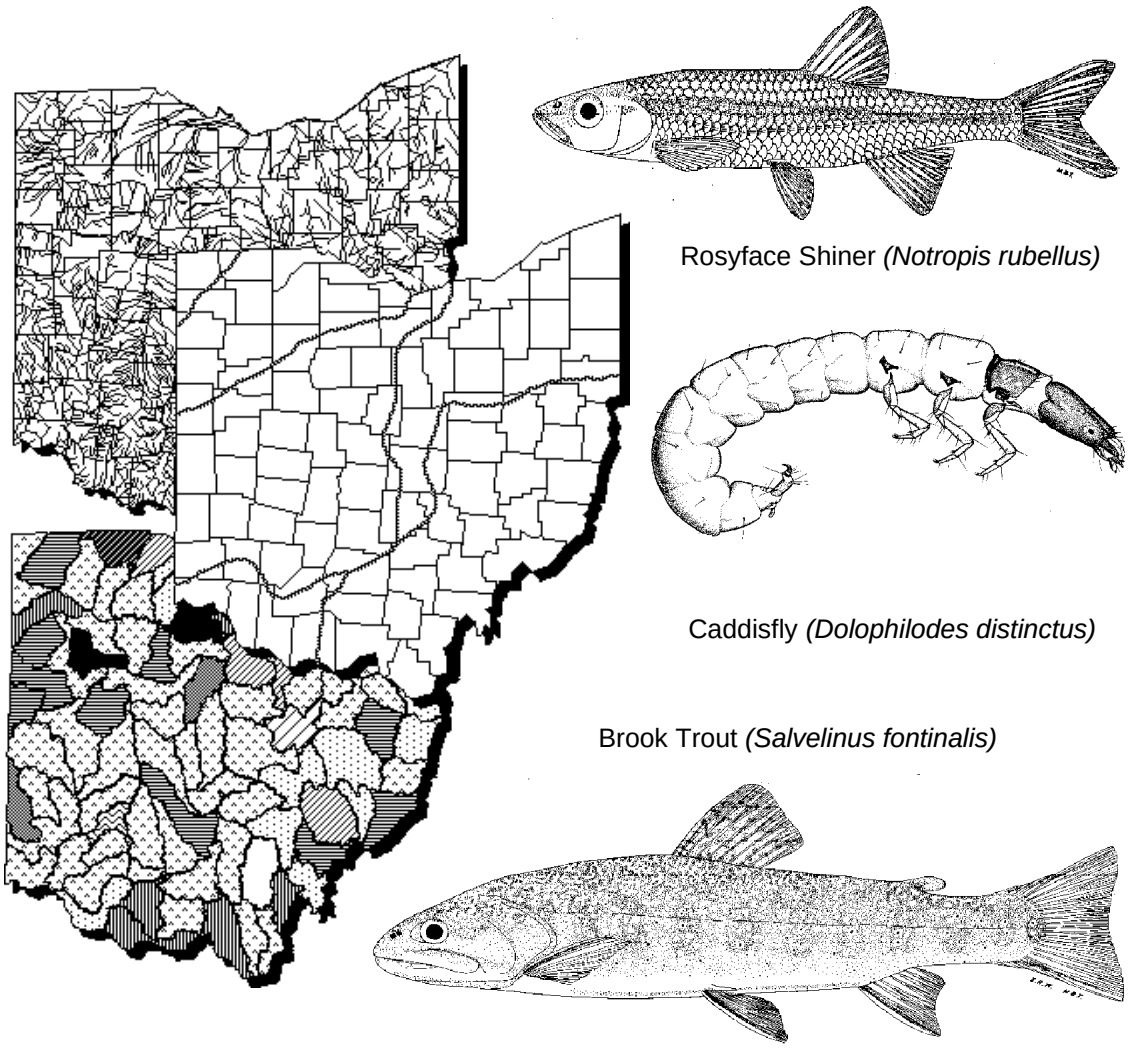
State of Ohio
Environmental Protection Agency

Ecological Assessment
Division of Surface Water

1995-96 Biological and Water Quality Study of the Chagrin River and Selected Tributaries

Cuyahoge, Geauga, Lake and Portage Counties, Ohio



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NOTICE TO USERS

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

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

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

Ohio Environmental Protection Agency. 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Div. Water Qual. Monit. & Assess., Surface Water Section, Columbus, Ohio.

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

Ohio Environmental Protection Agency. 1989c. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div. Water Quality Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

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

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

Since the publication of the preceding guidance documents new publications by Ohio EPA have become available. The following publications should also be consulted as they represent the latest information and analyses used by 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:

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or via web site for Ohio EPA at:

www.epa.ohio.gov

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.

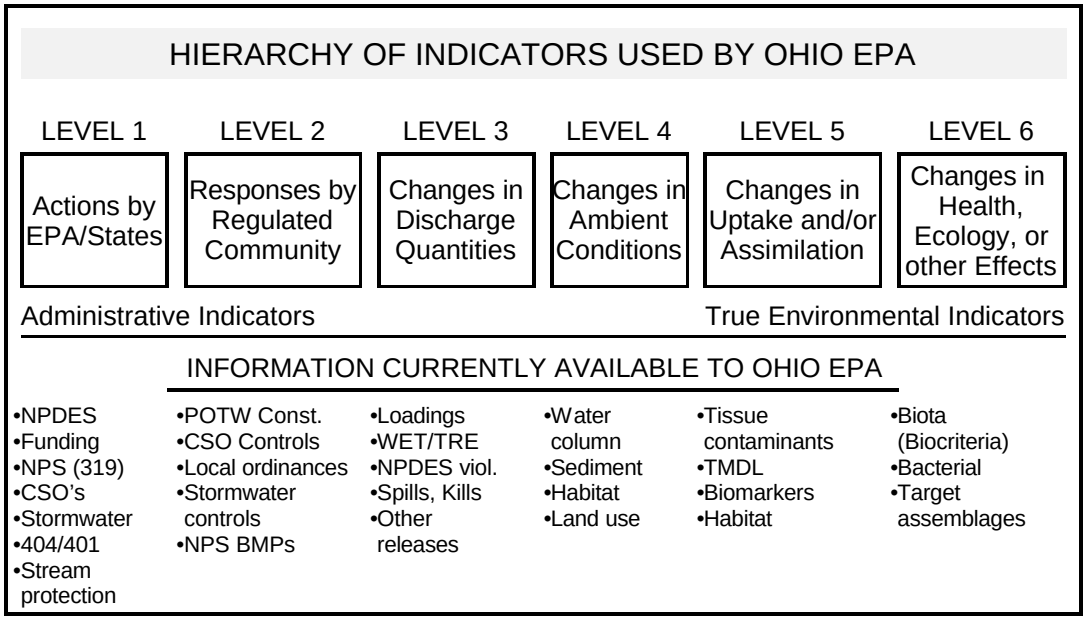

Figure I. Hierarchy of administrative and environmental indicators used by Ohio EPA for monitoring, assessment, reporting and evaluating program effectiveness. This is patterned after a model developed by the U. S. EPA, Office of Water.

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

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

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

3) *Coldwater 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 and permitted 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 coliforms, *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 are detailed in other documents.

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.

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1995 Biological and Water Quality Study of the Chagrin River and Selected Tributaries

Cuyahoga, Geauga, Lake and
Portage Counties (Ohio)

INTRODUCTION

Biological and chemical/physical sampling in the Chagrin River basin for the 1995 water quality survey was conducted on the mainstem (RM 36.55 at Fairmount Road to RM 4.0 at Todd Field), the Aurora Branch of the Chagrin River (RM 17.1 to RM 0.30), and selected tributaries (Table 1). This 1995 survey updates the previous 1990-1991 basinwide Chagrin River survey conducted by the Ohio EPA (Ohio EPA, 1991). Specific objectives of this evaluation were to:

1) Evaluate the Chagrin River and the Aurora Branch of the Chagrin River in relation to the impacts of increased suburban development, potential wastewater treatment plant (WWTP) expansions, and National Point Source Discharge Elimination System (NPDES) issues (McFarland Creek WWTP and Ivex Corporation). A determination was to be made on how these pressures impact assimilative capacity and biological quality.

2) Evaluate selected package WWTPs to assess impacts and determine the effectiveness and appropriateness of expansions, elimination, or connections to regional WWTP to minimize loadings impacts in the watershed.

3) Conduct a follow-up evaluation of the Chagrin River in the vicinity of Ivex to document current biological and chemical/physical condition (including sediments) in relation to the effluent discharge, stormwater runoff (metals contamination), and potential damages from upper dam failure.

4) Assess Warmwater Habitat (WWH) aquatic use designation and resource water designations in the Chagrin River mainstem and the Aurora Branch of the Chagrin River.

5) Evaluate nonpoint source pollution impacts in the Chagrin River and the Aurora Branch Chagrin River, particularly unsewered housing developments with failing septic systems and associated nutrient and bacteria problems.

6) Evaluate Silver Creek upstream and downstream from the failed Geauga County dam, which has been removed, to assess and substantiate the assigned CWH aquatic use designation.

7) Evaluate existing aquatic life use designations within sampled stream segments.

8) Resample and assess regional reference sites within the watershed.

SUMMARY and CONCLUSIONS

The Chagrin River watershed is of generally high overall quality throughout the basin. The greatest threats to this watershed is urban/suburban development both in terms of increased wastewater flows and adverse NPS effects. A total of 82.0 miles of the Chagrin River mainstem, its branches and selected tributaries were assessed as part of the 1995 sampling effort. Almost 75 percent of the total miles assessed (61.2 miles) are designated WWH aquatic life use (primarily the Chagrin River mainstem and Aurora Branch). The survey found 47.8 of 61.2 miles in full attainment of the WWH aquatic life use (78% of the WWH miles assessed), 12.1 miles in partial attainment (20% of the WWH miles assessed), and 1.3 miles in non-attainment of the WWH use (2% of the WWH miles assessed).

The CWH aquatic life use was the current or recommended designation for 20.2 of the 82.0 stream miles assessed (~25% of the total miles assessed). These are primarily small tributaries to the Chagrin River and the Aurora Branch. There were 16.0 of 20.2 miles in full attainment of the CWH aquatic life use (79% of the CWH miles assessed); the remaining 4.2 miles demonstrated partial attainment (21% of the CWH study area).

Less than one percent of assessed stream miles were recommended to retain the designated EWH aquatic life use, and that reach partially attained the use designation (0.6 miles). Aquatic life use attainment status and biocriteria scores for all sampling locations are presented in Table 1.

Chagrin River

The Chagrin River watershed is a high quality ecosystem (mainstem currently designated as a State Scenic River) that is threatened by suburban development pressures. Population growth has necessitated increased wastewater flows from various sources, including municipal and regional WWTPs, small package WWTPs, on-site septic systems, and stormwater runoff. The accumulation of silt and sediment from runoff and erosion, solids associated with increased loadings of nutrients, metals, organic enrichment/BOD, and elevated fecal bacteria counts is taxing the assimilative capacity of the watershed. Riparian protection is an essential part of maintaining the current high quality, and general riparian encroachment needs to be minimized.

The impact from Ivex, the major industrial discharger to the Chagrin River, has increased compared to 1990. Macroinvertebrate ICI scores at RM 30.0 downstream from Ivex were 16 (fair) in 1995 versus 26 (fair) in 1990; fish scores were marginally good both years. Sewage fungus and suspended solids covered the natural substrates downstream from the plant in late summer 1995. No mayflies or caddisflies were collected downstream from the plant discharge (RM 30.0) during qualitative sampling. Mercury was present at elevated concentrations in sediment samples downstream (RM 29.8), but concentrations were at non-detectable concentrations upstream from the Ivex lakes (RM 30.7).

A total of 17 violations of NPDES limitations (mostly for BOD_5) were reported by Ivex between 1990 and 1995. In addition, complaints and observations of solids in the Chagrin River downstream from Ivex have been noted since 1990. Analysis of long term trends based on monthly operating report (MOR) data showed a reduction in effluent flow from 1986 to 1995, but there were no significant reductions in BOD_5 or phosphorus loadings. Total suspended solids (TSS) loadings were slightly reduced from 1993 to 1995. Effluent dissolved oxygen (D.O.) concentrations have decreased over time which indicates the potential for increased stress on downstream biological communities. A new treatment facility became operational in October 1996, and pollutant loadings from the plant are expected to be reduced. The 1995 water quality survey sampling did not evaluate the most recent treatment upgrades. Future follow-up sampling will be needed to assess whether improved effluent quality translates into improved biological community performance downstream from Ivex.

Longitudinal data for a select number of chemical parameters were collected from the Chagrin River mainstem. D.O concentrations were above the WWH criteria at all locations. Samples collected from the Ivex 001 effluent during the 1995 survey found a minimum D.O. of 4.4 mg/l, and $cBOD_5$ and COD ranged from 65 to 292 mg/l and from 305 to 688 mg/l, respectively. The highest TDS concentrations were also measured in the Ivex effluent with a mean of 712 mg/l (range: 574 - 842 mg/l). High concentrations of total phosphorus (6.05 mg/l) and ammonia-nitrogen (26.7 mg/l) from Ivex outfall 001 effluent were noted on August 10, 1995 due to an upset in the treatment process. The ammonia concentration was at acutely toxic levels (USEPA, 1976). The elevated phosphorus and nitrogen compounds, comprising a portion of the TDS components, contributed to BOD indirectly via die-offs after algal production (probable diurnal D.O. swings). This effluent data indicated that the Ivex 001 discharge was the principal source of oxygen demanding substances in the Chagrin River and a major contributor to biological impairment.

Total suspended solids were above 40 mg/l on sample dates with elevated river flow. This concentration was between the 75th and 90th percentile for WWH sites in the EOLP ecoregion and exceeded the reference range. TSS is also an indicator of increased stormwater, riparian loss, bank erosion, and unstable stream substrates, and all of these factors can contribute to decreased biological quality. Increased stormwater runoff and riparian loss would increase TSS and further impact biological communities (OEPA, 1996b).

Fish tissue samples collected downstream from Ivex and the Chagrin Falls WWTP contained elevated mercury and some elevated lead concentrations. Mercury concentrations ranged from 0.197-0.442 ug/g (ppm). The latter concentration was above the 95th percentile of samples collected throughout Ohio. Concentrations continued to be elevated near the mouth of the Chagrin River. At least 75 percent of fish sampled from the Chagrin River exceeded 0.1 mg/kg (ppm) of mercury in their tissues which is above the concentration considered harmful to piscivorous birds (Eisler, 1987).

Nonpoint source runoff is a major concern in the Chagrin River watershed. Effects such as destabilized riffle areas (riffle instability) and eroding banks contribute to embedded substrates

which is deleterious to biological quality. The Chagrin River, upstream from Fairmount Rd. in Hunting Valley, is an example of shifting bedloads with at least 12 inches of unstable soft sand and gravel. Stormwater runoff contributes significantly to this type of sedimentation. Increased stormwater runoff associated with increased suburban development also yields rapidly increased and high volume flows which increases erosion problems.

Nutrient enrichment is another associated cause of impairment in the Chagrin River community between RMs 25.5 to 4.1. Both water hardness and nitrate+nitrite-nitrogen concentrations peaked below Chagrin Falls and the Aurora Branch confluence indicating a wastewater effluent signature. Phosphorus concentrations increased downstream from the Chagrin Falls WWTP, Ivex (periodically), and below the Aurora Branch confluence (wastewater contributions). Phosphorus concentrations were also elevated near the mouth due to stormwater runoff and effluent contributed from populated areas in the East Branch area and lower mainstem. Overall, good quality habitat and past biological performance indicate the potential for improved fish and macroinvertebrate communities. However, nutrient enrichment and sedimentation (noted above) emanating from various WWTPs, failing on-site septic systems, stormwater runoff, industrial sources, and new construction are deterring a more complete recovery. Continued attainment of designated uses will be further threatened if loadings continue to increase.

Aurora Branch Chagrin River

Water quality problems associated with nutrient enrichment were evident in the upper Aurora Branch based on macroinvertebrate and chemical sampling. The effects of nutrient enrichment was evident in the tolerant biological communities present downstream from areas with failing on-site septic systems and three small wastewater discharges. The Yogi Bear Jellystone Campground WWTP had seasonal chemical and TSS permit exceedences (see loadings discussion) due to more intensive use during the summer season. The Lamson and Sessions (Carlon) sanitary discharge augmented late summer stream flows. An unknown source of copper (Table 7) was noted downstream from Chamberlain Rd. (RM 16.09). The stream recovered quickly through a low gradient area (RM ~15) to very good quality (exhibiting some coldwater attributes) upstream of Sunny Lake Tributary. Episodic toxic impacts have been caused by blooms of the blue-green algae *Microcystis* sp. in Sunny Lake which discharges to the Aurora Branch at RM 14.61. Additional storm sewer and/or septic problems were evident just downstream of SR 82 (RM 12.1).

The State Scenic River designated segment of the Aurora Branch (dst. SR 82) ranged from good to poor quality during 1995 (OEPA) and 1996 (consultant) surveys. A segment of fair to poor conditions was identified downstream from a sewer sanitary line break at the Aurora Central WWTP upstream from the 001 discharge. Problems occurred with sewage solids, nutrients, and fecal bacteria. The 1995 results indicated recovery to good conditions had occurred before SR 306 (> RM 9.0). However follow-up fish sampling conducted in 1996 downstream from the sewer line break (RM 11.4), the Aurora Central WWTP (RM 11.1), and downstream to SR 306 (RM 9.0) indicated a more persistent problem, as only fair conditions were observed. Also, the community at RM 5.6, located approximately 5.5 river miles downstream from the Aurora Central WWTP, was

dominated by tolerant fishes. Marginal instream habitat, caused by narrow riparian vegetation and severe bank erosion permitting increased siltation, contributed to the limited fish community; however, the index scores performed independently of habitat scores in several cases, implying a more pervasive cause. A possible source impacting the fish community through this reach is the Funtime Inc. Geauga Lake Amusement Park WWTP. Recent data suggests problems with their effluent with high nutrient (ammonia and phosphorus), BOD and fecal coliform bacteria concentration discharges in excess of permit limits at potentially toxic levels (see discharger loadings section). The discharge is to a roadside ditch, then a railroad ditch, and finally to an unnamed tributary at approximately RM 0.57 that empties into the Aurora Branch Chagrin River at RM 7.2.

Water quality in the reach between SR 306 and SR 422 (RM 3.7), while still very good, is threatened. Potential problem sources include on-site septic systems (high fecal bacteria/solids) and small WWTPs. For example, fecal coliform bacteria exceedences and sewage solids were observed in Linton Creek, whose confluence to Aurora Branch is at RM 5.27. Suburban development and some agricultural practices have decreased stream riparian habitat or caused riparian fragmentation. Encroachment on the riparian corridor in this high gradient stream reach results in increased bank destabilization, sedimentation and erosion from stormwater runoff. These are activities that pose threats to the good to exceptional quality biological communities.

Effects from the construction of St. Rt. 422 on stream habitat and fish communities were still evident. As in the upper reaches of the Aurora Branch, riparian loss, bank destabilization and stormwater runoff issues are major concerns throughout this lower reach. The Geauga Co.-McFarland Creek WWTP performed well, but loads contributed to slight nutrient enrichment downstream. Some poorly functioning, smaller WWTPs are being diverted to this plant for better treatement. Cumulative nutrient loadings are of concern and pose a threat to the very good to exceptional biological communities in this lower reach. High macroinvertebrate densities with increased proportion of tolerant organisms and larger numbers of nutrient tolerant fish species (e.g., stonerollers) show the effects of nutrient enrichment from the WWTP discharge. The fish community recovered to a very good condition at RM 0.3 from fair to marginally good conditions upstream from and just downstream from the McFarland Creek WWTP. High gradient riffle/runs rapidly reaerated the water and aided the assimilation of oxygen-demanding pollutants contributed by wastewater discharges and unsewered residential areas. These ecological responses near McFarland Creek WWTP and near the mouth indicate that the assimilative capacity of the Aurora Branch is nearing a critical threshold.

Silver Creek

Silver Creek, a small high-quality coldwater tributary of the Chagrin River, is protected in its middle reaches by the Geauga County Park system and privately-owned wooded riparian areas. It also is home to one of the few surviving transplanted populations of native brook trout. The upper headwater reaches of Silver Creek contained a more diverse fish fauna prior to construction of low-head dam and mainstem impoundments within the watershed. In 1975, least brook lamprey and

smallmouth bass were found upstream from St. Rt. 87, but in 1995 these species were restricted to the reach below SR 87 because of an impoundment. The dam at SR 87 has been recently breached, and the stream is being allowed to regain free-flowing characteristics that may allow for recovery of these fauna attributes.

Silver Creek water quality based on macroinvertebrate community monitoring was exceptional at all sites (ICI=52 to 56). Many sensitive or polution intolerant organisms were collected, and 22 to 25 total EPT taxa were collected at all sites. The number of coldwater (Nemourid stoneflies, *Dolophilodes sp.* caddisflies and four coldwater midge species) taxa decreased from upstream to downstream (Fig. 29, OEPA 1987b). With the impoundment removed the water temperature downstream should decrease. Organism density at RM 1.9 increased ten times to 3398/m.^{2} from 401/m.^{2} above the impoundment. The higher relative density was indicative of the more open riparian canopy near the former impoundment in Geauga Co. Park where nutrient enrichment from further upstream was most evident from on-site septic systems. Sedimentation from suburban areas could cause embedded conditions limiting brook trout spawning areas. Any protective expansion of the riparian zone would benefit the watershed and further protect the critical water temperature regimes. This watershed, with its coldwater attributes, requires limited nutrients and sediment entering from the upper reaches to prevent embedded conditions and ensure the viability of the high quality macroinvertebrate community necessary to support and undergird the native brook trout reintroduction and repopulation project.

Selected Chagrin River Tributaries

Most other Chagrin River tributaries are high gradient small streams with coldwater attributes where the riparian zone is partially intact or has not been completely degraded by suburban development. Development pressure, loss of riparian buffer zones, stormwater runoff, effluent and nutrient loadings, bacteria, and solids from failing on-site septic systems, and flow/temperature modifications from small impoundments are all threats to the existing biological communities and recreational uses in these smaller tributaries.

Other specific streams sampled were Tributary (Trib.) to Chagrin R. (Confluence at RM 15.42), Beaver Creek, Linton Creek, McFarland Creek, Willey Creek, Griswold Creek, Trib. to Chagrin R. (RM 22.81), Trib. to Trib. to Chagrin R. (RM 22.81/2.17), and Trib. to Chagrin R. (RM 14.88). Summary descriptions of each of these sampled tributaries are listed in Table 1d. The aquatic life use attainment status for recommended and existing use designations are listed in Tables 1 and 2. Specific habitat, fish and macroinvertebrate evaluations for each stream are located in each appropriate section.

Table 1. Aquatic life use attainment status for the streams sampled in the Chagrin River basin, July-October, 1995 (unless otherwise noted). The Index of Biotic Integrity (IBI), Modified Index of Well being (Miwb), and Invertebrate Community Index (ICI) scores are based on the performance of fish (IBI, Miwb) or macroinvertebrate communities (ICI). The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support biological communities. Wading sites unless noted as NA.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
Chagrin River (1995)						
Erie-Ontario Lake Plain: WWH Use Designation (Existing)						
36.4 /36.6[R]	46	8.7	48	80.5	FULL	Fairmount Rd.
36.2[R]	---	---	54	---	(FULL)	Riverview Park dst. SR306
33.4/33.4[R]	46	8.6	50	83.5	FULL	Ust. SR 87
30.6	34[ns]	8.2	G	71.5	FULL	Ust. Ivex between the lakes
30.08	*34*	*6.5*	*P*	---	-	*Ivex acute mixing zone*
30.0	34[ns]	7.5[ns]	16[*]	71.5	PARTIAL	Dst. Ivex
28.9	43	7.8[ns]	E	80.0	FULL	Ust. Miles Rd.
28.0/28.2	45	7.6[ns]	G	78.0	FULL	Adj. Solon Rd. dst. Chagrin FallsWWTP
26.5/26.7	44	8.2	46	84.0	FULL	Dst. Miles Rd. in gorge
25.5	---	---	36	---	(FULL)	Ust. Chagrin Blvd (old SR 422)
24.2	40	6.9[*]	---	91.5	(PARTIAL)	Ust. SR 87 (Kinsman Rd.) & Griswold Cr.
19.4/21.0	40	7.4[ns]	-[c]	80.5	FULL	Dst. Fairmount Rd.
13.1/13.0	43	7.3[*]	38	71.0	PARTIAL	Rodgers Rd. bridge
12.5	---	---	38	---	(FULL)	Dst. Rodgers Rd.
4.8	42	9.0	---	69.0	FULL	Daniels Park
4.1	---	---	38	---	(FULL)	At Todd Field
Chagrin River (1990)						
33.4/33.4[R]	45	8.3	46	82.0	FULL	Ust. SR 87
29.9/30.0	35[ns]	7.4[ns]	26[*]	70.0	PARTIAL	Dst. Ivex
Chagrin River (1986)						
33.4/33.4[R]	46	8.3	46	83.5	FULL	Ust. SR 87
30.6/30.7	36[ns]	8.6	48	78.0	FULL	Ust. Ivex between lakes

RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
Chagrin River (1986) (cont.)						
Erie-Ontario Lake Plain: WWH Use Designation (Existing)						
29.9/--	36[ns]	7.8[ns]	--	82.0	(FULL)	Dst. Ivex
29.0/28.8	45	7.9	40	77.0	FULL	Ust. Miles Rd.
28.3/28.2	43	8.0	40	76.0	FULL	Adj. Solon Rd./dst.Chagr.Falls WWTP
26.5/26.8	44	8.2	36	84.0	FULL	Dst. Miles Rd (gorge) & Aurora Br.
25.2/25.3	40	6.9[*]	46	80.0	PARTIAL	Chagrin Blvd., old 422, Chagrin Falls
20.8/20.9	43	8.2	48	76.0	FULL	Dst. Fairmount Rd., Hunting Valley
12.5/13.0	43	7.3[*]	42	70.0	PARTIAL	Dst. Rogers Rd.
4.0/4.2	44	7.9	40	76.0	FULL	Todd Field
Aurora Branch (1996 - Consultant Data) [d]						
Erie-Ontario Lake Plain: WWH Use Designation (Existing)						
11.4	28[*]	NA	--	75.0	**(NON)**	Ust. Aurora Central WWTP
11.1	30[*]	NA	--	74.3	**(NON)**	Dst. Aurora Central WWTP
9.0	33[*]	NA	--	78.0	**(NON)**	Ust. SR 306
Aurora Branch (1995)						
17.1	---	NA	10[*]	---	**(NON)**	Ust. SR 82
16.6	---	NA	22[*]	---	**(NON)**	Dst. Chamberlain Rd.
14.5 (**1996**)	26[*]	NA	VG	79.5	PARTIAL	Dst. Sunny Lake Tributary
12.1/12.0	38[ns]	NA	MG[ns]	65.0	FULL[g]	SR 82 (ust. sewer break)
11.3	30[*]	NA	8[*]	74.0	**NON**	Ust. Aurora Central WWTP
11.1/11.0	38[ns]	NA	24[*]	71.5	PARTIAL	Dst. Aurora Central WWTP
9.0/9.1	39[ns]	NA	48	81.5	FULL	Ust. SR 306
5.6/5.7[R]	38	8.1	54	70.5	FULL	Adj. Geauga Lk Rd near Field Rd
3.5	33[*]	7.1[*]	56	69.0	PARTIAL	Ust. McFarland Cr. WWTP
3.45	*35[ns]*	*7.9*	*MG*	---	-	*WWTP acute mixing zone*
3.4	38	7.9	VG	75.0	FULL	Dst. McFarland Cr. WWTP
1.6	39	7.7[ns]	48	59.5	FULL	Chagrin R. Rd. opp. Holbrook Rd.
0.3	48	8.8	E	79.5	FULL	Ust. bridge abutment (Bentleyville)

RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
Aurora Branch (1991)						
Erie-Ontario Lake Plain: WWH Use Designation (Existing)						
11.3	32*		40	78.0	PARTIAL	Ust. Aurora Central WWTP
11.2/11.14	*25*		*20*	--	-	*WWTP acute mixing zone*
11.1	27*		38ns	80.0	PARTIAL	Dst. Aurora Central WWTP
9.0/9.1	33*		48	78.0	PARTIAL	Ust. SR 306
Aurora Branch (1990)						
9.0/8.9	32*	7.4ns	50	80.0	PARTIAL	Dst. SR 306
3.9/3.5	38	7.9	46	82.0	FULL	Ust.McFarland Cr. WWTP
3.4/3.45	*37*	*8.0*	*46*	--	-	*WWTP acute mixing zone*
3.3/3.4	36ns	6.6*	50	71.0	PARTIAL	Dst. McFarland Cr. WWTP
--/2.0	--	--	54	--	(FULL)	Adj. Chagrin R. Rd.
0.3	41	8.3	48	76.0	FULL	Near mouth
Aurora Branch (1986)						
3.8	--	--	48	--	(FULL)	Dst. Bainbridge Rd.
2.0	--	--	48	--	(FULL)	Adj. Chagrin R. Rd.
0.3	37ns	8.1	50	63.0	FULL	Near mouth
Silver Creek (1995)						
Erie-Ontario Lake Plain: CWH## Use Designation (Existing)						
5.0 **(1996)**	---	---	52	65.0	(FULL)	Dst. Music St. (follow-up)
4.0/3.9	30*	NA	56	69.5	PARTIAL	Amer. Soc. of Metals (ASM)
1.7/1.9	35*	NA	52	76.0	PARTIAL	Near SR 87 dst. of dam
0.5	40	NA	52	61.5	FULL	Dst. SR 306
Silver Creek (1994- Consultant Data) [e]						
5.1	42	NA	--	73.0	(FULL)	Ust. Music St.
2.7	50	NA	40[g]	87.5	FULL	Ust. of S. Br. & old park impoundment

RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
South Br. Silver Creek (confluence at RM 2.62) (1994 - Consultant Data) [e]						
Erie-Ontario Lake Plain: WWH Use Designation (Recommended)						
1.1	42	NA	--	50.5	(FULL)	At Music St.
Trib. to Chagrin R. (confluence at RM 15.42) (1995)						
Erie-Ontario Lake Plain: CWH Use Designation (Recommended)						
0.4[R]/0.3	48	NA	46	75.5	FULL	Chagrin R. Rd S Wilson Mills Rd
Beaver Creek (1995)						
Erie-Ontario Lake Plain: CWH Use Designation (Recommended)						
2.4	--	NA	E	--	(FULL)	Ust. Bean Rd.
Linton Creek (1995)						
Erie Ontario Lake Plain: CWH Use Designation (Recommended)						
0.1	--	NA	VG	--	(FULL)	Dst. Geauga Lake Rd.
McFarland Creek (1995)						
Erie Ontario Lake Plain: EWH Use Designation (Existing)						
0.1	46[ns]	NA	G[*]	72.0	PARTIAL	Ust. Chagrin River Rd.
Willey Creek (1995)						
Erie Ontario Lake Plain: CWH Use Designation (Recommended)						
0.2	46	NA	VG	72.0	FULL	Ust. Chagrin River Rd.
Griswold Creek (1996 - Consultant Data) [f]						
Erie-Ontario Lake Plain: CWH Use Designation (Recommended)						
6.7	40	NA	--	74.0	(FULL)	Bessie Benner Metzenbaum Park
3.5	48	NA	--	83.5	(FULL)	Fairmount Road
0.9	36[ns]	NA	--	77.5	(FULL)	Upstream of SR 87

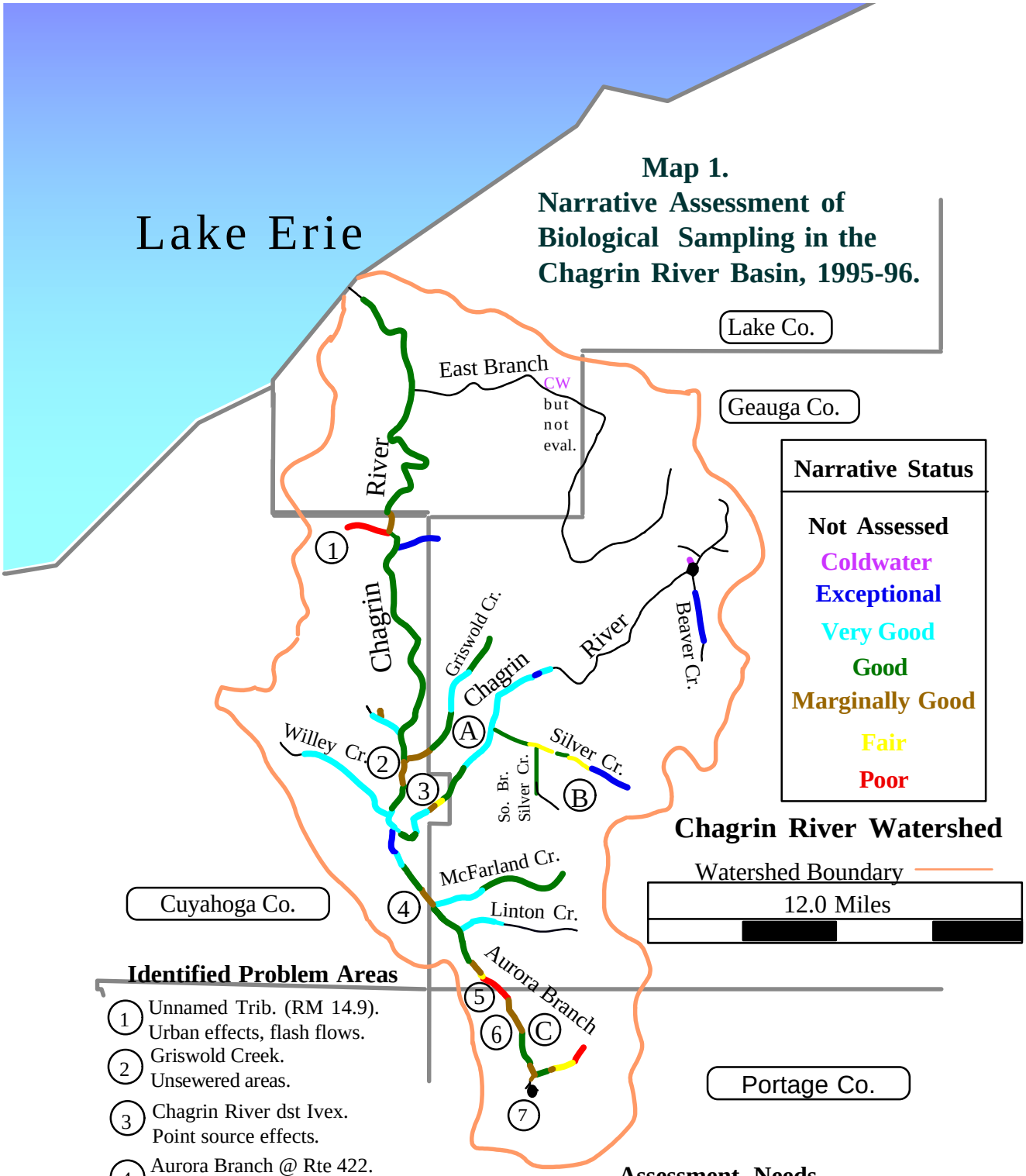
RIVER MILE Fish/Invert.	IBI	MIwb	ICI[a]	QHEI	Attainment Status[b]	Site Location
Griswold Creek (1995)						
	Erie-Ontario Lake Plain: CWH Use Designation (Recommended)					
0.7/0.1	32*	NA	VG	63.5	PARTIAL	Ust. Falls River Rd.
Trib. to Chagrin R. (confluence at RM 22.81) (1995)						
	Erie-Ontario Lake Plain: WWH Use Designation (Recommended)					
0.3/0.2	50	NA	MG[ns]	60.5	FULL	Shaker Blvd.(@ Rankin Estates)
Trib. to Trib. to Chagrin R. (confluence at RM 22.81/2.17) (1995)						
	Erie-Ontario Lake Plain: WWH Use Designation (Recommended)					
0.1	---	NA	MG[ns]	---	(FULL)	Roundwood Rd. dst.Woodland Glen STP
Trib. to Chagrin R. (confluence at RM 14.88) (1995)						
	Erie-Ontario Lake Plain: WWH Use Designation (Recommended)					
0.2/0.2	20*	NA	MG[ns]	57.5	PARTIAL	Buttermilk Falls Pkwy N Wilson Mills Rd.
Sunny Lake Trib. (1996)						
	Erie-Ontario Lake Plain: WWH Use Designation (Recommended)					
0.1/0.1	26*	NA	MG[ns]	64.0	PARTIAL	Near mouth at Aurora Branch

Ecoregion Biocriteria: Erie-Ontario Lake Plain (EOLP)
(OAC Chapter 3745-1-07, Table 7-14)

INDEX-Site Type	WWH	EWH	CWH ##
IBI - Headwaters	40	50	**No**
IBI - Wading	38	50	**Number**
MIwb-Wading	7.9	9.4	**Criteria**
ICI	34	46	**Available**

* - Significant departure from biocriteria (>4 IBI or ICI units; >0.5 MIwb units). Underlined scores are in the Poor or Very Poor range.
ns - Nonsignificant departure from biocriteria (≤4 IBI or ICI units; ≤0.5 MIwb units).
R - Regional Reference Site.

a - Narrative evaluation used in lieu of ICI numeric score (Exc.=Exceptional; VG=Very Good;G=Good;MG=Marginally Good;P=Poor;VP=Very Poor)).
b - Attainment status based on one organism group is parenthetically expressed.
c - Assessed MG/G based on three site observations. Artificial substrates buried in shifting sediments twice.
d - *Biological Water Qual. Study of Aurora Br. of the Chagrin River*, by Enviroscience, Inc. 1996.
e - *Water Quality Survey of Silver Creek*, by ARCT, Inc. 1994.
f - *Aquatic Ecological Survey, Griswold Creek, Geauga County, Ohio*, by ARCT, Inc. 1996.
g - Qualitative assessment used on lieu of quantitative score due to lack of requisite current and/or vandalism of artificial substrates.
NA - Headwater site; MIwb is not applicable to streams with drainage areas less than 20 mi^2.
- Ohio EPA currently uses attainment of WWH criteria to assess numerical attainment of CWH criteria.



Identified Problem Areas

1. Unnamed Trib. (RM 14.9). Urban effects, flash flows.
2. Griswold Creek. Unsewered areas.
3. Chagrin River dst Ivex. Point source effects.
4. Aurora Branch @ Rte 422. Effects of highway construction.
5. Aurora Branch ust Aurora Central WWTP. Sewer break.
6. Aurora Branch near SR 82. Septic runoff from stormwater and other sources.
7. Aurora Branch. Periodic toxic Microcystis from Sunny Lake via Sunny Lake Trib..

Assessment Needs

A. Griswold Creek. Uunsewered areas. Septic runoff.
B. Headwaters Silver Creek. Review of construction in area and effects on brook trout & use designation.
C. Aurora Branch ust Aurora Central WWTP. Loss of sensitive fish species, recovery.

Table 1a. Summary of Biomonitoring Miles Assessed for aquatic life use attainment staus in the Chagrin River watershed, 1995-96.

Miles Assessed and Attainment Miles				
WWH	FULL	PARTIAL	NON	Miles Assessed
Chagrin River mainstem	32.1	7.5	0.0	39.6
Aurora Branch Chagrin River	13.75	2.28	1.27	17.3
South Branch Silver Creek	1.0	-	-	1.0
Trib. to Chagrin R. (RM 22.81)	-	1.0	-	1.0
Trib. to Trib. to Chagrin R.	1.0	-	-	1.0
Trib. to Chagrin R. (RM 14.88)	-	0.7	-	0.7
Sunny Lake Trib. to Aurora Br.	-	0.6	-	0.6
WWH Totals	**47.85**	**12.08**	**1.27**	**61.2**
EWH	FULL	PARTIAL	NON	Miles Assessed
McFarland Creek	**0.0**	**0.6**	**0.0**	**0.6**
CWH	FULL	PARTIAL	NON	Miles Assessed
Silver Creek	3.3	3.3	-	6.6
Trib. to Chagrin R. (RM 15.42)	1.0	-	-	1.0
Beaver Creek	4.0	-	-	4.0
Linton Creek	1.0	-	-	1.0
Willey Creek	1.5	-	-	1.5
Griswold Creek	5.2	0.9	-	6.1
CWH Totals	**16.0**	**4.2**	**0.0**	**20.2**
TOTALS	**63.85**	**16.88**	**1.27**	**82.0**

Biological Integrity Equivalents - Chagrin River Mainstem

The following figure below illustrates the three major biocriteria (IBI, MIwb, ICI) equally on a scale of a total 100 points. These scores represent the actual percentage of biological community attributes (biological integrity) that are being attained with respect to the theoretical potential (100%). The actual potential score that can be attained is probably *less* than the 100% theoretical potential. The scores needed for each relative narrative assessment rating are listed to the right of the figure (color and character coded) (Figures 1a,1b).

The Biological Integrity Equivalents figures illustrated below combined the different biological indices to create a general comparative trend between the different survey years. Table 1c following will highlight and summarily compare each biological index separately between sampling years with the associated use attainment status and an overall biological quality trend.

Table 1d (following page) summarizes the waterbody stream segments sampled and comments on the stream miles analyzed and use attainment status in those reaches. Causes and sources of decreased or threatened attainment of aquatic life use designations are listed specifically for each stream segment. Summary comments and information about particular sampled streams or stream segments in the various subbasins are included.

Table 2 specifically denotes each stream segment and the assigned waterbody use designations under the categories of Aquatic Life Habitat, Water Supply, and Recreation in the Water Quality Standards.

