/22/95
	Dist Fished: 0.30 km	No of Passes: 2	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	180	180.00	76.27	0.64	62.29	3.53
WHITE SUCKER	W	O	S	T	1	1.00	0.42	0.03	2.84	29.00
BLACKNOSE DACE	N	G	S	T	1	1.00	0.42	0.00	0.29	3.00
CREEK CHUB	N	G	N	T	24	24.00	10.17	0.11	10.48	4.46
SOUTH. REDBELLY DACE	N	H	S		2	2.00	0.85	0.01	0.88	4.50
CENTRAL STONEROLLER	N	H	N		27	27.00	11.44	0.23	22.33	8.44
PUMPKINSEED SUNFISH	S	I	C	P	1	1.00	0.42	0.01	0.88	9.00
Mile Total					236	236.00		1.02		
Number of Species					7					
Number of Hybrids					0					

Species List

River Code: **03-100**	Stream: **Big Creek**	Sample Date: **1995**
River Mile: **13.90**	Basin: Grand River	Date Range: 07/11/95
	Time Fished: 4500 sec Drain Area: 5.2 sq mi	Thru: 08/22/95
	Dist Fished: 0.38 km No of Passes: 2	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	5	3.95	0.70	0.02	0.34	5.80
NORTHERN HOG SUCKER	R	I	S	M	1	0.79	0.14	0.01	0.15	13.00
WHITE SUCKER	W	O	S	T	72	56.84	10.14	4.22	62.30	74.24
BLACKNOSE DACE	N	G	S	T	200	157.89	28.17	0.41	5.98	2.57
CREEK CHUB	N	G	N	T	267	210.79	37.61	1.77	26.09	8.39
REDSIDE DACE	N	I	S	I	2	1.58	0.28	0.01	0.08	3.50
COMMON SHINER	N	I	S		55	43.42	7.75	0.19	2.74	4.27
CENTRAL STONEROLLER	N	H	N		51	40.26	7.18	0.09	1.31	2.20
RAINBOW DARTER	D	I	S	M	57	45.00	8.03	0.07	1.03	1.55
Mile Total					710	560.53		6.78		
Number of Species					9					
Number of Hybrids					0					

Species List

River Code: **03-100**	Stream: **Big Creek**		Sample Date: **1995**
River Mile: **9.50**	Basin: Grand River		Date Range: 07/11/95
	Time Fished: 5280 sec	Drain Area: 14.9 sq mi	Thru: 08/22/95
	Dist Fished: 0.40 km	No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
CENTRAL MUDMINNOW		I	C	T	6	4.50	0.30	0.04	0.52	7.83
NORTHERN HOG SUCKER	R	I	S	M	62	46.50	3.10	0.58	8.54	12.54
WHITE SUCKER	W	O	S	T	187	140.25	9.34	1.92	28.17	13.70
BLACKNOSE DACE	N	G	S	T	489	366.75	24.41	0.53	7.75	1.44
CREEK CHUB	N	G	N	T	61	45.75	3.05	0.38	5.50	8.19
COMMON SHINER	N	I	S		142	106.50	7.09	0.42	6.21	3.98
SILVERJAW MINNOW	N	I	M		6	4.50	0.30	0.02	0.24	3.67
BLUNTNOSE MINNOW	N	O	C	T	47	35.25	2.35	0.09	1.36	2.63
CENTRAL STONEROLLER	N	H	N		749	561.75	37.39	2.40	35.21	4.28
YELLOW BULLHEAD		I	C	T	3	2.25	0.15	0.15	2.13	64.67
LARGEMOUTH BASS	F	C	C		2	1.50	0.10	0.02	0.26	11.50
BLUEGILL SUNFISH	S	I	C	P	5	3.75	0.25	0.01	0.15	2.60
HYBRID X SUNFISH					1	0.75	0.05	0.05	0.68	62.00
JOHNNY DARTER	D	I	C		34	25.50	1.70	0.03	0.49	1.29
RAINBOW DARTER	D	I	S	M	207	155.25	10.33	0.19	2.76	1.21
FANTAIL DARTER	D	I	C		2	1.50	0.10	0.00	0.07	3.00
Mile Total					2,003	1,502.25		6.82		
Number of Species					15					
Number of Hybrids					1					

River Code: **03-120**	Stream: **Mill Creek (Grand R. RM 41.28)**	Sample Date: **1995**
River Mile: **18.10**	Basin: Grand River	Date Range: 07/12/95
	Time Fished: 4320 sec Drain Area: 69.0 sq mi	Thru: 08/24/95
	Dist Fished: 0.38 km No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GRASS PICKEREL		P	M	P	2	1.67	0.23	0.04	1.24	24.50
NORTHERN HOG SUCKER	R	I	S	M	35	27.67	3.78	0.27	8.12	9.54
WHITE SUCKER	W	O	S	T	26	20.83	2.84	0.13	3.96	6.54
CREEK CHUB	N	G	N	T	54	41.92	5.72	0.26	7.73	6.20
REDFIN SHINER	N	I	N		7	5.25	0.72	0.01	0.35	2.14
STRIPED SHINER	N	I	S		5	4.17	0.57	0.00	0.12	1.00
BLUNTNOSE MINNOW	N	O	C	T	189	146.33	19.98	0.24	7.10	1.60
CENTRAL STONEROLLER	N	H	N		173	134.83	18.41	0.55	16.64	4.08
YELLOW BULLHEAD		I	C	T	12	9.92	1.35	0.12	3.67	13.00
ROCK BASS	S	C	C		66	52.08	7.11	1.21	36.50	23.75
GREEN SUNFISH	S	I	C	T	1	0.75	0.10	0.02	0.45	20.00
BLUEGILL SUNFISH	S	I	C	P	6	4.75	0.65	0.08	2.43	17.83
BLACKSIDE DARTER	D	I	S		7	5.67	0.77	0.02	0.48	2.86
LOGPERCH	D	I	S	M	3	2.42	0.33	0.02	0.56	7.67
JOHNNY DARTER	D	I	C		72	57.17	7.81	0.06	1.78	1.03
GREENSIDE DARTER	D	I	S	M	56	44.92	6.13	0.10	2.88	2.14
RAINBOW DARTER	D	I	S	M	90	70.42	9.62	0.09	2.72	1.28
FANTAIL DARTER	D	I	C		131	101.58	13.87	0.11	3.31	1.08
Mile Total					935	732.33		3.31		
Number of Species					18					
Number of Hybrids					0					

River Code: **03-120**	Stream: **Mill Creek (Grand R. RM 41.28)**	Sample Date: **1995**
River Mile: **10.00**	Basin: Grand River	Date Range: 07/12/95
	Time Fished: 4800 sec Drain Area: 86.0 sq mi	Thru: 08/24/95
	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GRASS PICKEREL		P	M	P	7	5.25	1.11	0.16	2.07	30.57
SILVER REDHORSE	R	I	S	M	1	0.75	0.16	0.00	0.01	1.00
GOLDEN REDHORSE	R	I	S	M	19	14.25	3.00	0.03	0.32	1.74
NORTHERN HOG SUCKER	R	I	S	M	48	36.00	7.58	0.74	9.53	20.49
WHITE SUCKER	W	O	S	T	1	0.75	0.16	0.00	0.01	1.00
CREEK CHUB	N	G	N	T	2	1.50	0.32	0.02	0.19	10.00
REDFIN SHINER	N	I	N		7	5.25	1.11	0.01	0.14	2.00
STRIPED SHINER	N	I	S		8	6.00	1.26	0.08	0.98	12.63
MIMIC SHINER	N	I	M	I	28	21.00	4.42	0.04	0.47	1.71
BLUNTNOSE MINNOW	N	O	C	T	139	104.25	21.96	0.24	3.09	2.29
CENTRAL STONEROLLER	N	H	N		50	37.50	7.90	0.40	5.23	10.78
YELLOW BULLHEAD		I	C	T	18	13.50	2.84	1.81	23.41	134.22
STONECAT MADTOM		I	C	I	1	0.75	0.16	0.04	0.52	54.00
BLACK CRAPPIE	S	I	C		8	6.00	1.26	0.75	9.69	125.00
ROCK BASS	S	C	C		37	27.75	5.85	1.07	13.87	38.70
LARGEMOUTH BASS	F	C	C		13	9.75	2.05	1.20	15.46	122.69
GREEN SUNFISH	S	I	C	T	6	4.50	0.95	0.08	0.97	16.67
BLUEGILL SUNFISH	S	I	C	P	15	11.25	2.37	0.44	5.68	39.07
PUMPKINSEED SUNFISH	S	I	C	P	11	8.25	1.74	0.22	2.78	26.00
B'GILL X PUMPKINSEED					1	0.75	0.16	0.10	1.28	132.00
HYBRID X SUNFISH					1	0.75	0.16	0.09	1.10	113.00
BLACKSIDE DARTER	D	I	S		3	2.25	0.47	0.01	0.09	3.00
LOGPERCH	D	I	S	M	16	12.00	2.53	0.12	1.54	9.88
JOHNNY DARTER	D	I	C		27	20.25	4.27	0.02	0.21	0.80
GREENSIDE DARTER	D	I	S	M	16	12.00	2.53	0.02	0.26	1.69
RAINBOW DARTER	D	I	S	M	59	44.25	9.32	0.05	0.61	1.07
FANTAIL DARTER	D	I	C		91	68.25	14.38	0.04	0.54	0.61
Mile Total					633	474.75		7.74		
Number of Species					25					
Number of Hybrids					2					