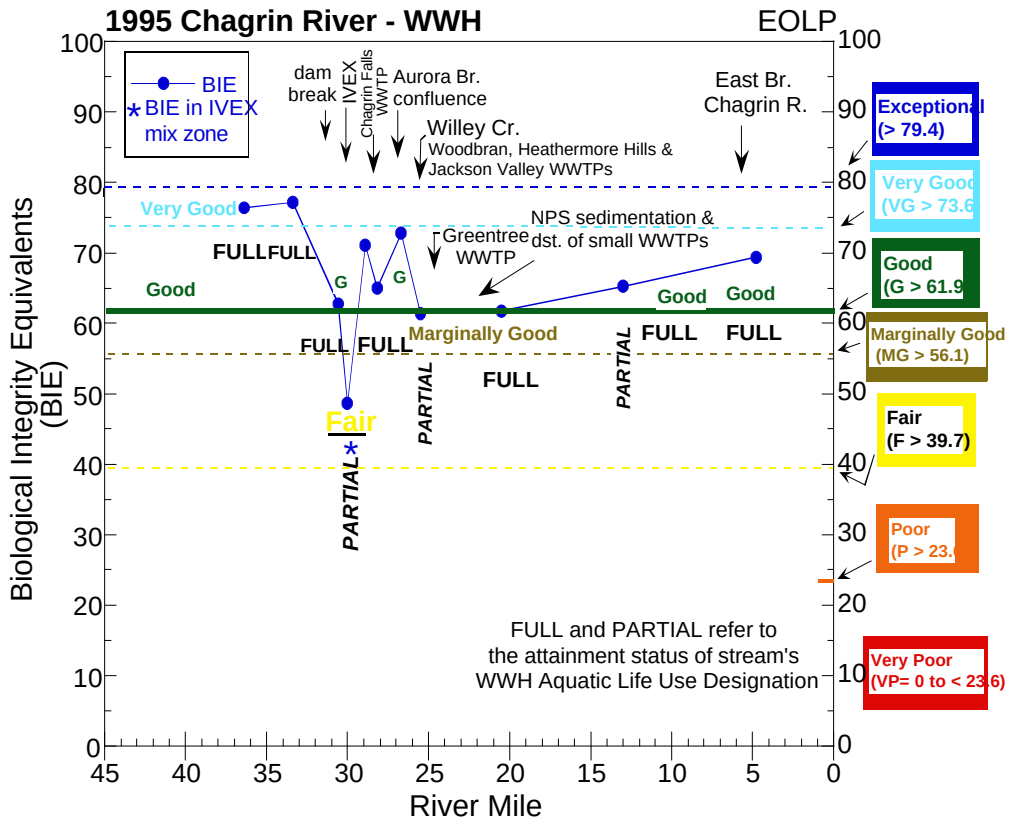


Figure 1a. Attainment Status and Biological Integrity Equivalents (BIE) longitudinally in the Chagrin River, 1995-6.

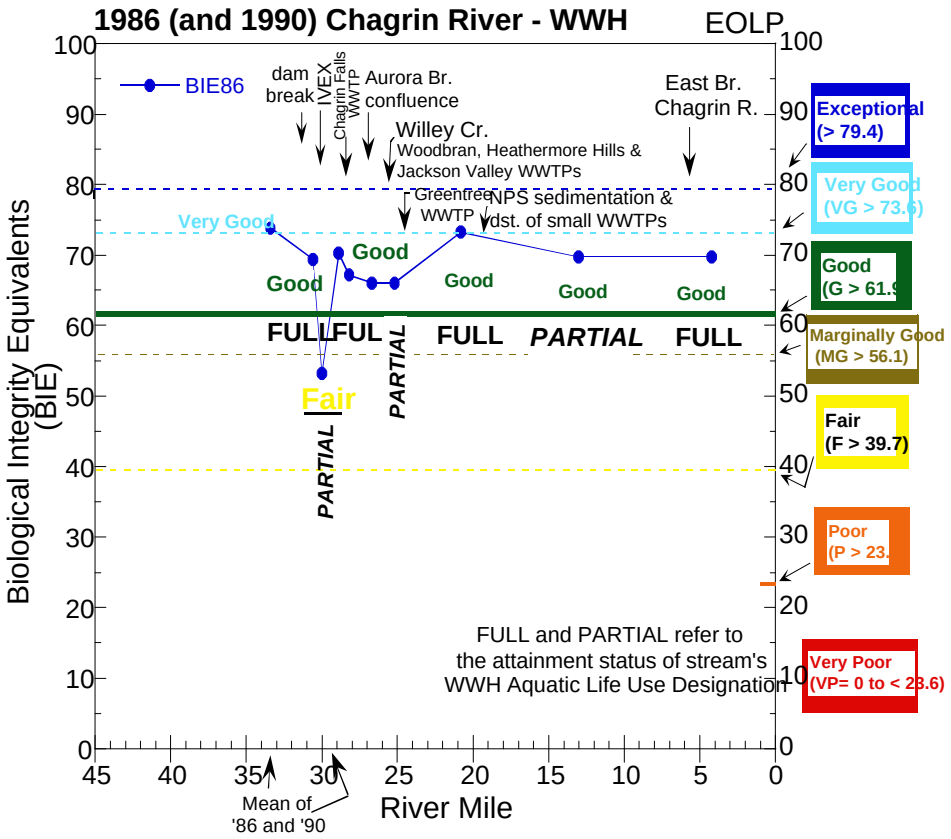


Figure 1b. Attainment Status and Biological Integrity Equivalents (BIE) longitudinally in the Chagrin River, 1986 and 1990 (where indicated).

Table 1c. Comparison of 1995 and previous survey biological index scores (Index of Biotic Integrity (IBI), Modified Index of Well-Being (MIwb), and Invertebrate Community Index (ICI)) and the aquatic life use attainment status for commonly sampled segments in the Chagrin River (1986[a]) and the Aurora Branch of the Chagrin River (1990, 1991).

Segment Rm	**IBI** (Diff.) 1986/1995	Trend	**MIwb** (Diff.) 1986/1995	Trend	**ICI** (Diff.) 1986/1995	Trend	**Attainment Status** (1986/1995)	**Overall Trend**
Chagrin River Mainstem								
34.8-31.1[a]	46/46 (0)	NC[b]	8.3/8.6 (+0.3)	NSC[c]	46/50 (+4)	NSC	FULL/FULL	No S. Change
31.1-30.1	36/34 (-2)	NSC	8.6/8.2 (-0.4)	NSC	48/G **(-14)**	**Decrease**	FULL/FULL	**Degraded**
30.05-29.7[a]	36/34 (-2)	NSC	7.6/7.5 (-0.1)	NSC	26/16 **(-10)**	**Decrease**	PARTIAL/PARTIAL	**Degraded**
29.7-28.44	45/43 (-2)	NSC	7.9/7.8 (-0.1)	NSC	40/E **(+6)**	**Increase**	FULL/FULL	**Improved**
28.42-27.4	43/45 (+2)	NSC	8.0/7.6 (-0.4)	NSC	40/G **(-6)**	**Decrease**	FULL/FULL	**Degraded**
27.4-26.0	44/44 (0)	NC	8.2/8.2 (0)	NC	36/46 **(+10)**	**Increase**	FULL/FULL	**Improved**
26.0-22.6	40/36 (-4)	NSC	6.9/6.9 (0)	NC **NON**	46/36 **(-10)**	**Decrease**	PARTIAL/PARTIAL	**Degraded**
22.6-16.2	43/40 (-3)	NSC	8.2/7.4 **(-0.8)**	**Decrease**	48/G **(-14)**	**Decrease**	FULL/FULL	**Degraded**
16.2-8.7	43/43 (0)	NC	7.3/7.3 (0)	NC **NON**	42/38 (-4)	NSC	PARTIAL/PARTIAL	No S. Change
8.7-2.0	44/42 (-2)	NSC	7.9/9.0 **(+1.1)**	**Increase**	40/38 (-2)	NSC	FULL/FULL	**Improved**
Segment Rm	**IBI** (Diff.) 1990-91/1995	Trend	**MIwb** (Diff.) 1990-91/1995	Trend	**ICI** (Diff.) 1990-91/1995	Trend	**Attainment Status** (1990-91/1995)	**Overall Trend**
Aurora Branch of the Chagrin River								
11.5-11.2	32/29[d] (-2)	NSC	NA --	NA	40/8 **(-32)**	**Decrease**	PARTIAL/NON	**Degraded**
11.13-10.5	27/34[d] **(+7)**	**Increase**	NA --	NA	38/24 **(-16)**	**Decrease**	PARTIAL/PARTIAL	**Degraded**
10.5-8.9	32[a]/36[d] (+4)	Mixed	7.4/-- --	--	49[a]/48 (-1)	NSC	PARTIAL/FULL	Mixed
8.9-4.0	--/38 --	--	--/8.1 --	--	--/54 --	--	FULL/FULL	---
4.0-3.47	38/33 **(-5)**	**Decrease**	7.9/7.1 **(-0.8)**	**Decrease**	46/56 **(+10)**	**Increase**	FULL/PARTIAL	Mixed
3.44-2.5	36/38 (+2)	NSC	6.6/7.9 **(+1.3)**	**Increase**	50/VG **(-8)**	**Decrease**	PARTIAL/FULL	Mixed
2.5-1.0	--/39 --	--	--/7.7 --	--	54/48 **(-6)**	**Decrease**	FULL/FULL	**Degraded**
1.0-0.0	41/48 **(+7)**	**Increase**	8.3/8.8 **(+0.5)**	**Increase**	48/E (-2)	NSC	FULL/FULL	**Improved**

[a] These segments were averaged with 1990 results.
[b] NC = No Change
[c] NSC or No S. Change = No Significant Change
[d] Averaged 1995 data and 1996 follow-up IBI data which indicate continued degradation with lower scores and NON-attainment ust. (28) and dst. (30) of Aurora Central WWTP and ust. of State Route 306 (33) (Table 1).
NON or ____ = Non-attainment of aquatic life use designation

Table 1d. Waterbody segment (305b) summaries for streams sampled in the Chagrin River basin during 1995-96.

Waterbody (RM) Upper/Lower	Stream Reach Length	Attainment Miles Status				Causes, Sources, and Comments
		FULL	Partial	**NON**	Threatened	
Chagrin River mainstem						
51.47/27.09	24.38	23.78	0.6		23.78	*Causes*: Suspended solids, organic enrichment/BOD, Hg in sediment, fecals, NH_3 *Sources*: Ivex, suburban stormwater runoff and wastewater *Comments*: Sewage fungus dst. Ivex with lots of solids. Lead and Hg in fish tissue dst. Ivex and Chagrin Falls WWTP. High NH3-N conc. during Ivex plant upset. Suburban runoff with failing septic systems ust. Chagrin Falls with highest ambient fecal conc. and elevated sediment metals (Cr, Zn). Elevated arsenic sediment conc. and fecals dst. Chagrin Falls WWTP. Elevated Hg and lead in fish tissue from industrial/suburban sources.
27.09/5.0	22.1	15.2	6.9		10.5	*Causes*: Pollutant loadings accumulation, sedimentation, metals, organic enrichment/D.O., suspended solids, occasional fecal exceedences *Sources*: Suburban/land development, stormwater runoff, WWTPs, Ivex *Comments*: Suburban runoff and sedimentation with WWTP flow from upst. & in Aurora Branch and small local mainstem plants accumulating. Failing septic systems add to increase. Elevated lead and Hg in fish tissue from suburban/industrial sources.
5.0/2.0	3.0	3.0			3.0	*Causes*: Pollutant loadings accumulation, suspended solids, metals, organic enrichment/D.O., sedimentaton, occasional fecal exceedences *Sources*: Suburban development, storm runoff, upstream point sources, private on-site septic failures *Comments*: From dam to lacustuary (lake effect/no riffles) threats are from nutrient enrichment (with episodic low D.O.s). Storm runoff cause high fecal counts (ust. and E. Br Chagrin R.) and high suspended solids. Metals/toxics accumulation (elevated Hg and PCB in fish tissue) from upstream municipal/industrial sources and storm runoff in lower reach depositional areas and lacustuary.

Table 1d. (cont.) Waterbody segment (305b) summaries for streams sampled in the Chagrin River basin during 1995-96.

Waterbody (RM) Upper/Lower	Stream Reach Length	Attainment Miles Status				Causes, Sources, and Comments
		FULL	Partial	**NON**	Threatened	
Aurora Branch Chagrin River						*Causes*: Nutrients, organic enrichment/D.O., habitat changes/siltation, toxic algal blooms, chlorine, pollutant loadings accumulation, suspended solids/BOD, fecal coliform bacteria, riparian encroachment
18.44/0.00	18.44	13.75	2.28	1.27	16.03	*Sources*: Aurora, failing on-site septic systems, stormwater runoff, Sunny Lake, campground package plant (seasonal high pH, NH3, TSS), Suburban/land development, WWTPs, highway construction *Comments*: Sewer line break ust. Aurora Central WWTP put raw sewage in stream with D.O. and fecal coliform exceedences. Organic enrichment from accumulative loadings from WWTP increases, suburban runoff and on-site septic systems push the assimulative recovery capacity of Aurora Br.
Silver Creek						*Causes*: Flow alteration, siltation (riparian encroachment), thermal changes *Sources*: Suburb. development, Storm runoff, on-site septic systems, dams, natural
6.60/0.00	6.60	3.3	3.3		6.6	*Comments*: Silver Creek has a coldwater complexion and dams restricted fish movements or recolonization. CWH tribs threatened by housing construction (new storm runoff/loss of habitat). Sensitive brook trout & mussel pop. dst. of old dam need riparian protection for low water temperatures and low turbidity from siltation runoff.
South Branch Silver Creek						*Causes*: Nutrients, organic enrichment/D.O., thermal modification, flow alteration *Sources*: Suburbanization (riparian encroachment), impoundments, storm runoff
4.64/0.00	4.64	4.64			4.64	*Comments*: Development in upper watershed and impoundments changed flow with increased temp. and siltation. Riffles not well developed dst. Paw Paw Lake. Riparian area N. Of Music St. (and upper reach near stream), if kept intact, would be more protective of waters quality in park & CWH fauna.

Table 1d. (cont.) Waterbody segment (305b) summaries for streams sampled in the Chagrin River basin during 1995-96.

Waterbody (RM) Upper/Lower	Stream Reach Length	Attainment Miles Status				Causes, Sources, and Comments
		FULL	Partial	**NON**	Threatened	
Beaver Creek						*Comments*: Cold flowing stream interspersed with wetland components from Beaver dams. Proposed housing development in watershed could cause stream modification with decreased riparian and increased event flow (storm sewers and runoff) changing stream dynamics (more siltation, higher temperatures, nutrients) and possibly effecting sensitive taxa.
5.00/0.00	5.00	5.00			5.00	
Willey Creek						*Causes*: Nutrients, organic enrichment, flow alteration, siltation (riparian loss), solids, fecals, chlorine *Sources*: Suburb. development, small WWTPs,storm runoff, private septic systems *Comments*: Drains west side of watershed (most dense development). Threats by increased loads to assimilative capacity via WWTPs and storm runoff. Upsets can cause impacts;ongoing tie-ins to regional STP helpful. Riparian protection needed due to steep wateshed gradient.
5.58/0.00	5.58	5.58			5.00	
Griswold Creek						*Causes*: Nutrients, suspended solids, organic enrichment., silt, flow s, fecals, BOD *Sources*: Suburb. development, private failing septic systems, storm runoff, dams *Comments*: Septic contamination in upper 1/3 of creek. Failing septic systems cause. New plant will help with that but could change temperature dynamics. Still some coldwater and silt-intolerant taxa present. Impoundments limit fish movements and affect temp.. Riparian protection needed- steep grade.
6.10/0.00	6.10	5.20	0.9		5.20	
Trib. to Chagrin River (RM 22.81)						*Causes*: BOD, nutrients, TSS, organic enrichment., fecals, chlorine, siltation *Sources*: Suburban development, periodic plant upsets, storm runoff *Comments*: Development in watershed (Pepper Pike/Creekside/Woodland Glen) - mostly houses, golf courses, service industry, large orchard. A decrease in loadings could benefit stream water quality. Exceptional fish scores with bugs in recovery cycle indicates episodic impact spikes. Riparian buffer protection needed- steep grade. High bedload in Chagrin R. downstream.
5.94/0/00	5.94		5.94		5.5	

Table 1d. (cont.) Waterbody segment (305b) summaries for streams sampled in the Chagrin River basin during 1995-96.

Waterbody (RM) Upper/Lower	Stream Reach Length	Attainment Miles Status				Causes, Sources, and Comments
		FULL	Partial	**NON**	Threatened	
Trib. to trib. to Chagrin River (RM 22.81/2.17)						*Comments*: A marginally good community present dst. of Woodland Glen WWTP. The threats are excessive nutrients and organic enrichment/BOD. Flashy runoff causes erosion/siltation problems - high bedload and embeddedness downstream. Increase and strengthen riparian buffers where possible.
1.74/0.00	1.74	1.74			1.74	
Trib. to Chagrin River (RM 15.42)						*Comments*: Small coldwater stream with many sensitive taxa, including trout. Threats are suburban expansion that could cause turbidity/siltation, embeddedness, temperature changes and increase of pollutant inputs (metals) from flashy runoff.
3.65/0.00	3.65	3.65			2.65	
Trib. to Chagrin River (RM 14.88)						*Causes*: Flow alterations, unknown causes *Sources*: Urban runoff/storm sewers, other urban runoff *Comments*: Drains urban area and is scoured by stormwater further threatening the amphibian pop. in Chagrin Reservatioin. Need sediment metals sampling.
3.10/0.00	3.10		3.10		3.10	
Sunny Lake Trib. to Aurora Br. Chagrin R. (RM 14.61)						*Comments*: Decrease or loss of sensitive taxa downstream of Sunny Lake likely due to toxic algal blooms. Past fish kills. Ust. reach is adjacent to gasoline tank park and airport.
3.31/0.00	3.31		1.21		3.31	

Table 1d. (cont.) Waterbody segment (305b) summaries for streams sampled in the Chagrin River basin during 1995.

Waterbody (RM) Upper/Lower	Stream Reach Length	Attainment Miles Status				Causes, Sources, and Comments
		FULL	Partial	**NON**	Threatened	
Linton Creek						*Causes*: Organic enrichment., nutreints, solids, fecals *Sources*: Minor WWTPs upsets, suburban development, storm runoff
2.6/0.00	2.6	2.6			2.6	*Comments*: Small wooded stream with many coldwater & sensitive macroinvertebrate taxa. Pilgrim Village WWTP (Taylor Creek) being diverted to McFarland Creek WWTP will help decrease stream waste load. Pathogens have in past caused some problems downstream. Some sediment from dam break.
McFarland Creek						*Causes*: Habitat and flow alteration, siltation, filling and draining, fecals *Sources*: Suburban development, highway construction, upstream impoundments
5.80/0.00	5.80		5.80		5.80	*Comments*: Incomplete habitat recovery from SR 422 construction with sedimentation and embedded unstable riffles. Mouth was dry for one month previous year: filled upst. impoundment which effect fish migration & temperature. Threats are increased development and loss of riparian area upstream.

Table 2. Waterbody use designations for the Chagrin River basin. Changes to existing use designations appear in **bold** ▲. Designations based on the 1978 water quality standards (denoted with *) 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**
Chagrin River													
-Daniels Park Dam (RM 4.8) to the mouth	*	+			+				+	+		+	
-at RM 4.9	*	+						+	+	+		+	
-all other segments	*	+							+	+		+	
East Branch Chagrin River	*					*/+			*/+	*/+		*/+	
-and tributaries	*					*			*	*		*	
Unnamed tributary (Chagrin River RM 14.88)		▲							▲	▲		▲	
Unnamed tributary (Chagrin River RM 15.42)		+				▲			*/+	*/+		*/+	
Unnamed tributary (Chagrin River RM 22.81)		▲							▲	▲		▲	
Unnamed trib to unnamed tributary (Chagrin River RM 22.81/2.17)		▲							▲	▲		▲	
Griswold Creek	*		*			▲			*/+	*/+		*/+	
Willey Creek	*		*			▲			*/+	*/+		*/+	
Aurora Branch Chagrin River	*	+							+	+		+	
McFarland Cr. (RM 3.73)	*		*/+						*/+	*/+		*/+	
Linton Creek (RM 5.27)						▲			▲	▲		▲	
Sunny Lake tributary to Aurora Branch Chagrin River (RM 14.61)		▲							▲	▲		▲	
Silver Creek	*					*/+			*/+	*/+		*/+	
South Branch Silver Cr. (RM 2.62)		▲							▲	▲		▲	
Unnamed trib. to Silver Creek (ASM Tributary) (RM 34.21/3.50) [A]		▲				▲			▲	▲		▲	
Unnamed trib. to Silver Creek (RM 34.21/4.54) [A]		▲				▲			▲	▲		▲	

Stream Segment	Use Designations												
		Aquatic Life Habitat						Water Supply			Recreation		
	SRW	WWH	EWH	MWW	SSH	CWH	LRW	PWS	AWS	IWS	BW	PCR	SCR
Dewdale Creek (Chagrin R. RM 42.55)													
Unnamed trib. to Dewdale Creek (RM 42.55/0.31) [A]						▲			▲	▲		▲	
Unnamed trib. to Dewdale Creek (RM 42.55/0.5) [A]						▲			▲	▲		▲	
Beaver Creek	*		*			▲			*/+	*/+		*/+	
Unnamed trib. to Bass Lake (Chagrin RM 47.65)						+			+	+		+	
Unnamed tributary (Chagrin River RM 47.65)						+			+	+		+	

[A] Assigned WQS use designations based on 1997 brook trout stocking information in these listed tributaries.

RECOMMENDATIONS

Status of Aquatic Life Uses

- Several of the streams evaluated during this study were originally designated for aquatic life uses in the 1978 Ohio WQS. The techniques used then did not include standardized approaches to the collection of instream biological data or numerical biological criteria. Therefore, because this study represents a first use of this type of biological data to evaluate and establish aquatic life use designations, several revisions are recommended. While some of the changes may appear to constitute "downgrades" (*i.e.* EWH to WWH, WWH to MWH, etc.) or "upgrades" (*i.e.* LWH to WWH, WWH to EWH, etc.), any changes should not be construed as such because this constitutes the first use of an objective and robust use evaluation system and database. Ohio EPA is under obligation by a 1981 public notice to review and evaluate all aquatic life use designations outside of the WWH use prior to basing any permitting actions on the existing, unverified use designations. Thus some of the following aquatic life use recommendations constitute a fulfillment of that obligation. The designations apply to the entire length of the streams unless otherwise noted.

- The Chagrin River mainstem and Aurora Branch Chagrin River were surveyed in 1995-6 and are recommended to retain their current WWH aquatic life use designations.

- The following Chagrin River basin streams were surveyed in 1995-6. These previously undesignated streams were found to contain warmwater communities and recommended to WWH aquatic life use designations.

  1) Unnamed tributary (Chagrin River RM 14.88)
  2) Unnamed tributary (Chagrin River RM 22.81)
  3) Unnamed tributary to unnamed tributary (Chagrin River RM 22.81/2.17)
  4) South Branch Silver Creek
  5) Sunny Lake Tributary to Aurora Branch Chagrin River (RM 14.61)

- McFarland Creek was surveyed in 1995 and is recommended to retain its current EWH aquatic life use designation.

- Silver Creek was surveyed in 1995-96 and is recommended to retain its current CWH aquatic life use designation.

- The following Chagrin River basin streams were surveyed in 1995 and are recommended to change their current aquatic life use designations to Coldwater Habitat (CWH).

  1) Tributary to Chagrin River (RM 15.42) (currently WWH)
  2) Beaver Creek (currently EWH)
  3) Griswold Creek (currently EWH)
  4) Willey Creek (currently EWH)

- Linton Creek was surveyed in 1995. This previously undesignated stream was found to contain

a coldwater macroinvertebrate community and is recommended to the CWH aquatic life use designation.

- The following Chagrin River basin streams were recommended to be designated CWH aquatic life use after ODNR has stocked or has planned to stock brook trout in reintroduction project.

  1) Unnamed trib. to Silver Creek (ASM Tributary) (RM 34.21/3.50)
  2) Unnamed trib. to Silver Creek (RM 34.21/4.54)
  3) Unnamed trib. To Dewdale Creek (RM 42.55/0.5)
  4) Unnamed trib. To Dewdale Creek (RM 42.55/0.31)

  Future monitoring of the subwatershed of Dewdale Creek will be conducted to assess the appropriateness of these designations.

- The State Resource Water (SRW) currently applied to the Chagrin River mainstem and selected tributaries should be retained. The resource water designation is currently being revised and these streams already designated or that are recommended for CWH aquatic life use designations should have an equivalently protected resource status (Superior or Outstanding High Quality Waters) to ensure protection for these unique subwatersheds.

Status of Non-Aquatic Life Uses

- The existing Primary Contact Recreation (PCR) designation for the previously designated streams should be retained based on sampling observations. All newly sampled streams were recommended to receive a PCR designation. The designation given as recommended to those streams noted in Table 2 was based on field observations or recommendations by district OEPA personnel with helpful input and information from Phil Hillman and Vince LaConte of the Ohio Div. Of Wildlife (particularly with regard to stream depths and areas for streams where the brook trout recolonization program has been implemented - specifically unnamed tributaries to both Silver Creek and Dewdale Creek). The streams have pools with average depths of 3 feet covering an area exceeding 100 square feet which is the requisite habitat feature to qualify for a Primary Contact Recreation use designation.

- The existing Water Supply Use designations for the previously designated streams were appropriate based on sampling/field observations and should be retained. All sampled and designated streams listed in Table 2 were recommended to have Agricultural and Industrial Water Supply use designations.

Other Recommendations

- The native brook trout reintroduction into the Silver Creek watershed highlights the importance of maintaining and protecting Silver Creek as a Coldwater Habitat aquatic life use designation. The cumulative effect of thermal and chemical loadings from numerous small point source discharges to Silver Creek could have a negative impact on the attempt by Ohio DNR to reestablish native brook trout, *Salvelinus fontinalis (Mitchill)*, populations in this region of Ohio and have a supplemental native genetic strain population in addition to Spring Brook in the Bass Lake headwater segment of the Chagrin River (see Study Area for more information). Future

increased chemical and thermal loadings to its tributaries needs to be very restricted.

- The majority of streams that were investigated as part of this study were threatened by the cumulative impacts of increasing urbanization and associated point and nonpoint pollution sources (e.g., changes in flow from stormwater, reduction of riparian zones, sedimentation from construction or land use changes). A watershed based planning approach is needed to minimize future impacts and allow for the restoration and the protection of the Chagrin River basin watershed resources for the public use.

- Unsewered areas need to be evaluated by local health departments to correct failed septic systems along Griswold Creek discovered during sampling (especially the lower reach near the Chagrin River).

- Unsewered areas need to be periodically evaluated by local health departments to correct failed septic systems in the basin to protect the public during recreational contact.

Future Monitoring Issues (Some of these activities are already ongoing.)

- The source(s) of bacteria to the mainstem Chagrin River between RM 33.35 and RM 30.7 needs to be identified.

- Follow-up chemical and biological monitoring needs to be conducted on the Aurora Branch upstream and downstream from the 1995 influent sewer break to establish background conditions for the new Aurora Central WWTP.

- The source(s) of mercury found in the stream sediments below the Ivex property needs to be investigated and identified.

- Fish tissue samples need to be collected upstream from the Ivex dam to help determine the levels (if any) of fish contamination upstream and to check for other mercury sources (via air deposition, or other suburban sources). Fish tissue samples should be collected above Chagrin Falls waterfall to isolate effects from Ivex and Chagrin Falls WWTP.

- The source(s) of septic gray water (and likely bacteria) observed being discharged at SR 82 on the Aurora Branch Chagrin River needs to be investigated and identified.

- The source(s) of the copper exceedence found in the upper Aurora Branch needs to be identified.

- A site at Pettibone Rd (RM ~7.0) needs to be included in the next Aurora Branch survey to monitor any possible changes to water quality (possible nutrient and/or toxic impacts) and the biological communities from Geauga Lake Amusement Park Funtime. Inc. outfall 001 effluent (RM 7.2).

- An intensive survey of the Silver Creek watershed and upper Chagrin River watershed could be conducted to determine the seasonal changes in water temperature and the presence of coldwater benthic invertebrate taxa. This data could be used to identify potential tributaries for other possible reintroductions of brook trout by the Ohio DNR (study ongoing).

- A survey of Dewdale Creek mainstem and other tributaries should be conducted to designate other portions of the subwatershed and support the ongoing ODNR brook trout recolonization project.

STUDY AREA

The Chagrin River basin, a tributary of Lake Erie, is located in Cuyahoga, Lake, Geauga, and Portage Counties in northeast Ohio. The basin drains an area of 267 square miles (ODNR, 1980). The length of the mainstem is approximately 47.9 miles with an average fall of 15.9 feet per mile. The terrain of most of the watershed is generally rolling with a substantial percentage of wooded land. The river is deeply entrenched over the lower 25 miles and flows on bedrock in a narrow valley through most of this length. The source of the mainstem is near Chardon, which then flows southwesterly to Chagrin Falls where it is joined by the Aurora Branch which confluences from the south. From Chagrin Falls, the river flows northerly through the eastern suburbs of Cleveland to its confluence with the East Branch near Willoughby. The Chagrin River then continues to its point of discharge into Lake Erie at Eastlake. Table 3 presents the general characteristics of the major tributaries in the basin.

On July 2, 1979 the State of Ohio designated 49 miles of the Chagrin River and two of its tributaries (the East Branch and the Aurora Branch) in Cuyahoga, Lake, and Portage counties as Ohio's ninth Scenic River. The designation begins on the Aurora Branch from the State Route 82 bridge (RM 12.00), downstream approximately 12 miles to a point where the Aurora Branch joins the Chagrin River. Also included is the mainstem of the Chagrin from the confluence with the Aurora Branch, downstream approximately 16 miles to the U.S. Route 6 bridge (RM 11.10). The East Branch of the Chagrin is included in the scenic river designation from the Heath Road bridge (RM 14.49) about 14.5 miles to its confluence with the main stem of the Chagrin River.

Large segments of the Chagrin River are essentially natural in character, possessing excellent aquatic habitat, making it one of the highest quality water resources in northeast Ohio. The Chagrin River basin has the greatest percentage of tributaries assigned the EWH and CWH aquatic life uses of all the major rivers in northeast Ohio. Eighty percent of the stream segments of tributaries to the Chagrin mainstem are assigned either the EWH or CWH use designation in Ohio WQS, Chapter 3745-1 of the Administrative Code.

The 1995 study area is situated within the Erie-Ontario Lake Plain ecoregion. The following discussion is from the 1991 Ohio EPA Chagrin River report (Ohio EPA, 1991). "The nearly level to rolling terrain exhibits a mosaic of cropland, pasture, livestock and poultry production, woodland, and forest. Dairy cattle are raised throughout the ecoregion with approximately one-tenth of the region providing pasture for cattle. Cropland covers about one-third of the area and is interspersed with some pasture, woodland, and forest. Approximately 20% of the ecoregion is urbanized with some oil and gas drilling and strip mining for coal also occurring."

Table 3. Stream characteristics and pollution sources in the Chagrin River basin study area, 1995.

Stream Name (Aquatic Life Use)	Length (Miles)	Gradient (Ft/Mile)	Drainage (Sq. Mi.)	Major Point Evaluated	Suspected Non Point Source Categories
Chagrin River Mainstem (WWH, SSH)	47.9	15.9	267.0	Ivex Paper Mill Corp. Chagrin Falls WWTP	Agriculture Urban Resource Extraction
East Branch Chagrin R. (CWH)	19.4	34.8	50.8	**Not Evaluated in 1995**	Agriculture Urban On-site Waste Treatment Hydromodification
Aurora Br. Chagrin R. (WWH)	16.1	20.0	57.6	Aurora Central WWTP McFarland Creek WWTP	Agriculture Urban
McFarland Creek (EWH)	5.8	48.5	10.8		Agriculture
Griswold Creek (EWH)	6.1	59.0	7.29		Urban On-site Waste Treatment
Willey Creek (EWH)	2.7	85.8	5.18	Jackson Valley WWTP	Urban Development Pressure
Silver Creek (CWH)	6.2	28.6	13.36		Agriculture Development Pressure
Beaver Creek (EWH)	5.0	37.8	3.43		Agriculture Development Pressure

Northeast Ohio Area Coordinating Association (NOACA) has conducted an analysis of population growth and number of new houses in the Chagrin River watershed for the period 1970 to 2000 (Andy Vidra, personal communication with Mark Bergman, Div. of Surface Water, NEDO OEPA, 1996). Raw data are summarized in Table 4. The data show that, during the 1970 to year 2000 time period, the highest rate of population growth and new housing was between 1970 and 1980, with a significant relative reduction in the rate of growth between 1980 and 1990, and a projected increased rate from 1990 to the year 2000. The rate of growth for new housing far exceeded the rate of population growth over the thirty year period. The conversion of land to residential housing will increase the rate of stormwater runoff as more impervious areas from streets, driveways, and rooftops are added to the Chagrin River watershed (Table 4).

Table 4. Population growth and number of new houses constructed in the Chagrin River watershed, 1970 to 2000 (NOACA, 1996). Year 2000 population values are estimated. Year 2000 housing values extrapolated from population*.

Year	Watershed Population Number	Population Increase Per 10 yrs.	Pop. Growth Rate	Watershed Housing Number	Housing Increase Per 10 yrs.	Housing Growth Rate
1970	122,518	--------	--------	38,261	--------	--------
1980	133,244	+10,726	+8.05%	50,018	+11,757	+23.51%
1990	138,212	+ 4,968	+3.60%	55,444	+5,426	+9.79%
2000*	145,000*	+6,788*	+4.68%	62,858*	+7,414*	+11.80%

The last remaining native Ohio population (native genetic strain) of the brook trout , *Salvelinus fontinalis (Mitchill)*, was located in the Bass Lake headwater segment of the Chagrin River mainstem in a small tributary called Spring Brook (communication with Phil Hillman, ODNR, District Manager of Fish and Wildlife). From 1992 to1995, the Ohio DNR, Division of Wildlife, surveyed the Chagrin River and Silver Creek watersheds for the presence of additional native Brook Trout populations and for possible sites where they could be reintroduced into their native range. In 1995, fifty-one native Brook Trout were reintroduced into a tributary of Silver Creek by Ohio DNR. DNR has subsequently established a Native Brook Trout Reintroduction Project, to be funded from 1997 through 2002, to reintroduce native Ohio brook trout into other tributaries throughout the Silver Creek watershed. (contact: Vince LaConte, ODNR, Wildlife District Three Office, Akron). This project is being supported by the Geauga County Park District, Cleveland Museum of Natural History Trout Club, and private landowners. ODNR is also using two small unnamed tributaries to Dewdale Creek (confluence with Chagrin River at RM 42.55) for the brook trout reintroduction efforts. Genetic testing is also being conducted to confirm that the brook trout found are a unique native strain.

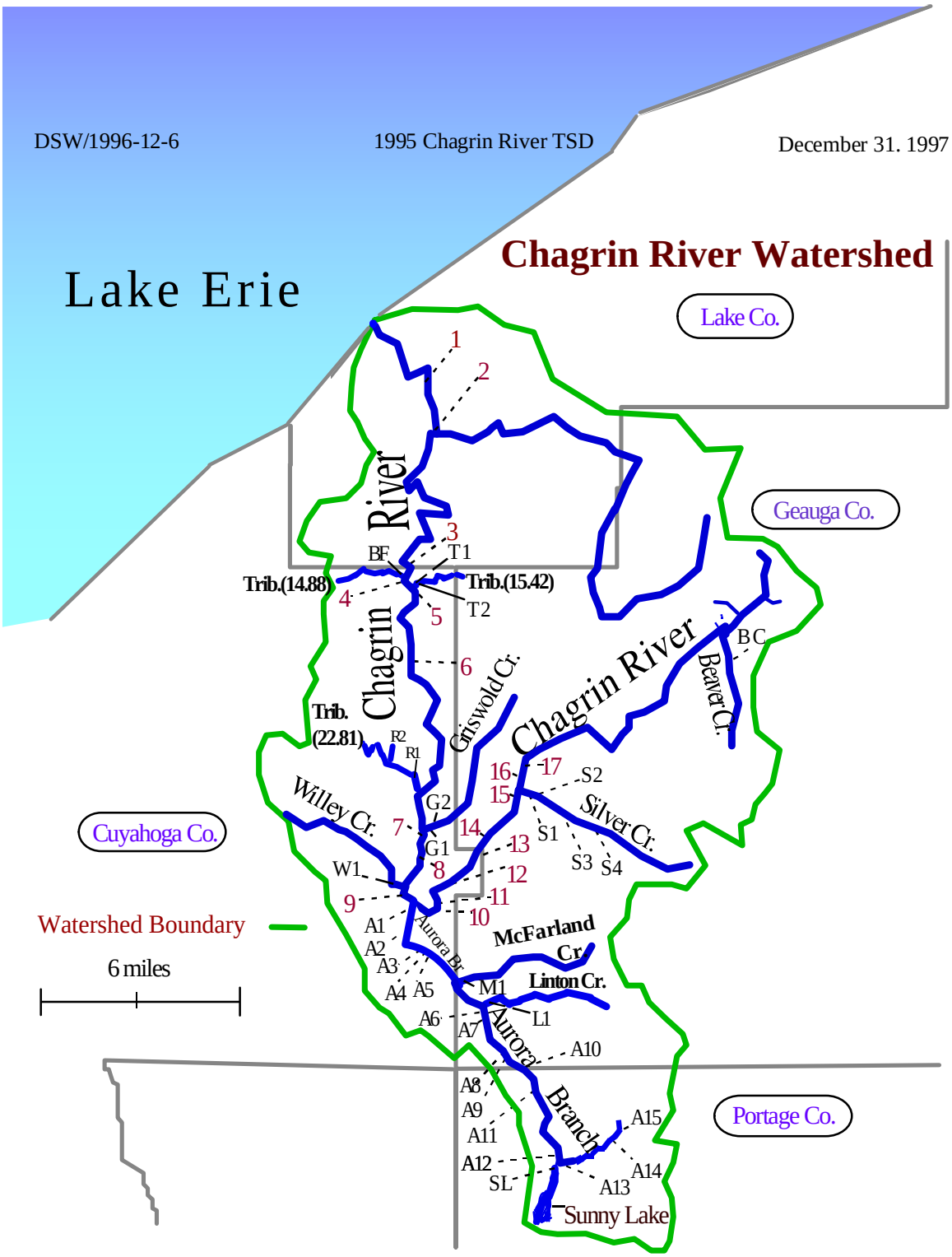
Table 5. Sampling locations (effluent sample -E; conventional water chemistry -C, fecal coliform bacteria -FC; organic water chemistry -CO; sediment metals chemistry -S; sediment organics -SO; datasonde -D; macroinvertebrates -B; and fish -F) in Chagrin River study area, 1995. Current designation is in ( ).

Stream RM	Type of Sampling	Latitude/Longitude (Deg., Min., Sec.)	Landmark	Map I.D.[a]	USGS Quad. Map
Chagrin River Mainstem (WWH)					
36.6	B_{ref}	41 29 46/81 20 07	Ust Fairmount Rd.	17	S. Russel
36.55	C,FC	41 29 26/81 20 8.5	Fairmount Rd.	17	S. Russel
36.4	F	41 29 22/81 20 19	Dst. Fairmount Rd.	17	S. Russel
36.2	B_{ref}	41 29 23/81 20 26	Riverview Park dst. SR 306	16	S. Russel
33.4	F_{ref},B_{ref}	41 27 45/81 21 10	Ust. SR 87	15	S. Russel
33.35	C,S,SO,S	41 27 45/81 21 12	St. Rt. 87, Ust. Chagrin Falls	15	S. Russel
30.70	C,FC,S	41 26 30/81 22 44	Ust. Ivex, Dst. first dam	14	Chagrin Falls
30.6	F,B	41 26 19/81 22 42	Ust. Ivex between the lakes	14	Chagrin Falls
30.08	*F,B*	41 26 06/81 23 08	*Ivex acute mixing zone*	*13*	Chagrin Falls
30.07	E	41 26 06/81 23 08	Ivex 001 Effluent	13	Chagrin Falls
30.0	F,B	41 26 03/81 23 15	Dst. Ivex	*13*	Chagrin Falls
29.80	C,FC,S	41 25 56/81 23 23	Dst. Ivex, at City Park	13	Chagrin Falls
28.96	C,FC	41 25 32/81 23 53	Miles Rd., Ust. Chagrin Falls WWTP	12	Chagrin Falls
28.9	F,B	41 25 31/81 23 58	Ust. Miles Rd.	12	Chagrin Falls
28.36	C,D,FC	41 25 12/81 23 53	Just Ust. Chagrin Falls WWTP	11	Chagrin Falls
28.2	B	41 25 09/81 24 03	Adj. Solon Rd., Dst Chagrin Falls WWTP	11	Chagrin Falls
28.0	F	41 25 04/81 24 18	Dst. Chagrin Falls WWTP	10	Chagrin Falls
28.00	C,S	41 25 05/81 24 12	Dst. Chagrin Falls WWTP	10	Chagrin Falls
26.80	C,D,FC	41 25 26/81 25 02	Miles Rd., Dst. Aurora Branch	9	Chagrin Falls
26.7	B	41 25 30/81 25 03	Dst. Miles Rd. in gorge	9	Chagrin Falls
26.5	F	41 25 45/81 25 03	Dst. Miles Rd. in gorge	9	Chagrin Falls
25.5	B	41 26 11/81 24 31	Ust. Chagrin Blvd. (old SR 422)	8	Chagrin Falls
25.30	C,D,FC	41 26 22/81 24 28	Chagrin Blvd., Chagrin Falls	8	Chagrin Falls
24.2	F	41 27 09/81 24 17	Ust.Kinsman Rd.(SR 87)&Griswold Cr.at polo fields	7	Chagrin Falls
20.95	C,D,FC,S	41 29 20/81 23 48	Fairmount Rd., Hunting Valley	6	Chagrin Falls
21.0	B	41 29 16/81 23 47	Ust. Fairmount Rd., Hunting Valley	6	Chagrin Falls
19.4	F	41 30 10/81 24 12	Fairmount Rd adj Chagrin R Rd nr. Cedar Rd	5	Mayfield Hts
13.1	F	41 34 07/81 24 47	Ust. Rogers Rd.	4	Mayfield Hts
13.04	C,D,FC	41 34 11/81 24 47	Rogers Rd.	4	Mayfield Hts
13.0	B	41 34 11/81 24 47	Just dst. Rogers Rd. Bridge	3	Mayfield Hts
12.5	B	41 34 35/81 24 57	Dst. Rogers Rd. at reserve picnic area	3	Mayfield Hts
4.95	C,Q,FC	41 37 51/81 24 13	Ridge Rd., Willoughby	2	Eastlake
4.8	F_{ref}	41 37 54/81 24 10	At Daniels Park	2	Eastlake
4.1	B_{ref}	41 38 28/81 24 07	Todd Field	1	Eastlake
4.0	D,S,SO	41 38 26/81 24 08	Todd Field	1	Eastlake

Stream RM	Type of Sampling	Latitude/Longitude (Deg., Min., Sec.)	Landmark	Map I.D.	USGS Quad. Map
Aurora Branch Chagrin River (WWH)					
17.1	D,B	41 18 32/81 16 43	Near SR 82 E. of Chamberland Dr.	A15	Aurora
16.6	B	41 18 17/81 16 56	Dst. Chamberlain Rd. S. of SR 82	A14	Aurora
14.7	F 1996	41 18 12/81 18 38	Ust. Sunny Lake (qual. only)	A13	Aurora
14.5	F,B 1996	41 18 17/81 18 39	Dst. Sunny Lake trib. (RM 14.61)	A12	Aurora
12.1	F	41 18 58/81 19 44	Ust. SR 82	A11	Aurora
12.00	C,FC	41 19 02/81 19 45	St. Rt. 82, Aurora	A11	Aurora
12.0	B	41 19 03/81 19 48	Dst. SR 82	A11	Aurora
11.30	C,FC	41 19 28/81 20 17	Ust. Aurora Central WWTP	A10	Aurora
11.10	C,FC,S	41 19 31/81 20 09	Dst. Aurora Central WWTP mix-zone	A9	Aurora
11.1	F	41 19 33/81 20 09	Dst. Aurora Central WWTP mix-zone	A9	Aurora
11.0	B	41 19 34/81 20 07	Dst. Aurora Central WWTP mix-zone	A9	Aurora
9.1	B	41 20 36/81 20 32	Ust. SR 306	A8	Aurora
9.0	F	41 20 37/81 20 30	Ust. SR 306	A8	Aurora
9.00	C,D,FC	41 20 37/81 20 32	Ust. St. Rt. 306	A8	Aurora
5.7	B_R	41 22 23/81 22 04	Adj. Geauga Lk. Rd. at 90º bend S. of Field Rd.	A7	Aurora
5.6	F	41 22 25/81 22 04	Ust. Geauga Lk. Rd.	A7	Aurora
5.52	C,D,FC,S	41 22 27/81 22 06	Geauga Lake Rd.	A6	Aurora
3.67	C,D,FC,S	41 23 21/81 23 22	Ust. McFarland Creek WWTP	A5	Chagrin Falls
3.5	F,B	41 23 23/81 23 22	Ust. McFarland Creek WWTP	A4	Chagrin Falls
3.45	*F,B*	*41 23 25/81 23 23*	*McFarland Creek WWTP acute mix-zone*	*A4*	*Chagrn Falls*
3.4	D,F,B	41 23 25/81 23 22	Dst. McFarland WWTP mix-zone	A4	Chagrin Falls
3.30	C,FC,S	41 23 26/81 23 28	Dst. McFarland Creek WWTP	A3	Chagrin Falls
1.6	F,B	41 24 32/81 24 28	Chagrin River Rd. at Holbrook Rd	A2	Chagrin Falls
1.53	C,D,FC	41 24 32/81 24 29	Near Holbrook Rd	A2	Chagrin Falls
0.30	C,D,FC	41 25 08/81 24 46	Chagrin River Rd.	A1	Chagrin Falls
0.30	F,B	41 25 06/81 24 47	Near mouth (ust. old bridge abutment)	A1	Chagrin Falls
Silver Creek (CWH)					
5.07	C,D,FC,S	41 26 51/81 17 17	Music Street	S4	S. Russel
5.0	B	41 26 46/81 17 17	Dst. Music Street	S4	S. Russel
4.0	F	41 27 18/81 18 08	American Society of Metals	S3	S. Russel
3.9	B	41 27 19/81 18 12	American Society of Metals	S3	S. Russel
1.9	B	41 27 44/81 19 41	Dst. removed dam & ust. SR 87 (south)	S2	S. Russel
1.7	F	41 27 47/81 19 57	Dst. SR 87 (north of road)	S2	S. Russel
0.54	C,D,FC	41 28 11/81 20 36	Hitching Post Lane	S1	S. Russel
0.5	F,B	41 28 11/81 20 41	Dst. SR 306	S1	S. Russel

Stream RM	Type of Sampling	Latitude/Longitude (Deg., Min., Sec.)	Landmark	Map I.D.	USGS Quad. Map
Unnamed Trib. to Chagrin R. (confluence at RM 15.42) (ref.) (WWH)					
0.4	F	41 32 40/81 24 29	Chagr R Rd nr Little Church in the Vale	T2	Mayfield Hts.
0.3	B	41 32 42/81 24 41	Chagrin R. Rd. S. of Wilson Mills Rd.	T2	Mayfield Hts.
0.16	C,D,FC,S	41 33 56/81 24 56	South of Wilson Mills Rd.	T1	Mayfield Hts.
Beaver Creek (EWH)					
2.4	B	41 30 54/81 13 21	Ust. Bean Rd.	BC	Chardon
Linton Creek (Undesignated)					
0.1	B	41 22 37/81 22 02	Dst. Geauga Lake Rd.	L1	South Russell
McFarland Creek (EWH)					
0.1	F, B	41 23 13/81 23 08	Near mouth	M1	Chagrin Falls
Trib. to Aurora Branch (Sunny Lake) (confluence at RM 14.61/0.61) (1996) (Undesignated)					
0.1	F,B 1996	41 18 12/81 18 39	Near mouth	SL	Aurora
Willey Creek (EWH)					
0.5	D	41 25 51/81 25 26	Near mouth	W1	Chagrin Falls
0.2	F, B	41 25 52/81 25 04	Near mouth	W1	Chagrin Falls
Griswold Creek (EWH)					
0.7	F	41 27 33/81 23 41	Dst. SR 87	G2	Chagrin Falls
0.6	D	27 30 01/81 23 36	Dst. SR 87	G2	Chagrin Falls
0.1	B	41 27 22/81 24 11	Near mouth	G1	Chagrin Falls
Unnamed Trib. to Chagrin R. (confluence at RM 22.81) Woodland Glen (Undesignated)					
0.4	D	41 28 30/81 24 53	At Rankin Estates near mouth	R1	Chagrin Falls
0.3	F	41 28 32/81 24 43	At Rankin Estates near mouth	R1	Chagrin Falls
0.2	B	41 28 16/81 24 38	At Rankin Estates near mouth	R1	Chagrin Falls
U.Trib. to U. Trib. to Chagrin R. (confl. at RM 22.81/2.17) Woodland Glen (Undesignated)					
0.1	B	41 28 02/81 25 52	Dst. of Woodland Glen WWTP	R2	Chagrin Falls
Unnamed Trib. to Chagrin R. (confl. at RM 14.88) Buttermilk Falls Prkwy (Undesignated)					
0.2	F,B	41 33 02/81 25 08	Dst. of unsewered Mayfield Heights	BF	Mayfield Hts.

a - Sample location identification number for sample location map on next page
ref - Biological reference site.



Map 2. Sample sites for the Chagrin River Watershed, 1995-96. Sample site map identification codes are are listed in sample. location table (Table 5).

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 ??.

Determining Use Attainment Status

Use attainment status is a term which describes 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 which include the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), which indicate 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 which are used include the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), based on fish community characteristics, and the Invertebrate Community Index (ICI) which is based on macroinvertebrate community characteristics. The IBI and ICI are multimetric indices patterned after an original IBI described by Karr (1981) and Fausch *et al.* (1984). The ICI was developed by Ohio EPA (1987b) and further described by DeShon (1995). The MIwb is a measure of fish community abundance and diversity using numbers and weight information and is a modification of the original Index of Well-Being originally applied to fish community information from the Wabash River (Gammon 1976; Gammon *et al.* 1981).

Performance expectations for the principal aquatic life uses in the Ohio WQS (Warmwater Habitat [WWH], Exceptional Warmwater Habitat [EWH], and Modified Warmwater Habitat [MWH]) were developed using the regional reference site approach (Hughes *et al.* 1986; Omernik 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 at least fair, and non-attainment if all indices fail to attain or any index indicates poor or very poor performance. Partial and non-attainment indicate that the receiving water is impaired and does not meet the designated use criteria specified by the Ohio WQS.

Biological Integrity Equivalents

The results of each of the biological indices are graphically and individually portrayed in a longitudinal format (*i.e.*, upstream to downstream) by sampling location each of which is demarked by the river mile designation assigned to each site. If results from multiple years are available this method is also used to visually portray changes or trends through time. In addition, the results may be shown on a map of the study area drainage network using a color scheme developed to portray the five narrative ratings used by Ohio EPA (*i.e.*, exceptional, good, fair, poor, and very poor).

A relatively new approach developed by Ohio EPA to visualize the extent to which a particular site or entire river or stream reach is or is not attaining the goals set forth in the Ohio WQS is the use of Biological Integrity Equivalents (BIE). These involve using the information compiled in the use attainment table by summing the available indices at each sampling location and dividing by the total maximum possible for each index as follows:

$$BIE = IBI + MIwb\ (x\ 5^{a}) + ICI \div 180^{b} \times 100$$

[a] index value multiplied times 5 to normalize with IBI and ICI.
[b] divisor changes to 120 for two indices, 60 for one index.

The BIE value is expressed numerically as a percentage equivalent and graphed longitudinally. This allows the numerical vizualization of the use attainment table on a standardized theoretical scale of 0 to 100. Different symbols can be used to indicate full attainment, nonsignificant departures from the numerical biocriteria, partial attainment, and non-attainment.

Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the metrics used to determine the QHEI score which generally ranges from 20 to 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 Chagrin River study area, the median tolerance value of all organisms from a site resulted in a score termed the Qualitative Community Tolerance Value (QCTV). The QCTV shows potential as a method to supplement existing assessment methods using the natural substrate collections. Use of the QCTV in evaluating sites in the Chagrin River study area was restricted to relative comparisons between sites and was not unilaterally used to interpret quality of the sites or aquatic life use attainment status.

Fish Community Assessment
Fish were sampled using wading 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 not used. The mainstem Chagrin River was sampled at a frequency of two passes (samples) at each site. There was a minimum of four weeks duration between each sampling pass at a site.

Antidegradation 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 1.). 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 the principal arbiter of aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria in the role of principal arbiter within a weight of evidence framework has been extensively discussed elsewhere (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures (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 with linkages to the biosurvey data being based on previous experience with strata of analogous situations and impacts. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified. The process is similar to making a medical diagnosis in which a doctor relies on multiple lines of evidence concerning patient health. Such diagnoses are based on previous research which experimentally or statistical links symptoms and test results to specific diseases or pathologies. Thus a doctor relies on previous experiences in interpreting symptoms (*i.e.*, multiple lines from test results) to establish a diagnosis, potential causes and/or sources of the malady, a prognosis, and a strategy for alleviating the symptoms of the disease or condition. As in medical science, where the ultimate arbiter of success is the eventual recovery and well-being of the patient, 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) we are here referring to the process for evaluating biological integrity and causes/sources associated with observed impairments, not whether human health and ecosystem health are analogous concepts.

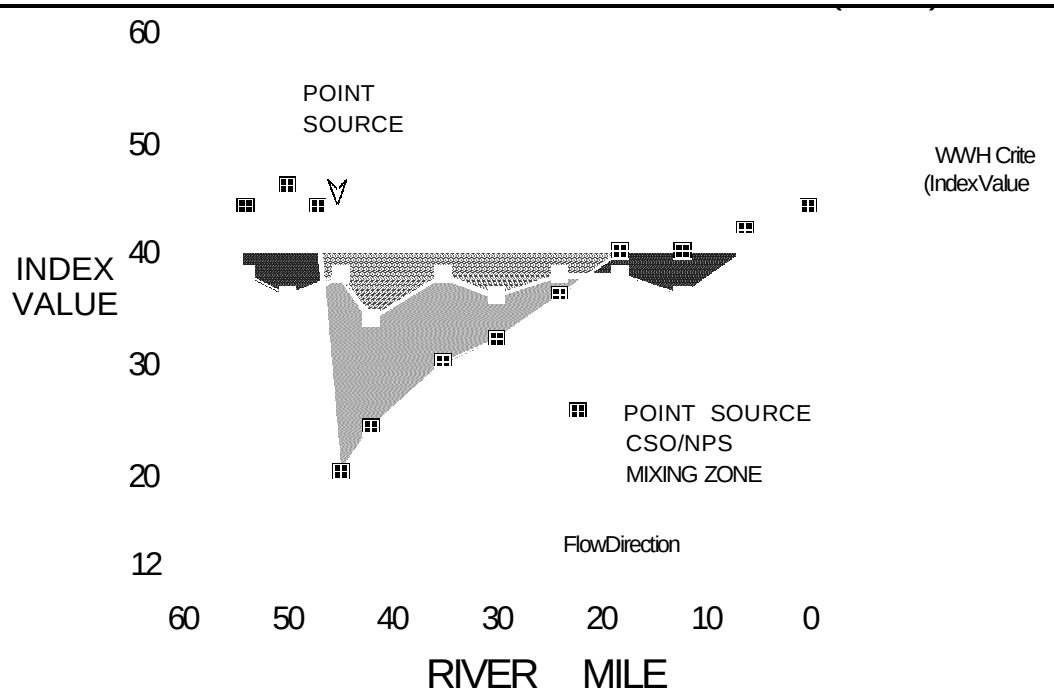


Figure 1. Graphic illustration of the Area of Degradation Value (ADV) based on the ecoregion biocriterion (WWH in this example). The index value trend line indicated by the unfilled boxes and solid shading (area of departure) represents a typical response to a point source impact (mixing zone appears 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: 1976-1995

Aurora Branch Chagrin River (Confluence with Chagrin River at RM 27.09)

Jellystone Park Camp Ground, 3PR00090 (RM 16.79)

- An analysis of self monitoring effluent data from 1992 to 1995 indicates a significant reduction in effluent flow between 1993 and 1994, due to the installation of a continuous flow meter late in 1993 (Figure 2). As a result, loadings of TSS, cBOD5, and ammonia-N were also significantly reduced after the installation of the flow meter. Annual 50th percentile loadings for these parameters during 1994 and 1995 were below permit limits (Figure ???). Fecal coliform numbers were below the primary contact standard of 1000 /100 ml througout this time period. Monthly violations of NPDES limits were recorded in 1994 for pH, TSS, and ammonia-N, possibly due to the seasonal nature of the influent flow.

Rockin Robin Mobile Home Park WWTP, 3PV00058 (RM 16.97)

- The Rockin Robin Association MHP WWTP is a tertiary extended aeration plant that serves about 648 people on a yearly basis. The design flow is 0.066 mgd. Current treatment includes aeration, flow equalization, dosing, slow sand filters, chlorine disinfection, dechlorination, and sludge holding. The effluent discharges to an unnamed tributary of the Aurora Branch of the Chagrin River. The NPDES permit expires on April 27, 1997. Current average NPDES permit limits are cBOD5 (10 mg/l; 2.5 kg/day); TSS (12 mg/l; 3.0 kg/day); and summer ammonia-N (2.0 mg/l; 0.5 kg/day).

- An analysis of self monitoring effluent data from 1992 to 1995 indicates stable effluent flow with no long term exceedences of average NPDES loading limits for TSS, cBOD5, and ammonia-N (Figure 3). Average fecal coliforms numbers have been below the 1000/100 ml primary recreational standard. A June 21, 1995 NEDO inspection found the WWTP was producing a good quality effluent; no recent NPDES violations were noted.

Lamson and Sessions, Aurora Plant (aka Carlon Products), 3IF00024 (RM 16.8/0.15)

- The Lamson and Sessions, Aurora Plant (a.k.a. Carlon Products) is a manufacturer of rigid PVC conduit, flexible PVC conduit, PVC piping and PVC compound. Processes include compounding and extrusion. Well water is used for both non-contact and contact cooling. Cooling water is discharged untreated to an unnamed tributary of the Aurora Branch of the Chagrin River from outfall 001. Sanitary wastewater is discharged after secondary treatment from outfall 002 in the same general location as the 001 discharge. Estimated daily flow is 0.296 mgd from outfall 001 and 0.002 mgd from outfall 002. Outfall 001 also receives flow from storm water runoff, thus an internal monitoring station 602 is used by the entity to monitor oil-grease.

- From January to April 1992 the entity had problems with loadings of BOD, ammonia, and fecal coliform from the 002 sanitary treatment plant. Repairs were made and a new consulting

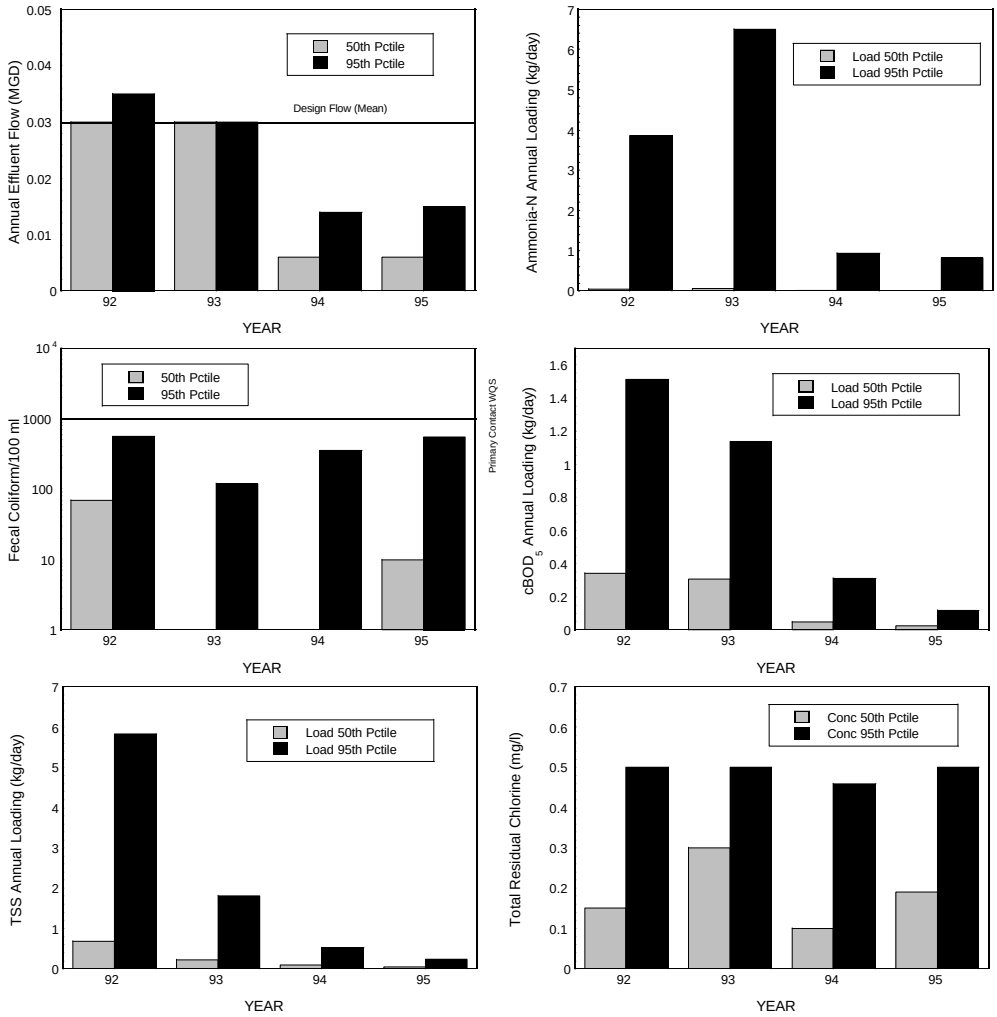


Figure 2. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at Jellystone Park Campground WWTP, (3PR00090) 001 outfall.

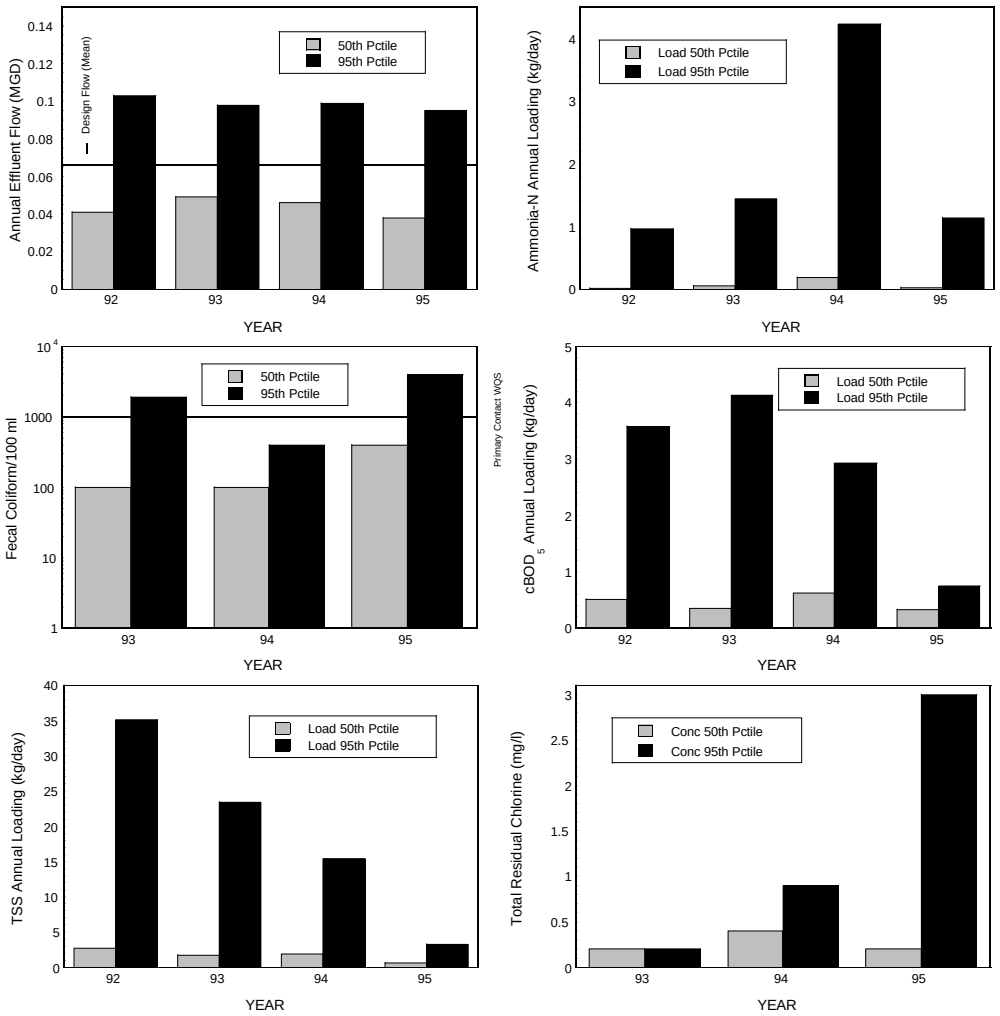


Figure 3. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at Rockin Robin MHP WWTP, (3PV00058) 001 outfall.

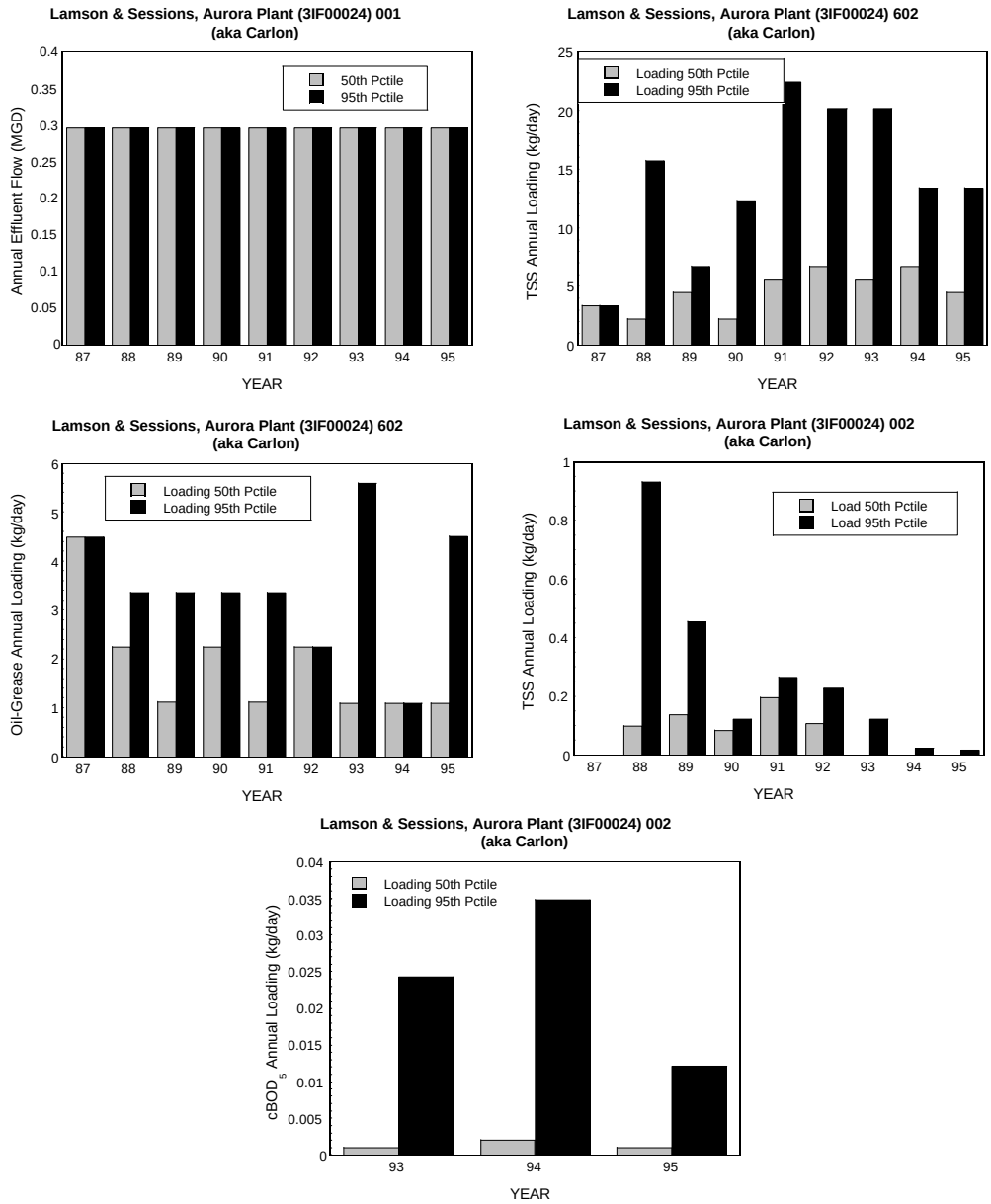


Figure 4. Annual loadings for Flow (001), Total Suspended Solids (602 and 002), Oil and Grease (602), and $cBOD_5$ (002) for Lamson and Sessions (aka Carlon), internal outfall 602 or 001 or 002 outfalls.

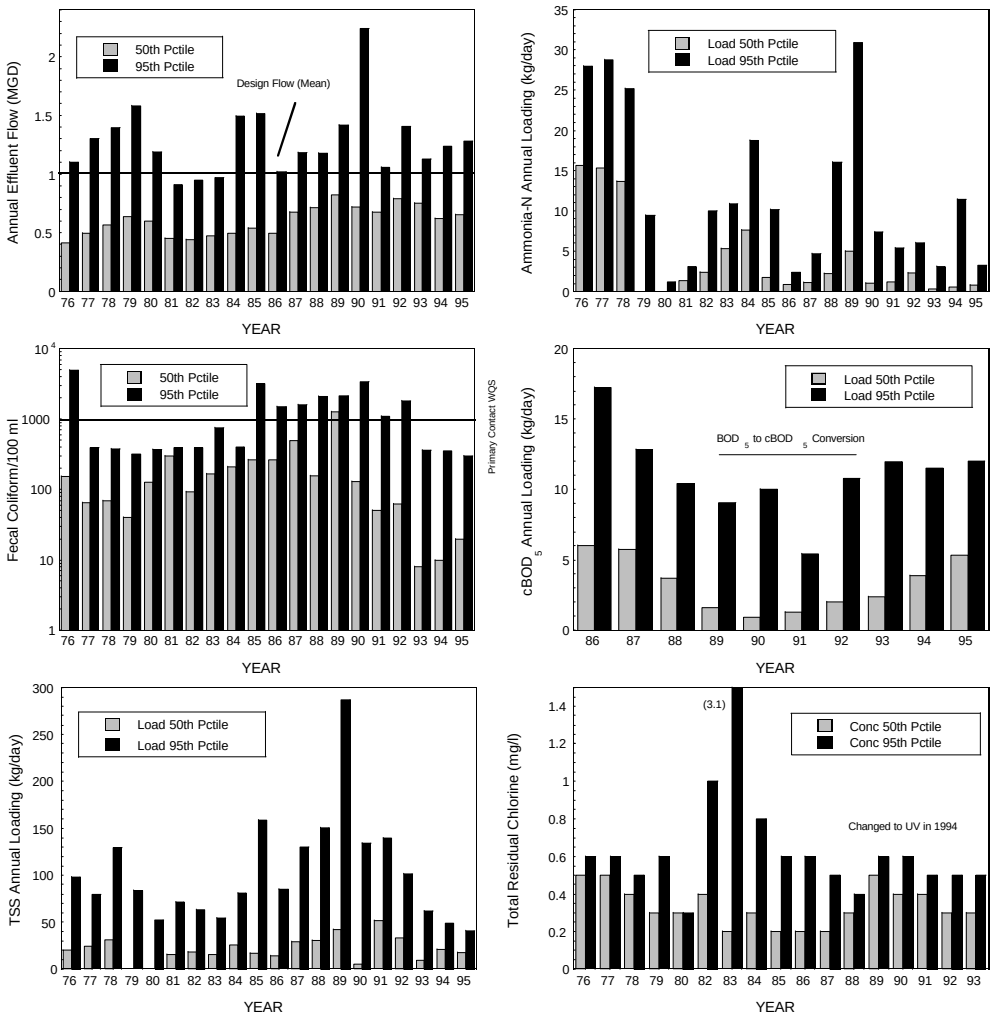


Figure 5. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at the Aurora Central WWTP (3PC00016) 001 outfall.

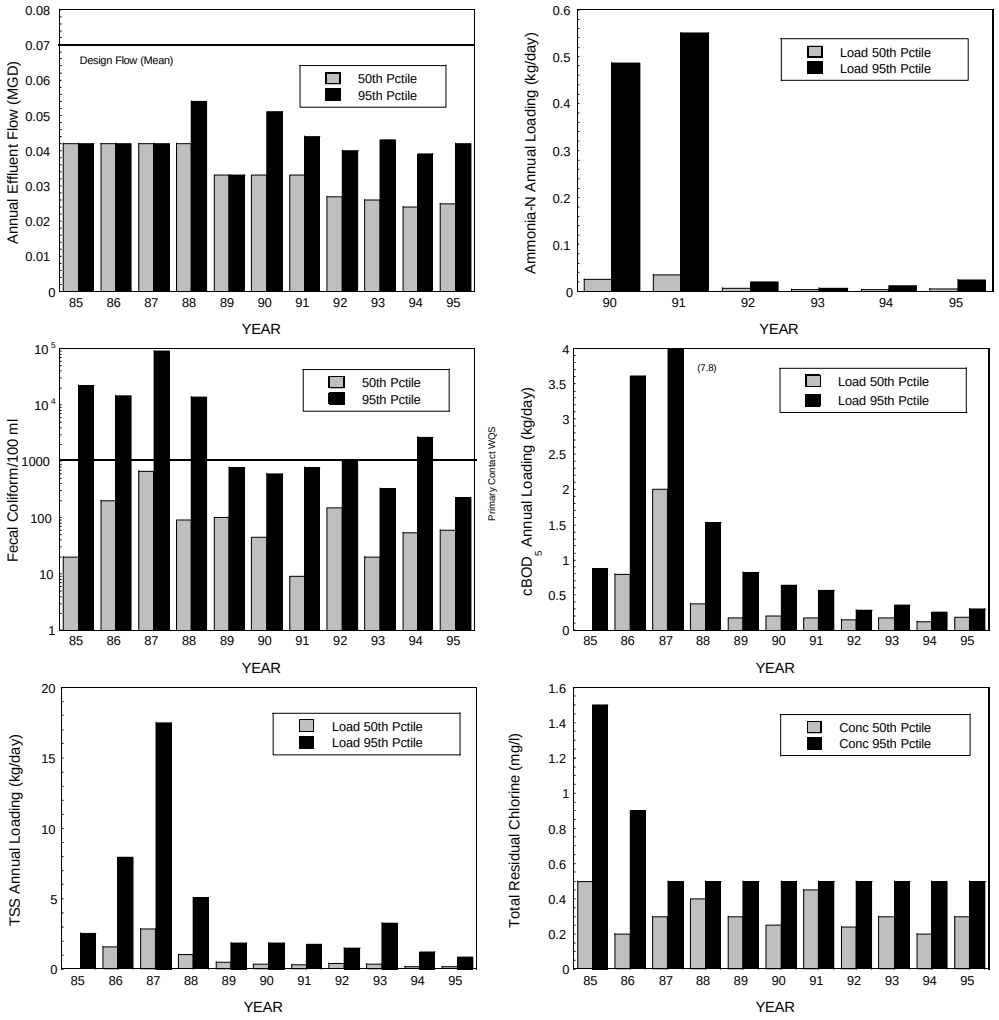


Figure 6. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at Living Home WWTP, (3PG00101) 001 outfall.

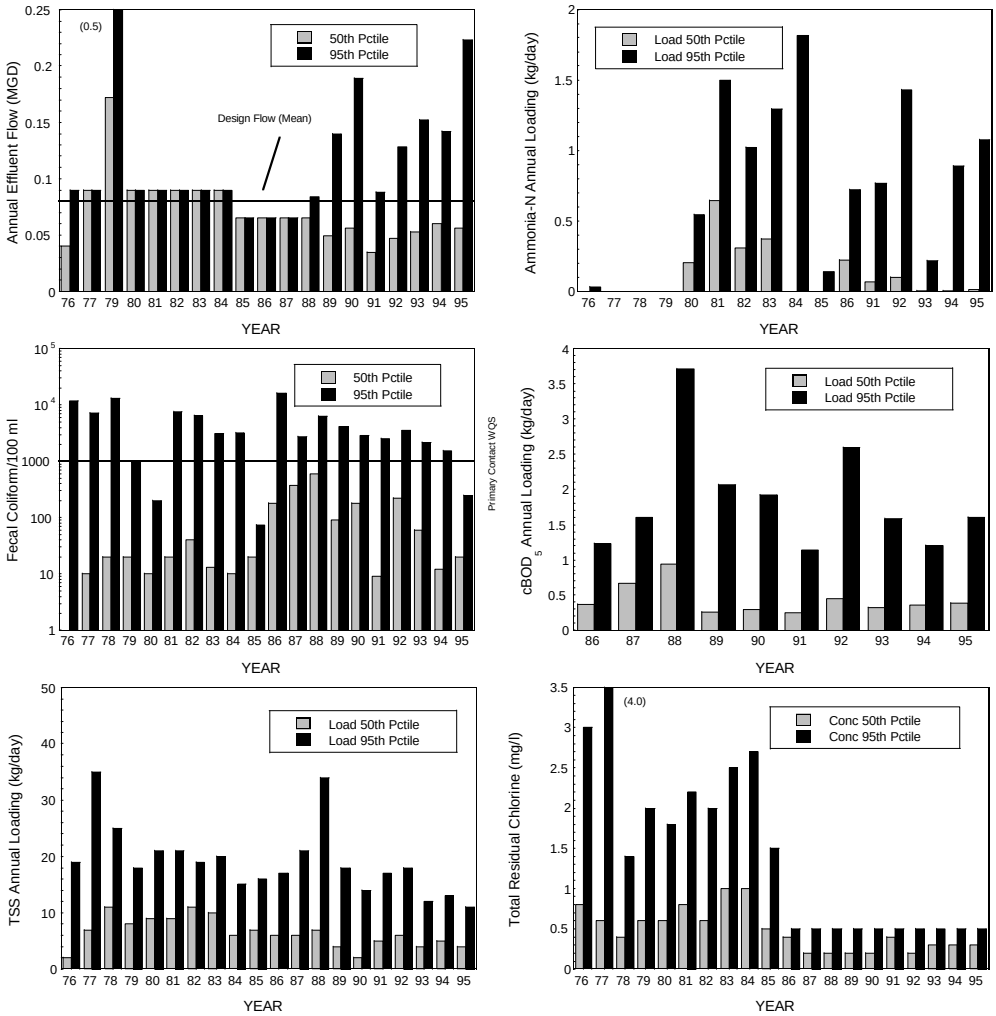


Figure 7. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at Pilgrim Village WWTP, (3PK00010) 001 outfall.

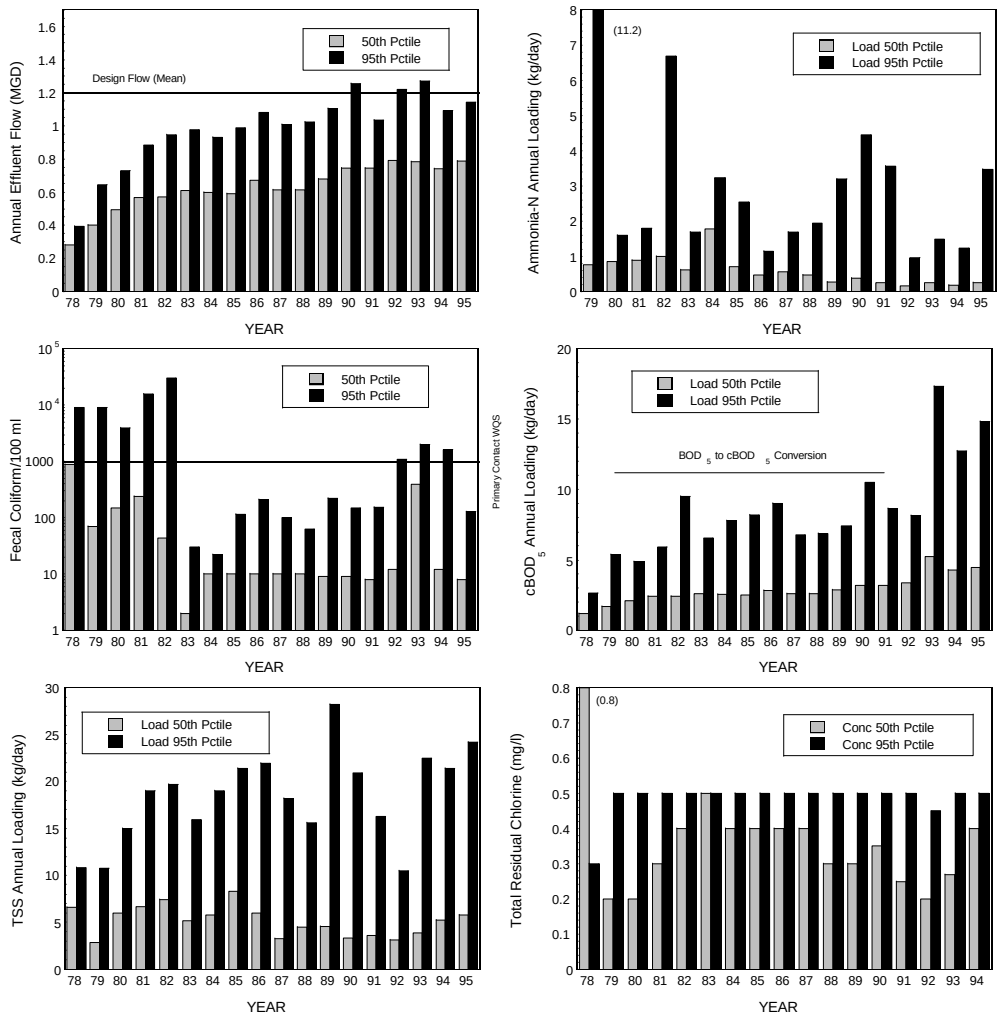


Figure 8. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at McFarland Creek WWTP, (3PK00010) 001 outfall.