Species List

River Code: **07-001**	Stream: **Ashtabula River**		Sample Date: **1995**
River Mile: **27.20**	Basin: Ashtabula River		Date Range: 08/01/95
	Time Fished: 900 sec	Drain Area: 72.0 sq mi	Thru: 09/12/95
	Dist Fished: 0.40 km	No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GOLDEN REDHORSE	R	I	S	M	2	1.50	0.14	0.12	1.47	80.00
NORTHERN HOG SUCKER	R	I	S	M	29	21.75	2.10	0.89	10.89	40.83
WHITE SUCKER	W	O	S	T	8	6.00	0.58	0.13	1.54	20.88
BIGEYE CHUB	N	I	S	I	73	54.75	5.27	0.15	1.89	2.81
CREEK CHUB	N	G	N	T	14	10.50	1.01	0.17	2.08	16.14
REDFIN SHINER	N	I	N		27	20.25	1.95	0.02	0.19	0.74
STRIPED SHINER	N	I	S		81	60.75	5.85	0.46	5.67	7.61
SAND SHINER	N	I	M	M	37	27.75	2.67	0.03	0.36	1.05
MIMIC SHINER	N	I	M	I	345	258.75	24.93	0.30	3.70	1.17
BLUNTNOSE MINNOW	N	O	C	T	321	240.75	23.19	0.54	6.64	2.25
CENTRAL STONEROLLER	N	H	N		163	122.25	11.78	1.26	15.46	10.31
YELLOW BULLHEAD		I	C	T	6	4.50	0.43	0.33	4.07	73.67
ROCK BASS	S	C	C		83	62.25	6.00	2.73	33.52	43.89
SMALLMOUTH BASS	F	C	C	M	16	12.00	1.16	0.75	9.17	62.25
GREEN SUNFISH	S	I	C	T	3	2.25	0.22	0.03	0.34	12.33
BLUEGILL SUNFISH	S	I	C	P	11	8.25	0.79	0.01	0.11	1.09
PUMPKINSEED SUNFISH	S	I	C	P	2	1.50	0.14	0.03	0.33	17.50
GR'N SF X PUMPKINS'D					1	0.75	0.07	0.01	0.15	16.00
BLACKSIDE DARTER	D	I	S		2	1.50	0.14	0.01	0.07	3.50
JOHNNY DARTER	D	I	C		4	3.00	0.29	0.00	0.04	1.00
GREENSIDE DARTER	D	I	S	M	44	33.00	3.18	0.07	0.83	2.05
RAINBOW DARTER	D	I	S	M	68	51.00	4.91	0.07	0.83	1.31
FANTAIL DARTER	D	I	C		44	33.00	3.18	0.06	0.72	1.77
	Mile Total				1,384	1,038.00		8.15		
	Number of Species				22					
	Number of Hybrids				1					

River Code: **07-001**	Stream: **Ashtabula River**		Sample Date: **1995**
River Mile: **19.10**	Basin: Ashtabula River		Date Range: 07/25/95
	Time Fished: 3600 sec	Drain Area: 93.0 sq mi	Thru: 09/08/95
	Dist Fished: 0.35 km	No of Passes: 2	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
LEAST BROOK LAMPREY		F	N		2	1.75	0.47	0.02	0.33	9.50
GOLDEN REDHORSE	R	I	S	M	2	2.00	0.53	0.08	1.56	39.50
NORTHERN HOG SUCKER	R	I	S	M	6	5.50	1.46	0.16	3.19	28.17
BIGEYE CHUB	N	I	S	I	5	3.75	1.00	0.01	0.18	2.40
STRIPED SHINER	N	I	S		145	118.25	31.47	0.67	13.28	5.74
MIMIC SHINER	N	I	M	I	33	28.50	7.58	0.03	0.55	0.97
BLUNTNOSE MINNOW	N	O	C	T	4	3.25	0.86	0.01	0.19	3.00
CENTRAL STONEROLLER	N	H	N		2	1.50	0.40	0.02	0.43	14.50
ROCK BASS	S	C	C		89	79.75	21.22	2.68	53.00	33.06
SMALLMOUTH BASS	F	C	C	M	3	2.75	0.73	1.10	21.80	393.33
LONGEAR SUNFISH	S	I	C	M	8	7.00	1.86	0.12	2.45	17.25
BLACKSIDE DARTER	D	I	S		13	12.00	3.19	0.03	0.50	2.08
JOHNNY DARTER	D	I	C		7	5.75	1.53	0.00	0.07	0.57
GREENSIDE DARTER	D	I	S	M	40	33.00	8.78	0.07	1.35	2.03
RAINBOW DARTER	D	I	S	M	79	62.75	16.70	0.05	0.97	0.78
FANTAIL DARTER	D	I	C		11	8.25	2.20	0.01	0.20	1.22
Mile Total					449	375.75		5.06		
Number of Species					16					
Number of Hybrids					0					

River Code: **07-001**	Stream: **Ashtabula River**		Sample Date: **1995**
River Mile: **12.10**	Basin: Ashtabula River		Date Range: 07/24/95
	Time Fished: 6000 sec	Drain Area: 107.0 sq mi	Thru: 09/08/95
	Dist Fished: 0.35 km	No of Passes: 2	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
GOLDEN REDHORSE	R	I	S	M	3	2.50	0.41	0.05	0.59	20.33
NORTHERN HOG SUCKER	R	I	S	M	103	77.25	12.73	1.53	19.57	19.83
WHITE SUCKER	W	O	S	T	70	65.00	10.71	0.85	10.85	13.29
BIGEYE CHUB	N	I	S	I	32	26.00	4.29	0.06	0.73	2.19
CREEK CHUB	N	G	N	T	9	7.25	1.19	0.10	1.24	13.22
STRIPED SHINER	N	I	S		113	90.75	14.96	0.92	11.77	10.34
MIMIC SHINER	N	I	M	I	1	1.00	0.16	0.00	0.01	1.00
SILVERJAW MINNOW	N	I	M		1	1.00	0.16	0.00	0.03	2.00
BLUNTNOSE MINNOW	N	O	C	T	45	36.25	5.97	0.25	3.20	7.06
CENTRAL STONEROLLER	N	H	N		201	172.00	28.35	1.79	22.93	10.59
STONECAT MADTOM		I	C	I	2	1.50	0.25	0.02	0.26	13.50
ROCK BASS	S	C	C		32	27.25	4.49	0.66	8.39	24.54
SMALLMOUTH BASS	F	C	C	M	30	27.00	4.45	1.39	17.74	54.11
GREEN SUNFISH	S	I	C	T	1	0.75	0.12	0.00	0.04	4.00
BLUEGILL SUNFISH	S	I	C	P	4	3.00	0.49	0.05	0.69	18.00
PUMPKINSEED SUNFISH	S	I	C	P	1	1.00	0.16	0.02	0.20	16.00
GR'N SF X PUMPKINS'D					1	1.00	0.16	0.02	0.27	21.00
JOHNNY DARTER	D	I	C		3	2.25	0.37	0.00	0.02	0.67
GREENSIDE DARTER	D	I	S	M	37	28.75	4.74	0.06	0.72	1.92
RAINBOW DARTER	D	I	S	M	27	21.50	3.54	0.04	0.46	1.70
FANTAIL DARTER	D	I	C		18	13.75	2.27	0.02	0.29	1.67
Mile Total					734	606.75		7.83		
Number of Species					20					
Number of Hybrids					1					

Species List

River Code: **07-001**	Stream: **Ashtabula River**		Sample Date: **1995**
River Mile: **6.30**	Basin: Ashtabula River		Date Range: 08/03/95
	Time Fished: 3600 sec	Drain Area: 121.0 sq mi	Thru: 09/08/95
	Dist Fished: 0.40 km	No of Passes: 2	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		13	9.75	2.33	0.54	12.79	55.08
QUILLBACK CARPSUCKER	C	O	M		2	1.50	0.36	0.01	0.14	4.00
GOLDEN REDHORSE	R	I	S	M	5	3.75	0.89	0.01	0.30	3.20
NORTHERN HOG SUCKER	R	I	S	M	10	7.50	1.79	0.61	14.58	81.60
WHITE SUCKER	W	O	S	T	5	3.75	0.89	0.00	0.11	1.25
BIGEYE CHUB	N	I	S	I	5	3.75	0.89	0.02	0.54	6.00
CREEK CHUB	N	G	N	T	3	2.25	0.54	0.04	0.92	17.00
ROSYFACE SHINER	N	I	S	I	1	0.75	0.18	0.00	0.04	2.00
STRIPED SHINER	N	I	S		69	51.75	12.34	0.41	9.82	7.96
SPOTFIN SHINER	N	I	M		14	10.50	2.50	0.03	0.71	2.86
SAND SHINER	N	I	M	M	1	0.75	0.18	0.00	0.02	1.00
MIMIC SHINER	N	I	M	I	19	14.25	3.40	0.02	0.54	1.56
SILVERJAW MINNOW	N	I	M		1	0.75	0.18	0.00	0.02	1.00
BLUNTNOSE MINNOW	N	O	C	T	90	67.50	16.10	0.21	4.91	3.05
CENTRAL STONEROLLER	N	H	N		121	90.75	21.65	0.52	12.37	5.72
YELLOW BULLHEAD		I	C	T	2	1.50	0.36	0.06	1.42	39.50
STONECAT MADTOM		I	C	I	20	15.00	3.58	0.33	7.77	21.70
ROCK BASS	S	C	C		24	18.00	4.29	0.69	16.33	38.08
SMALLMOUTH BASS	F	C	C	M	11	8.25	1.97	0.34	7.98	40.55
GREEN SUNFISH	S	I	C	T	2	1.50	0.36	0.02	0.54	15.00
BLUEGILL SUNFISH	S	I	C	P	11	8.25	1.97	0.12	2.76	14.03
PUMPKINSEED SUNFISH	S	I	C	P	2	1.50	0.36	0.07	1.64	46.00
HYBRID X SUNFISH					1	0.75	0.18	0.02	0.50	28.00
LOGPERCH	D	I	S	M	4	3.00	0.72	0.02	0.52	7.25
JOHNNY DARTER	D	I	C		1	0.75	0.18	0.00	0.02	1.00
GREENSIDE DARTER	D	I	S	M	32	24.00	5.72	0.05	1.07	1.87
RAINBOW DARTER	D	I	S	M	90	67.50	16.10	0.07	1.72	1.07
	Mile Total				559	419.25		4.20		
	Number of Species				26					
	Number of Hybrids				1					