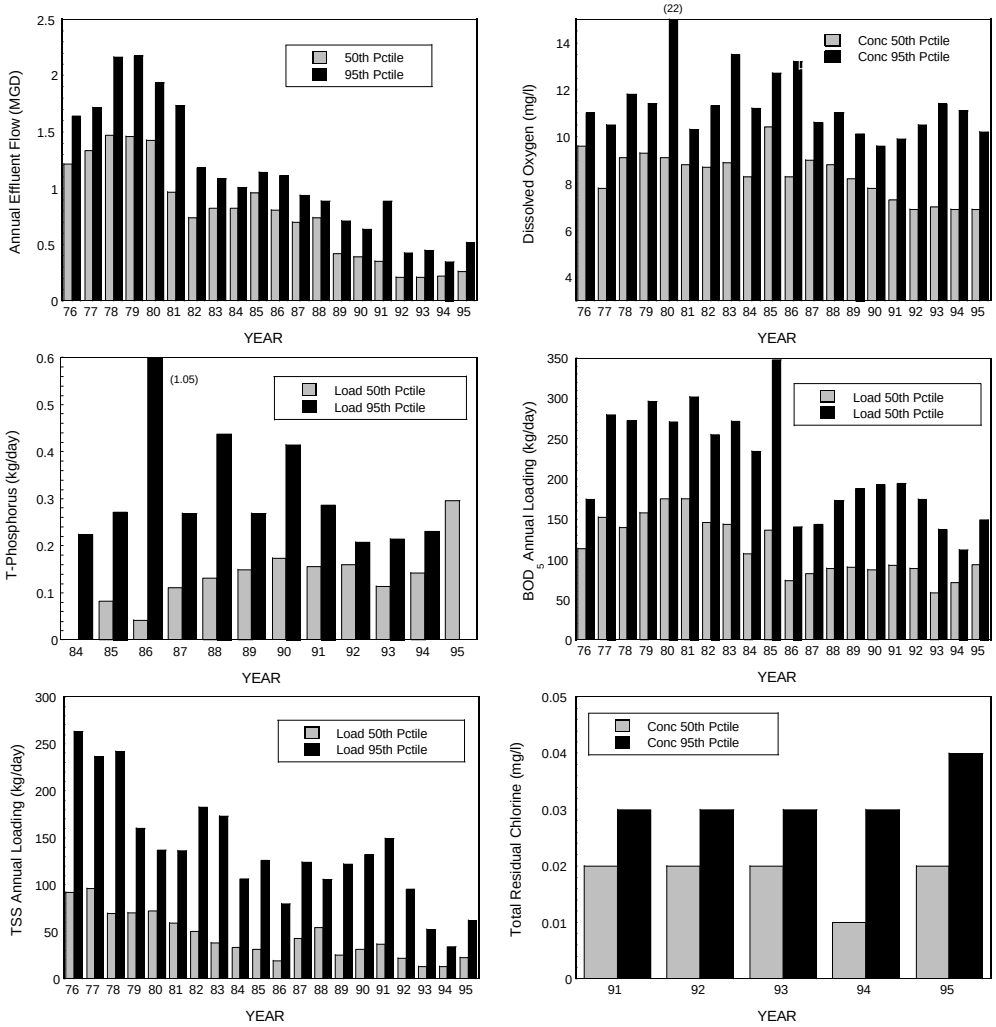


Figure 9. Annual loadings for Flow, Total Phosphorus, Total Suspended Solids (TSS), Dissolved Oxygen, BOD_5, and Total Residual Chlorine at Ivex (3IA00000) 001 outfall.

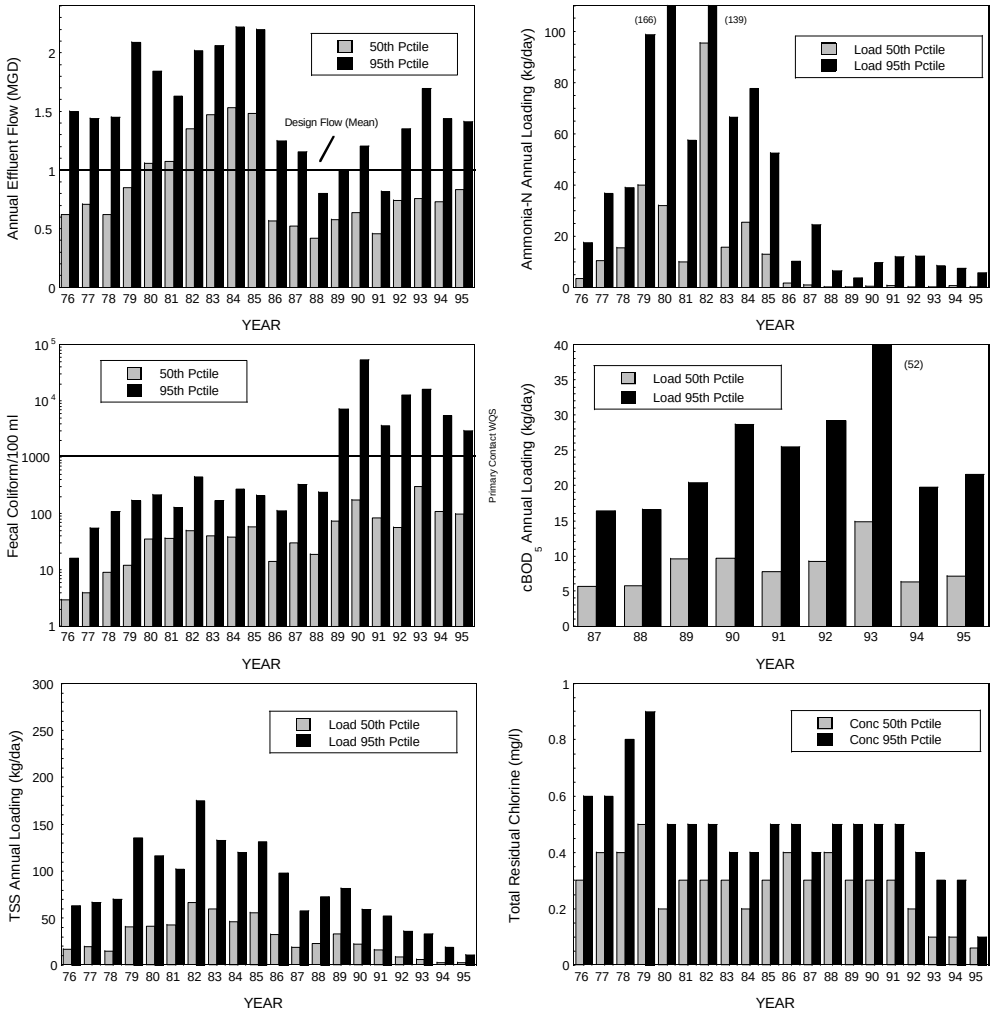


Figure 10. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at the Chagrin Falls WWTP (3PD00038) 001 outfall.

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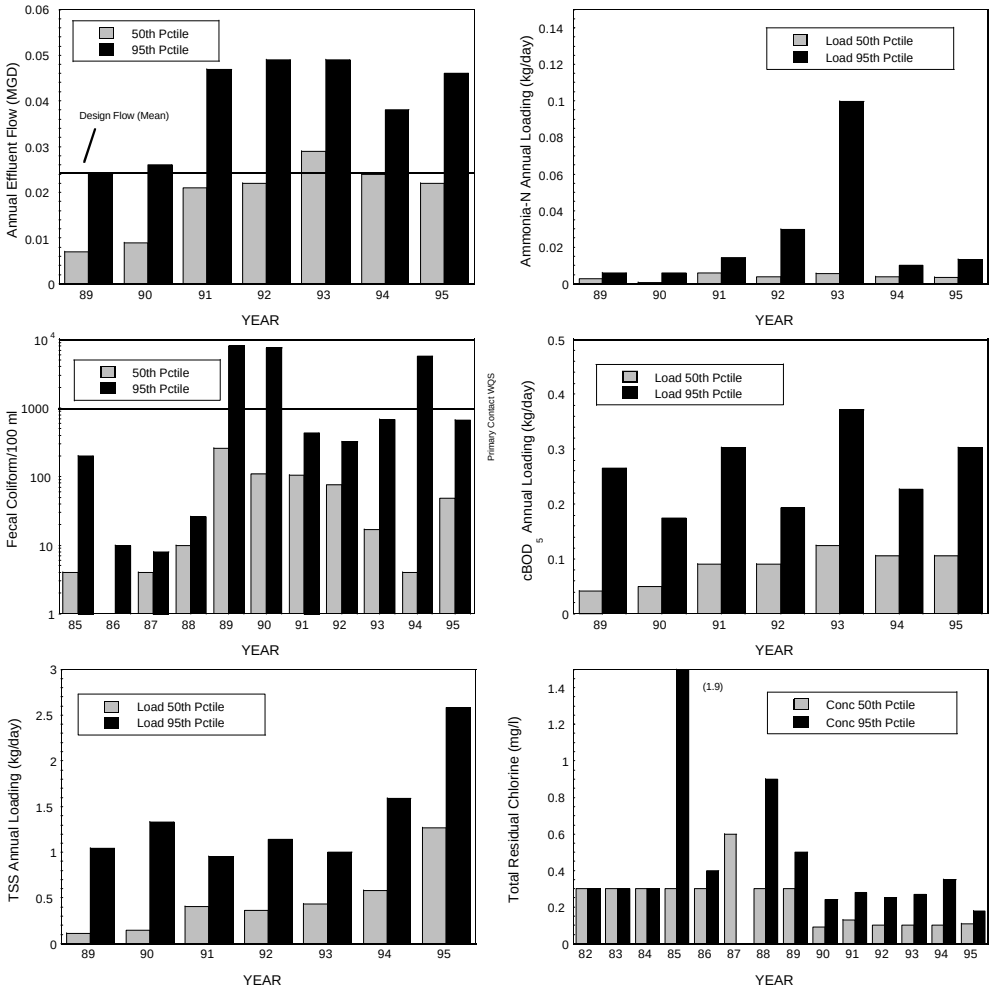


Figure 11. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at the Hickory Hills WWTP (3PG00059) 001 outfall.

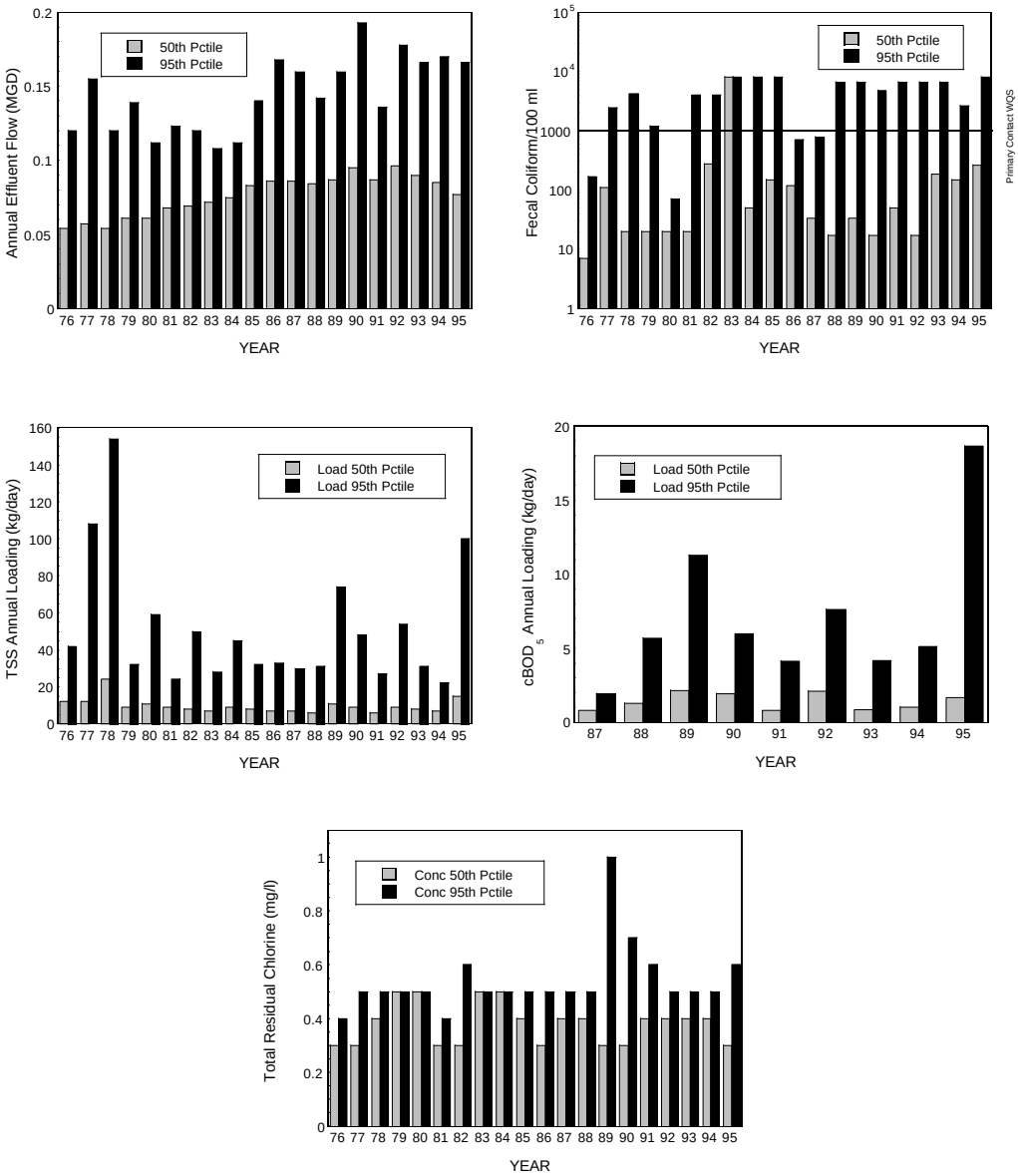


Figure 12. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), $cBOD_5$, and Total Residual Chlorine at Pepper Hill WWTP, (3PG00048) 001 outfall.

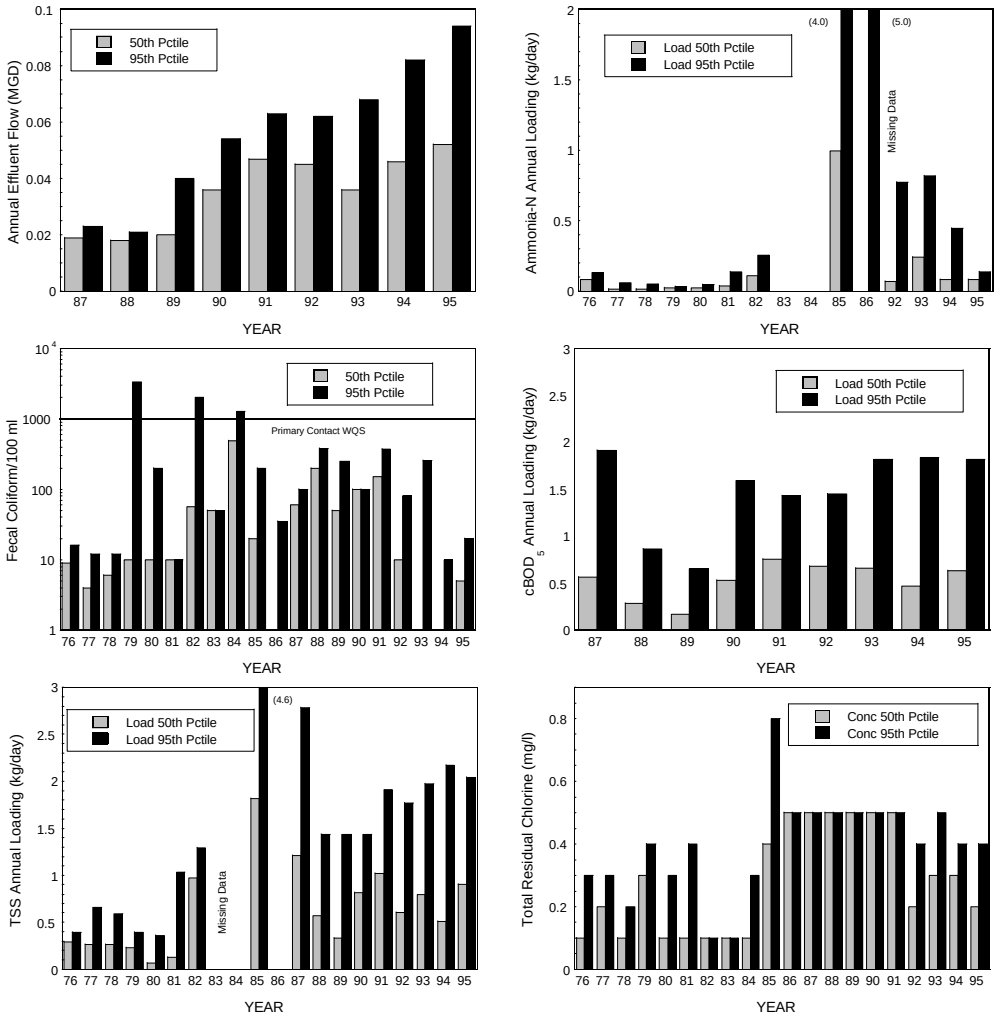


Figure 13. Annual loadings for Flow, Fecal Coliform Bacteria, Total Suspended Solids (TSS), Ammonia-Nitrogen, $cBOD_5$, and Total Residual Chlorine at Woodland Glen WWTP, (3PA00011) 001 outfall.

laboratory was hired to provide operation and monitoring expertise. Loadings of TSS have dropped significantly from outfall 002 since 1992, perhaps due to increased attention to routine operation (Figure 4). Carbonaceous BOD5 ($cBOD_5$) was not monitored prior to 1993.

Aurora Central WWTP, 3PC00016 (RM 11.15)

- The Aurora Central WWTP is a tertiary wastewater treatment plant with grit removal, pre-aeration, flow equalization, contact stabilization, sand filters, post-aeration, sludge holding, and UV disinfection. The current NPDES permit became effective March 1, 1993 and expires February 25, 1998. Current (1996) design flow is 1.0 mgd. Current average NPDES permit limits are cBOD5 (10 mg/l; 38 kg/day), TSS (12 mg/l; 45 kg/day), ammonia-N (2.0 mg/l; 7.6 kg/day), total phosphorus (1.0 mg/l; 3.8 kg/day). An analysis of long term self monitoring data (Figure 5) indicates no violations of annual loadings and relatively constant loadings, with a trend towards increased average effluent flow. Fecal coliform bacteria numbers have on the average remained below the 1000/100 ml standard except for 1989.
- The city of Aurora was referred to the Ohio Attorney Generals Office on June 18, 1991 for violations of their NPDES permit limits. Although some rehabilitation was conducted by the city, this AGO enforcement action was pending as of January 1996; overflows of raw sewage at the inflow grit auger (5 incidents were reported in 1995 for a total of 117.5 hours) continue to result in violations of the current NPDES permit. The city has proposed to upgrade the Aurora Central WWTP to eliminate the grit auger overflows and to eliminate problems of meeting current ammonia-N NPDES limits. The new Aurora Central WWTP will have a design flow of 1.5 mgd and will include replacing the contact stabilization system with an oxidation ditch, final settling tanks, aerobic digester, and an expanded flow equalization basin. Final approval to begin construction was granted by the Ohio EPA in 1995. The upgraded plant is expected to be operational by April 1, 1998.

- An analysis of self-monitoring data from 1991 to 1995 indicates NPDES violations at outfall 001 for dissolved oxygen (1992, 4 months); total phosphorus (1993, 2 months); TSS (1993, 1 month); ammonia-N (1993, 1 month; 1994, 5 months); and pH (1995, 1 month). Five overflows of raw sewage at the grit auger for a total of 117.5 hours were reported in 1995; and five overflows for a total of 163 hours were reported in 1994. From June 1992 to May 1993 twenty-seven (27) overflows at the grit chamber were reported. These overflows discharged raw sewage to the Aurora Branch Chagrin River immediately upstream from the outfall 001 discharge which is at RM 11.15.

- On August 28, 1995 Ohio EPA personnel discovered a broken influent line that was discharging untreated sewage to a small tributary stream less than 1000 feet upstream from the Central WWTP 001 outfall. The duration of the raw sewage discharge is unknown, but entity self monitoring data for fecal bacteria collected from the stream above the 001 discharge indicates much higher fecal levels in June 1995 than in May (3 times higher). Thus it is possible that the raw sewage was being discharged for 3-4 months prior to the August 28th discovery. Immediate corrective actions were taken by the city, including the removal of sewage sludge from the small tributary. A visit to the stream in October 1995 indicated significant improvement in the visual quality of the small tributary.

- Bioassay data on potential toxicity of the 001 outfall was collected by the city during May 1993, August 1993, and February 1994. The data indicate variable toxicity to both fish (*Pimephales*) and *Ceriodaphnia*. The May 1993 bioassay tests showed chronic toxicity effects to fish (NOEC = 45% effluent; CTU = 1.5 TUC). Of interest is the fact that the upstream bioassay test showed effects on both fish (30% affected) and daphnia (20 % affected). The mix-zone far field showed 100% affected for fish, and 10% for daphnia. The August 1993 bioassay tests also showed chronic toxicity effects on fish (100% toxicity for all effluent dilutions). The February 1994 bioassay tests showed chronic toxicity effects for daphnia (NOEC = 45% effluent), but no effects on fish. The upstream bioassay showed 100% toxicity effects on daphnia, but only 15% effects on fish. These tests indicate the presence of some upstream source of toxicity, which is unknown, but may be related to the broken influent line discovered in August of 1995.

Living Homes WWTP, 3PG00101 (RM 5.27, 1.71)

- The Living Homes WWTP is a tertiary plant built in 1976 that serves about 150 residential homes. The plant has an average design flow of 0.07 mgd. Treatment systems include grit removal, extended aeration, clarification, rapid sand filter, chlorine disinfection, and sludge holding. The plant is operated by the office of the Geauga County Water Resources Department. The discharge is to an unnamed tributary of the Aurora Branch Chagrin River, known locally as “Linton Creek”. Linton Creek empties into the Aurora Branch at RM 5.27. Average NPDES permit limits are cBOD5 (10 mg/l, 2.6 kg/day); TSS (12 mg/l, 3.2 kg/day), and summer ammonia-N (2.2 mg/l; 0.58 kg/day). The current NPDES permit was issued October 1, 1995 and expires September 27, 2000.

- An analysis of self monitoring data shows little change in loadings of pollutants over the past five years, with no exceedences of annual permit loadings (Figure 6). Only one monthly violation of TSS was recorded between May 1993 and September 1994.

Pilgrim Village WWTP, 3PG00012 (RM 5.27, 2.02, 0.63)

- The Pilgrim Village WWTP is a tertiary wastewater treatment works with a design flow of 0.08 mgd. It discharges to an unnamed tributary of Linton Creek, known locally as “Taylor Creek”. Treatment processes include trash trap, extended aeration, clarification, rapid sand filter, chlorine disinfection, and sludge holding. Current average NPDES permit limits are; cBOD 5 (10 mg/l, 3.0 kg/day), TSS (12 mg/l, 3.6 kg/day), and summer ammonia-N (1.5 mg/l, 0.45 kg/day). The plant is operated by the Geauga County Water Resources Department office.

- An analysis of self monitoring data from 1993 to 1995 indicates NPDES violations for TSS, cBOD5, dissolved oxygen, and numerous exceedences of average design flow. Relatively constant loadings of pollutants have been reported over time (Figure 7). TSS average loadings have consistently been above the 3.6 kg/day permit limit). These data agree with visual observations by Ohio EPA inspectors of significant deposition of sewage sludge in Taylor Creek downstream from the WWTP 001 outfall. A 11/29/94 inspection of the WWTP indicated problems with floating solids and solids being discharged to the stream. The tertiary filters were inoperable at the time of the inspection.

- Ohio EPA NE district office has been informed by the Geauga County Water Resources

Department office that they plan to eliminate the Pilgrim Village WWTP in the near future (before 1998) and have the sewage diverted to the McFarland Creek WWTP.

McFarland Creek WWTP, 3PK00010 (RM 3.73)

- The McFarland Creek WWTP is a tertiary wastewater treatment works with a design capacity of 1.2 mgd. Processes include bar screen, grit removal, extended aeration, clarification, rapid sand filters, chlorination (prior to April 1995)/UV disinfection (after April 1995), and post-aeration. Sludge is aerobically digested and routed to a sludge press and sludge storage pad. Dried sludge is land applied. The collection system is 100% separate and the influent is primarily residential. The current NPDES permit expired October 1, 1996. Current average NPDES permit limits are: cBOD5 (8 mg/l; 36 kg/day), TSS (8 mg/l, 36 kg/day), and ammonia-N (1.5 mg/l, 6.8 kg/day), total phosphorus (1.0 mg/l, 4.6 kg/day). Numerical limits are also present for total cadmium, total copper, total mercury, and fecal coliform bacteria. The WWTP is operated by the Geauga County Water Resources Department office.

- A review of self monitoring data indicates NPDES violations from 1991 to 1995 for a number of parameters including cBOD5, pH, dissolved oxygen, phosphorus, ammonia-N, cadmium, zinc, mercury, and fecal coliforms. Long-term self monitoring data indicates relatively stable loading of pollutants over time, with a slight increase in cBOD5 loadings since 1993 (Figure 8). Loadings of cBOD5, TSS, and ammonia-N were well below NPDES limits over time. Prior to removal of chorine in April 1995, the concentrations of chlorine in the stream below the discharge may have resulted in near field instream toxic effects. Ohio EPA personnel observed evidence of chlorine toxicity as shown by a lack of green algae growing in the 001 mix-zone.

- A review of bioassay tests conducted by the Ohio EPA in January and September 1990, November 1994, and August 1995 indicated no acute toxicity to either fish or *Ceriodaphnia* during any of these tests.

Chagrin River Mainstem

Ivex Paper Mill Corporation (a.k.a. Chase Bag), 3IA00000 (RM 30.09)

- Ivex is a manufacturer of natural and bleached kraft paper and has one existing discharge, outfall 001. The current design flow for the wastewater treatment plant is 0.250 mgd. The NPDES permit expired April 1, 1997. Current waste treatment from water that leaves the recirculation system involves sedimentation-clarification before discharge to the Chagrin River. Paper pulp sludge produced during clarification is filtered and the dry sludge is sent to a landfill.

- Analysis of long term trends from self monitoring data in Figure 9 shows a reduction in effluent flow from 1986 to 1995, but no significant reduction in BOD_5 and phosphorus loadings to the stream. TSS loadings have been slightly reduced from 1993 to 1995. Dissolved oxygen concentrations have fallen over time, which indicates the potential for increased stress on downstream biological communities.

- The following is a summary of NPDES violations documented for Ivex outfall 001 between 1990 and 1995:

YEAR	MONTH	Total #	VIOLATION: Parameter (Values)
1990	July	1	BOD_5 (306 kg/day) ▲
1991	July	1	BOD_5 (121.8 kg/day)
	July	3	BOD_5 (291, 265, 330 kg/day) ▲
	October	1	BOD_5 (149 kg/day)
1992	April	1	BOD_5 (114.099 kg/day)
	May	1	BOD_5 (116.9 kg/day)
	May	1	BOD_5 (227.8 kg/day) ▲
	August	1	BOD_5 (116 kg/day)
1995	May	3	BOD_5 (1291, 1213, 1209 mg/l) ▲▲
	May	3	BOD_5 (586.4, 826.4, 1052.5 kg/day) ▲
	May	1	BOD_5 (240.3 kg/day)
	May	1	BOD_5 (340 mg/l)

▲ Violated NPDES permit for daily loading limit of 227.0 kg/day.
Violated NPDES permit limit for 30-day loading average of 114.0 kg/day.

▲▲ Violated NPDES permit limit for daily cocentration of 240 mg/l.
Violated NPDES permit limit for 30-day average concentration of 120 mg/l.

- The following is a summary of compliance issues for Ivex since 1990:

March 1990: complaint received by Ohio EPA alleging that Ivex discharges directly to the river at night. OEPA sampled river at Mill St. and dam pool at Main St. Floc observed on rocks at Mill St., dam pool had 0.05 mg/l chlorine.
December 1990: CSI conducted by Ohio EPA. Acute toxicity to *Ceriodaphnia* detected in one grab sample.
April 1991: CSI conducted by Ohio EPA. Acute toxicity detected in all effluent samples to both *Ceriodaphnia* and fathead minnows. *Ceriodaphnia* LC_{50}=38.7% and EC_{50}=27.8%.

December 1991: Findings and Orders issued requiring bimonthly bioassay testing. If 4 consecutive tests showed no toxicity, testing could be discontinued. If toxicity was found then a toxics reduction evaluation would need to be performed. A 1991 review of biomonitoring data indicated that acute toxicity could be a problem. Tests results submitted by the company exceeded acute toxicity limits for both *Daphnia* and fathead minnows (1 out of 5 tests). USEPA bioassay conducted in 1987 also showed acute toxicity for both species. Test results submitted by the company showed no acute toxicity. Additional permit limits for company to be delayed until after intensive survey and WQBEL's could be done.
March 1993: Meeting held at NEDO to discuss conceptual plans for upgrade of the Ivex treatment system.
June 1993: Inspection: oil sheen noted on clarifier. Problems noted with analytical techniques for residual chlorine and phenols. Inspection report notes that plant is scheduled to reopen on June 28, 1993.
July 1993: Complaint received by the Ohio EPA alleging that Ivex is pumping sludge directly to the river.
March 1994: Inspection: oil sheen noted on clarifier. Problems noted regarding analytical techniques for TRC and phenol.
April 1994: NPDES renewal application submitted.
August 1994: Draft NPDES permit renewal public noticed. August 13, 1994 Upper mill pond dam breaks.
September 1994: draft comments submitted by Ivex re: draft permit. Company requests relief from BOD loading limits when river exceeds 150 cfs flow, higher concentration limits if and when company ties in most of their flow to the Village WWTP, reduced metals monitoring frequencies, and the option within the compliance schedule to submit documentation that the facility has tied into the Village WWTP in lieu of submitting a PTI for upgrade of the treatment plant. Consultant submits update to Ohio EPA regarding actions taken in response to the dam break.

October 1994: Ivex submits summary of options available for remediating the problems associated with the dam break. Company indicates that the Village is interested in taking over the property and that the dam may be rebuilt. Company indicates that they will seek approval for temporary sediment control measures.
November 1994: DMR-QA study finds TRC and acute bioassay analyses not within acceptable limits. NPDES renewal becomes effective. Final limit applicable in 27 months. Provisions: BOD conc limits reduced to 10 mg/l (30d avg.) and 70 mg/l (daily max.). BOD loading reduced to 9.5 kg/d (30d avg.) and 99.5 kg/d (daily max.). TSS limits decreased to 30 mg/l (30d avg.) and 45 mg/l (daily max). Acute and chronic bioassay testing requirements added to the permit. Interim permit limits in effect for 24 months. PTI for upgrade of facility or documentation that the plant is tied into the POTW due within 12 months. CSI conducted by the Ohio EPA. No acute toxicity observed in effluent samples.
December 1994: inspection report from November CAI. Continuing problem with TRY meter, new one to be purchased. Lower mill pond was noted as being very turbid due to the erosion of the sediments from the upper pond. No erosion control measures had been implemented. Letter threatens enforcement action unless measures are taken to prevent erosion.
January 1995: Ivex notifies Ohio EPA of plans to install air diffuser into the effluent tank.
June1995: CAI conducted by Ohio EPA. Effluent acutely toxic to fathead minnow but not to *Ceriodaphnia*. Low D.O. concentration was likely cause.
July 1995: Ivex notifies Ohio EPA of plans to install a hydrogen peroxide feed pump next to the clarifier to help reduce odors from the clarifier.
September 1995: Permit To Install (PTI) application for a biological treatment system submitted by Ivex. Plan calls for installation of two Kales moving bed biofilm reactor systems. Units would be installed between the existing pre-treatment and clarification equipment.

October 1995: CEI conducted. Effluent murky due to a failing polymer pump. Pilot plant being used to determine sizing for new treatment equipment. PTI for the addition of biological treatment equipment approved (10-19-95).

- In 1997 the treatment system was upgraded to include biological treatment and dissolved air floatation. These changes were made to meet permit-mandated lowering of effluent limits from TSS = 137 mg/l and BOD = 120 mg/l to TSS = 30 mg/l and BOD = 10 mg/l.

- Ivex's permit is now up for renewal. They have requested an expansion to 0.35 mgd from 0.25 mgd. Ivex wants to demonstrate a 5% deminimus increase in concentration for this permit which would exempt the socio-economic impact analysis portions of the anti-degradation review. Because this will still be an increase in loading, an anti-degradation review will be conducted.

- Permit limits will also be established for NH_3-N and Heavy metals (Cu, Pb, and Cd). Monitoring will also be required for Hg as per findings of the TSD for sediment metals downstream.

Village of Chagrin Falls WWTP, 3PD00038 (RM 28.43)

- Chagrin Falls WWTP is a tertiary plant with an average design flow of 1.0 mgd. The plant was upgraded in the early 1990s after the Ohio EPA issued Findings and Orders on March 25, 1989 requiring the village to achieve final NPDES permit limits by June 1990. The improvements were completed by April, 1992. Current treatment process include grit removal, flow equalization basin, commutator, primary settling, aeration tanks, rapid sand filter, and chlorine disinfection. Final average NPDES effluent limits include: cBOD5 (10 mg/l, 37.9 kg/day); TSS (12 mg/l, 45.4 kg/day); summer ammonia-N (2.5 mg/l, 9.5 kg/day), and total phosphorus (1.0 mg/l; 3.8 kg/day). The NPDES permit expires August 28, 2000.

- Analysis of self monitoring data indicates only two monthly permit violations since the upgrade in 1992, cBOD5 and total chlorine. The entity reported a high flow bypass that occurred August 13, 1994; 57,000 gallons of untreated sewage was bypassed to the river, the cBOD5 was measured at 13.8 mg/l and TSS was 131.0 mg/l. Long term trends of the self monitoring data shown in Figure 10 indicate reductions in flow, ammonia-N, and TSS since the early 1980s, but a slight increase in fecal coliform numbers.

Hickory Hills WWTP, 3PG00045 (RM 13.50/0.77/0.25)

- The Hickory Hills WWTP is a secondary plant consisting of comminutor, aeration, settling and chlorination. The plant discharges to an unnamed tributary of the Chagrin River whose confluence with the Chagrin R. is at RM 13.5. The plant serves about 64 residential homes and has a design capacity of 0.03 mgd. The plant is operated by the Cuyahoga County Sanitary Engineers Office. The NPDES permit expired September 27, 1992 and the renewal was delayed pending enforcement actions with the Ohio Attorney Generals Office. Detailed plans for converting the WWTP into a pump station with a force main to the NEORSD Easterly WWTP received final Ohio EPA approval on August 18, 1995. The most recent consent order required that the project be completed by July 30, 1996 (was completed and WWTP has been abandoned

since survey).

- A review of self monitoring data since 1990 indicates numerous NPDES violations for TSS and fecal coliform bacteria and exceedences of the 0.03 mgd design flow. TSS loadings have increased over time, well above the 1992 TSS average permit limit of 3.4 kg/day (Figure 11).

Pepper Hill WWTP, 3PG00048 (RM 22.81/5.54)

- The Pepper Hill WWTP is a secondary plant owned by the city of Pepper Pike and operated by the office of the Cuyahoga County Sanitary Engineers. The design flow is 0.094 mgd. The discharge is to the headwaters of an unnamed tributary of the Chagrin River at RM 5.54 whose confluence with the Chagrin R. is at RM 22.81. Treatment processes include comminutor, aeration, settling, scum holding tank, activated sludge, and chlorine disinfection. The current NPDES permit expired September 27, 1992 and has not been renewed pending enforcement actions with the Ohio Attorney Generals office. The plant is under orders to eliminate their discharge and tie into the regional sewers of the NEORSD. Current average NPDES permit limits are: cBOD5 (25 mg/l; 8.9 kg/day) and TSS (30 mg/l; 10.7 kg/day).

- An analysis of self monitoring data indicates stable effluent quality with a slight increase in flow over time (Figure 12). Annual average loadings of TSS were above 30 day average permit limits in 1995. The WWTP has a history of exceeding design flow and numerous violations for TSS, cBOD5, fecal coliform bacteria, and chlorine were recorded in 1994 and 1995.

Creekside WWTP, 3PH00018 (RM 22.81/3.4)

- The Creekside WWTP is a tertiary plant owned by the city of Pepper Pike and operated by the office of the Cuyahoga County Sanitary Engineers. The design flow is 0.350 mgd. The discharge is to an unnamed tributary to the Chagrin River at RM 22.81. Treatment processes include comminutor, grit removal, aeration tanks, clarifier, rapid sand filter, and chlorine disinfection. A dechlorination system was installed in 1996. The current NPDES permit was renewed September 19, 1994.

- The WWTP has a history of problems with inflow and infiltration that result in violations of NPDES permit limits during wet weather. Since 1992 violations have been reported for TSS, cBOD5, fecal coliform bacteria, and chlorine.

Woodland Glen WWTP, 3PA00011 (RM 22.81/2.17/0.34/0.35)

- The Woodland Glen WWTP is a tertiary plant owned by the Village of Moreland Hills. The plant serves about 300 residential homes with a design flow is 0.040 mgd. Discharge is to an unnamed tributary of the Chagrin River whose confluence with the Chagrin River is at RM 22.81. Current average NPDES effluent limts are: cBOD5 (10 mg/l, 1.5 kg/day); TSS (12 mg/l, 1.8 kg/day); summer ammonia-N (6.8 mg/l; 1.03 kg/day). Treatment processes include bar screen, aeration tank, clarifier, rapid sand filter, and chlorine disinfection.

- In 1993 the Ohio EPA approved expansion of the WWTP up to a design flow of 0.157 mgd, but the expansion was never constructed. Detailed plans for expansion to 0.08 mgd were due in

January 1998. Since 1990, the plant has had few NPDES violations. Some dissolved oxygen violations occurred in 1993, and problems with a flow meter were corrected in 1994 (Figure 13).

Jackson Valley WWTP, 3PA00023 (RM 26.31/1.80)

- The Jackson Valley WWTP is a tertiary plant owned by the village of Moreland Hills. Discharge is to Willey Creek at RM 1.8. The plant serves about 152 residential homes and has a design flow of 0.060mgd. The current NPDES permit expired April 27, 1997. Current average NPDES permit limits are: $cBOD_5$ (10 mg/l, 2.3 kg/day); TSS (12 mg/l, 2.7 kg/day), and summer ammonia-N (1.5 mg/l; 0.4 kg/day). Treatment processes include flow equalization basin, extended aeration, slow sand filter, chlorine disinfection. NPDES violations for 1993 includes $cBOD_5$, TSS, and dissolved oxygen.

Greentree WWTP, 3PA00010 (RM 25.77)

- The Greentree WWTP is a tertiary plant owned by the village of Moreland Hills. Discharge is to the Chagrin River at RM 25.77. The plant serves about 24 residential homes and has a design flow of 0.010 mgd. The current NPDES permit expired April 27, 1997. Current average NPDES permit limits are: cBOD5 (10 mg/l, 0.4 kg/day); TSS (12 mg/l, 0.5 kg/day); summer ammonia-N (2.0 mg/l, 0.08 kg/day). Treatment processes include trash trap, aeration, clarifier, media filter, surface sand filter, and chlorine disinfection. Violations of NPDES permit limits in 1993 and 1994 included ammonia-N, cBOD5, and dissolved oxygen. A 1993 letter in the NEDO file indicated that the village was to conduct a study to determine the feasibility of having the WWTP eliminated and the flow pumped to the Chagrin Falls WWTP. Chagrin Falls WWTP is at capacity and cannot accept additional flow. This plant also is to be relocated due to stream bank erosion.

Quail Hollow WWTP, 3PA0009 (RM 23.93/0.86)

- The Quail Hollow WWTP is a tertiary plant owned by the village of Moreland Hills. Discharge is to an unnamed tributary at RM 0.86 whose confluence with the Chagrin R. is at RM 23.93. The plant serves about 56 residential homes with a design flow of 0.020 mgd. The current NPDES permit expired April 27, 1997. Current average NPDES permit limits are: cBOD5 (10 mg/l, 0.76 kg/day); TSS (12 mg/l, 0.9 kg/day); summer ammonia-N (1.9 mg/l, 0.14 kg/day). Treatment processes include trash trap, extended aeration, clarifier, fixed media filter, surface sand filter, and chlorine disinfection. Since 1993 a number of NPDES violations have been reported for TSS, cBOD5, ammonia-N, and fecal coliform bacteria. In a letter dated September 16, 1993 the Ohio EPA approved expansion of the plant to a design flow of 0.042 mgd, with the understanding that the village would eliminate 35 potentially failing home septic systems and have them connected to the Quail Hollow WWTP sanitary sewers. In a letter dated February 18, 1993 the village requested another expansion to a design flow of 0.175 mgd and also requested that the Ohio EPA conduct a study to determine the assimilative capacity of the stream for the additional loading of pollutants.

Funtime, Inc. Geauga Lake Amusement Park WWTP, 3PR00061 (RM 7.2/~0.57)

- The Funtime, Inc. Geauga Lake Amusement Park WWTP is a tertiary plant with rapid sand filters and uv disinfection and an average flow of 0.155 mgd. The plant serves the geauga Lake

Amusement Park an would be expected to have seasonal design difference in flow and pollutant loadings to the Aurora Branch. The discharge is to a roadside ditch, then a railroad ditch, and finally to an unnamed tributary at approximately RM 0.57 that empties into the Aurora Branch Chagrin River at RM 7.2.

- No MOR data for the 1995 survey was available to review since an NPDES permit was not issued until January, 1998. However, a complaint filed in 1996 resulted in a distinct inspection and subsequent effluent sampling in July and August, of 1996. The effluent data from from the 1996 sampling indicated elevated levels of ammonia-N (as high as 12.0 mg/l), total phosphorus (4.0 mg/l), fecal coliform bacteria at 65,000/100 ml, and very low dissolved oxygen (0.6 mg/l). More recent 1997 MOR data from the WWTP indicates continued problems with effluent quality. Ammonia-N concentrations were as high as 40.0 mg/l. BOD_5 was 40 mg/l, and TSS was 50 mg/l. The entity is on a compliance schedule to improve effluent quality and attain final tertiary effluent limits by May, 1998.

Chemical Water Quality

Chagrin River Mainstem

- The USGS maintains a continuous stream flow gage at RM 4.95, about 150 feet downstream from the Daniels Park dam. This station is downstream from the confluence of the East Branch Chagrin River. During the 1995 survey, from June to October, this flow gage was not on line due to lack of matching funds. Historical mean, maximum, and minimum monthly flows at this station for the water years 1925 to 1994 are shown in Table 6.

Table 6. Historical monthly stream discharge (cfs) at the USGS gaging station, Chagrin River mainstem (RM 4.95), 1925 to 1994 water years. Dates correspond to Ohio EPA field sampling season.

1925-1994	June	July	August	September	October
Mean	183	198	491	124	149
Maximum	522	1680	7450	902	482
Minimum	62	55	50	58	65

Grab chemical water samples were collected from the mainstem sampling sites five times from July 13 to September 7 during the 1995 survey. Stream discharges recorded at the U.S.G.S.gage (RM 4.95) on these five sample dates were as follows: 07/13=235 cfs; 07/27=1438 cfs; 08/10=539 cfs; 08/17=439 cfs; and 09/07=155 cfs. These data indicate that the grab water samples were collected under a wide range of stream flows, with only two of the five samples (07/13 and 09/07) collected at average baseflow conditions. This fact complicates the interpretation of data, especially any attempt to compare the data to chronic 30-day average Water Quality Standards criteria. For example, Table 7 shows exceedences of WWH standards for total copper and lead in the July 27th grab sample at RM 4.95; however, the TSS was extremely elevated (937 mg/l). Concentrations of these metals collected under lower stream flow conditions were well below chronic Water Quality Standards (see Appendix Table 2), thus the chemical data do not indicate chemical water quality should have a significant chronic effect on aquatic life. This observation is supported by the 1995 biological data for fish and macroinvertebrate populations in the Chagrin River mainstem, which indicate well balanced communities having IBI, MIwb, and ICI scores above the WWH ecoregion criteria.

Figure 14 shows the association of TSS to total copper, lead, and zinc from monthly grab samples collected in 1995 at the RM 4.95 Chagrin River ambient monitoring station. The graph indicates that the concentrations of these heavy metals do not increase in the range of TSS from 5 to 100 mg/l; this indicates a lack of fine clay particles that could bind the metal ions. Increased metals concentrations at TSS values well above 100 mg/l are more likely due to resuspension of deposited metal ions rather than any association of Heavy metals with clay-silt particles. Lack of clay associated with Chagrin River water is also indicated by the particle size analysis that was conducted on sediment samples. Most sites on the mainstem contained less than 1% clay-silt sized particles (Appendix Table 1).

Figure 15 shows that there is a significant positive association between stream discharge and TSS concentrations at the RM 4.95 Chagrin River ambient station, a trend observed but not quantified due to lack of flow data at the other locations sampled in the Chagrin River basin.

Longitudinal graphs for dissolved oxygen, water hardness, TSS, TDS, COD and nitrate-nitrite nitrogen collected from the mainstem of the Chagrin River are shown in Figure 16. Dissolved oxygen was above 6 mg/l at all locations *except* at RM 29.8 where a minimum dissolved oxygen concentration of 6.0 mg/l was recorded. RM 29.8 is downstream from the Ivex 001 discharge but upstream from the natural bedrock waterfall in Chagrin Falls. Samples collected of the Ivex 001 effluent during the 1995 survey found a minimum D.O. of 4.4 mg/l, and $cBOD_5$ and COD ranged from 65 to 292 mg/l and from 305 to 688 mg/l, respectively. The highest TDS concentrations were also measured in the Ivex effluent with a mean of 712 mg/l (range: 574 - 842 mg/l). High concentrations of total phosphorus (6.05 mg/l) and ammonia-nitrogen (26.7 mg/l) from Ivex outfall 001 effluent were noted on 8/10/95 due to upset conditions. The ammonia concentration was at acutely toxic conditions (USEPA, 1976). These particular TDS components would contribute to BOD indirectly via die-offs after algal production (diurnal D.O. swings). These effluent data indicated that the Ivex 001 discharge was the principal source of oxygen demanding substances in the Chagrin River and contributed to biological impairment.

Total suspended solids were above 40 mg/l on sample dates with high flow. This concentration was between the 75th and 90th percentile for WWH sites in the EOLP ecoregion and exceeded the normal range for TSS in WWH streams. TSS is an indicator of habitat degradation (e.g. increased stormwater, riparian loss, erosion, unstable stream substrates) that contributes to decreased biological diversity. Increasing stormwater runoff and riparian loss would increase TSS and impact biological communities (OEPA, 1996b).

Fecal coliform bacteria data, presented in Figure 17, show a significant difference in the counts of coliforms from samples collected under high flow conditions on July 27th (discharge at USGS gage = 1438 cfs) compared to counts observed on August 8th under much lower stream flow conditions (USGS gage= ~ 530 cfs). Fecal coliform counts were above the 1000/100 ml Primary Contact Recreational criterion at all sample stations on July 27, and below the standard at all stations under the lower stream flow conditions on August 8. These data indicate that nonpoint source runoff of bacteria (e.g., primarily from failing home septic system discharges or in small measure horse livestock activity) is widespread throughout the Chagrin River mainstem, well above point sources and urban area influences in Chagrin Falls and downstream of the confluence with East Branch Chagrin River.

Table 7. Exceedences of Ohio EPA (OAC 3745-1) Warmwater Habitat Criteria detected in the Chagrin River study area during 1995 (units are ug/l for metals, # colonies/100 ml for fecal coliform, and mg/l for all other parameters).

Stream	River Mile	Parameter (value)
Chagrin River Mainstem (WWH, PCR)		
	36.55	F. Coliform (5200)***@
	30.70	F. Coliform (5100)***@
	29.80	F. Coliform (9300)***@
	28.96	F. Coliform (3700)**@
	28.36	F. Coliform (3100)**@
	26.80	F. Coliform (2900)**@; T-Cu (40)#@
	25.30	F. Coliform (1900)*@
	20.95	F. Coliform (1100) *@
	13.04	F. Coliform (1900)*@
	4.95	F. Coliform (13000)***@; T-Cu (33)#@; T-Pb (23)#@
	4.0	*D.O. (4.8)*◊
Aurora Branch Chagrin River (WWH, PCR)		
	16.09	T-Cu (34)#
	11.3	F. Coliform (8900***,7300***,1000*; D.O. (4.8)◊
	11.1	F. Coliform (48000***, 8300***); D.O. (3.8)◊◊
	9.0	F. Coliform (3100)**
	0.3	F. Coliform (1200)*

@ Exceedences on 07/27/95 after rain event and elevated stream flow (1438 cfs at RM 4.95 gage, TSS= 968).
# Concentrations exceed numerical criteria for outside mixing zone 30-day mean.
Concentrations exceeding the numerical criteria for human 30-day average.
◊ 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). *Dissolved oxygen concentrations noted in italics are readings from datasonde continuous monitors.*
* Data exceed the average Primary Contact Recreation criterion for fecal coliform bacteria (1,000/100 ml).
** Data exceed maximum Primary Contact Recreation criterion for fecal coliform bacteria (2,000/100 ml).
*** Data exceed the maximum Secondary Contact Recreation criterion for fecal coliform bacteria (5,000/100 ml).

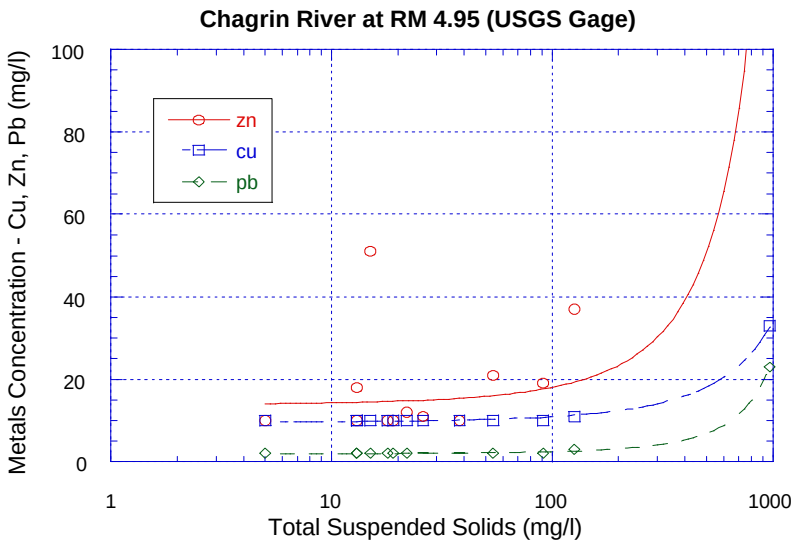


Figure 14. Total suspended solids (TSS) versus total copper, lead, and zinc concentrations in the Chagrin River at RM 4.95 from monthly grab samples, 1995.

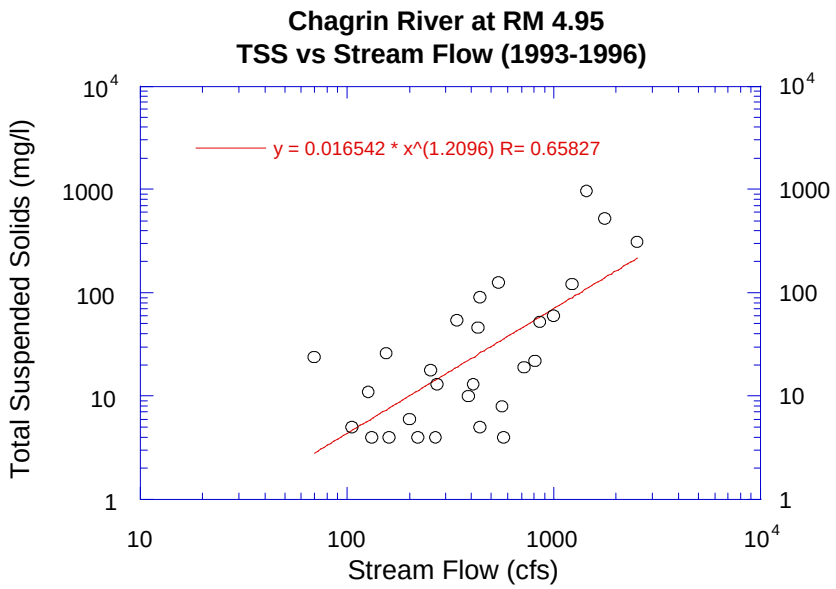


Figure 15. Stream flow (CFS) versus total suspended solids (TSS) at RM 4.95 for the Chagrin River, 1993-1996.

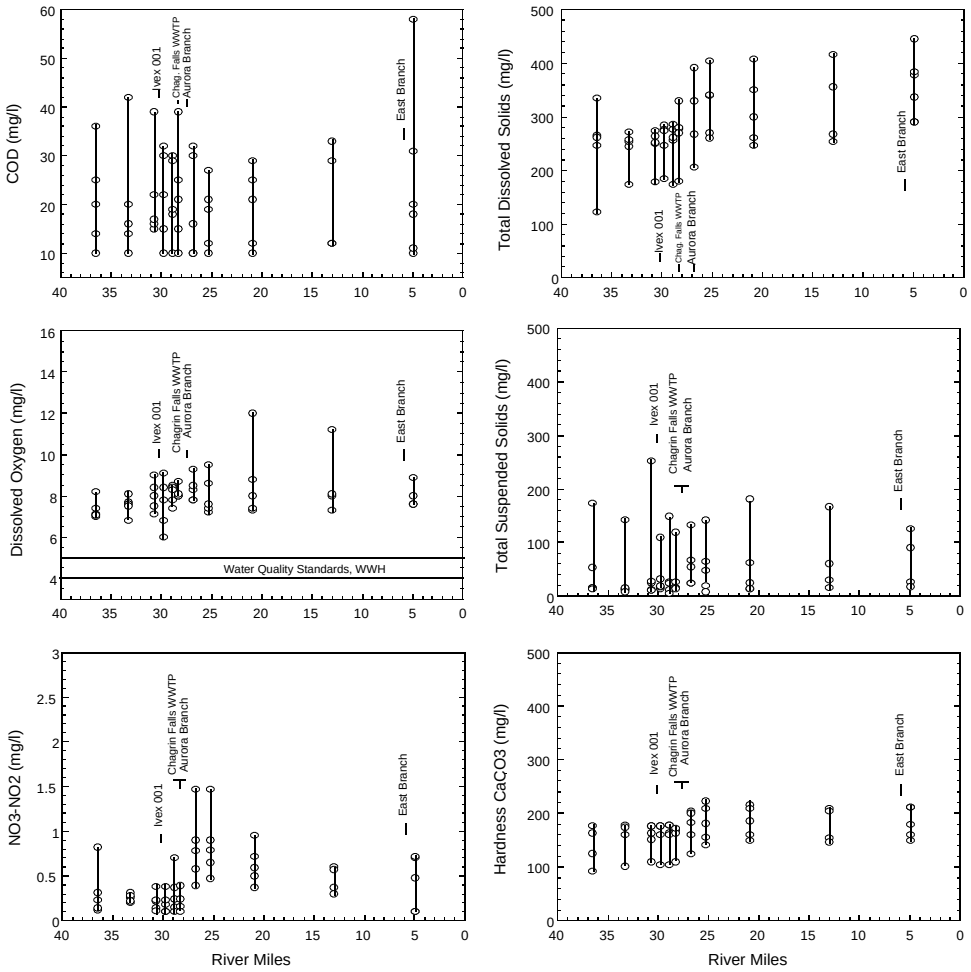


Figure 16. Longitudinal graphs for dissolved oxygen (D.O.), water hardness, total suspended solids (TSS), total dissolved solids (TDS), chemical oxygen demand (COD), and nitrate-nitrite nitrogen (NO_3) from the mainstem Chagrin River, 1995. All data points represented with line extending from lowest to highest concentration.

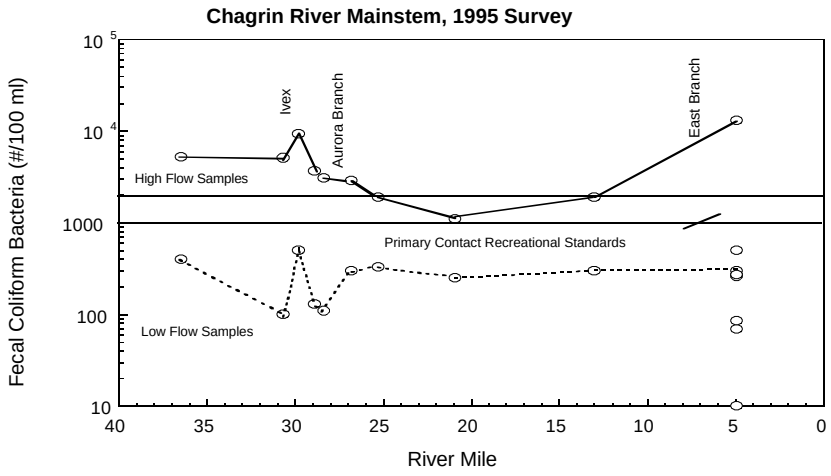


Figure 17. Longtiudinal fecal coliform data from the Chagrin River mainstem during the 1995 survey during low flow versus high flow events.

Both the high and low flow bacteria samples show a slight increase between RM 33.35 and RM 30.7, just above the Ivex dams. Potential sources of bacteria include a number of small package type WWTPs and failing and/or poorly-treated discharges from home sewage systems. More intensive fecal bacteria sampling needs to be conducted between RM 33.35 and RM 30.70 to identify possible sources of this bacterial contamination.

The Cuyahoga County Board of Health conducted an intensive fecal bacteria and water quality survey of the Chagrin River tributaries in four communities: Moreland Hills, Hunting Valley, Chagrin Falls Village, and Chagrin Falls Township (Picciano, 1995, Ohio Journal of Environmental Health, March/April pp. 50-54). They sampled a total of 28 locations in the four communities and recorded fecal coliform bacteria counts ranging from 117 to 61,272 per 100 ml. The highest count was in the Hunting Valley area and the lowest in Moreland Hills. However, two sites in Moreland Hills had counts of 27,700 and 37,994/100 ml; both were well above the Secondary Contact Recreation criterion of 5000/100 ml. Piccianco (1994) reported there are 1700 home sewage systems in these four communities and that 75% are estimated to be failing due to age or improper use and maintenance. As of 1995, the Cuyahoga County Board of Health has begun an inspection program to inspect every home system at least once every five years and to require homeowners to make changes or replace failing systems.

A low diurnal D.O. concentration of 4.8 mg/l near the mouth could indicate slow degenerative effects from cumulative inputs from upstream (effluent (industrial and WWTP), nutrients from home sewage systems, and stormwater runoff) or from more localized sources (Willoughby/Eastlake) (Table 8). Assimilative capacity needs to be studied.

Table 8. Summary of diurnal D.O. (mg/l) data recorded with continuous D.O. monitors at select locations in the Chagrin River study area, August 8-10, 1995.

Stream (Use Designation) River Mile	Total Hours	Median (mg/l)	Min (mg/l)	Max (mg/l)	25th %ile (mg/l)	75th %ile (mg/l)
Chagrin River Mainstem (WWH)						
4.0	38	7.6	4.8#	8.0	6.2	7.7
13.0	39	8.7	8.1	10.6	8.4	8.8
20.9	42	7.9	7.2	9.8	7.5	8.0
25.3	42	8.4	7.3	8.9	7.9	8.5
26.8	43	8.0	7.3	8.7	7.6	8.1
28.3	44	8.2	7.4	8.8	7.8	8.5
Aurora Branch Chagrin River (WWH)						
0.3	49	8.9	8.2	9.7	8.6	9.1
3.4	44	8.4	7.6	10.9	8.2	8.8
3.5	43	7.6	6.7	10.0	7.3	8.0
5.6	43	8.1	7.4	10.2	7.9	8.4
8.9	43	7.7	7.2	8.8	7.5	8.0
Silver Creek (CWH)						
5.1	51	8.0	7.7	8.4	7.9	8.2
Willey Creek (EWH)						
0.5	46	8.7	8.4	9.1	8.5	8.7
Griswold Creek (EWH)						
0.6	47	8.0	7.7	8.6	7.9	8.2
RM 15.42 Unnamed Tributary (WWH)						
0.4	47	8.7	7.8	9.4	8.0	8.9
Unnamed Tributary-aka Willey Creek, (Undesignated)						
0.5	46	8.7	8.4	9.1	8.5	8.7
Unnamed Tributary-Woodland Glen (Undesignated)						
0.4	47	9.0	8.1	9.8	8.5	9.1

# Indicates a value below the average D.O. criterion of 5 mg/l for WWH designated streams.
Violation of the minimum D.O. criterion of 4 mg/l for WWH designated streams.

Aurora Branch Chagrin River

Grab water samples were collected five times between July 13 and September 7, 1995 from eight stations on the Aurora Branch. All samples from the mainstem and Aurora Branch were collected on the same day to allow for the assessment of chemical water quality upstream and downstream from point sources under the similar stream flow conditions. Fecal coliform bacteria and stream sediment samples were also collected at a select number of stations as identified in Table 1. Continuous D.O. monitoring data was collected August 8-10, 1995 with data summarized in Table 8.

No stream discharge measurements were conducted on the Aurora Branch during the study, although field observations indicated that two of the five samples (07/27, 08/17) were collected under higher stream flows than the other three samples. Total suspended solids were 57 and 46 mg/l, respectively, on these two days at RM 0.3 near the mouth. Those TSS concentrations were above the 75th percentile, and 57 mg/l was above the 90th percentile for higher quality streams. This indicates high TSS concentrations can be a detriment to continued good water quality conditions and diverse biological fauna (OEPA, 1996b).

From August 24 to September 7, three grab samples were collected at RM 16.09. These samples were initiated because of reports by OEPA staff of some contamination in the river just upstream of the Aurora Central WWTP. On August 28, 1995 Ohio EPA personnel discovered a broken influent sewage line that was discharging untreated raw sewage to a small tributary of the Aurora Branch less than 1000 feet above the Aurora Central WWTP 001 outfall. This spilling sewage was just upstream of the RM 11.3 station located upstream from the Aurora Central WWTP effluent discharge. The duration of the raw sewage discharge is unknown, but entity self-monitoring data for fecal coliform bacteria collected from the stream above the 001 discharge indicates much higher fecal coliform levels in June 1995 than in May (three times higher). Thus it is possible that raw sewage was being discharged for as long as three to four months prior to the August 28th discovery degrading stream conditions. Once notified by NEDO, immediate corrective actions were taken by the city, including the removal of sewage sludge from the small tributary. A visit to the stream in October 1995 indicated significant improvement in the visual quality of the small tributary.

The effects of the raw sewage discharge on the interpretation of the 1995 stream chemical data collected just upstream and downstream from the Aurora Central WWTP are pervasive. During the summer of 1995, violations of the dissolved oxygen criteria (min. = 3.8 mg/l) and very high fecal coliform bacteria counts (48,300/100 ml) were found at RM 11.1 station downstream from the Aurora Central outfall 001 effluent. These excessive concentrations were collected when the raw sewage was present from the sewer break (Figure 18). Thus, it was not possible to isolate the effects of the WWTP from those of the sewer break on chemical water quality.

The data does, however, indicate that the Central WWTP was significantly increasing the concentrations of nitrate-nitrite and total phosphorus independent of the sewer break (Figure 19). The N/P ratios in the Aurora Branch change significantly downstream from the Aurora Central WWTP discharge (Figure 20). Enriched conditions were evident downstream from the WWTP. The nutrient enrichment effect from the Aurora Central WWTP discharge was not seen downstream at RM 9.0 on the Aurora Branch. Nitrates concentrations were still increased, but the phosphorus inputs have been largely utilized limiting primary production causing an increase in the N/P ratio (more phosphorus-limiting) (Figure 20). Upsteam from RM 5.5 higher relative phosphorus inputs from the Geauga Lake Funtime Inc., WWTP (RM 7.2 to an unnamed trib. to Aurora Branch) and possible limited agriculture NPS runoff near the chemical site at RM 5.5 decreased the N/P ratio. These changes correspond to macroinvertebrate densities collected at RM 11.0, 9.0 and 5.7 (see macroinvertebrate section - Table 12). A chemical site near Pettibone Road (RM ~7.0-7.1) would have better monitored instream chemical conditions and changes downstream from Geauga Lake Funtime, Inc. WWTP. Effluent data

from 1996 and 1997 MOR data indicated high ammonia (12 to 40 mg/l), TSS, and fecal coliform bacteria concentrations (65,000/100 ml) with low D.O. problems (0.6 mg/l). The possibility of impacts from this discharge is possible depending on actual tributary conditions downstream at the confluence to the Aurora Branch (RM 7.2). The lack of continued improvement in the fish community through this reach as evidenced by the IBI scores at RM 5.6 could be related (see fish section).

Samples for fecal coliform bacteria in the Aurora Branch shown in Figure 18 indicate values below the Primary Contact Recreation Criterion, except for the stream section below the Aurora Central WWTP raw sewage influent sewer line break.

No significant effect on chemical or bacterial water quality was observed in samples collected downstream from the McFarland Creek WWTP. However, there was an increase in nitrate-nitrite and total phosphorus concentrations. The N/P ratio downstream from the WWTP had not yet decreased to previous values upstream from the discharge before its confluence with the Chagrin River (nutrient enriched conditions) (Figure 20, Table 12). Diurnal dissolved oxygen concentrations were approximately 10 mg/l or higher from RM 5.6 to 0.3. Relatively high macroinvertebrate densitites also indicate nutrient-enriched conditions (see macroinvertebrate section - Table 12). The curb of phosphorus inputs would help control nutrient enriched conditions in extended reaches of the Aurora Branch and help prevent possible future detrimental diurnal D.O. effects. Maintaining phosphorus loadings at low levels as is technically and economically feasible would help maintain diverse biological communities in Aurora Branch.

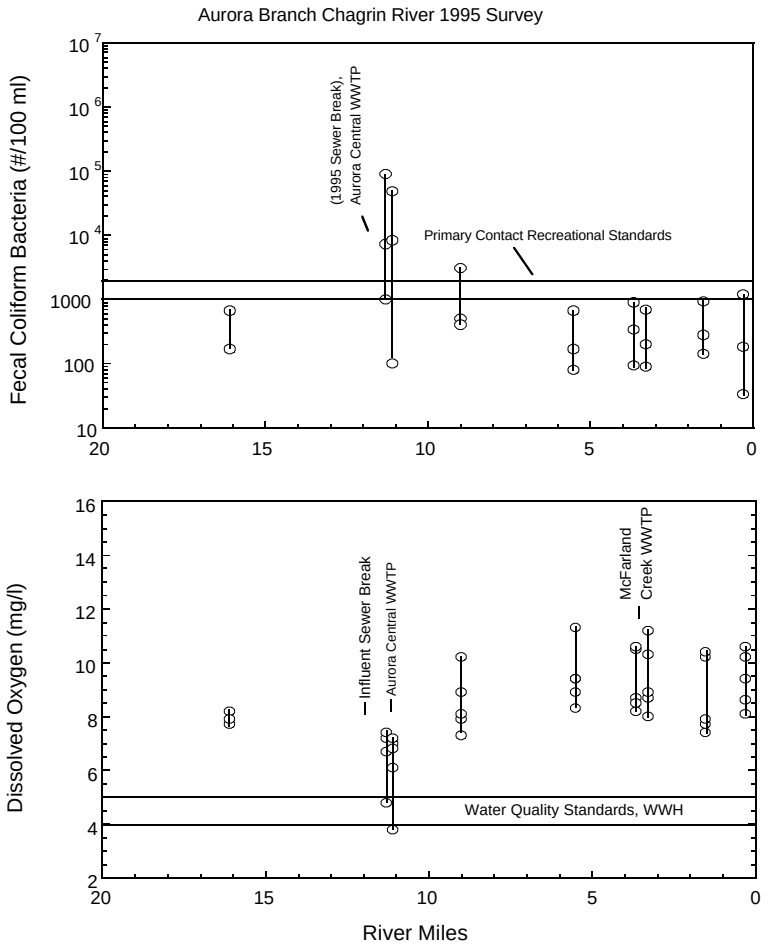


Figure 18. Longitudinal data for fecal coliform bacteria and dissolved oxygen for Aurora Branch Chagrin River, 1995. All data points represented with line extending from lowest to highest concentration.

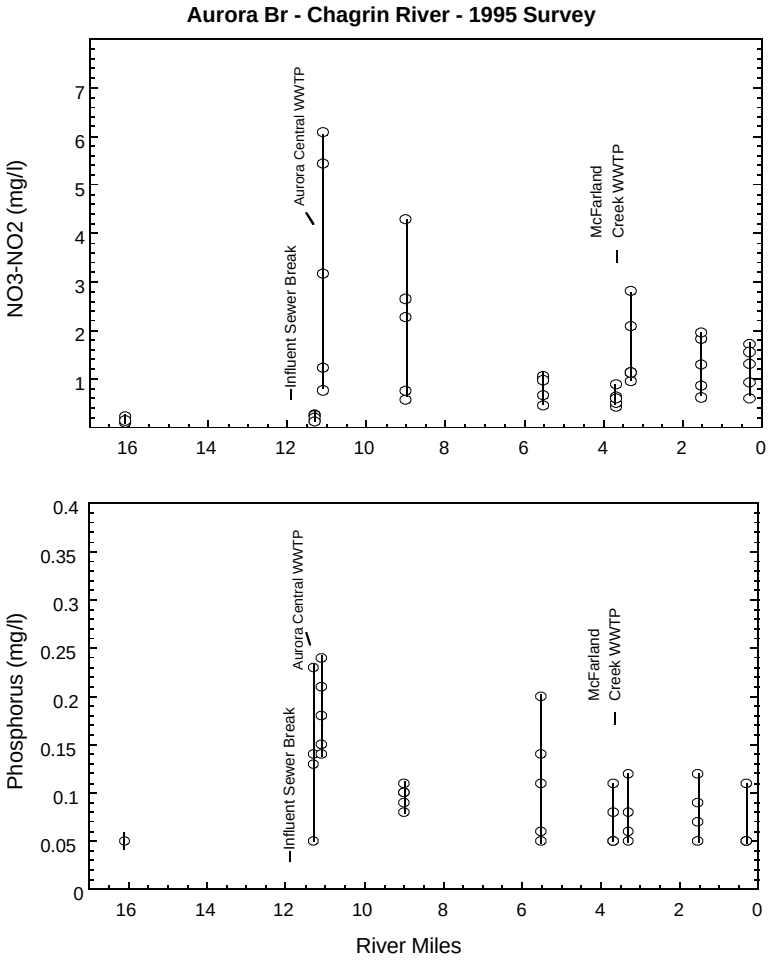


Figure 19. Longitudinal data for nitrate-nitrite and phosphorus concentrations in Aurora Branch Chagrin River, 1995. All data points represented with line extending from lowest to highest concentration.

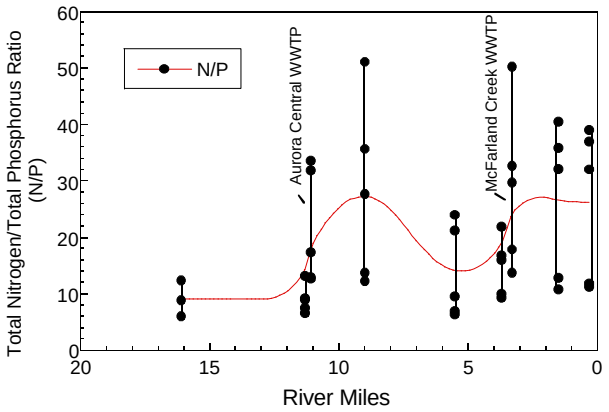


Figure 20. Longitudinal data for total nitrogen/total phosphorus ratios in Aurora Branch Chagrin River, 1995. All data points represented with line extending from lowest to highest concentration. Mean N/P ratio shown as curvilinear line.

Select Tributaries

No significant problems with chemical water quality were observed in samples collected from Silver Creek and at the mouth of the unnamed tributary to the Chagrin River (RM 15.42). No violations of Water Quality Standards criteria were recorded during the survey. Perhaps the most significant finding was that the water temperature in these two tributaries was on average 4-5° C. cooler during the summer months than was the temperature of the mainstem Chagrin River. These data indicate that potential CWH temperature conditions exist in the tributaries of the Chagrin River. A survey of seasonal changes in water temperature for other tributaries not yet sampled would be helpful information in determining use designations.

Sediment Quality

Analysis of heavy metals found in sediment samples collected within the Chagrin River watershed are summarized in Table 9. Using the Kelly and Hite (1984) sediment classification system, four samples showed heavy metals at highly elevated levels in the Chagrin River mainstem. Looking at zinc, chromium and arsenic, which are compounds associated with urban/municipal influences, there was an elevation pattern that paralleled these suburban/urban areas with declines where there was more riparian shielding from more immediate inputs. Measured Heavy metal concentrations that were available indicate sediment contamination would not be expected to have a significant effect on biological communities except for some localized areas downstream from municipal or industrial areas. No sediment data was collected between RM 20 and the impoundment downstream from the East

Branch Chagrin River confluence at Daniels Park (RM 4.9).

At RM 30.7 between the two dams the chromium (Cr) at 38 mg/kg (ppm) was highly elevated and zinc concentration (130 ppm) was highly elevated and exceeded the Lowest Effect Level (LEL=26 ppm) based on the Ontario guidance criteria (Persaud et al., 1994). The measured concentration was well below the Severe Effect Level (SEL) of 110 ppm. The LEL indicates "a level of sediment concentration that can be tolerated by the majority of benthic organisms" but "will effect sediment use by some benthic organisms" (Persaud et al., 1994). This increase is likely accumulation from sedimentation associated with the ruptured upper impoundment (primarily municipal sources and suburban NPS).

Table 9. Concentrations of heavy metals in sediments of the Chagrin River study area, 1995. All parameter concentrations, excluding barium, selenium, and nickel, were ranked based on a stream classification system described by Kelly and Hite (1984). The Kelly and Hite classification system addresses relative concentrations, but does not directly assess toxicity. Parameters were also ranked to ecotoxic effects guidelines established in the "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario" (Persaud et al, 1994). These 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.

Stream Sediment Concentration (mg/kg dry weight = ppm)											
RM	As	Ba	Cd	Cr	Cu	Fe	Pb	Ni	Zn	Se	Hg
Chagrin River Mainstem											
33.35	*(12 c)*	54	0.13	17K	8.5	11700	17K	23K	43	1.1ND	na
30.70	*(11 c)*	246	0.46	(**38 d**)	(22.5)	*30200 c*	22K	30K	*130 c*	1.5ND	0.05K
29.80	(9)	131	0.22	*25 c*	(16.5)	*21000 b*	21	23K	*88 b*	1.2ND	(**0.250 d**)
28.00	(**18 d**)	185	0.48	(*27 c*)	(25)	*22500 b*	27	30K	*104 c*	1.5ND	*0.119 c*
20.95	(7)	42	0.12	13K	9	12000	13K	18K	52	0.9ND	0.026
4.0	5	127	0.13	*22 b*	13	*20400 b*	14K	19K	60.5	1.0ND	0.041
Aurora Branch Chagrin River											
11.10	na	na	0.2K	15K	8	7900	16K	21K	58	na	0.04
5.52	na	na	0.2K	15K	5K	8480	15K	20K	23	na	0.02K
3.67	na	na	0.2K	16K	6	10800	16K	21K	34	na	0.02K
3.30	na	na	0.2K	16K	8	11400	16K	21K	37	na	0.04K
Silver Creek											
5.07	na	na	0.2K	17K	9	15400	17K	22K	75	na	0.05K
Unnamed trib., RM 15.42 Confluence with Chagrin River											
0.16	na	na	0.22	*(37 c)*	(18)	**37400 d**	16K	(26)	*107 c*	na	0.04K

na = not analyzed. K = below lab detection limit. ND = not detected
b=Slightly elevated. c=Elevated. **d=Highly elevated.** ***e=Extremely elevated.*** (from Kelly and Hite)
( ) Values in parentheses exceed Ontario Low Effects Level (LEL).
____ Underlined values exceed Ontario SEL.

The 1995 sediment samples collected upstream (RM 30.7) and downstream from the Ivex effluent (RM 29.8) show no significant difference for most heavy metals (upstream concentrations likely affected by sediment from ruptured dam), although the downstream samples did have significant amounts of

organic matter when compared to upstream samples. Significantly higher concentrations of mercury (Hg) (Kelly and Hite classification was highly elevated) were observed downstream from Ivex (0.25 mg/kg) compared to non-detectable concentrations upstream at RM 30.7 (<0.05 mg/kg). This marginally polluted concentration (Ontario criteria) is slightly above the LEL of 0.2 ppm (Persaud et al, 1994) and above the ER-L (low effect level) of 0.15 ppm from NOAA criteria (Long and Morgan, 1991). The SEL concentration is $\geq$ 2.0 ppm. This sediment concentration can be tolerated by most benthic organisms but affects some sediment dependent benthic organisms. It should be noted that mercury toxicity increases in the presence of other Heavy metals such as zinc, lead or chromium (some of which are at slightly elevated to elevated concentrations) (Eisler ,1987; Long and Morgan, 1991).

At RM 28.0 downstream from Chagrin Falls WWTP a highly elevated arsenic (As) concentration of 18 ppm exceeded the LEL ($\geq$ 6 ppm) considerably. This concentration was approximately fifty percent of the SEL concentration of 33 ppm. One would expect some decrease in sediment dependent benthic organisms at this concentration. In addition, the mercury concentration was elevated and just slightly lower than the NOAA ER-L (low effect) level of 0.15 ppm and could possibly contribute to sediment impacts due to additive interaction of elevated Heavy metals (As, chromium, and zinc) (Eisler, 1987; Long and Morgan, 1991).

An unnamed tributary to the Chagrin River (RM 15.42) was sampled near the mouth (RM 0.16) and had a highly elevated iron (Fe) concentration of 37400 mg/kg. The source could be from NPS runoff or from a few private households near the mouth. Corresponding elevated copper, zinc and chromium concentrations present, which exceed the LEL concentrations (Persaud et al, 1994), indicated human not natural source(s).

Particle size analysis of sediments collected in the Chagrin River basin indicate that sand particles above 28.3 microns are the predominant fine grain sediment type in the basin.

Sediment samples collected at RM 33.4 (ust. SR 87) and RM 4.0 (Todd Field) on the Chagrin River mainstemwere analyzed for pesticides/PCBs and base-neutral and acid extractables organics. The only compound detected was the pesticide dieldrin at 8.9 ug/kg (ppb) at RM 33.4 and 6.6 ug/kg (ppb) at RM 4.0 at Todd Field. These concentrations exceed the LEL of 2.0 ppb but were < 0.1 percent of the SEL concentration of 9100 ppb according to the Ontario screening guidelines (Persaud et al., 1994). These presence of similar concentrations in the headwaters and at the mouth illustrate the persistent suburban influence in this watershed.

Fish Tissue Contaminants

Concentrations of contaminants measured in fish tissue samples collected from the Chagrin River 1989-1995 are reported in Table 10. Elevated mercury concentrations were detected in a variety of species at most sampling locations.

Higher mercury concentrations and the greatest number of affected fish were found at RM 28.1, coinciding with elevated sediment mercury concentrations found downstream from the Ivex facility. Elevated concentrations of lead (a monitored compound from Ivex) were also detected in tissue samples collected downstream from the Ivex facility, but did not coincide with significantly higher sediment concentrations. Mercury (Hg) concentrations from fish fillet tissue analyses from 1995 downstream from Ivex and the Chagrin Falls WWTP (RM 28.1) were ND (0.00), 0.197, 0.241, and 0.442 ug/g (ppm). The geometric mean mercury fish tissue concentration in Ohio currently is 0.132 ppm (Schmitt and Brumbaugh 1990). Based on 2740 state records, a majority of the fish tissue mercury concentrations collected from the Chagrin River were >80th percentile statewide. The observed fish tissue mercury concentration of 0.442 ppm was greater than *the 95th percentile of fish tissue mercury concentrations collected in Ohio*.

Since January of 1994, ODH has issued tiered sportfish consumption advisories. These fish tissue mercury concentrations collected downstream from Ivex and Chagrin Falls WWTP (except for the one ND) would be included into ODH's Group 2 and Group 3 categories (.051-.200 ppm - slightly elevated and .201-1.0 ppm - moderately elevated, respectively). Concentrations in these groups would require some fish consumption restrictions (ODH, 1997, OEPA,1996).

Elevated fish tissue concentrations were collected downstream in the mainstemdownstream from Chagrin Falls (RM 28.1) to the mouth (RMs 24.9, 12.5, 5.1-4.8, and lacustuary sites at RM 1.3 and 1.0). The highest fish tissue mercury concentrations were found downstream near the mouth - as high as 0.49 ppm at RM 1.0 and a carp whole body composite sample of *0.77 ppm* at RM 1.3. The latter concentration was *one of the top ten mercury concentrations collected since 1985*. This could be indicative of sediment bedload migration downstream and then accumulation due to the lacustuary and harbor areas functioning as sediment sinks.

The US Fish and Wildlife Service has determined that mercury contamination levels should not exceed 0.1 µg/g in order to protect piscivorous birds and 1.1 µg/g for piscivorous mammals to prevent bioaccumulation (Eisler, 1987). The US EPA (1992) indicated that piscivorous wildlife exposed to diet concentrations of one to two ppm Hg will die. Using this guidance, 18 of 24 samples (75%) collected 1994-95 from Chagrin River would be considered toxic to piscivorous birds.

Measurable concentrations of lead were found in fish tisssue samples, and three were detected at levels corresponding to the Group 2 and Group 3 categories. Two samples were collected at RM 28.1 downstream from Ivex and the Chagrin Falls WWTP. *Fish tissue samples need to be collected upstream from the Ivex dam to help determine the levels (if any) of fish contamination upstream and to check for other mercury sources (via air deposition, or other suburban sources). Fish tissue*

samples should be collected above Chagrin Falls waterfall to isolate effects from Ivex and Chagrin Falls WWTP.

Table 10. Concentrations of contaminats detected in fish tissue samples collected from the Chagrin River, 1989-1995. Slightly elevated conc. in *italics*. Moderately elevated conc. in **bold**.