River Code: **07-001**	Stream: **Ashtabula River**		Sample Date: **1995**
River Mile: **3.50**	Basin: Ashtabula River		Date Range: 08/02/95
	Time Fished: 3300 sec	Drain Area: 128.0 sq mi	Thru: 09/08/95
	Dist Fished: 0.38 km	No of Passes: 2	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		18	15.00	1.99	0.08	4.03	5.56
BLACK REDHORSE	R	I	S	I	9	7.50	0.99	0.04	2.05	5.67
GOLDEN REDHORSE	R	I	S	M	15	12.25	1.62	0.03	1.38	2.30
WHITE SUCKER	W	O	S	T	22	18.08	2.40	0.04	1.93	2.18
BIGEYE CHUB	N	I	S	I	42	33.42	4.43	0.09	4.44	2.74
CREEK CHUB	N	G	N	T	1	0.83	0.11	0.00	0.07	2.00
ROSYFACE SHINER	N	I	S	I	23	17.25	2.29	0.05	2.46	2.96
STRIPED SHINER	N	I	S		76	61.25	8.12	0.10	4.93	1.68
SPOTFIN SHINER	N	I	M		5	3.92	0.52	0.01	0.27	1.40
MIMIC SHINER	N	I	M	I	5	3.75	0.50	0.00	0.22	1.20
SILVERJAW MINNOW	N	I	M		7	5.75	0.76	0.01	0.51	1.86
BLUNTNOSE MINNOW	N	O	C	T	295	240.17	31.83	0.43	20.93	1.83
CENTRAL STONEROLLER	N	H	N		130	105.17	13.94	0.50	24.22	4.72
CHANNEL CATFISH	F		C		4	3.08	0.41	0.01	0.34	2.25
YELLOW BULLHEAD		I	C	T	3	2.25	0.30	0.03	1.67	15.33
ROCK BASS	S	C	C		7	5.75	0.76	0.33	15.89	59.29
SMALLMOUTH BASS	F	C	C	M	24	18.42	2.44	0.04	1.88	2.00
LOGPERCH	D	I	S	M	1	0.75	0.10	0.00	0.22	6.00
JOHNNY DARTER	D	I	C		10	8.17	1.08	0.01	0.46	1.10
GREENSIDE DARTER	D	I	S	M	32	25.08	3.32	0.07	3.50	2.88
RAINBOW DARTER	D	I	S	M	206	160.50	21.27	0.17	8.43	1.09
FANTAIL DARTER	D	I	C		8	6.25	0.83	0.01	0.31	1.00
	Mile Total				943	754.58		2.07		
	Number of Species				22					
	Number of Hybrids				0					

River Code: **07-007**	Stream: **Cowles Creek**		Sample Date: **1995**
River Mile: **7.20**	Basin: Ashtabula River		Date Range: 07/31/95
	Time Fished: 2400 sec	Drain Area: 6.8 sq mi	Thru: 09/11/95
	Dist Fished: 0.30 km	No of Passes: 2	Sampler Type: F 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	61.00	15.72	1.18	25.05	19.38
BLACKNOSE DACE	N	G	S	T	41	41.00	10.57	0.10	2.06	2.37
CREEK CHUB	N	G	N	T	200	200.00	51.55	2.97	62.84	14.83
COMMON SHINER	N	I	S		15	15.00	3.87	0.11	2.35	7.40
BLUNTNOSE MINNOW	N	O	C	T	2	2.00	0.52	0.00	0.06	1.50
CENTRAL STONEROLLER	N	H	N		50	50.00	12.89	0.17	3.62	3.42
GREEN SUNFISH	S	I	C	T	5	5.00	1.29	0.08	1.76	16.60
BLUEGILL SUNFISH	S	I	C	P	5	5.00	1.29	0.05	0.97	9.20
GR'N SF X PUMPKINS'D					1	1.00	0.26	0.05	1.02	48.00
JOHNNY DARTER	D	I	C		5	5.00	1.29	0.00	0.06	0.60
FANTAIL DARTER	D	I	C		3	3.00	0.77	0.01	0.19	3.00
Mile Total					388	388.00		4.72		
Number of Species					10					
Number of Hybrids					1					

River Code: **07-007**	Stream: **Cowles Creek**		Sample Date: **1995**
River Mile: **6.20**	Basin: Ashtabula River		Date Range: 07/27/95
	Time Fished: 3600 sec	Drain Area: 8.9 sq mi	Thru: 09/11/95
	Dist Fished: 0.30 km	No of Passes: 2	Sampler Type: F 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
AMER BROOK LAMPREY		F	N	R	1	1.00	0.19	0.02	0.82	22.00
WHITE SUCKER	W	O	S	T	62	62.00	11.65	0.50	18.81	8.13
BLACKNOSE DACE	N	G	S	T	53	53.00	9.96	0.13	5.00	2.53
CREEK CHUB	N	G	N	T	156	156.00	29.32	1.32	49.39	8.48
COMMON SHINER	N	I	S		17	17.00	3.20	0.05	2.02	3.18
BLUNTNOSE MINNOW	N	O	C	T	10	10.00	1.88	0.03	1.19	3.20
CENTRAL STONEROLLER	N	H	N		174	174.00	32.71	0.56	20.71	3.19
JOHNNY DARTER	D	I	C		26	26.00	4.89	0.02	0.71	0.73
RAINBOW DARTER	D	I	S	M	10	10.00	1.88	0.01	0.49	1.30
FANTAIL DARTER	D	I	C		23	23.00	4.32	0.02	0.86	1.00
Mile Total					532	532.00		2.68		
Number of Species					10					
Number of Hybrids					0					