SPCODE	SPECNAME	YEAR	COLLNO	RM	CHEMID	CONC	UNIT	NAME
77-002	BLACK CRAPPIE	1989	59	5.00	6	0.01300	ug/g	Cadmium
77-002	**BLACK CRAPPIE**	**1989**	**59**	**5.00**	**15**	**0.23700**	**ug/g**	**Mercury**
77-002	BLACK CRAPPIE	1989	59	5.00	23	9.32000	ug/g	Zinc
43-001	COMMON CARP	1989	57	5.00	10	0.76400	ug/g	Copper
43-001	**COMMON CARP**	**1989**	**57**	**5.00**	**15**	**0.32000**	**ug/g**	**Mercury**
43-001	COMMON CARP	1989	57	5.00	23	23.20000	ug/g	Zinc
40-010	**GOLDEN REDHORSE**	**1989**	**60**	**5.00**	**15**	**0.29400**	**ug/g**	**Mercury**
40-010	GOLDEN REDHORSE	1989	60	5.00	23	8.43000	ug/g	Zinc
77-004	**SMALLMOUTH BASS**	**1989**	**58**	**5.00**	**15**	**0.34700**	**ug/g**	**Mercury**
77-004	SMALLMOUTH BASS	1989	58	5.00	23	7.96000	ug/g	Zinc
43-001	COMMON CARP	1990	225	5.10	10	0.54000	ug/g	Copper
43-001	COMMON CARP	1990	225	5.10	23	10.20000	ug/g	Zinc
77-004	SMALLMOUTH BASS	1990	224	5.10	23	11.20000	ug/g	Zinc
40-016	WHITE SUCKER	1990	223	5.10	10	0.32800	ug/g	Copper
40-016	WHITE SUCKER	1990	223	5.10	23	10.00000	ug/g	Zinc
43-001	COMMON CARP	1992	24	5.10	8	20.05	ug/kg	4,4'-DDD
43-001	COMMON CARP	1992	24	5.10	9	32.51	ug/kg	4,4'-DDE
43-001	COMMON CARP	1992	24	5.10	10	0.25300	ug/g	Copper
43-001	COMMON CARP	1992	24	5.10	12	6.98	ug/kg	Dieldrin
43-001	*COMMON CARP*	*1992*	*24*	*5.10*	*15*	*0.18700*	*ug/g*	*Mercury*
43-001	COMMON CARP	1992	24	5.10	11	52.56	ug/kg	Totl. DDT
43-001	COMMON CARP	1992	24	5.10	23	6.44000	ug/g	Zinc
77-004	SMALLMOUTH BASS	1992	26	5.10	8	5.20	ug/kg	4,4'-DDD
77-004	SMALLMOUTH BASS	1992	26	5.10	9	17.27	ug/kg	4,4'-DDE
77-004	SMALLMOUTH BASS	1992	26	5.10	10	2.52	ug/kg	4,4'-DDT
77-004	SMALLMOUTH BASS	1992	26	5.10	10	0.39900	ug/g	Copper
77-004	**SMALLMOUTH BASS**	**1992**	**26**	**5.10**	**15**	**0.23500**	**ug/g**	**Mercury**
77-004	SMALLMOUTH BASS	1992	26	5.10	11	24.99	ug/kg	Total DDT
77-004	SMALLMOUTH BASS	1992	26	5.10	30	11.95	ug/kg	Total PCB
77-004	SMALLMOUTH BASS	1992	26	5.10	23	13.20000	ug/g	Zinc
40-016	WHITE SUCKER	1992	25	5.10	8	8.74	ug/kg	4,4'-DDD
40-016	WHITE SUCKER	1992	25	5.10	9	14.66	ug/kg	4,4'-DDE
40-016	WHITE SUCKER	1992	25	5.10	10	5.10	ug/kg	4,4'-DDT
40-016	WHITE SUCKER	1992	25	5.10	6	0.00566	ug/g	Cadmium
40-016	WHITE SUCKER	1992	25	5.10	10	0.47800	ug/g	Copper
40-016	WHITE SUCKER	1992	25	5.10	12	3.09	ug/kg	Dieldrin
40-016	*WHITE SUCKER*	*1992*	*25*	*5.10*	*15*	*0.15800*	*ug/g*	*Mercury*
40-016	WHITE SUCKER	1992	25	5.10	29	11.41	ug/kg	PCB-1260
40-016	WHITE SUCKER	1992	25	5.10	11	28.50	ug/kg	Total DDT
40-016	WHITE SUCKER	1992	25	5.10	30	11.41	ug/kg	Total PCB
40-016	WHITE SUCKER	1992	25	5.10	23	12.50000	ug/g	Zinc
40-010	GOLDEN REDHORSE	1995	417	4.80	9	15	ug/kg	4,4'-DDE
40-010	GOLDEN REDHORSE	1995	417	4.80	15	0.146	ug/g	Mercury
40-010	*GOLDEN REDHORSE*	*1995*	*417*	*4.80*	*29*	*57*	*ug/kg*	*PCB-1260*
77-003	**ROCK BASS**	**1995**	**418**	**4.80**	**15**	**0.328**	**ug/g**	**Mercury**
40-010	GOLDEN REDHORSE	1995	419	12.50	9	14	ug/kg	4,4'-DDE
40-010	**GOLDEN REDHORSE**	**1995**	**419**	**12.50**	**15**	**0.239**	**ug/g**	**Mercury**

SPCODE	SPECNAME	YEAR	COLLNO	RM	CHEMID	CONC	UNIT	NAME
77-003	*ROCK BASS*	*1995*	*420*	*12.50*	*12*	*0.132*	*ug/g*	*Lead*
77-003	**ROCK BASS**	**1995**	**420**	**12.50**	**15**	**0.239**	**ug/g**	**Mercury**
40-015	*HOG SUCKER*	*1995*	*422*	*24.90*	*15*	*0.182*	*ug/g*	*Mercury*
77-004	SMALLMOUTH BASS	1995	423	24.90	9	13	ug/kg	4,4'-DDE
77-004	*SMALLMOUTH BASS*	*1995*	*421*	*24.90*	*15*	*0.191*	*ug/g*	*Mercury*
77-004	**SMALLMOUTH BASS**	**1995**	**423**	**24.90**	**15**	**0.259**	**ug/g**	**Mercury**
77-003	ROCK BASS	1995	426	28.10	6	0.0118	ug/g	Cadmium
77-003	*ROCK BASS*	*1995*	*424*	*28.10*	*12*	*0.115*	*ug/g*	*Lead*
77-003	**ROCK BASS**	**1995**	**426**	**28.10**	**12**	**0.254**	**ug/g**	**Lead**
77-003	*ROCK BASS*	*1995*	*424*	*28.10*	*15*	*0.197*	*ug/g*	*Mercury*
77-003	**ROCK BASS**	**1995**	**426**	**28.10**	**15**	**0.241**	**ug/g**	**Mercury**
77-004	**SMALLMOUTH BASS**	**1995**	**425**	**28.10**	**15**	**0.442**	**ug/g**	**Mercury**

Spills and Unauthorized Releases

Four quantified spills were reported to the Ohio EPA Division of Emergency and Remedial Response in 1995. Three involved the release of diesel fuel (total of 965 gallons estimated) to unnamed tributaries of the Chagrin River mainstem. One spill of 40 gallons of lacquer thinner was reported on 8/17/95 from Milbar Company located in Chagrin Falls. The small number of recorded spills reflect the small percentage of large industral land use in the Chagrin River basin.

Chemical Assessment Trends

Chemical Water Quality Changes, 1972-1995

Figures 21 to 24 show long term trends for selected chemicals that Ohio EPA has collected at the RM 4.95 ambient station on the Chagrin River mainstem. Likely due to the Lake Erie basin phosphorus detergent ban, unleaded gas usage and improved wastewater treatment, concentrations of total phosphorus, ammonia-N, and total lead have decreased since the early 1980s and have remained relatively constant up to 1995 (Figure 21). The data show relatively stable concentration of water hardness over time. The yearly mean dissolved oxygen concentration has increased from 8.5 to 10.4 from 1972 to 1995 (Figure 22). The pH showed a significant increase between 1975 and 1982 and has remained generally constant since that time (Figure 23). These trends parallel a general decrease in industrial discharge volume over time, an improved wastewater treatment quality through *WWTP upgrades* and a general increase in suburban/municipal discharges. They include *WWTP expansions and increasing urban/suburban stormwater runoff with dissolved metals, fertilizers,* etc. (see major discharge loadings). The fecal coliform bacteria concentration trends (Figure 23) seem to relate to the following: 1) improved WWTP quality [*decrease in fecal coliform bacteria conc.*]; 2) increased demand and waste discharge volumes from population increases [*occasional spikes of high fecal coliform bacteria during upsets*]; and 3) nearing capacity with usually decreasing treatment efficiency [*increase in WQS criteria violations*] (see and compare with major discharger loadings). Total suspended solids (TSS) and nitrates-nitrites show fluctuation that is likely related to stream discharge (Figure 24). TSS average concentrations were about 50 mg/l from 1972 to 1996 at RM 4.95 which was the near the 90th percentile for fish sites where IBI scores ranged from 40-49 in the EOLP ecoregion. EOLP streams with this level of TSS (related to storm water runoff) are near the threshold where it

could be a prelude to degraded biological communities (OEPA, 1996b).

Previous chemical samples were collected in the Chagrin River basin for the 1990 intensive survey. During the 1990 survey, the only exceedences of Ohio WQS criteria involved a few total iron concentrations and some elevated fecal coliform bacteria counts at high flows. The major conclusion of the 1990 survey was that most water quality parameters were generally at background concentrations. The 1995 survey data indicate no significant change in the chemical water quality compared to the 1990 results.

Sediment Quality Changes, 1986-1995

Historical sediment data for the Chagrin River basin is limited to 1986 and 1990 samples collected by Ohio EPA upstream and downstream from Ivex in Chagrin Falls. Previous samples downstream from Ivex showed elevated concentrations of lead, chromium, copper, zinc, and cadmium. The sediment data from 1995 indicate that all of these metals were found at higher concentrations *upstream* from the Ivex property. This increase upstream was likely accumulation from sedimentation associated with the ruptured upper impoundment. However, the 1995 data indicate significantly higher levels of mercury in sediment downstream from Ivex (0.25 mg/kg) compared to non-detect (< 0.05 mg/kg) levels upstream at RM 30.7. Mercury was not sampled for in earlier surveys. This marginally-polluted sediment is likely affecting some sediment use by macroinvertebrates and is likely the source or one of the sources for the mercury that has contaminated fish sampled just downstream. The potential source(s) of mercury between these two sites needs to be determined.

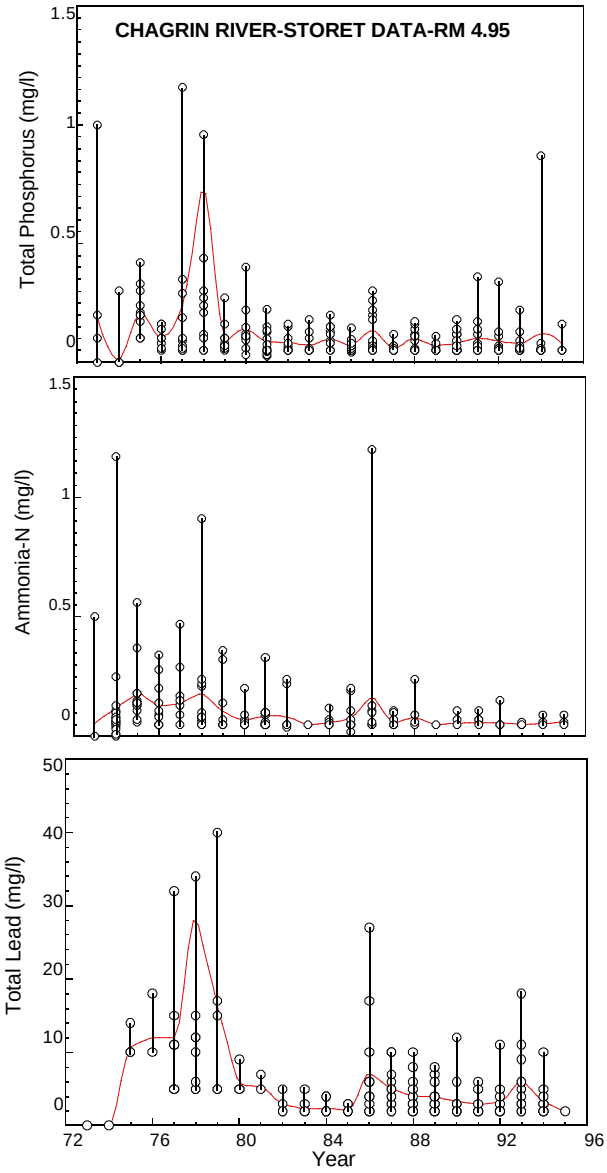
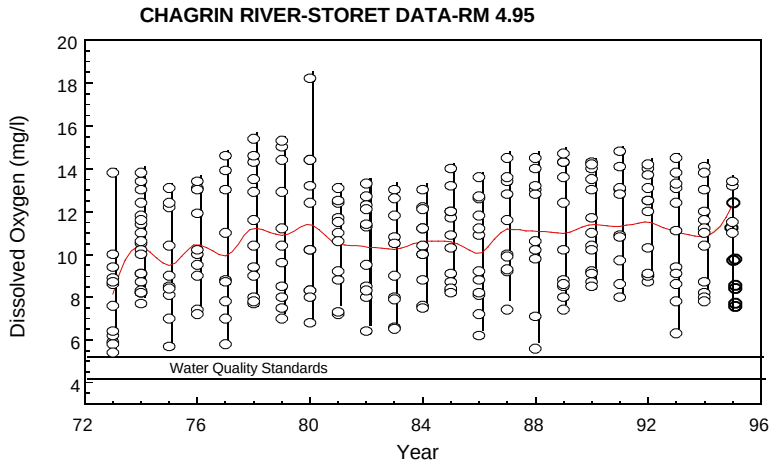


Figure 21. Historical trends for total phosphorus, ammonia-nitrogen, and total lead for the Chagrin River at RM 4.95, 1973-1995. Computer-generated smooth curve takes data from previous, current and following years into account to draw trend line.



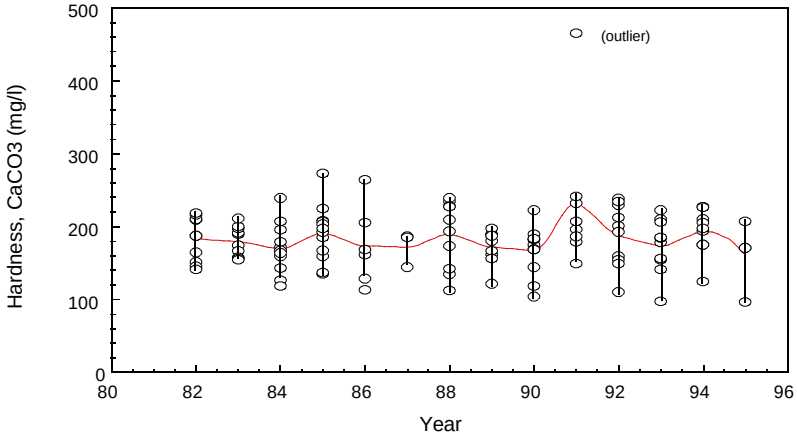


Figure 22. Historical trends for dissolved oxygen and total hardness for the Chagrin River at RM 4.95, 1973-1995. Computer-generated smooth curve takes data from previous, current and following years into account to draw trend line.

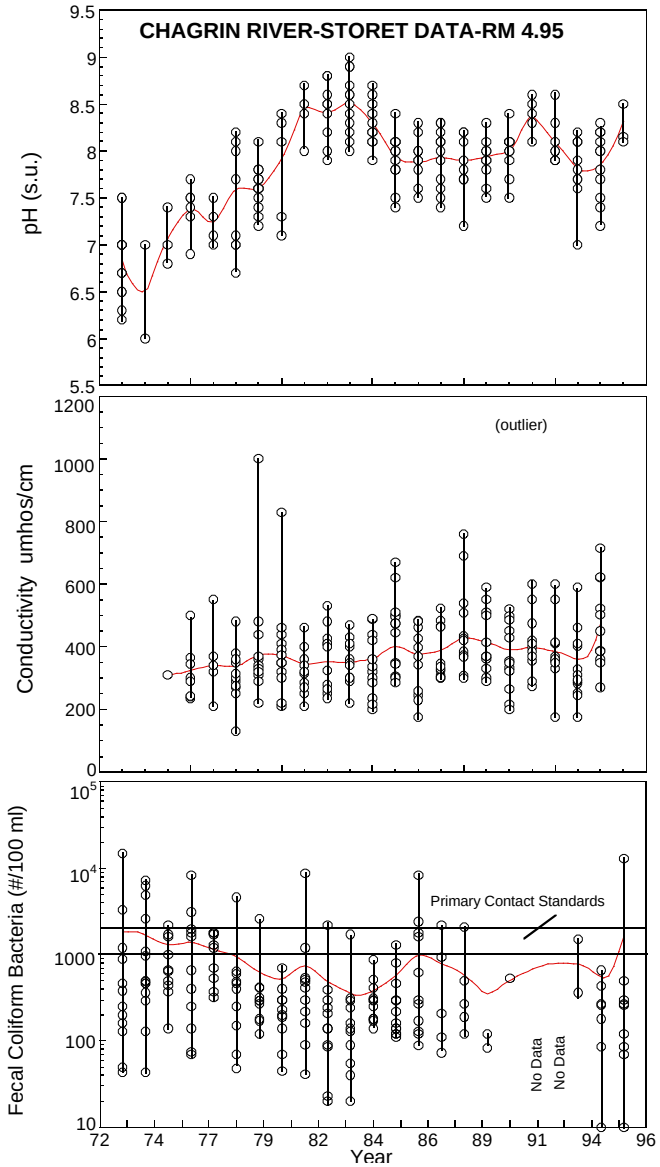


Figure 23. Historical trends for pH, conductivity and fecal coliform bacteria for the Chagrin River at RM 4.95, 1973-1995. Computer-generated smooth curve takes data from previous, current and following years into account to draw trend line.

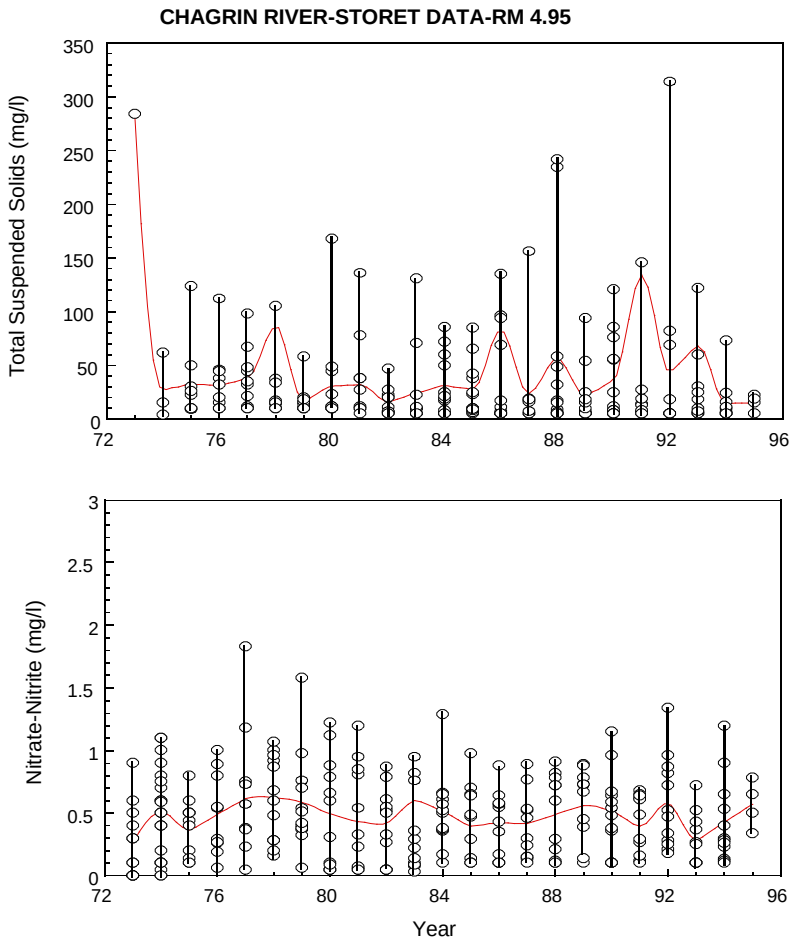


Figure 24. Chemical trends for total suspended solids and nitrates-nitrites for the Chagrin River at RM 4.95, 1973-1995. Computer-generated smooth curve takes data from previous, current and following years into account to draw trend line.

Physical Habitat For Aquatic Life

Chagrin River
The macro-habitat quality, as measured by the Qualitative Habitat Evaluation Index (QHEI), was evaluated at all fish sampling locations in the Chagrin River. QHEI scores ranged from 85.5 to 69.0, and averaged 77.3, indicating excellent habitat quality capable of supporting a diverse aquatic fauna. Individual habitat attributes generally scored well, especially those relating to channel morphology and substrates (*i.e.*, sinuosity, channel development, substrate size and composition; Table 11). However, several attributes related to urban and suburban development scored low at all locations. Moderate to heavy silt cover and moderate to extensive riffle and substrate embeddedness pervaded the Chagrin River mainstem. Sediment runoff from a residential development (< 5 acres in size) in the flood plain at RM 28.0 demonstrated localized impact and the cumulative effect of flood plain development on the Chagrin River. Exposed dirt was being washed into the river, leaving fans of sediment embedding the channel and contributing to the bed load of sediment affecting the entire channel. Immediately upstream from the development, the substrates, though moderately embedded, were comparatively clean.

Aurora Branch
The average QHEI score of 68.7 at fish sampling locations in the Aurora Branch indicated the macro-habitats were generally capable of supporting an aquatic fauna consistent with WWH criteria. Like the Chagrin mainstem, positive habitat attributes generally arose from good channel morphology, whereas poor habitat attributes were ascribed to sedimentation (Table 11). However, the cause of sedimentation in the Aurora Branch was more closely linked to poor riparian habitat than residential development. Soils in the Aurora Branch subbasin contain high amounts of sand and are susceptible to erosion (ODNR 1973). Severe bank erosion, especially downstream from US 422, resulted in marginal habitat conditions characterized by highly embedded riffles and poor riffle-pool development.

Silver Creek
The macro-habitats at three locations sampled for fish in Silver Creek were of sufficient quality to support a diverse aquatic fauna (Table 11; QHEI $\bar{x}$ = 69.0). Habitat quality in Silver Creek was generally limited by poor riffle-pool development and a low percentage of coarse substrates, owing to parent material derived from sandstone and wetlands. As with the Aurora Branch, soils in the relatively undeveloped Silver Creek subbasin are highly erodible, and the stream channel is highly susceptible to destabilization with loss of riparian habitat. In fact, the stream bank has already needed to be artificially stabilized at RM 0.5 where a residential development impinges on the stream. Much of stream discharge is spring-fed.

Griswold Creek
Habitat quality in Griswold Creek was judged suitable for supporting a good diverse aquatic community. Deposits of glacial till in portions of the otherwise shale bedrock creek bed created heterogeneous habitat with boulder and cobble substrate. The interstitial spaces of the cobble in the riffles were not significantly embedded. An unstable stream channel was the source of embeddedness comprised mainly of glacial outwash. Griswold Creek seems to add some silt load to the Chagrin

River, as below the confluence the Chagrin River was more silty.

McFarland Creek
Very good to excellent habitat was observed in McFarland Creek. There was sinuosity with well-developed riffles, runs and deeper pools. The riparian habitat and channel is recovering near the mouth due to recent highway construction. There were portions where fast runs occurred, and the substrates and riffles were only slightly embedded. Substrate sizes ranged from boulders to sand with increased sand/sediment deposited at pool edges from some erosion/runoff.

Willey Creek
Good to excellent habitat was observed in Willey Creek. Glacial deposits, under-cut root wads and large woody debris provided a diversity of habitats for aquatic life. The upper portion of Willey Creek drains the highly suburbanized area of Moreland Hills and Orange. Consequently, moderate siltation and substrate embeddedness were observed.

Unnamed tributary to Chagrin River (confluence at RM 22.81)
Moderately good habitat was present in this unnamed tributary that drains the suburbanized area of Pepper Pike and Beachwood. The habitat was slightly limited by past channel modifying activities which had constrained sinuosity and reduced instream cover. Habitat quality was augmented by glacial deposits, and good riffle-run-pool development in the recovered channel. The substrates and riffles were surprisingly clean, given the characteristics of the watershed.

Unnamed tributary to Chagrin River (confluence at RM 14.88)
This unnamed tributary drains the heavily urbanized area of Mayfield Heights. Consequently, it experiences frequent and highly flashy discharges of storm water runoff. Severe bank erosion, a wide stream channel for the drainage area, and a well defined high water mark were observed. The macrohabitats were accordingly disturbed; the QHEI scored 57.5. Though glacial deposits were the predominant substrate type, the magnitude and frequency of flooding had eliminated all patchiness in distribution, effectively rendering the habitat uniform. Woody debris was exported from the stream bed intothe flood plain or downstream, and riffle-pool development was lowered.

Unnamed tributary to Chagrin River (confluence at RM 15.42)
Excellent habitat exists in this unnamed tributary owing to a wide and intact riparian corridor. The intact riparian facilitated excellent channel development and clean substrates, and contributed large woody debris to the stream bed. The QHEI scored 75.5.

Table 11. QHEI matrix for sites sampled in the Chagrin River basin, 1995.

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max. Depth > 40cm	Low/No Riffle Embeddedness	**Total WWH Attributes**	MWH Attributes – *High Influence*: Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max. Depth < 40 cm (WD/HW)	**Total H.I. MWH Attributes**	MWH – *Moderate Influence*: 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**
(15-001) Chagrin R.																																		
36.4	80.5	6.41											8						0										▲			1	0.11	0.22
33.4	83.5	16.39											9						0													0	0.10	0.10
30.6	71.5	0.10											8						0									▲	▲			2	0.11	0.33
30.0	71.5	23.26											7						0		▲							▲	▲			3	0.13	0.50
28.9	80.0	20.41											9						0		▲											1	0.10	0.20
28.0	78.0	6.99											8						0		▲							▲	▲			3	0.11	0.44
26.5	85.5	16.13											9						0													0	0.10	0.10
24.2	79.5	11.24											9						0		▲											1	0.10	0.20
19.4	80.5	5.81											9						0		▲							▲	▲			3	0.10	0.40
13.1	71.0	11.76											8						1													0	0.22	0.22
4.8	69.0	5.68											9						1		▲							▲	▲			3	0.22	0.50
(15-003) Griswold Creek																																		
0.7	63.5	31.25											8						2													0	0.33	0.33
(15-004) Willey Creek																																		
0.2	72.0	100.0											9						0									▲	▲			2	0.10	0.30
(15-005) Aurora Branch																																		
12.1	65.0	50.00											8						0									▲	▲			2	0.11	0.33
11.3	74.0	24.39											7						1									▲	▲			2	0.25	0.50
11.1	71.5	24.39											6						0		▲						▲	▲	▲			4	0.14	0.71
9.0	81.5	17.54											8						0									▲	▲			2	0.11	0.33
5.6	70.5	18.87											8						1													0	0.22	0.22
3.5	69.0	6.54											6						0		▲							▲	▲			3	0.14	0.57
3.4	75.0	6.54											6						0		▲							▲	▲			3	0.14	0.57
1.6	59.5	8.40											3						1		▲		▲				▲	▲	▲			5	0.50	1.75
0.3	79.5	17.54											8						0													0	0.11	0.11
(15-006) McFarland Creek																																		
0.1	72.0	35.71											9						0		▲											1	0.10	0.20

Table 11. (Cont.)

Key QHEI Components

River Mile	QHEI	Gradient (ft/mile)	WWH Attributes: No channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low/Normal Embeddedness	Max. Depth > 40cm	Low/No Riffle Embeddedness	**Total WWH Attributes**	MWH Attributes (*HighInfluence*): Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max. Depth < 40 cm (WD/HW)	**Total H.I. MWH Attributes**	(*Moderate Influence*): 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**
(15-007) Silver Creek																																		
4.0	69.5	16.39											6						0		▲		▲						▲	▲		4	0.14	0.71
1.7	76.0	12.99											7						0		▲								▲	▲		3	0.13	0.50
0.5	61.5	7.14											4						1		▲		▲				▲	▲	▲	▲		5	0.40	1.40
(15-012) Trib. to Chagrin River at RM 15.4																																		
0.4	75.5	125.0											9						0													0	0.10	0.10
(15-017) Trib. to Chagrin River at RM 14.88																																		
0.2	57.5	125.0											6						1					▲		▲			▲	▲		4	0.29	0.86
(15-018) Trib. to Chagrin River at RM 22.81																																		
0.3	60.5	55.56											9						2						▲							1	0.30	0.40

Biological Assessment: Macroinvertebrate Community

A total of 37 regular sampling site and, two mixing zone sampling sites (sampled twice each) were collected in the Chagrin River study area in 1995; in addition, three follow-up sampling sites were collected in 1996 by Ohio EPA personnel. Qualitative macroinvertebrate collections were used alone for assessments at sites where artificial substrates were not recovered. Due to several expansion and protection issues, some recently available consultant data will be referred to to assist in assessments and use designation issues.

Chagrin River Mainstem
Macroinvertebrates were collected from 13 sampling locations on the Chagrin River mainstem including the Ivex mixing zone site. Nine of twelve quantitative artificial substrate samplers were recovered. Narrative evaluations ranged from exceptional in the upper reaches ($\geq$ RM 30.8) to poor and fair in the Ivex mixing zone and downstream from Ivex (RM 30.0) (Table 12) (Fig. 25). The macroinvertebrate community collected indicated the Chagrin River mainstem met the WWH aquatic life use designation at all sites except immediately downstream from Ivex (Table 1). The QCTV scores parallel the ICI performance (Fig. 25).

The macroinvertebrate community upstream of the millpond dams (upstream of Fairmount Rd. at RM 36.6 to RM 30.7) were found to be exceptional. ICI scores greatly exceeded the WWH biocriterion. These exceptional scores are consistent with past community performance upstream from Ivex. A good macroinvertebrate community (though attaining the WWH ecoregional criterion) at the sampling location below the first dam reflected incomplete recovery from a dam break in August 1994 that inundated this reach with sand and small gravel. Ten qualitative EPT taxa were collected from natural substrate sampling in August 1995 compared to 29 in 1986 sampling at the same site. This lowered diversity of pollution sensitive taxa indicated a state of transitional recovery from the dam rupture and/or was a symptom of increased suburbanization influences to this stream reach. The high fecal coliform bacteria counts collected during the study from this reach does indicate increasing suburbanization affects.

Sampling in the Ivex mixing zone indicated variably adverse conditions for aquatic life. The July 18 macroinvertebrate sample collection was considered marginally good with no evidence of acute toxicity; eight EPT taxa were collected. The macroinvertebrate diversity and density did increase in relation to the distance from the outfall which likely was related to increased effluent dilution. Flow over the lower mill dam at this time was sufficient to adequately aerate the stream in the natural substrates and in the mixing zone area. A small amount of settleable solids partially covered some of the natural bedrock substrates. However the August 30 sample indicated acutely toxic conditions, and the macroinvertebrate community reflected a very poor performance. Low flows, higher water temperatures, and excessive solids deposition with high BOD from the 001 effluent limited the macroinvertebrate community to tolerant midges, a few fingernail clams, and flatworms; no EPT taxa were collected (Fig. 26). The coarse substrates in the runs were covered with sewage fungus, and the pooled areas were coated with black sludge.

Table 12. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Chagrin River basin, July - October, 1995 and 1996. Aquatic life uses listed are those currently designated in the Ohio Water Quality Standards or are proposed use designation changes.

Stream River Mile	Drainage Area (mi.^{2})	Rel. Density (#/ft.^{2})	No. Quant. Taxa	No. Qual. Taxa	Total No. Taxa	Qual. EPT[a]	Total EPT	Predominant Organisms	QCTV[b]	ICI	Narrative Evaluation[c]
Chagrin River (existing WWH)											
36.6	36.0	529	51	49	73	21	25	5,3,11	40.5	48	Exceptional
36.2	37.0	969	46	66	86	19	22	3,1,6,33,11,12	39.3	54	Exceptional
33.4	54.0	792	48	37	51	17	24	3,2,9,8,5,11	40.9	50	Exceptional
30.6	56.0	Mod-High	--	48	48	10	10	5,3,2,8,6,7	38.9	G	Good
30.08A	57.0	Mod-Low	--	34	34	8	8	6,7,29	37.1	MG[ns]	Marg. Good
30.08B	57.0	Mod-Low	--	10	10	0	0	7,22,29	24.6	VP*	Very Poor
30.0	57.0	641	31	26	42	0	1	13,27	32.6	16*	Fair
28.9	58.0	Mod-High	--	41	41	18	18	3,27,5,6	40.5	E	Exceptional
28.2	59.0	Mod-High	--	51	51	12	12	7,8,3,18	37.5	G	Good
26.7	119.0	631	34	51	64	15	17	3,5,8,11	38.5	46	Exceptional
25.5	124.0	1335	37	35	54	9	13	3,7,5	38.9	36	Good
13.0	166.0	569	32	40	56	12	15	5,19,3,6,7,8	39.0	38	Good
12.5	168.0	390	42	39	56	11	13	3,5,11,7,19,8,6	39.9	38	Good
4.1	246.0	2258	30	40	52	8	12	3,5,8,19,7	38.9	38	Good
Aurora Branch Chagrin River (existing WWH)											
17.1	1.1	60	34	34	53	1	2	27,26	19.6	10*	Poor
16.6	2.8	205	29	25	42	2	4	26	31.3	22*	Fair
14.5[+]	9.1	Mod-High	--	44	44	13	13	3,6	40.2	VG	Very Good
12.0	11.0	Mod-Low	36	29	59	8	9	3,33	39.2	[18*][d]	Marg. Good[d]
11.3	12.0	192	20	24	34	1	1	18,7	30.7	8*	Poor
11.0	12.2	1347	38	32	49	5	6	27	33.9	24*	Fair
9.1	15.1	335	43	57	79	17	17	5,27,3,8,6,28	39.2	48	Exceptional
5.7	31.4	535	40	65	76	22	24	3,2,1,11,5,14	40.5	54	Exceptional
3.5	48.8	1590	44	45	66	14	17	3,1,12,6	39.7	56	Exceptional
3.45A	48.8	Mod-Low	--	19	19	6	6	18,7	39.1	MG	Marg. Good
3.45 B	48.8	Mod-Low	--	17	17	6	6	18,5	38.9	MG	Marg. Good
3.4	48.8	Mod-High	--	34	34	11	11	3,8,5	41.5	VG	Very Good
1.6	55.5	1457	52	48	77	17	26	5,27,9,34	40.5	48	Exceptional
0.3	57.5	Mod-High	--	40	40	15	15	11,3,27,5,14	39.3	E	Exceptional
Beaver Creek (proposed CWH)											
2.4	1.4	Mod.	--	46	46	12	12	3,11,27	40.0	E	Exceptional

Table 12. (cont.)

Stream River Mile	Drainage Area (mi.^{2})	Rel. Density (#/ft.^{2})	No. Quant. Taxa	No. Qual. Taxa	Total No. Taxa	Qual. EPT[a]	Total EPT	Predominant Organisms	QCTV[b]	ICI	Narrative Evaluation[c]
Willey Creek (proposed CWH)											
0.2	5.2	Mod-Low	--	34	34	9	9	3,8,5,27,15	38.9	VG	Very Good
Griswold Creek (proposed CWH)											
0.1	7.2	Mod-Low	--	39	39	11	11	3,27,8	38.9	VG	Very Good
Silver Creek (proposed CWH)											
5.0[+]	2.5	497	57	49	88	15	23	6,3,11,12,21,32	40.0	52	Exceptional
3.9	4.1	401	50	40	69	14	23	3,27,8,1,6,11,9	40.5	56	Exceptional
1.9	11.1	3398	44	70	90	18	25	5,3,8,11,20,7,6	38.9	52	Exceptional
0.5	13.3	467	44	45	64	18	22	3,9,5,11,4,6	39.7	52	Exceptional
Sunny Lake Trib. To Aurora Branch Chagrin R. (RM 14.61) (WWH)											
0.1[+]	2.9	Mod.	--	24	24	5	5	6,29,3	38.5	MG[ns]	Marg. Good
Linton Creek (proposed CWH)											
0.1	1.9	Mod-High	--	31	31	9	9	5,3,2,11	41.6	VG	Very Good
McFarland Creek (EWH)											
0.1	10.8	Mod-High	--	26	26	8	8	1,3,5,28	38.9	G[*]	Good
Unnamed Trib. to Chagrin River (RM 22.81) (WWH)											
0.2	9.3	Mod-Low	--	24	24	6	6	18,8,3,7,27	38.9	MG[ns]	Marg. Good
Unnamed Trib. to Unnamed Trib. to Chagrin River (RM 22.81/2.17) (WWH)											
0.1	1.4	Mod.	--	27	27	3	3	5,8,3,18	34.8	MG[ns]	Marg. Good
Unnamed Trib. to Chagrin River (RM 15.42) Ref. Site (proposed CWH)											
0.3	1.7	262	61	39	78	14	22	3,5,8,12,6	42.4	46	Exceptional
Unnamed Trib. to Chagrin River (RM 14.88) (WWH)											
0.2	1.8	Mod-Low	--	13	13	4	4	8,15,3	38.5	MG[ns]	Marg. Good

Ecoregion Biocriteria: Erie-0ntario Lake Plain (EOLP)

INDEX	WWH	EWH
ICI	34	46

[a]-EPT=total Ephemeroptera (mayflies), Plecoptera (stoneflies), & Trichoptera (caddisflies) taxa richness.
[b]-Qualitative Community Tolerance Value (QCTV) is derived as the median of the tolerance values calculated for each qualitative taxon present (see discussion in Methods Section).
[c]-Qualitative narrative evaluation is based on best professional judgment utilizing sample attributes such as taxa richness, EPT richness, and QCTV score and is used when quantitative data are not available to calculate an Invertebrate Community Index (ICI) score.
[d]-Qualitative assessment used in lieu of quantitative score due to lack of requisite current velocity and/or vandalism of artificial substrates.
*-Significant departure from ecoregion biocriterion (>4 ICI units); poor and very poor results are underlined.
ns-Nonsignificant departure from ecoregion biocriterion (≤4 ICI units).
+-Sample collected in 1996.

Predominant organism code list

1 Isonychia mayflies	6 flathead mayflies	11 cased caddis	16 aquatic worms	21 damselflies	26 scuds	31 water bugs
2 Chimarra caddisflies	7 nonred midges	12 water pennies	17 Tricorythodes	22 fingernail clams	27 midges	32 dragonflies
3 Hydropsyche caddis	8 minnow mayflies	13 L-Hand snails	18 red midges	23 burrowing mayfly	28 crayfish	33 Atherix
4 snail-cased caddisfly	9 riffle beetles	14 moth larvae	19 bryozoans	24 various beetles	29 flatworms	34 Argia
5 Tanytarsini midges	10 river (RH) snails	15 blackflies	20 Caenis mayfly	25 isopods	30 tipulids	

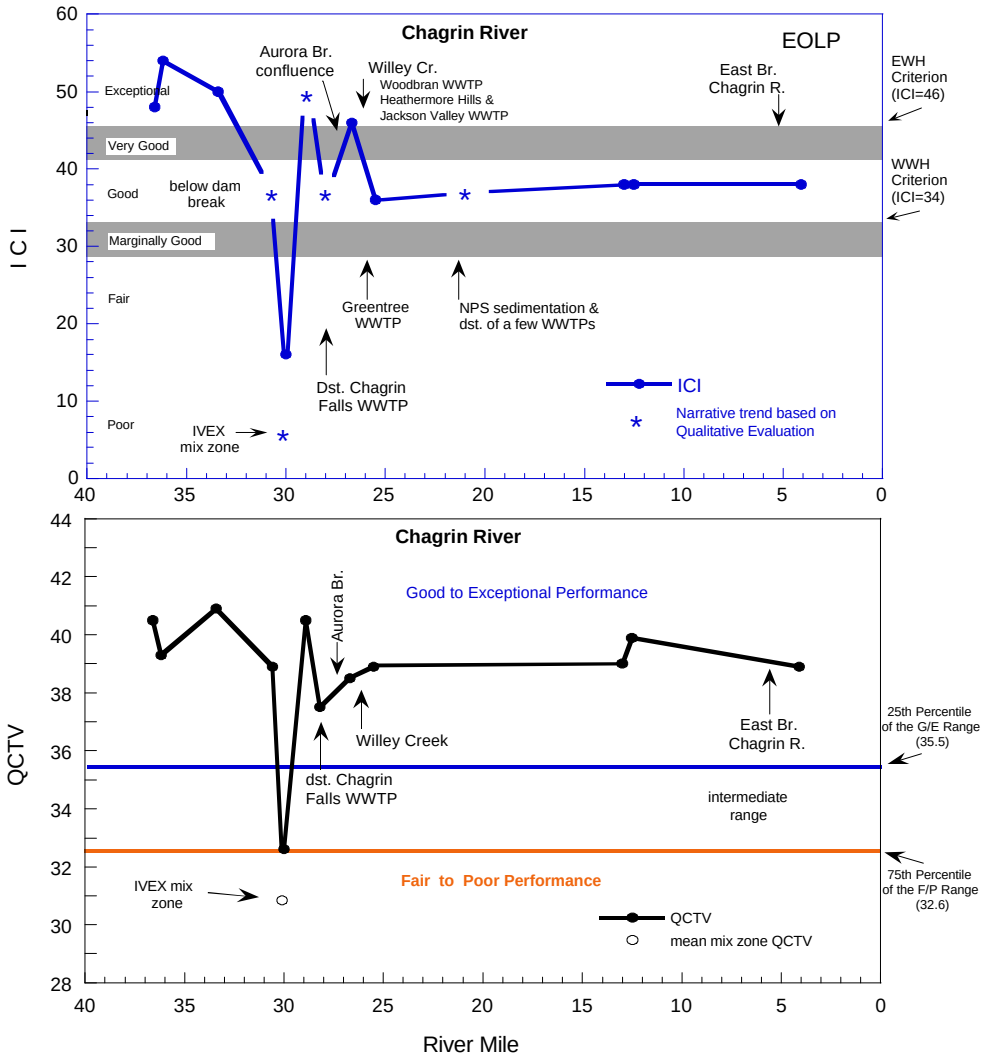


Figure 25. Longitudinal plots of ICI scores (upper) and QCTV values (lower) from the Chagrin River mainstem, 1995.