River Code: **07-007**	Stream: **Cowles Creek**	Sample Date: **1995**
River Mile: **5.00**	Basin: Ashtabula River	Date Range: 07/26/95
	Time Fished: 3000 sec Drain Area: 11.4 sq mi	Thru: 09/11/95
	Dist Fished: 0.30 km No of Passes: 2	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
WHITE SUCKER	W	O	S	T	64	64.00	11.92	0.13	6.34	2.09
BLACKNOSE DACE	N	G	S	T	17	17.00	3.17	0.05	2.56	3.18
CREEK CHUB	N	G	N	T	170	170.00	31.66	1.17	55.69	6.90
COMMON SHINER	N	I	S		6	6.00	1.12	0.01	0.57	2.00
SILVERJAW MINNOW	N	I	M		3	3.00	0.56	0.01	0.28	2.00
FATHEAD MINNOW	N	O	C	T	2	2.00	0.37	0.00	0.14	1.50
BLUNTNOSE MINNOW	N	O	C	T	15	15.00	2.79	0.05	2.37	3.33
CENTRAL STONEROLLER	N	H	N		221	221.00	41.15	0.61	28.95	2.76
GREEN SUNFISH	S	I	C	T	3	3.00	0.56	0.03	1.33	9.33
JOHNNY DARTER	D	I	C		19	19.00	3.54	0.02	0.71	0.79
RAINBOW DARTER	D	I	S	M	9	9.00	1.68	0.01	0.62	1.44
FANTAIL DARTER	D	I	C		8	8.00	1.49	0.01	0.43	1.13
Mile Total					537	537.00		2.11		
Number of Species					12					
Number of Hybrids					0					

River Code: **07-007**	Stream: **Cowles Creek**		Sample Date: **1995**
River Mile: **4.20**	Basin: Ashtabula River		Date Range: 07/20/95
	Time Fished: 3300 sec	Drain Area: 12.7 sq mi	Thru: 09/11/95
	Dist Fished: 0.34 km	No of Passes: 2	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
CENTRAL MUDMINNOW		I	C	T	6	6.00	0.40	0.04	0.56	6.00
WHITE SUCKER	W	O	S	T	150	128.74	8.67	0.56	8.72	4.15
BLACKNOSE DACE	N	G	S	T	139	118.79	8.00	0.42	6.55	3.59
CREEK CHUB	N	G	N	T	828	701.68	47.26	3.73	57.70	5.43
COMMON SHINER	N	I	S		6	5.79	0.39	0.04	0.69	7.50
SILVERJAW MINNOW	N	I	M		47	39.84	2.68	0.13	2.00	3.32
FATHEAD MINNOW	N	O	C	T	1	0.79	0.05	0.00	0.02	2.00
BLUNTNOSE MINNOW	N	O	C	T	24	21.47	1.45	0.07	1.04	3.21
CENTRAL STONEROLLER	N	H	N		540	457.89	30.84	1.46	22.64	3.11
COMMON SH X FATHEAD M					1	1.00	0.07	0.00	0.02	1.00
JOHNNY DARTER	D	I	C		2	1.79	0.12	0.00	0.03	1.00
FANTAIL DARTER	D	I	C		1	0.79	0.05	0.00	0.02	2.00
	Mile Total				1,745	1,484.58		6.46		
	Number of Species				11					
	Number of Hybrids				1					

River Code: **07-007**	Stream: **Cowles Creek**		Sample Date: **1995**
River Mile: **3.30**	Basin: Ashtabula River		Date Range: 07/26/95
	Time Fished: 3300 sec	Drain Area: 12.9 sq mi	Thru: 09/12/95
	Dist Fished: 0.35 km	No of Passes: 2	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	138	115.00	5.21	0.64	12.93	5.59
BLACKNOSE DACE	N	G	S	T	257	212.50	9.63	0.72	14.54	3.46
CREEK CHUB	N	G	N	T	1,587	1,239.25	56.14	2.07	41.60	1.52
STRIPED SHINER	N	I	S		15	11.25	0.51	0.02	0.33	1.47
COMMON SHINER	N	I	S		27	27.00	1.22	0.05	1.01	1.85
SILVERJAW MINNOW	N	I	M		28	23.50	1.06	0.05	1.05	2.13
FATHEAD MINNOW	N	O	C	T	2	1.75	0.08	0.00	0.07	2.00
BLUNTNOSE MINNOW	N	O	C	T	66	58.50	2.65	0.17	3.40	2.86
CENTRAL STONEROLLER	N	H	N		662	515.00	23.33	1.24	24.96	2.37
FANTAIL DARTER	D	I	C		4	3.50	0.16	0.01	0.12	1.75
	Mile Total				2,786	2,207.25		4.98		
	Number of Species				10					
	Number of Hybrids				0					

River Code: **07-011**	Stream: **Arcola Creek**	Sample Date: **1995**
River Mile: **7.40**	Basin: Ashtabula River	Date Range: 08/01/95
	Time Fished: 3300 sec Drain Area:	Thru: 09/12/95
	Dist Fished: 0.30 km No of Passes: 2	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	1.00	0.06	0.01	0.07	7.00
WHITE SUCKER	W	O	S	T	178	178.00	9.94	1.60	16.21	8.97
GOLDEN SHINER	N	I	M	T	5	5.00	0.28	0.05	0.53	10.40
BLACKNOSE DACE	N	G	S	T	95	95.00	5.30	0.35	3.54	3.67
CREEK CHUB	N	G	N	T	897	897.00	50.08	5.91	60.01	6.59
BLUNTNOSE MINNOW	N	O	C	T	411	411.00	22.95	1.05	10.65	2.55
CENTRAL STONEROLLER	N	H	N		84	84.00	4.69	0.70	7.15	8.38
GREEN SUNFISH	S	I	C	T	5	5.00	0.28	0.02	0.16	3.20
BLUEGILL SUNFISH	S	I	C	P	14	14.00	0.78	0.02	0.19	1.33
JOHNNY DARTER	D	I	C		96	96.00	5.36	0.14	1.38	1.42
RAINBOW DARTER	D	I	S	M	5	5.00	0.28	0.01	0.11	2.20
	Mile Total				1,791	1,791.00		9.85		
	Number of Species				11					
	Number of Hybrids				0					

Species List

River Code: **07-011**	Stream: **Arcola Creek**		Sample Date: **1995**
River Mile: **7.00**	Basin: Ashtabula River		Date Range: 08/01/95
	Time Fished: 3300 sec	Drain Area: 7.9 sq mi	Thru: 09/12/95
	Dist Fished: 0.30 km	No of Passes: 2	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
RAINBOW TROUT	E		N		1	1.00	0.04	0.02	0.09	15.00
WHITE SUCKER	W	O	S	T	325	325.00	13.30	4.92	28.34	15.15
GOLDEN SHINER	N	I	M	T	1	1.00	0.04	0.02	0.09	15.00
BLACKNOSE DACE	N	G	S	T	271	271.00	11.09	1.14	6.58	4.21
CREEK CHUB	N	G	N	T	1,709	1,709.00	69.95	10.81	62.25	6.33
FATHEAD MINNOW	N	O	C	T	1	1.00	0.04	0.00	0.01	2.00
BLUNTNOSE MINNOW	N	O	C	T	82	82.00	3.36	0.27	1.57	3.32
CENTRAL STONEROLLER	N	H	N		6	6.00	0.25	0.03	0.20	5.67
GREEN SUNFISH	S	I	C	T	2	2.00	0.08	0.06	0.34	29.50
BLUEGILL SUNFISH	S	I	C	P	12	12.00	0.49	0.03	0.16	2.33
JOHNNY DARTER	D	I	C		33	33.00	1.35	0.07	0.38	2.00
Mile Total					2,443	2,443.00		17.37		
Number of Species					11					
Number of Hybrids					0					

River Code: **07-011**	Stream: **Arcola Creek**	Sample Date: **1995**
River Mile: **5.00**	Basin: Ashtabula River	Date Range: 08/01/95
	Time Fished: 2400 sec Drain Area: 11.0 sq mi	Thru: 09/12/95
	Dist Fished: 0.30 km No of Passes: 2	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	41	41.00	24.70	0.13	26.40	3.22
COMMON CARP	G	O	M	T	11	11.00	6.63	0.03	5.80	2.64
BLACKNOSE DACE	N	G	S	T	1	1.00	0.60	0.00	0.40	2.00
CREEK CHUB	N	G	N	T	56	56.00	33.73	0.20	40.60	3.63
FATHEAD MINNOW	N	O	C	T	3	3.00	1.81	0.01	2.40	4.00
BLUNTNOSE MINNOW	N	O	C	T	27	27.00	16.27	0.02	3.40	0.63
CENTRAL STONEROLLER	N	H	N		23	23.00	13.86	0.10	20.40	4.43
JOHNNY DARTER	D	I	C		4	4.00	2.41	0.00	0.60	0.75
Mile Total					166	166.00		0.50		
Number of Species					8					
Number of Hybrids					0					