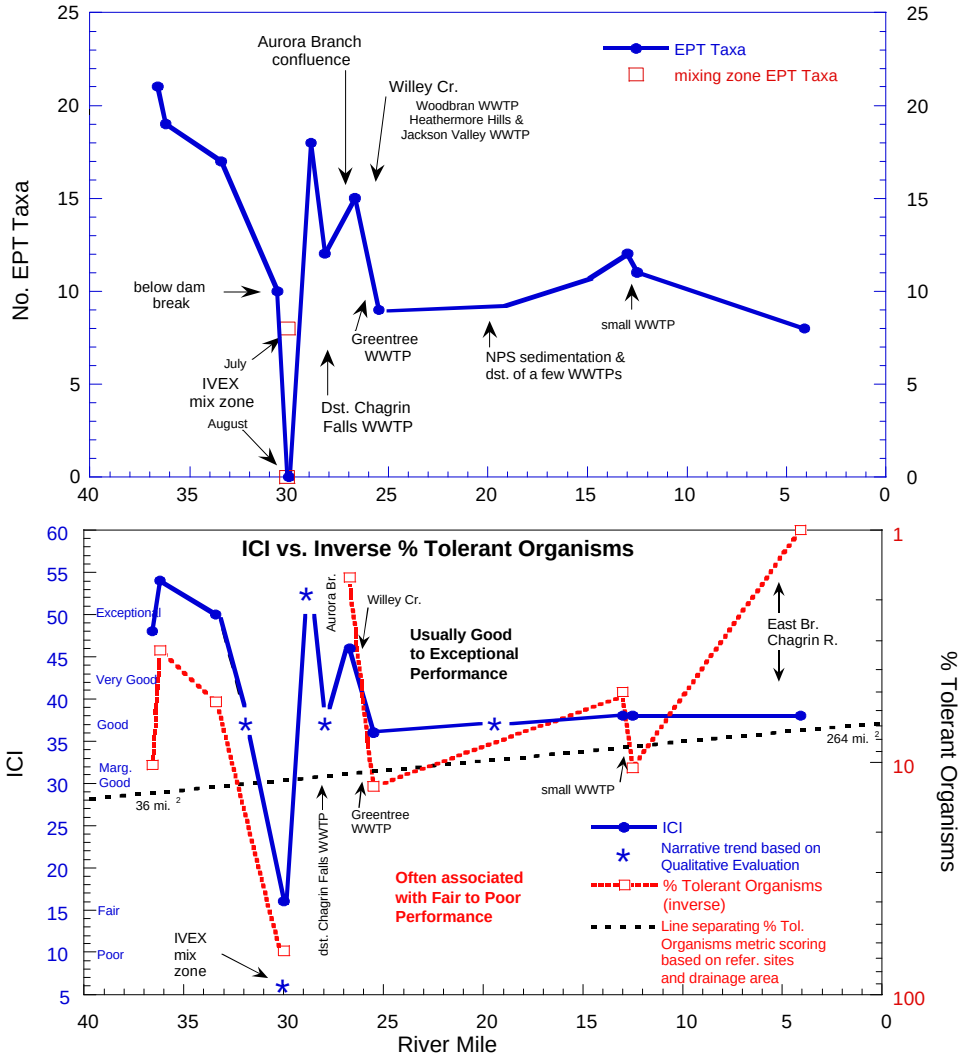


Figure 26. Longitudinal plots of EPT Taxa (ICI Metric 10) collected (upper)and a comparison plot of the ICI and Inverse % Tolerant Organisms (lower) from the Chagrin River mainstem, 1995.

Downstream from Ivex (RM 30.0) the macroinvertebrate community was predominated by tolerant taxa which resulted in an ICI score of 16 (fair) which did not meet WWH biocriteria. Severe organic enrichment was very evident with 'sewage fungus' covering all of the available natural substrates (similar to or worse than the mixing zone). These conditions limited the macroinvertebrate community to largely tolerant organisms that were not restricted by the normal minimum D.O. threshold requirements (5-7 mg/l). The high concentration of suspended solids in the Ivex effluent, the extremely high BOD and COD contributed markedly to localized low dissolved oxygen concentrations and thus limited the macroinvertebrate community. Another important factor were periodic ammonia-nitrogen concentrations (26.7 mg/l) from Ivex outfall 001 effluent causing acutely toxic conditions as noted on 8/10/95 due to a treatment plant upset (USEPA, 1976) (see Chemical Water Quality Section). No. EPT taxa were collected at RM 30.0 during qualitative sampling, and tolerant oligochaete worms comprised 41% of the organisms collected from the artificial substrates (Fig. 26). The toxic tolerant midge species *Cricotopus bicinctus*, *Dicrotendipes simpsoni*, and *Polypedilum illinoense* comprised 7% of the sample. Elevated mercury sediment concentrations also were likely contributing to macroinvertebrate community degradation and limited sediment use by some benthic organisms. Compared with the results of the previous surveys in 1986 and 1990, the macroinvertebrate community preformance was essentially unchanged which suggested a nutrient enrichment and a periodic toxicity problem, especially at late summer low flow conditions. Recovery occurred by RM 28.9 (upstream from Miles Rd.) with the macroinvertebrate community performance assessed as exceptional. The number of EPT taxa increased to 18 with a typical exceptional quality community present.

Downstream from the Chagrin Falls WWTP (RM 28.2), there was a decrease in macroinvertebrate performance to good from exceptional upstream. The EPT taxa collected during natural substrate sampling decreased 33% (18 to 12), and the QCTV score decreased to 37.5 from 40.5 previous upstream site. Increased algal production was evident within the stream which suggested a slight nutrient enrichment problem. A shift toward a midge-dominated community occurred with decreased caddisfly and mayfly representation. The particular absence of the caddisfly genera *Chimarra* and *Helicopsyche* and the mayfly genera *Isonychia* and *Leucrocuta* , all found upstram at RM 28.9, was noteworthy. The increase of more tolerant midges (i.e., *Cricotopus (C.) bicinctus*, *Chironomus (C.) decorus group* and *Polypedilum (P.) illinoense*) coincided with increased fecal bacteria loads and highly elevated or elevated trace or Heavy metals (arsenic, chromium, zinc, copper and mercury) in sediment from suburban sources (Table 9).

Below the Aurora Branch confluence downstream from Miles Rd. (RM 26.7) the macroinvertebrate community was of exceptional quality (ICI=46) and simlar to the lower Aurora Branch assemblage. Rare and/or sensitive caddisflies, like the microcaddisfly *Leucotrichia pictipes* and three species of the genus *Ceratopsyche*, were representative of the community present. Baetid mayflies, the midge genus *Rheotanytarsus*, and with hydropsychid caddisflies predominated the community. Well-oxygenated water, high gradient, and swift current are good physical attributes through this reach.

Downstream in the Chagrin Valley at RM 25.5 (upstream of old SR 422 - Chagrin Blvd.), the macroinvertebrate community attained the WWH bicriterion, but the ICI score of 36 (good) decreased substantially from an exceptional rating scored at the same site in 1986 (46) (Table 1). QHEI scores at adjacent sites were from 84 to over 91 which is indicative of exceptional habitat quality. Willey Creek, carrying several WWTP discharges (Heathermore Hills, Woodbran, and Jackson Valley), joins the Chagrin River upstream at RM 26.31. Upstream about 0.2 miles farther is an unnamed tributary into which the Greentree WWTP discharges. Substantially increased algal growth on rock substrates demonstrated the additional nutrient loadings. Slight to moderate sedimentation with some embeddedness was evident. Excess nutrient enrichment caused an abundance of midges, an increase in the percentage of tolerant organisms, and a decreased mayfly representation. These factors decreased several ICI metrics scores. A decrease in nutrient loadings could positively enhance community diversity and performance through this reach.

Along with nutrient enrichment due to suburbanization, increasing nonpoint (NPS) sedimentation is a major cause for concern in the lower 25 miles of the Chagrin River. NPS sedimentation inhibits permanent stream structure (riffle instability) and decreases community population diversity. Upstream from Fairmount Rd. (RM 21.0) in Hunting Valley is one particular reach where NPS sedimentation is a concern. Soft and shifting bottom substrates (sand and gravel) up to twelve inches deep buried any larger substrates present, and two attempts to retrieve artificial substrate samplers at this site failed due to being buried in the fine bottom sediments.

From RM 25.5 to RM 4.1 the macroinvertebrate community was assessed as good and attained WWH biocriteria. The QCTV values remained relatively high (38.9-39.9 $\geq$ 75th percentile) indicating potential for higher quality communities. Nutrient loadings and NPS sedimentation have precluded complete recovery to a more diverse community (e.g., the exceptional community below Aurora Branch confluence near Miles Rd. at RM 26.7), though QHEI scores within the middle reaches and through the North Chagrin Reservation were high and suggested EWH potential. An example was the drop in ICI scores at RM 25.5 (46 to 36) listed above, and there was a simlarly significant decrease in ICI scores at Fairmount Rd. (48 in 1986 to a narrative evaluation of good in 1995) (Table 1). Sources of degradation or potential impact sources included various WWTPs, failing home septic systems, stormwater runoff and construction sites (NPS sedimentation). The highest measured relative density at Todd Field (RM 4.1) of over 2250/m.^{2} clearly illustrated biological enrichment due to the accumulated nutrient load from the watershed.

Aurora Branch Chagrin River

Thirteen samples were collected from the Aurora Branch Chagrin River including the Geauga Co.-McFarland Creek WWTP mixing zone sample site (which was qualitatively sampled twice during the study). Nine of eleven substrate colonizers were recovered. One site, due to sampler vandalism, was assessed qualitatively along with those sites where the artificial substrates were not located or were out of the water at retrieval. The 1996 sample at RM 14.5 was a qualitative sample only.

In the extreme headwater reach (<3 mi.^{2}), the macroinvertebrate community was assessed as poor (RM 17.1) and fair (Rm 16.6) (Fig. 27). The poor community, consisting of primarily aquatic worms, leeches and tolerant midges (e.g., *Dicrotendipes simpsoni*, *Chironomus (C.) spp*., and *Psectrotanypus dyari*), was a reflection of severe nutrient enrichment combined with low gradient and slow current velocities. The stream was stagnant following the placement of the colonizer, and substrates were black and smelly. Possible sources which should be investigated incuded failing private septic systems and/or nutrients from NPS stormwater runoff. The site at RM 16.6 was downstream from Robin MHP WWTP, Jellystone Campground WWTP, and Carlon Products WWTP. The macroinvertebrate community at this sampling location improved to fair. The number of EPT taxa increased to four from two upstream, and the community structure improved with the presence of more mayflies, caddisflies and more sensitive midges on the artificial substrates (Fig. 28). The QCTV score increased from a low of 19.6 at RM 17.1 to 31.3 at RM 31.3. However, there was still approximately 40% of the individuals collected that were pollution tolerant or indicative of nutrient enrichment (Fig. 28). The point source discharges, especially the Carlon Products discharge (mostly sanitary), were augmenting the low stream flow in late summer, and the community improved. Just downstream, the Aurora Branch is a low gradient meandering stream with some groundwater recharge, beaver dams and slow current. In this reach natural water treatment processes occur, and upstream impacts are mitigated throughout this reach.

Downstream from Sunny Lake a very good macroinvertebrate community was observed at RM 14.5. Good habitat with various substrates was available, though moderate siltation was observed during sampling. Caddisflies, mayflies and riffle beetles were predominant with 13 total EPT collected. The QCTV score was 40.2 - well above the good/exceptional performance benchmark (Fig.28). Sunny Lake has historically produced documented toxic algal blooms caused by *Microcystus* spp. which possibly affects the Aurora Branch below the Sunny Lake Tributary confluence (RM 14.61) for a short distance. The macroinvertebrate community present indicated recovery from past periodic toxic algal blooms. A sample upstream from the Sunny Lake Tributary confluence would help clarify the indication of present episodic impacts from Sunny Lake algal blooms.

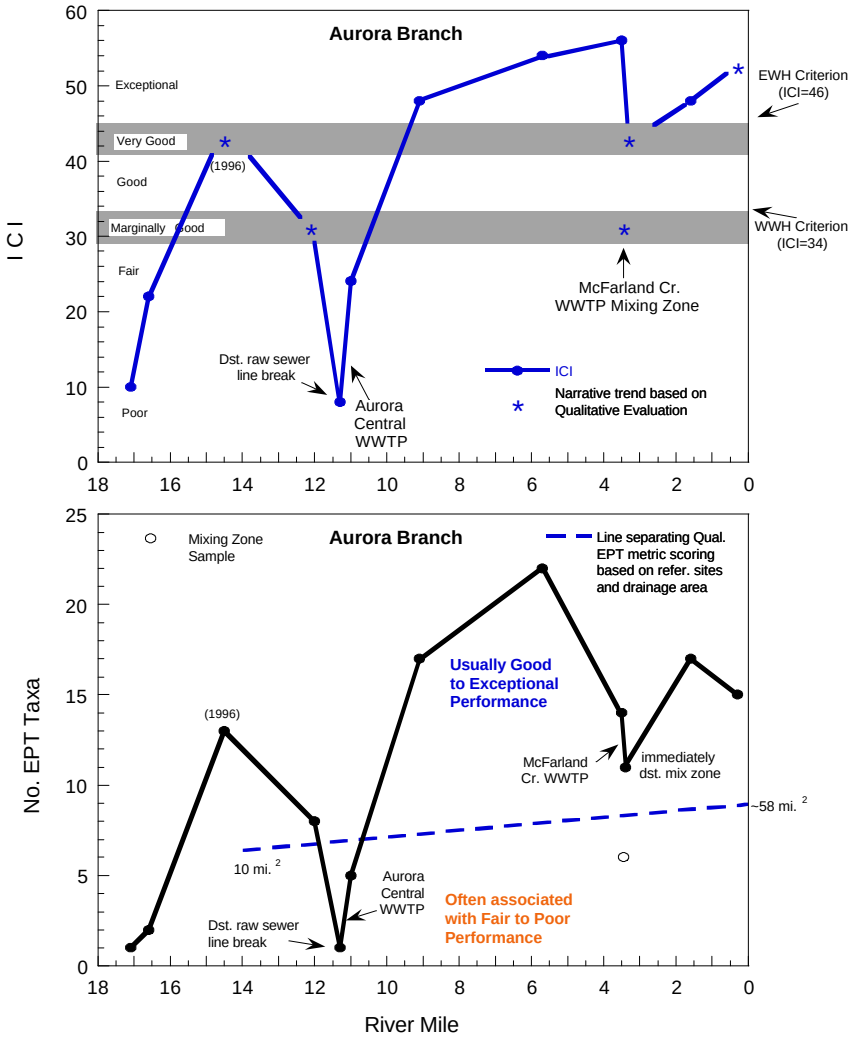


Figure 27. Longtudinal comparative plots of ICI scores (upper) and the number of EPT Taxa (ICI Metric 10) (lower) from the Aurora Branch Chagrin River, 1995 (except where noted).

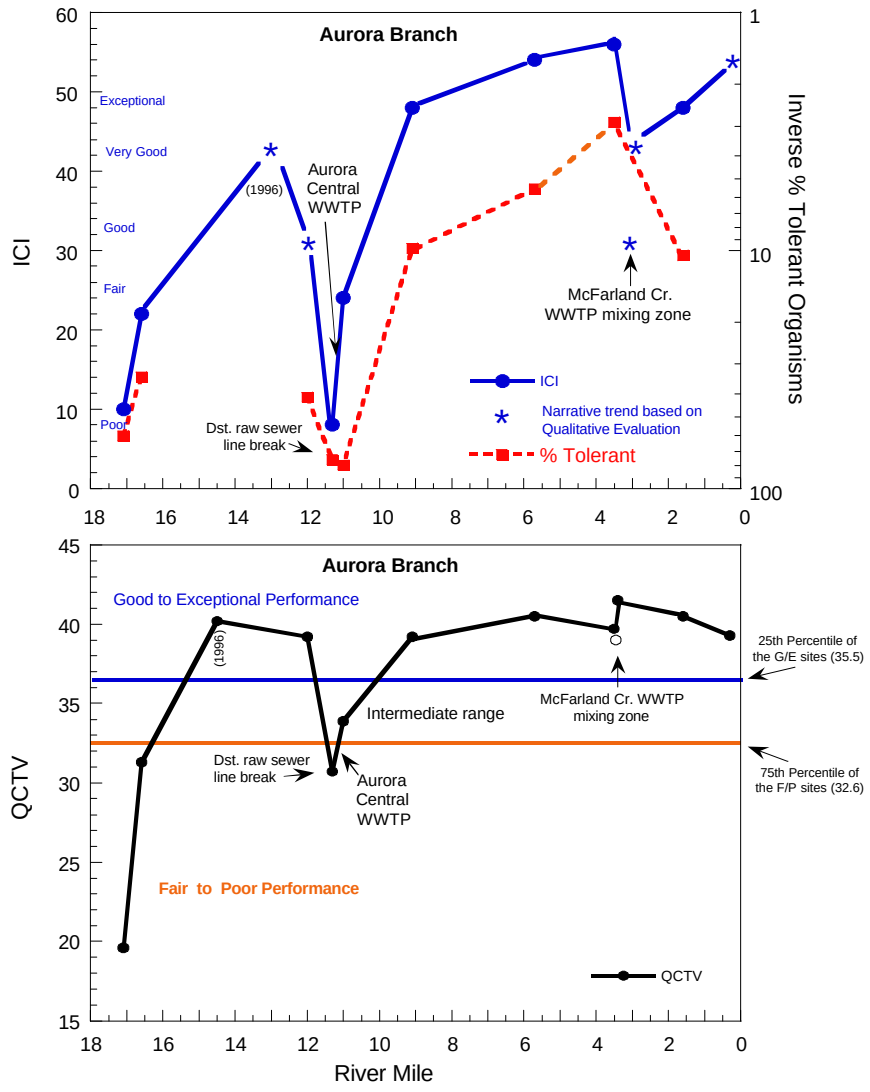


Figure 28. Longitudinal comparative plots of ICI scores and the Inverse % Tolerant Organisms (upper) and QCTV values (lower) from the Aurora Branch Chagrin River, 1995 (except where noted).

An additional site at SR 82 (RM 12.0), where the State Scenic River designation begins, was assessed because of the problems detected downstream near the Aurora Central WWTP. The marginally good community observed was being impacted by NPS sedimentation and a grayish septic water discharge from upstream. Clayey silt and organic deposition affected the more oxygen-sensitive mayfly and caddisfly taxa and facilitated the increase of more tolerant organisms and lowered diversity (Fig. 28). Caddisflies were still predominant where sufficient current was present. However, in areas with organic solids and clayey silt accumulation large numbers of *Atherix lantha*, a cool water dipteran predator, and aquatic worms indicated nutrient enriched conditions. Possible sources of this unknown septic discharge could be failing septic systems , NPS stormwater inputs, or a nearby food processing/packing plant. Investigation and location of the source(s) is warranted.

The reach near the Aurora Central WWTP was temporarily impacted by extreme organic enrichment from raw sewage due to a pipe break that possibly occurred during the colonization period (from 17 July 1995 or earlier); the break was discovered and repaired 28 August 1995. The gross pollution at RM 11.3 resulted in an ICI score of 8 (poor) (Fig. 28). Acutely toxic conditions were prevalent, as sewage fungus and black solids covered the natural and artificial substrates. There were D.O. and fecal coliform bacteria exceedences associated with this situation (Table 7). Relative density decreased to 192 organisms/m^2. The proportion of dipteran/non-insects (ICI Metric #8) was skewed to 98% of the number of organisms collected from the artificial substrates. Only one individual mayfly (the genus *Callibaetis*) was collected (Fig. 27). Pollution tolerant organisms comprised 76% of the sample. Included were aquatic worms, Physid snails, and midges of the genera *Chironomus (C.)* spp., *Polypedilum*, and *Psectrotanypus* midges (Fig. 28). A *Chironomus (C.) riparius* midge was observed with a labial plate deformity possibly attributable to the raw sewage input. Downstream from the Aurora Central WWTP, similar conditions were present though the community showed a slight improvement with an ICI score of 24 and a fair assessment. The sewage fungus was not as heavy, and six total EPT taxa were collected. Gross nutrient enrichment was still evident. The relative density increased from 192 organisms/$ft.^2$ at RM 11.3 to 1347 organisms/$ft.^2$ downstream at RM 11.0.

Exceptional or near exceptional macroinvertebrate communities were present from upstream SR 306 (RM 9.1) to the mouth; all sites achieved the WWH biocriterion throughout this stream reach which has historically supported an exceptional community. Once downstream from the Aurora Central WWTP, the ICI scores ranged from 48 to 56. The EPT taxa totals stayed relatively high throughout this reach (Fig. 27). Some sampling locations had enough temperature-sensitive taxa to qualify as coolwater (CW) macroinvertebrate communities. Some cw taxa collected through this reach were: the caddisfly *Ceratopsyche slossonae*, fishfly *Nigronia fasciatus*, and midges *Polypedilum aviceps*, *Parametriocnemus sp.* and *Zavrelimyia* sp.. Other intolerant or sensitive taxa collected through this reach included: the caddisflies *Ceratopsyche sparna* and *Leucotrichia pictipes*, the midges *Sublettea coffmani* and *Polypedilum laetum* group, and the mayflies *Baetis dubius*, *B. tricaudatus*, *Diphetor hageni*, *Acentrella sp*. and *Eurylophella sp.*.

The Geauga Co.-McFarland Creek WWTP acute mixing zone (RM 3.45) was determined to be not acutely toxic to macroinvertebrates and assessed as marginally good. The average number of EPT taxa collected in the acute mixing zone was six; the mean QCTV was 39.0. There could be an avoidance phenomenon occurring, as there was a slight decrease in EPT taxa present in the acute mixing zone beween 1991 and 1995. At RM 3.4 recovery is quickly occurring after the effluent is mixed. Eleven EPT taxa were collected just 0.05 river miles downstream from the 001 discharge; the sample QCTV value of 41.5 was the highest in the Aurora Branch (qualitative assessment of very good) (Fig. 28).

Less than two miles downstream from McFarland Creek WWTP, the total number of EPT taxa collected increased to totals similar to upstream sites prior to the WWTP (Fig. 27). However, there was a decrease in ICI (54 to 48) at RM 1.6 compared to upstream of the McFarland Creek WWTP (RM 3.5). The nutrient load influenced the community structure; tolerant or nutrient-loving organisms tripled (Fig. 28). The relative density was 1457 organisms/ft.^{2} indicating continued enriched conditions (Table 12). Care needs to be taken not to exceed the stream's assimilative capacity with increased loads which could decrease biological diversity.

Silver Creek

Silver Creek was sampled at four sites - three in 1995 and one follow-up sample in 1996 at a

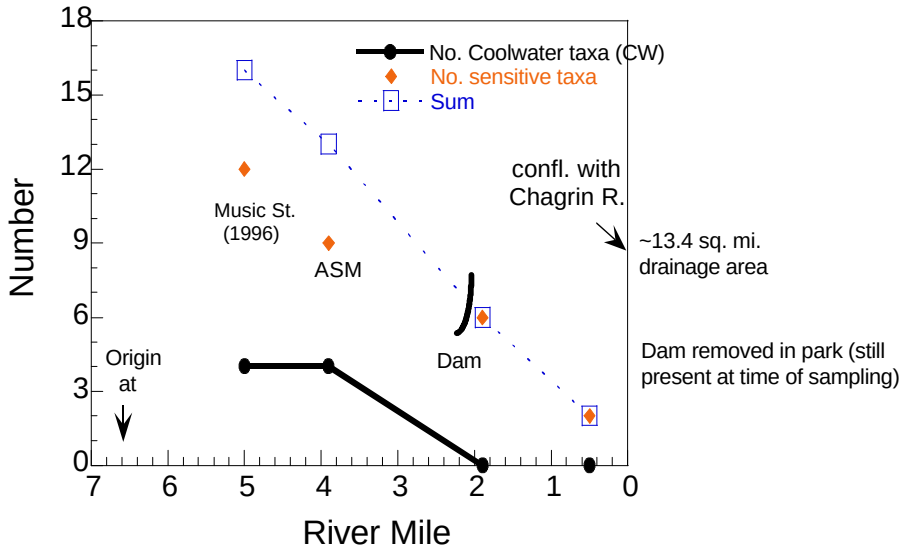


Figure 29. Longitudinal plot of number of coldwater taxa and sensitive taxa collected in Silver Creek, 1995 (except where noted).

site farther upstream. Silver Creek macroinvertebrate communities were exceptional at all sites (ICIs = 52 - 56). Many sensitive or pollution intolerant organisms were collected; 22 to 25 total EPT taxa were collected at all sites. The number of coolwater taxa (i.e., Nemourid stoneflies, the caddisfly genus *Dolophilodes* and four midge species) and other sensitive taxa decreased from upstream to downstream (Fig. 29, OEPA 1987b). After removal of the impoundment the temperature regime downstream should decrease. As a result, more coolwater and/or sensitive taxa should expand their range downstream.

The relative macroinvertebrate density at RM 1.9 increased ten times from 401/ft.^{2} to 3398/ft.^{2}. The higher relative density was indicative of more open riparian area near the former Geauga Co. Park impoundment where primary production was stimulated by excess nutrients from upstream (failing home on-site septic systems and unsewered areas near Paw Paw Lake and Lake Louise - South Branch Silver Creek). Soil runoff from suburban areas could cause embedded conditions limiting brook trout spawning areas.). Nutrients entering the Silver Creek watershed need to be limited, and wooded riparian habitat needs to be protected and expanded where possible to maintain the high quality macroinvertebrate communities necessary to support and undergird the native brook trout reintroduction and repopulation project.

Unnamed Trib. (U.T) to Chagrin River (confluence at RM 15.42)
Macroinvertebrates collected at this reference site reflected an exceptional coolwater community; the ICI was 46. Twenty-two EPT taxa were collected, and the 78 total taxa collected represented a diversehigh quality community. The QCTV of 42.4 was the highest in the survey and in the Erie-Ontario Lake Plain (EOLP) of Ohio. Over 25 percent of the organisms collected from the artificial substrates were from 10 coolwater taxa (Fig. 30). The high quality was attributed to an intact riparian zone, various unembedded substrates, secluded location, and minimal point and nonpoint impacts. For these same reasons this stream was being utilized by rainbow trout for spawning and rearing habitat.

Beaver Creek
Although some negative riparian influences as the result of past channelization and from agricultural activities are impacting downstream reaches, the upstream reach is still representative of an exceptional coolwater community. Some of the different coolwater taxa collected included the caddisflies *Diplectrona modesta* and *Frenesia sp*. and and the midges *Heterotrissocladius marcidus*, *Polypedilum aviceps* and *Paratanytarsus n. sp. 1*. Twelve EPT taxa were collected, and the QCTV was 40.0 which exceeded the 75th percentile value for good and exceptional macroinvertebrate communities collected in the EOLP ecoregion (Fig. 30).

Linton Creek
Linton Creek had a very good asssemblage of macroinvertebrates with a relatively high number of coolwater taxa collected at the sampling location near the mouth (RM 0.1). Some rare or sensitive taxa collected were the caddisflies *Ceratopsyche slossonae*, *Dolophilodes distinctus*, and *Glossosoma sp*. (all CW), and the dipteran *Clinocera (Clinocera) sp*.. The corresponding

QCTV was 41.6, and the midge genus *Rheotanytarsus* and caddisfly genus *Ceratopsyche* caddisflies largely comprised the predominant organisms (Fig. 30). The community present was apparently recovered from any temporary impact caused by an upstream impoundment that broke in 1994 (reported by a resident citizen on 8/28/95). Downed trees near the mouth were still evident at the time of sampling. There was concern over possible elevated bacterial concentrations near the mouth as another local citizen spoken to at the time of sampling told of incidences of sudden illnesses after short-term recreational contact with Linton Creek waters just upstream from the sampled area. This was approximately two miles downstream from two discharges - Living Homes WWTP and Geauga Co./Pilgrim Village WWTP; the latter has had NPDES violations from excess sewage deposition problems instream). The planned elimination of this discharge to Linton Creek will increase water quality and allow safer recreational opportunites.

McFarland Creek

Despite being dry near the mouth for four weeks in 1994 while an upstream impoundment was filled (Cannon Lake according to a local resident) and incomplete habitat recovery from SR 422 construction, a good community was observed at the sampling site near the mouth in 1995 (RM 0.1). However, macroinvertebrate community quality did not meet the EWH use designation expectations. Large numbers of the mayfly *Isonychia*, hydropsychid caddisflies, and tanytarsini midges predominated the community (Table 12). There was increased algal biomass accumulation where the canopy was open indicating some excess nutrient inputs upstream. Impoundments upstream and unrecovered riparian areas contributed to some increases in stream temperature at lower flows. Very soft, unstable sediments comprised of excess sand and small gravel were evident downstream from the highway construction. Given the current high qulaity habitat conditions as measured by the QHEI score of 72.0, it is very likely the macroinvertebrates will completely recover to an exceptional level if riparian regrowth continues and nutrient inputs from upstream are controlled.

Willey Creek

The macroinvertebrate community collected at RM 0.2 was assessed as very good. The largely intact riparian area with steep gradient and good oxygenation still supported a coolwater macroinvertebrate community. Four coolwater taxa were collected with some other sensitive organisms (Fig. 30). Noteworthy coolwater taxa collected were caddisflies *Dolophilodes distinctus* and *Diplectrona modesta*, and the midge *Polpedilum albicorne*. However the overall diversity was lower than expected (e.g., few mayfly taxa, no stoneflies, no riffle beetles) considering the potential exceptional quality habitat (QHEI=72.0). Lower diversity, the presence of more tolerant midges (e.g., *Chironomus (C.) spp*., *Polypedilum (P.) fallax gr*., and *Polypedilum (P.) illinoense*), and moderate numbers of blackflies are community structural changes that reflected the presence of effluent in Willey Creek from unsewered areas and three

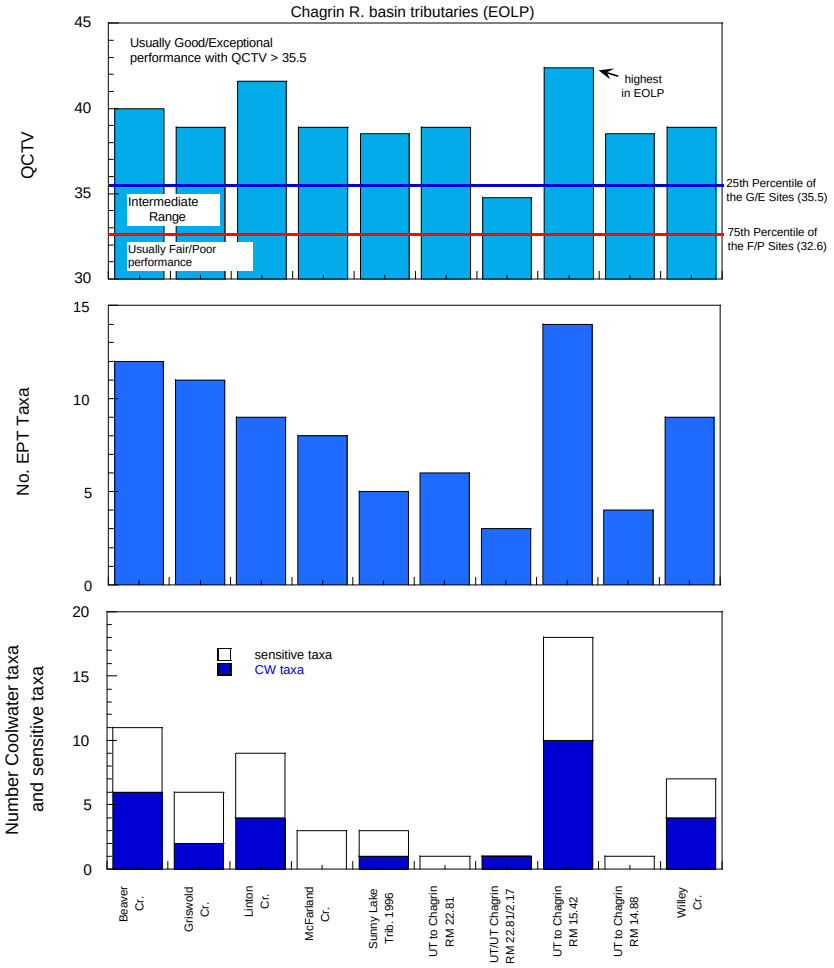


Figure 30. Comparative histograms of QCTV values, number of EPT taxa (ICI Metric #10), and the number of coolwater and sensitive taxa sampled at Chagrin River basin tributary sites, 1995-6.

WWTPs (Woodbran, Heathermore, and Jackson Valley WWTPs) that service Moreland Hills and the adjacent area. Any reduction in effluent volume or improved quality would positively enhance stream water quality, biological diversity, and allow safer public recreational contact.

Griswold Creek

The macroinvertebrate community collected from the Griswold Creek sampling location (RM 0.1) was assessed as very good and nearly achieved the EWH criterion. There were eleven EPT taxa collected, and the QCTV was 38.9 (Fig. 30). Also collected were the two coolwater taxa, the caddisfly *Dolophilodes distinctus* and the midge *Parametriocnemus sp.* along with other sensitive taxa (Fig. 30). High gradient (59.0 ft./mile) contributes to fast current velocites resulting in higher D.O. concentrations and lower stream temperatures instream reaches with an intact riparian zone. Hydropsychid caddisflies, baetid mayflies, and midges predominated the macroinvertebrate community. Community diversity could have been affected by some embedded and unstable conditions in the riffle and from possible impacts from malfunctioning septic systems just over 0.5 miles upstream (discovered during fish sampling by Bob Miltner, OEPA,1995). The pervasiveness of the problem of failing septic system discharges, among others in the watershed, factored in the pending construction of the Valley View WWTP (ACRT, 1996). Septic contamination in Griswold Creek will be decreased by the Valley View WWTP to be built in the extreme headwater reach of the creek.

U.T. to Chagrin R. (RM 22.81)

Threre was evidence of some nutrient enrichment at this sampling location (RM 0.2) as evidenced by algal production on the natural substrates and an unbalanced macroinvertebrate community structure. Though mayflies, caddisflies, and midges were predominant in the riffle/runs, flatworms and isopods were also very common. Large numbers of flatworms and isopods are often present under conditions such as excessive nutrient enrichment, solids deposition, and/or transitional recovery from episodic impact events (Hart and Fuller, 1974). Isopods were also common in the pools and margin. Tanytarsini midges were present but in lower numbers than the other midges present. Six EPT taxa were collected which indicated marginal presence of pollution sensitive taxa. Overall, the community was assessed as marginally good which did not meet the EWH expectations. The abundance of more tolerant transitional organisms is an ecological footprint best correlated to episodic wastewater problems upstream at the Pepper Hill and Creekside WWTPs (NPDES violations of TSS, $cBOD_5$, fecal coliform bacteria, and chlorine limits) and the total nutrient loading from all three WWTPs (including Woodland Glen WWTP). Reductions in pollutant loadings to the stream would improve water quality.

U.T. to U.T. to Chagrin R. (RM 22.81/2.17)

A marginally good macroinvertebrate community was resident at the sampling station (RM 0.1) located downstream from the Woodland Glen WWTP. Baetid mayflies, hydropsychid caddisflies and tanytarsini midges were the predominant organisms. The substrates were moderately embedded, probably due to a combination of riparian vegetation loss (stream abuts homes with some use of gabions where riparian vegetation was removed) and flashy erosional urban

stormwater runoff. This could have contributed to the lower EPT diversity observed. The number of pouch snails could be an artifact of past low D.O. problems in 1993 (see pollution loadings section), but they continue to thrive by utilizing the primary production from the WWTP nutrient inputs. Continuous D.O. data collected downstream from the Woodland Glen WWTP indicated good D.O. concentrations were being maintained (Table 8), so the macroinvertebrate community should improve over time unless the urban NPS effects are a more limiting factor.

U.T. to Chagrin R. (RM 14.88 - near Buttermilk Falls Pkwy.)
The macroinvertebrate community was assessed as marginally good at the sampling location near the mouth (RM 0.2). This small headwater stream (1.4 $mi.^2$ drainage) receives large amounts of runoff from urbanized Mayfield Heights. This flashy runoff (including urban NPS chemical inputs) decreased taxa diversity by chemical impacts and modifying habitat, as the large flow volumes widened the stream width and decreased riffle and run depths. Only four qual. EPT taxa were collected, but the QCTV scored 38.5 (near the median of 38.9 for exceptional and good sites in the EOLP ecoregion) (Fig. 30). It is noteworthy that some frogs were still present in pools and margins, and a salamander was collected and released during macroinvertebrate sampling. If stormwater runoff inputs can be slowed down or decreased (through use of stormwater retention ponds, wetland utilization or creation above the gorge, etc.), then recovery should be achieved. Possible steps to protect this area in the Chagrin Reservation, as a possible refuge for amphibians, needs to be explored.

Sunny Lake Trib. to Aurora Branch Chagrin R. (1996) (RM 14.61/0.61 - Sunny Lake outlet)
There was an nutrient enriched macroinvertebrate community collected at RM 0.1 downstream from eutrophic Sunny Lake. The community structure was a mixture of small numbers of sensitive good quality organisms with a much larger number of more tolerant and nutrient-loving organisms (flatworms, leeches, pond snails, aquatic worms). Predominant organisms were the mayfly genus *Stenacron*, flatworms and hydropsychid caddisflies. The very low number of pollution sensitiveorganisms indicated probable episodic impacts. There have been documented toxic *Microcystis* algal blooms from Sunny Lake. The macroinvertebrate community was assessed as marginally good with five EPT taxa collected and a QCTV score of 38.5 (Fig. 30).

Biological Assessment: Fish Community

Chagrin River Mainstem
Eleven locations plus one mixing zone were sampled to assess fish communities in the Chagrin River mainstem from RM 4.8 to 36.4 (Table 5 and location map,Table 13, Figure 31). Two significant point source discharges, the Ivex Corporation (formerly Chase Bag) and the Chagrin Falls WWTP were located on the mainstem in the study area (Table 5 and location map, Table 13). The fish community generally met WWH criteria at all locations sampled (Tables 1 and 13, Figure 31). However, the MIwb scores downstream from the Ivex mixing zone only marginally achieved WWH criteria, and were significantly lower than scores from all upstream sites. Also,

the IBI scores in and downstream from the Ivex mix zone marginally achieved the WWH criteria, but were significantly lower than the two most upstream reference sites and at sites downstream (Figure 31). An exception was the site bordered by two impoundments immediately upstream from the Ivex facility, where the IBI marginally met WWH criteria. The upper mill dam broke in August 1994 before the 1995 summer sampling survey. Although the IBI scores were the same for the two sites upstream and downstream from the Ivex mixing zone, component metrics of the IBI performed differently. The low score for the upstream site was driven by the presence of large numbers of young-of-the-year (YOY) bluntnose minnows in the second sampling pass. The presence of large numbers of YOY fishes in a sample may be more an artifact of temporal variation (Peterson and Rabeni 1995) than an indication of community integrity. The low score downstream from the Ivex mix zone was driven by the low relative abundance of intolerant fishes (Figure 32), and the high relative abundance of adult bluntnose minnows. Low relative abundance of intolerant fishes is generally indicative of toxic impacts, or disruption of normal trophic relationships through disturbance (*e.g.*, severe organic enrichment) (OEPA 1988). Massive growths of 'sewage fungus' (*Sphaerotilus* sp.) were present downstream from the Ivex discharge indicating gross organic enrichment. The performance of the fish community downstream from the Ivex discharge reflected this enrichment.

Downstream from the Ivex facility a low-head dam creates a long pool, followed by a natural waterfall. This combination allows for the assimilation of the less refractory component of the organic loads from the Ivex facility, and reaeration of the water column. Consequently, the fish community downstream from the Ivex facility recovered, as measured by the IBI, to near upstream reference conditions.

MIwb scores at sites downstream from the Ivex facility marginally achieved the WWH criterion (Figure 31). Both the IBI and MIwb scores at the location sampled downstream from the plant did not differ appreciably from the site upstream from the plant (Figure 31). Depth partially explains the low MIwb scores; However, the three sites (RM 30.0-28.0) immediately downstream from the Ivex mixing zone were generally shallow, yet those also had marginal MIwb scores, suggesting incomplete recovery from the more highly refractory components of the Ivex effluent combined with other nutrient load sources (*i.e.*, the Chagrin Falls WWTP, unsewered discharges). No significant localized impacts were detected with the Chagrin Falls WWTP. The IBI and MIwb scores at the location sampled downstream of the plant did not differ appreciably from the site upstream of the plant (Figure 31). RMs 24.2 and 19.4, where the MIwb scores were lowest, had the highest percentage of deep pool habitat of any of the sites sampled. The MIwb failed to attain WWH criteria at RM 24.2. The low abundance of fish in deep pool habitats indicates a protracted footprint from upstream loadings of nutrients, BOD, and solids in the stream segment downstream from Chagrin Falls.