River Code: **07-100**	Stream: **Conneaut Creek**		Sample Date: **1995**
River Mile: **23.10**	Basin: Conneaut Creek		Date Range: 08/02/95
	Time Fished: 2400 sec	Drain Area: 152.0 sq mi	Thru: 09/12/95
	Dist Fished: 0.40 km	No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BLACK REDHORSE	R	I	S	I	22	16.50	1.64	3.73	26.65	225.85
GOLDEN REDHORSE	R	I	S	M	49	36.75	3.66	0.80	5.70	21.67
NORTHERN HOG SUCKER	R	I	S	M	69	51.75	5.15	2.18	15.60	42.15
WHITE SUCKER	W	O	S	T	14	10.50	1.05	0.02	0.17	2.29
RIVER CHUB	N	I	N	I	8	6.00	0.60	0.22	1.58	36.75
BIGEYE CHUB	N	I	S	I	117	87.75	8.74	0.23	1.63	2.60
SILVER SHINER	N	I	S	I	1	0.75	0.07	0.00	0.01	1.00
ROSYFACE SHINER	N	I	S	I	42	31.50	3.14	0.06	0.40	1.76
STRIPED SHINER	N	I	S		198	148.50	14.79	0.53	3.76	3.54
SPOTFIN SHINER	N	I	M		8	6.00	0.60	0.02	0.15	3.38
SAND SHINER	N	I	M	M	3	2.25	0.22	0.00	0.02	1.33
MIMIC SHINER	N	I	M	I	51	38.25	3.81	0.07	0.47	1.73
BLUNTNOSE MINNOW	N	O	C	T	128	96.00	9.56	0.21	1.51	2.20
CENTRAL STONEROLLER	N	H	N		108	81.00	8.07	0.48	3.41	5.88
YELLOW BULLHEAD		I	C	T	6	4.50	0.45	0.38	2.74	85.17
STONECAT MADTOM		I	C	I	2	1.50	0.15	0.07	0.48	44.50
ROCK BASS	S	C	C		79	59.25	5.90	3.05	21.82	51.48
SMALLMOUTH BASS	F	C	C	M	29	21.75	2.17	1.47	10.53	67.66
GREEN SUNFISH	S	I	C	T	1	0.75	0.07	0.01	0.08	15.00
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.07	0.00	0.01	1.00
BLACKSIDE DARTER	D	I	S		26	19.50	1.94	0.03	0.20	1.42
LOGPERCH	D	I	S	M	16	12.00	1.19	0.11	0.76	8.81
JOHNNY DARTER	D	I	C		25	18.75	1.87	0.01	0.09	0.67
GREENSIDE DARTER	D	I	S	M	152	114.00	11.35	0.19	1.36	1.67
RAINBOW DARTER	D	I	S	M	151	113.25	11.28	0.11	0.76	0.94
FANTAIL DARTER	D	I	C		33	24.75	2.46	0.02	0.15	0.82
	Mile Total				1,339	1,004.25		13.98		
	Number of Species				26					
	Number of Hybrids				0					

River Code: **07-100**	Stream: **Conneaut Creek**	Sample Date: **1995**
River Mile: **12.10**	Basin: Conneaut Creek	Date Range: 08/02/95
	Time Fished: 5100 sec Drain Area: 169.0 sq mi	Thru: 09/13/95
	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BLACK REDHORSE	R	I	S	I	28	21.00	1.16	1.27	8.86	60.70
GOLDEN REDHORSE	R	I	S	M	56	42.00	2.33	0.55	3.83	13.14
NORTHERN HOG SUCKER	R	I	S	M	109	81.75	4.53	2.56	17.83	31.37
WHITE SUCKER	W	O	S	T	19	14.25	0.79	0.16	1.11	11.22
RIVER CHUB	N	I	N	I	20	15.00	0.83	0.36	2.50	23.95
BIGEYE CHUB	N	I	S	I	273	204.75	11.34	0.56	3.92	2.76
ROSYFACE SHINER	N	I	S	I	81	60.75	3.37	0.16	1.11	2.61
STRIPED SHINER	N	I	S		89	66.75	3.70	0.56	3.92	8.46
SPOTFIN SHINER	N	I	M		14	10.50	0.58	0.02	0.10	1.42
SAND SHINER	N	I	M	M	48	36.00	1.99	0.05	0.38	1.50
MIMIC SHINER	N	I	M	I	101	75.75	4.20	0.12	0.84	1.59
SILVERJAW MINNOW	N	I	M		6	4.50	0.25	0.02	0.15	4.67
BLUNTNOSE MINNOW	N	O	C	T	228	171.00	9.47	0.40	2.75	2.31
CENTRAL STONEROLLER	N	H	N		946	709.50	39.30	3.55	24.71	5.01
STRIPED SH X ROSYFACE SH		I			1	0.75	0.04	0.00	0.03	5.00
CHANNEL CATFISH	F		C		1	0.75	0.04	0.01	0.04	8.00
YELLOW BULLHEAD		I	C	T	7	5.25	0.29	0.22	1.51	41.40
STONECAT MADTOM		I	C	I	10	7.50	0.42	0.17	1.15	22.10
BRINDLED MADTOM		I	C	I	5	3.75	0.21	0.04	0.25	9.60
ROCK BASS	S	C	C		40	30.00	1.66	1.75	12.14	58.20
SMALLMOUTH BASS	F	C	C	M	30	22.50	1.25	1.39	9.64	61.60
GREEN SUNFISH	S	I	C	T	1	0.75	0.04	0.01	0.07	13.00
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.04	0.04	0.27	51.00
LOGPERCH	D	I	S	M	12	9.00	0.50	0.03	0.21	3.33
JOHNNY DARTER	D	I	C		19	14.25	0.79	0.02	0.11	1.06
GREENSIDE DARTER	D	I	S	M	159	119.25	6.61	0.27	1.87	2.25
RAINBOW DARTER	D	I	S	M	89	66.75	3.70	0.09	0.63	1.35
FANTAIL DARTER	D	I	C		14	10.50	0.58	0.01	0.08	1.14
	Mile Total				2,407	1,805.25		14.38		
	Number of Species				27					
	Number of Hybrids				1					