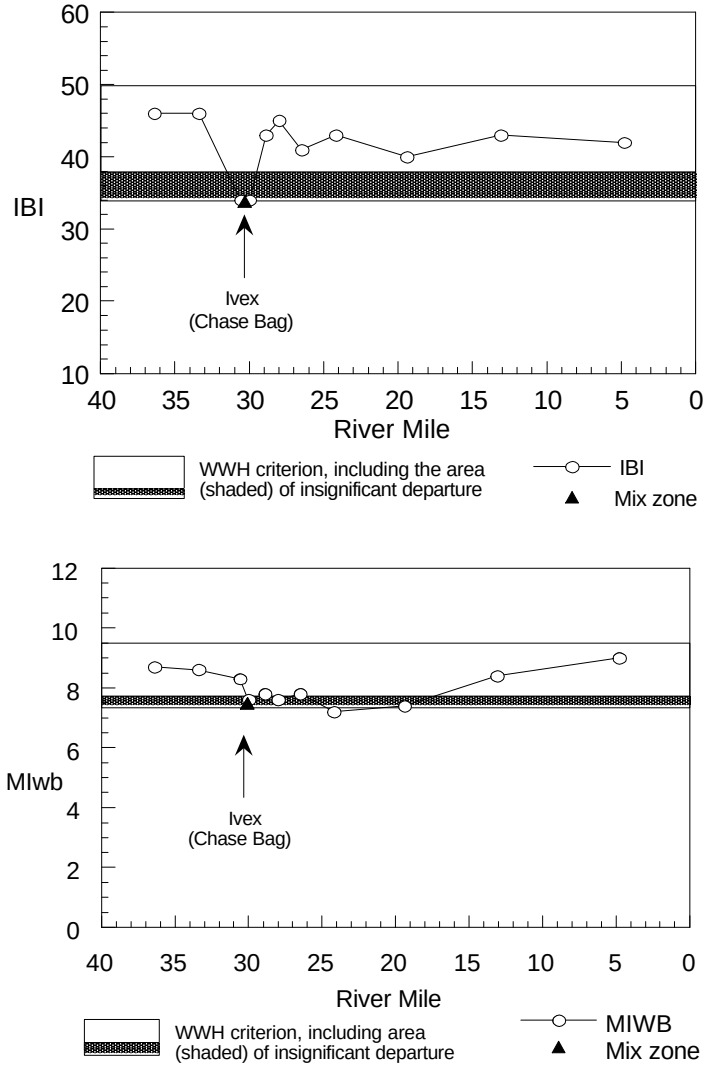


Figure 31. Longitudinal trends in the Index of Biotic Integrity (IBI - top) and Modified Index of well-being (MIwb - bottom) for sites sampled in the Chagrin River 1995 in relation to the Ivex discharge.

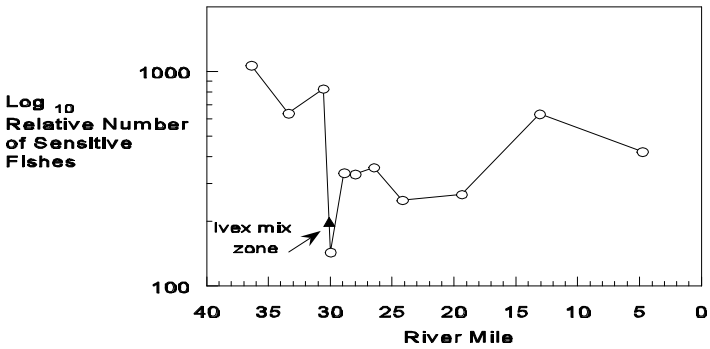


Figure 32. Relative number of sensitive fishes in relation to the Ivex discharge, 1995.

Aurora Branch Chagrin River

The fish communities in the Aurora Branch were sampled at nine locations plus a mixing zone, from RM 12.1 to 0.3. The communities met the WWH criteria at seven of the nine locations, but failed to meet at RMs 11.3 and 3.5 (Table 13, Figure 33). RM 11.3 was severely impacted by a sewer line break leading to the Aurora Central WWTP. The area impacted appeared to be localized , as the IBI scores at sites downstream of the plant and upstream of the sewer line break were the same, and met WWH criteria (Figure 33). Accordingly, effluent from the Aurora Central WWTP did not impact the fish community in comparison to upstream (RM 12.1) and downstream samples. The site at RM 3.5 was located downstream from the newly constructed US 422 and upstream from McFarland Creek WWTP. The fish community sampled at RM 3.9 in 1990, prior to construction of US 422, met WWH criteria (Table 13, also see *Trends in Biological Communities* below), indicating that run-off from the highway is degrading the community upstream from the plant. Index scores downstream from the McFarland Creek plant achieved WWH criteria, and improved at downstream locations (Figure 33), suggesting that the plant is not having a localized impact on the stream. Furthermore, the mixing zone sample collected at the plant did not show avoidance by fishes.

Although the fish community in the Aurora Branch generally realized the applicable WWH criteria, it was not a well balanced community, and showed signs of stress from anthropogenic sources at all locations except RM 0.3. Tolerant fishes (white sucker, creek chub and blacknose dace) composed a high percentage of all fishes sampled, whereas sensitive species (rosyface shiner), piscivores (rock bass and smallmouth bass) and darters were absent or present in lower abundance, especially at the upstream most sites. (It should be also noted that the above mentioned tolerant fishes are also the primary component of coolwater communities). RM 12.1,

a site upstream from all major point sources, was completely lacking in darters or sculpins even though the habitat was suitable. Biological survey data collected subsequent to the 1995 field study, showed rainbow darters present in Aurora Branch upstream from the Sunny Lake outlet, but not downstream. Sunny Lake is highly eutrophic and experiences blooms of the cyanobacter *Microcystis aeruginosa*. Toxins produced by *M. aeruginosa* may be responsible for the lack of darters downstream from the outlet. Also, the community at RM 5.6, located approximately 5.5 river miles downstream from the Aurora Central WWTP, was dominated by tolerant fishes. Marginal instream habitat, caused by narrow riparian vegetation and severe bank erosion permitting increased siltation, contributed to the limited fish community; however, the index scores performed independently of habitat scores in several cases, implying a more pervasive cause. A possible source impacting the fish community through this reach is the Funtime Inc. Geauga Lake Amusement Park WWTP. Recent data suggests problems with their effluent with high nutrient (ammonia and phosphorus), BOD and fecal coliform bacteria concentration discharges in excess of permit limits at potentially toxic levels (see discharger loadings section). Recovery of the fish community to a well balanced fauna at RM 0.3, a high gradient section, indicates that reaeration of the water column enables the recovery. This suggests that water quality is limited by oxygen demanding pollutants being contributed by wastewater discharges and unsewered residential areas, and implies that the assimilative capacity of the Aurora Branch is critically compromised.

Silver Creek

Silver Creek was sampled at three locations (Table 13). The downstream site (RM 0.5) met WWH criteria, but the upstream sites, RMs 1.7 and 4.0, did not. Silver Creek at RM 4.0 flows through a mix of swamp and marsh wetlands that potentially load oxygen demanding organic matter. Also, the bottom substrates, reflecting their wetland origin, were mostly sand and detritus. These two factors naturally limit the number of fish species present. Similarly, RM 1.7, situated downstream from a small impoundment and wetland, did not meet the WWH headwaters criterion.

Groundwater sustains high flow rates in Silver Creek, which, in turn, sustains a fish assemblage having a complexion resembling that of a moderate sized stream (i.e., high relative abundance of hog suckers, rock bass and smallmouth bass coupled with a complete absence of creek chubs). Therefore judging the communities at RMs 0.5 and 1.7 against the headwaters criteria underestimates their true nature as over 30% of the fishes are excluded from the scoring metrics. If judged against the wading criteria, which assumes a larger drainage area and different species mix, RM 1.7 would attain the WWH criteria. And, while true stenothermal coldwater fish species were not found, the high groundwater contribution adds a coldwater complexion to the stream that typically limits diversity (Lyons et al. 1996). Silver Creek is designated Cold Water Habitat (CWH) in the Water Quality Standards, and has supported stocked trout throughout the summer in the past.

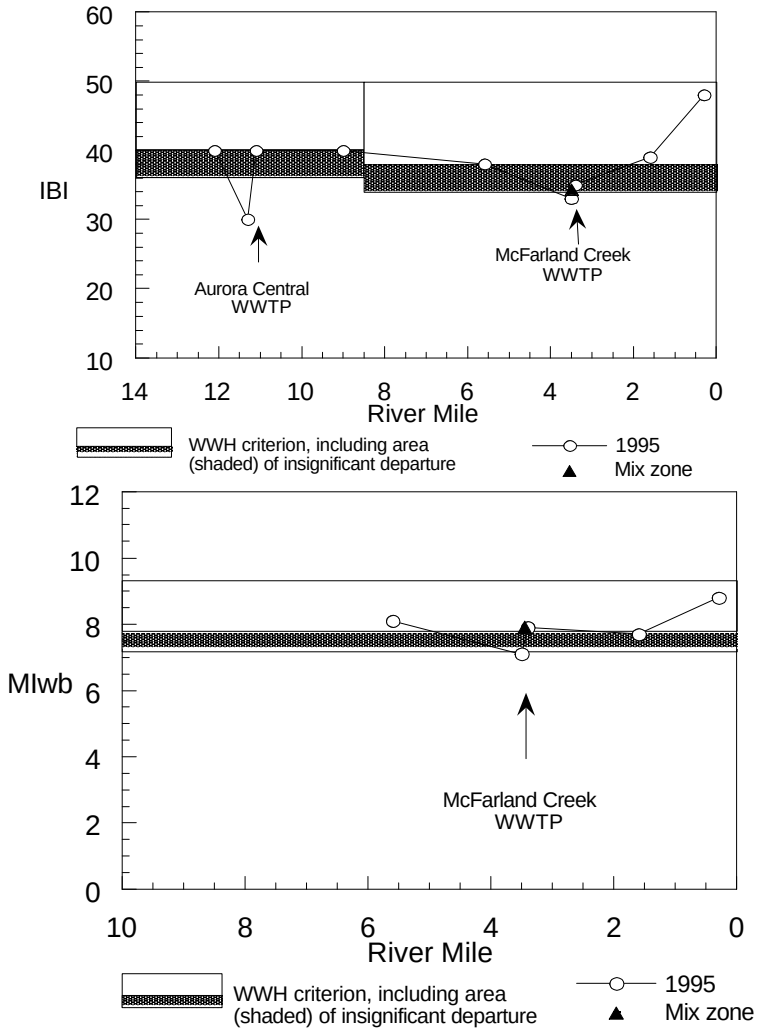


Figure 33. Longitudinal trends in the Index of Biotic Integrity (IBI - top) and Modified Index of well-being (MIwb - bottom) for sites sampled in the Aurora Branch in 1995, in relation to the Aurora Central WWTP and the McFarland Creek WWTP.

Table 13.
Fish

Community indices from samples collected in the Chagrin River basin study area for 1995, 1990 and 1986.

River Mile	Mean Number Species	Mean Cumulative Species	Mean Rel. No (No./0.3 km)	Mean Rel. Wt (wt./0.3 km)	QHEI	Mean Miwb[a]	Mean IBI	Narrative Evaluation
Chagrin River (1995)								
36.4	16.5	18	1147	14.4	80.5	8.7	46	Good/V.Good
33.4	15.0	17	710	26.9	83.5	8.6	46	Good/V.Good
30.6	16.5	18	1738	8.2	71.5	8.2	34^{ns}	Good/M.Good
30.08	*6.0*	*8*	*213*	*11.1*		*6.5^{*}*	*34^{ns}*	*Fair/M.Good*[b]
30.0	18.0	22	294	11.0	71.5	7.5^{ns}	34^{ns}	M.Good
28.9	14.5	16	376	38.7	80.0	7.8^{ns}	43	M.Good/Good
28.0	19.5	23	434	25.1	78.0	7.6^{ns}	45	M.Good/Good
26.5	12.5	17	371	17.5	85.5	7.4^{ns}	41	M.Good/Good
24.2	16.5	19	269	15.1	79.5	7.2^{*}	43	Fair/Good
19.4	16.5	21	355	8.8	80.5	7.4^{ns}	40	M.Good/Good
13.1	17.0	23	656	8.9	71.0	7.3^{*}	43	Fair/Good
4.8	21.0	24	720	17.5	69.0	9.0	42	V.Good/Good
Chagrin River (1990)								
33.4	NA	15	954	22.6	82.0	8.3	45	Good
29.4	NA	20	363	23.8	70.0	7.4^{ns}	35^{ns}	M. Good
Chagrin River (1986)								
33.4	21.3	NA	538	NA	83	8.3	46	Good/V.Good
30.6	20.7	NA	1526	NA	78	8.6	36^{ns}	Good/M.Good
29.9	18.0	NA	175	NA	82	7.8^{ns}	36^{ns}	M. Good
29.0	18.3	NA	362	NA	77	7.9	45	Good
28.3	16.3	NA	562	NA	76	8.0	43	Good
26.5	18.3	NA	542	NA	84	8.2	44	Good
25.2	15.0	NA	315	NA	80	6.9^{*}	40	Fair/Good
20.8	21.0	NA	649	NA	76	8.2	43	Good
12.5	18.0	NA	298	NA	70	7.3^{*}	43	Fair/Good
4.0	21.3	NA	497	NA	76	7.9	44	Good
Aurora Branch (1995)								
12.1	13.0	13	1374	15.6	65.0	-	38	M. Good
11.3	11.0	14	724	7.7	74.0	-	30^{*}	Fair
11.1	14.5	19	1780	30.1	71.5	-	38	M. Good
9.0	13.5	15	1121	14.1	81.5	-	38	M. Good
5.6	13.0	14	2174	12.9	70.5	8.1	38	Good
3.5	14.5	16	1289	9.7	69.0	7.1^{*}	33^{*}	Fair
3.45	*12.0*	*14*	*3225*	*11.9*		*7.9*	*35^{ns}*	*Good/M.Good*
3.4	18.0	20	1188	10.5	75.0	7.9	38	Good
1.6	18.5	21	833	15.6	59.5	7.7^{ns}	39	M.Good/Good
0.3	20.5	24	922	37.8	79.5	8.8	48	Good/V.Good
Aurora Branch (1991)								
11.3	NA	11	2007	7.7	78	-	32^{*}	Fair

River Mile	Mean Number Species	Mean Cumulative Species	Mean Rel. No (No./0.3 km)	Mean Rel. Wt (wt./0.3 km)	QHEI	Mean Miwb[a]	Mean IBI	Narrative Evaluation
Aurora Branch (1991) (cont.)								
11.2	*NA*	*10*	*1191*	*32.0*		-	*25*	*NA*
11.1	NA	13	1143	16.3	80	-	27*	Poor
9.0		12	1995	9.2	78	-	36	M.Good
Aurora Branch (1990)								
9.0	NA	12	1218	9.9	80	7.4[ns]	32*	M. Good/Fair
3.9	NA	15	1329	12.7	82	7.9	38	Good
3.4	NA	12	2004	24.2	-	8.0	37[ns]	Good/M. Good
3.3	NA	17	872	8.5	71	6.6*	36[ns]	Fair/M. Good
0.3	NA	20	1359	29.0	76	8.3	41	Good
Aurora Branch (1986)								
0.3	15.7	NA	1321	NA	63	8.1	37	Good/M. Good
Silver Creek (1995)								
4.0	8.0	8	172	2.3	69.5	-	30*	Fair
1.7	16.0	19	247	12.6	76.0	-	35*	Fair
0.5	16.5	18	228	18.0	61.5	-	40	Good
Griswold Creek (1995)								
0.9	7.0	7	978	1.9	63.5	-	32*	Fair
Willey Creek (1995)								
0.5	17.0	17	656	5.0	72.0	-	44	Good
McFarland Creek (1995)								
0.1	13.0	13	1500	5.0	72.0	-	46	V.Good
Unnamed trib - confluence at RM 15.42 (1995)								
0.4	8.0	8	602	2.7	75.5	-	48	V.Good
Unnamed trib - confluence at RM 15.42 (1987)								
0.2	12.0		1611	NA(qual.)	74	-	48	V.Good
Unnamed trib - confluence at RM 22.81 (1995)								
0.3	16.0	16	630	4.4	60.5	-	50	Exceptional
Unnamed trib - confluence at RM 14.88 (1995)								
0.2	2.0	2	158	1.0	57.5	-	20*	Poor
Sunny Lake Tributary - confluence at RM 14.61 (1996)								
0.1	10.0	10	NA(qual.)	NA(qual.)	64.0	-	26*	Poor

Ecoregion Biocriteria: Erie-Ontario Lake Plain

	IBI		MIwb[a]	
Site Type	WWH	EWH	WWH	EWH
Headwaters	40	50	NA	NA
Wading	38	50	7.9	9.4

a - MIwb is not applicable to headwater streams with drainage areas ≤ 20 mi^2.
b - *Italicized rows* are *mixing zones* and criteria do not apply.
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.

A failing dam was present at RM 1.9. The creek bed behind the dam has accumulated fine sediments, which are expected to move downstream as the dam is slowly removed. No adverse impacts to the fish community are expected as it does not contain sensitive or rare species, and the habitat downstream from the dam is already composed of a high proportion of fine sediments.

Unnamed Tributary to Chagrin River at RM 15.42

This relatively undisturbed, small headwater stream had a near exceptional fish community owing to a mature riparian corridor. Four rainbow trout were collected in early August, indicating the ability of this stream to support a cold water fauna throughout the year.

Griswold Creek

Tolerant fishes composed a large percentage of the fishes sampled in Griswold Creek; consequently, the community did not meet WWH expectations. A poorly maintained septic bed serving several houses was discharging black sludge directly to the creek toward the upstream end of the sampling zone. Whether this particular septic discharge caused the impairment or merely contributed to it is unknown, but it is likely symptomatic of a more pervasive problem given the prevalence of unsewered houses in the area. A consultant's survey in 1996 documented a decline in IBI scores at RM 0.9 relative to an upstream site and also cited septic pollution as source of water quality degradation (ACRT 1996, Table 1). The upper and middle reaches scored good and very good with some remnant coldwater fish taxa (i.e., redside dace, brook stickleback) (ACRT 1996).

Willey Creek

The fish community in Willey Creek met WWH criterion. Five sensitive species were found, but composed a small relative number of the total sample, and tolerant and pioneering fishes were abundant. This condition suggests some stress on the fish population. A combination of degraded water quality and altered flowed regimes may be responsible. The upper drainage is predominated by highly developed residential areas with a high percentage of impervious surfaces leading to flashy stream discharges. Also, Willey Creek receives effluent from the Woodbran wastewater package plant.

Unnamed Tributary to the Chagrin River at RM 22.81

Like Willey Creek, UT 22.8 drains residential areas on the west side of the Chagrin River valley, and receives effluent from small package WWTPs. Surprisingly however, an exceptional fish assemblage was collected here. A difference between this tributary and Willey Creek may be the presence of numerous small instream impoundments in the upper portion of UT 22.8 acting to help dampen flow peaks during storm events.

Unnamed Tributary to the Chagrin River at RM 14.88

Although the physical habitat in this tributary was sufficient to support a fish fauna capable of meeting the WWH criterion, only two species of fish, creek chub and blacknose dace, were collected. The exclusive presence of two tolerant, pioneering and headwater species, along with the fact that this tributary drains the heavily urbanized Mayfield Heights area, suggests that the stream experiences large and rapid fluctuations in stream flow. Signs of severe periodic flooding (severe bank erosion, wide stream channel for the drainage area, a well defined high water mark) were noted in the habitat evaluation, evidence for altered stream flows.

McFarland Creek
The fish community in McFarland Creek met the expectation of EWH criterion, having been spared impairment of habitat from extensive real estate development in the watershed.

Biological Community Trends, 1986-1995

Fish Community Trends, 1986-1995

Chagrin River, 1986-1995
The IBI scores measured downstream from the Ivex facility were nearly identical between 1995 and 1986, demonstrating continued impact on the Chagrin River by Ivex. MIwb scores were slightly lower in the reach downstream from Chagrin Falls in 1995 compared to 1986, but higher at the two downstream most locations. This pattern may reflect suppression of the community due to the Ivex discharge followed by augmentation due to release of nutrients. Cumulatively, the lowered community scores resulted in less miles in full attainment status and more miles in partial attainment status (Table 14), reflecting the slow, pervasive deterioration due to suburban development.

Aurora Branch Chagrin River, 1986-1995
Improved performance of the fish community downstream from the Aurora Central WWTP was observed in 1995 compared to 1991 owing to upgrades in the plant. However, IBI scores were similar upstream from the plant between surveys. In 1995, raw sewage was entering Aurora Branch upstream from the plant due to a sewer line break. Upstream from the sewer line break, a septic odor and dark sediments were still noted, indicating a more pervasive problem. Additionally, elevated levels of fecal coliform bacteria upstream from the plant were noted in 1991, although a sewer line break was not evident. Because the IBI score upstream from SR 82 (RM 12.1) was similar to scores downstream from the Aurora Central plant, the impact appears confined to the reach from SR 82 to Aurora Central. Given that septic or sewage impacts were noted upstream from the plant in both survey years (and by a private consulting firm in 1994), and because the impact appeared confined, it appears that unsewered discharges are entering the stream, or the integrity of the sewer line is compromised in more than one location. A follow up survey by a consulting firm in 1996 (EnviroScience 1996) showed biological communities

depressed at RMs 11.1 and 9.0 relative to 1995 - possibly indicating continued impacts from the sewer line break or upsets at the plant.

Community performance downstream from the McFarland Creek WWTP was similar between surveys in 1990 and 1995 at the mixing zone and near-field sites, and improved at the far field site (RM 0.3), possibly reflecting improved plant performance. A measurable decrease between surveys was detected upstream from the plant, however, due to construction of US 422, where IBI scores in 1995 decreased to 33 from 38 in 1990 (Figure 35). Together, the improved performance of both plants resulted in more miles in full attainment of the biological criteria, and less miles in partial attainment. The sewer line break upstream from Aurora Central WWTP resulted in a 0.6 additional miles in non-attainment (Table 14).

Silver Creek, 1975-1995

Silver Creek was previously sampled in 1994 and 1975 by outside sources. A summary of these results are available in ACRT (1994). Briefly, the upper headwater reaches of Silver Creek contained a more diverse fauna prior to construction of low-head dam and mainstem impoundments within the watershed. In 1975, least brook lamprey and smallmouth bass were found upstream from SR 87, but in 1995 they were restricted to the reach downstream from SR 87 because of an impoundment. The dam at SR 87 has been recently breached, and the stream is being allowed to regain free-flowing characteristics that may allow recovery of the fauna.

Table 14. Area of Degradation (ADV) statistics for similar segments of the Chagrin River and Aurora Branch, sampled in different survey years.

	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
Chagrin River												
1995												
IBI			34	46	41.1	0	0.0	0.0				
MIwb	33.4	1.6	7.2	8.6	7.69	71	2.2	1.52	18.3	13.5	0.0	0.0
ICI			16	50	37.6	68	2.1	22.87				
1986												
IBI			36	47	42.5	0	0.0	0.0				
MIwb	33.4	1.6	6.9	8.6	7.9	42	1.3	2.06	25.8	6.0	0.0	0.0
ICI			26	48	41.2	10	0.3	6.81				
Aurora Branch												
1995												
IBI			30	48	38.4	51	4.3	15.8				
MIwb	12.0	0.3	7.1	8.8	7.95	6	0.5	2.4	9.8	1.9	0.3	0.3
ICI			8.0	56	38.2	180	15.0	40.18				
1991-90												
IBI			26	42	33.1	130	24.7	16.1				
MIwb	11.3	0.0	5.8	8.3	7.14	144	16.0	13.42	3.9	7.0	0.4	0.4
ICI			40	54	47.0	0	0.0	0.0				

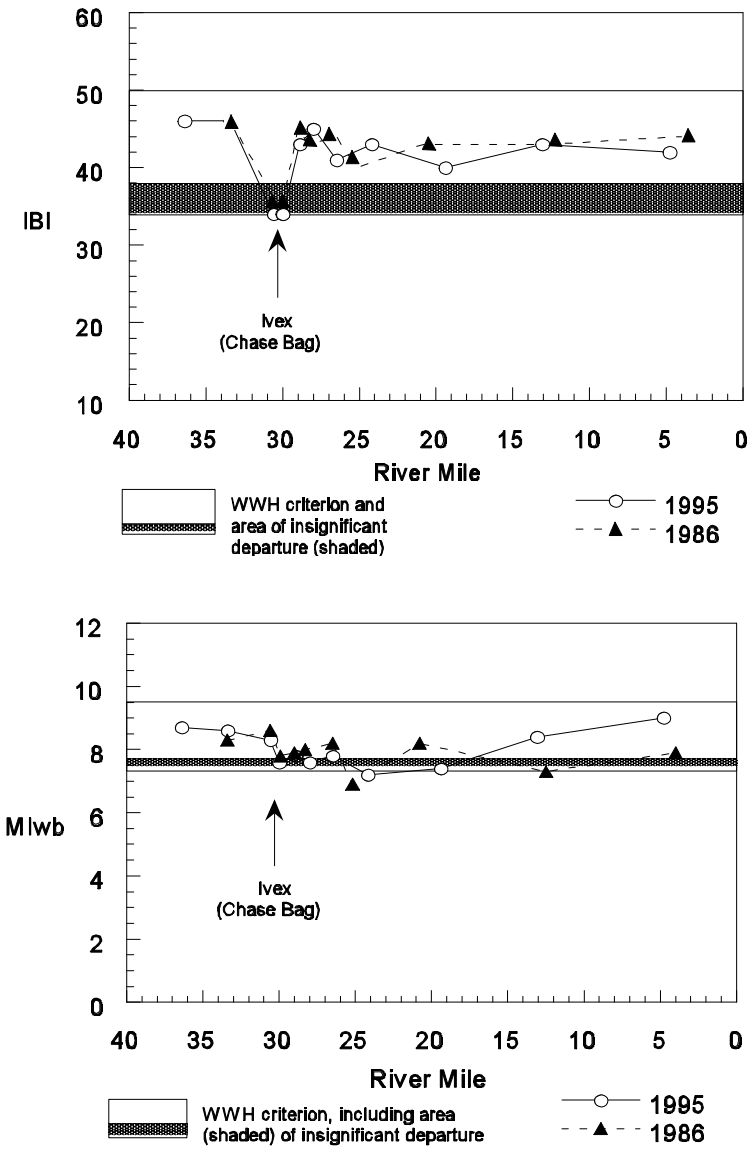


Figure 34. Longitudinal trends in IBI (top) and MIwb (bottom) scores for the Chagrin River by river mile for 1995 and 1986 in relation to the Ivex discharge.

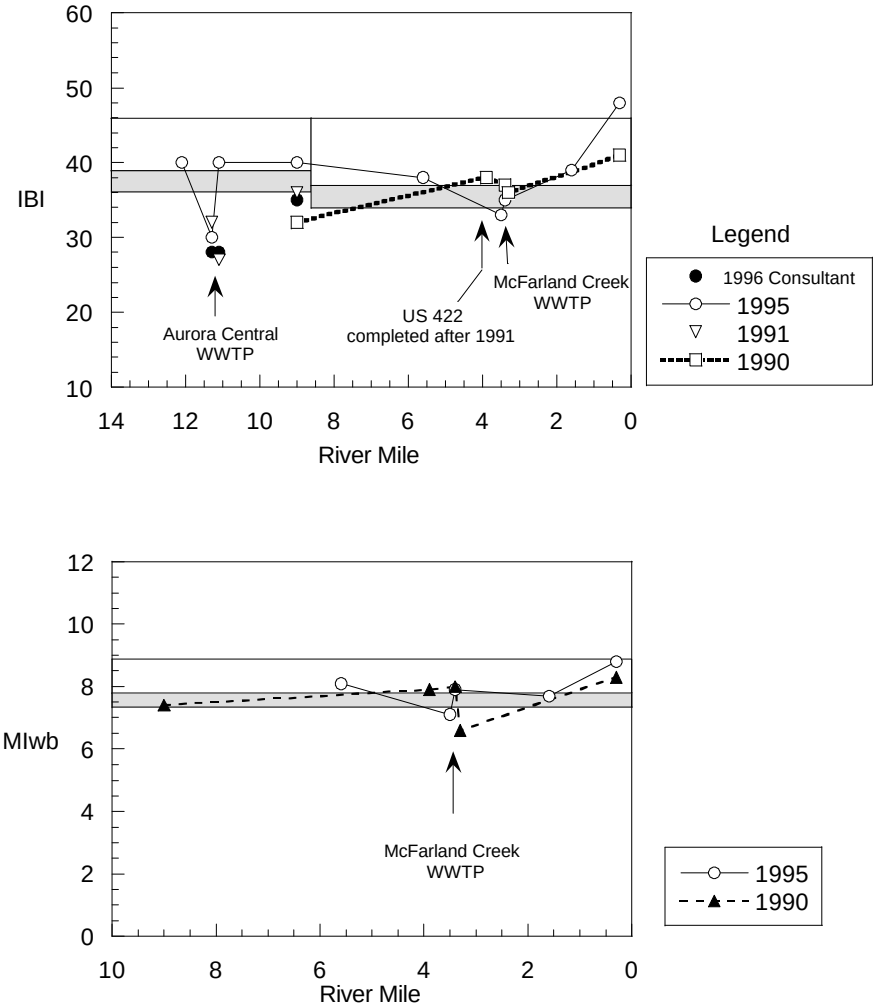


Figure 35. IBI (top) and MIwb (bottom) from similar sampling location in the Aurora Branch, 1990-1996. Note that 1996 IBI scores are from EnviroScience, Inc, consultants. The shaded box represents the area of insignificant departure from the Warmwater Habitat biocriteria.

Macroinvertebrate Community Trends, 1986-1995

Chagrin River, 1986-1995

The upper reach above the dam lakes still harbors an exceptional macroinvertebrate community (Fig. 36). Since 1986 there have been increases in suburban wastewater loadings and NPS runoff. Associated with the phenomena of suburbanization are substantially increased fecal bacteria loadings, flashy stormwater runoff which greatly increases erosion through construction areas, decreased habitat diversity in higher gradient streams, increased fine silt deposition (relating to cleared ground/ construction), or unstable migration of bottom substrates. Correspondingly there has been a decrease in the number of EPT taxa collected between 1986 and 1995 (Fig. 36). At RM 33.4 (an EOLP ecoregion reference site) the 29 EPT taxa collected in 1986 was among the highest collected at any one site statewide. Conversely in 1995, only seventeen EPT were collected at this site which was a 40% decline (Fig. 36). In addition, the highest fecal coliform bacteria concentration collected in this survey was from this site (Table 7).

The impact of Ivex facility on Chagrin River macroinvertebrates was worse in 1995 than in 1990. The 1990 ICI at RM 30.0 was 26 compared to 16 in 1995 (Fig. 36). No EPT were collected from the natural substrates downstream from Ivex at RM 30.0 in 1995 - a 100% decrease from upstream. This impact is increased compared to a 64% decrease in 1990 and 41% decrease in 1986 of EPT collected downstream from Ivex (Fig. 36). Survey sampling in 1995 was completed prior to completion of treatment upgrades at Ivex. Follow-up will be needed to assess whether the improvements will translate to improved macroinvertebrate community performance downstream from Ivex.

1995 ICI scores were significantly lower downstream from Willey Creek (36 at RM 25.5 vs. 46 in 1986) and slightly lower from RM 21.0 to the lowest downstream site at RM 4.1 in 1995 compared to 1986 (Fig. 36). The proportion of tolerant organisms collected from the artificial substrates increased by an order of magnitude downstream from Willey Creek and was elevated until downstream from the East Branch Chagrin River confluence (Fig. 36). The EPT taxa collected through this reach in 1995 was significantly decreased from the 1986 totals (Fig. 36).

The decrease in EPT diversity appeared to be largely due to effects from suburbanization. Growth increases have increased the accumulated wasteload volumes from the many WWTPs. Other sources of impacts are failing home septic systems and NPS stormwater runoff. This causes more sedimentation, higher fecal bacteria counts, and flashier runoff which has increased erosion and lowered insteam habitat diversity.

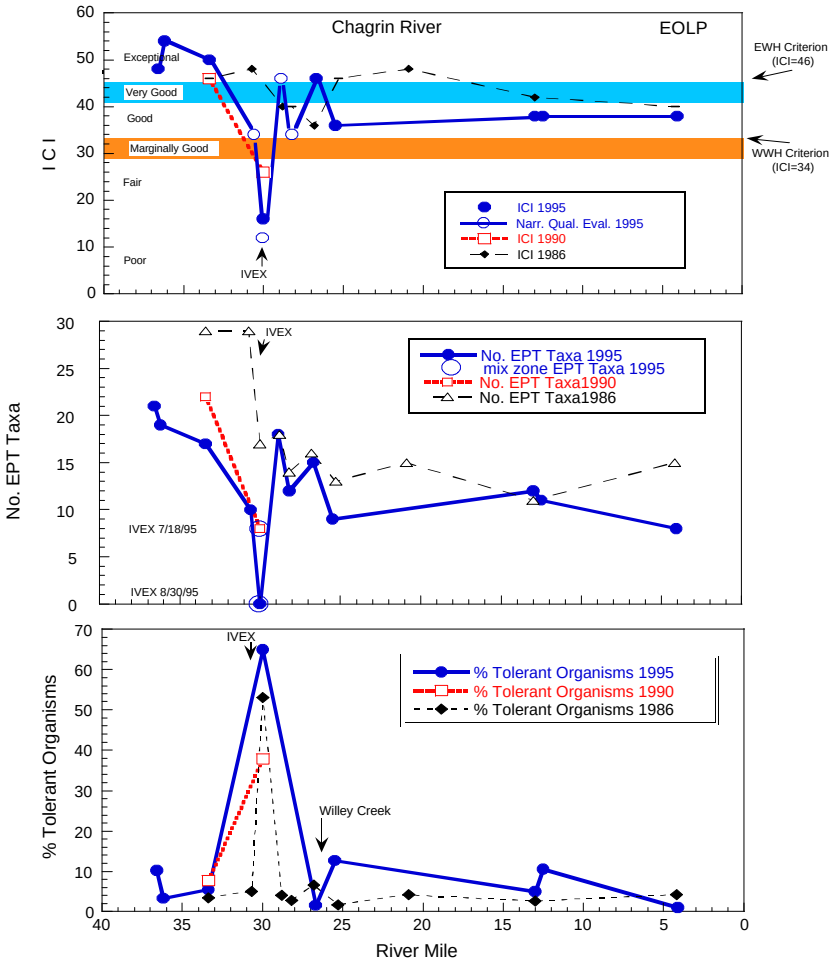


Figure 36. Trend plots for ICI/Narrative Qualitative Assessment scores (upper), Number of EPT Taxa, and Percent Tolerant Organisms (lower) for Chagrin River surveys, 1986 -1995.

Aurora Branch Chagrin River, 1986-1995

The reach upstream and downstream from the Aurora Central WWTP was much worse in 1995 than in 1991 (Fig. 37). In both years, recovery to an exceptional macroinvertebrate community was complete by RM 9.1. Follow-up is needed to insure that WWH expectations are achieved after the remedy of the raw sewage problem noted in 1995 and full recovery is complete.

The 1995 ICI scores were higher upstream from the McFarland Cr. WWTP (RM 3.5 and 5.7), but recovery was slower below the plant (Figures 27,28,37). Impacts to the Aurora Branch macroinvertebrate community from SR 422 construction were diminished. Based on trends in the Aurora Branch, a slightly decreased quality macroinvertebrate community was present from the McFarland Cr. WWTP mixing zone (RM 3.45) to the mouth (RM 0.3) with coolwater, pollution-sensitive and/or EPT taxa reduced (Table 15, Figures 27,28,37). Increased effluent volume, nutrient enrichment and temperature changes were the likely causes.

Table 15 . Number and percentage of coldwater (CW) and pollution-sensitive taxa (PS) collected from RM 9.1 to mouth, 1986 to 1995.

River Mile	Year	ICI	No. CW taxa	No. CW & PS taxa (sum)	% CW individ. of community totals	% CW & PS individuals of community totals
8.9	1990	50	3	12	7.4%	8.3%
9.1	1991	48	5	8	3.8%	4.5%
9.1	1995	48	3	12	1.1%	5.2%
5.7	1995	54	3	15	13.8%	20.6%
3.8	1986	48	2	9	0.45%	2.3%
3.5	1990	46	3	10	0.3%	5.3%
3.5	1995	56	2	6	2.8%	3.9%
3.45	1990	46	4	11	10.4%	13.3%
3.45 A	1995	MG	1	4	July 17, 1995	qual. only
3.45 B	1995	MG	0	1	Aug. 29, 1995	qual. only
3.4	1995	VG	2	5	~2.5% est.	~9% est.
2.0	1986	48	3	9	0.9%	2.2%
2.0	1990	54	3	9	1.1%	2.5%
1.6	1995	48	2	8	0.03%	0.3%
0.3	1986	50	3	7	1.7%	4.4%
0.3	1990	48	2	8	0.4%	4.3%
0.3	1995	E	0	2	Sept. 14, 1995	qual. only

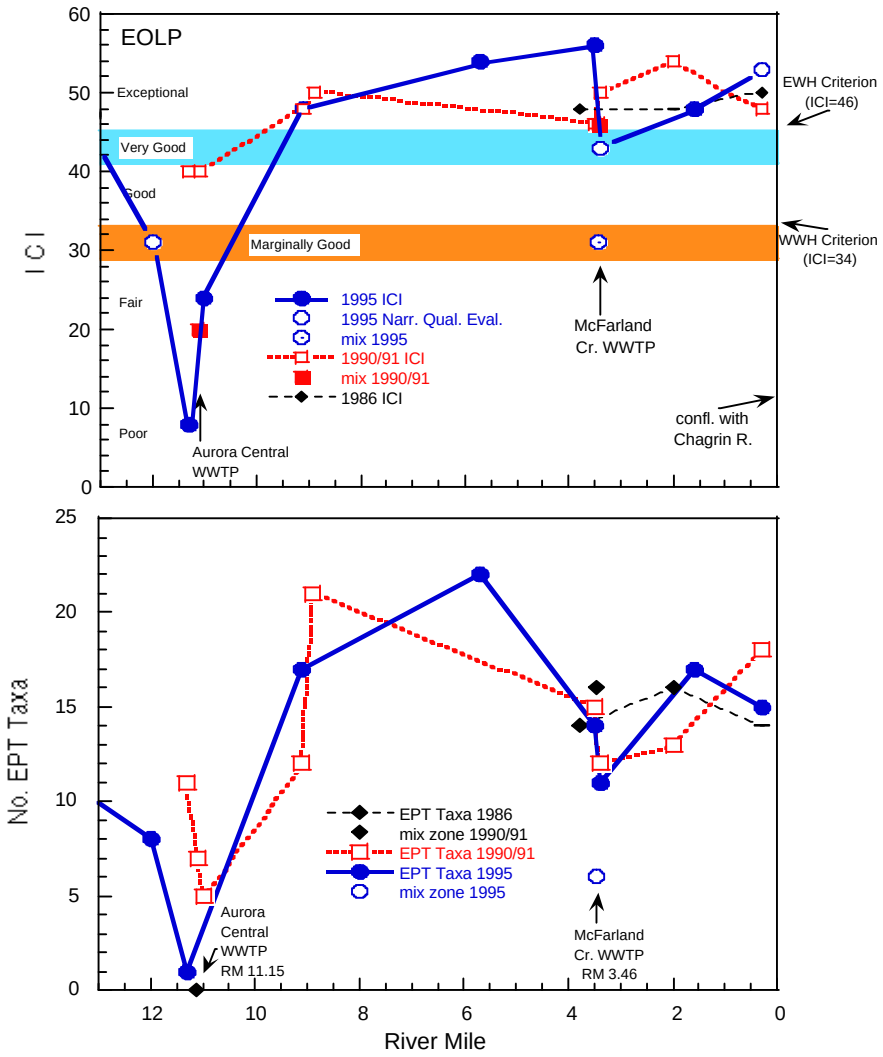


Figure 37. Trend plots for ICI/Narrative Qualitative Assessment (upper) and Number of EPT Taxa (lower) for Aurora Branch Chagrin River surveys, 1986 - 1995.

Overall a very good to exceptional macroinvertebrate community is still found in most of the Aurora Branch Chagrin River. Care needs to taken to ensure that the threshold assimilative capacity of the stream is not exceeded and irrevocable degradation does not occur in this designated State Scenic River.

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APPPENDIX TABLES

Appendix Table 1.

Sediment particle size analysis for stream sediment samples collected in Chagrin River basin, 1995.

==========

Stream Station:
Particle Size (μ):
Sample Percentage (%):
Type of Particle:

Chagrin River St. Rt. 87 (RM 33.35):

(μ):	66.4	48.1	28.3	15.7	9.0	5.3	3.0	1.9	1.3
(%):	77.5	6.0	4.5	3.0	1.5	3.0	1.5	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Chagrin River Ust Ivex, Ust First Dam (RM 30.70):

(μ):	57.5	41.6	25.1	14.8	8.6	5.1	3.0	1.9	1.3
(%):	30.7	5.9	11.9	13.9	11.9	9.9	4.0	4.0	2.0
Type:	silt	silt	silt	silt	silt	silt	clay	clay	clay

Chagrin River Dst Ivex, at City Park (RM 29.80):

(μ):	59.8	43.9	26.6	15.2	9.0	5.2	3.0	1.9	1.3
(%):	39.3	10.1	14.2	12.1	12.1	2.0	4.0	0.0	0.0
Type:	silt	silt	silt	silt	silt	silt	clay	clay	clay

Chagrin River, Dst Chagrin Falls WWTP (RM 28.00):

(μ):	68.1	48.8	28.5	15.7	9.1	5.3	3.0	1.9	1.3
(%):	77.7	4.1	4.1	2.0	4.1	2.0	0.0	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Chagrin River, Fairmount Rd., Hunting Valley (RM 20.95):

(μ):	68.1	48.8	28.7	15.8	9.1	5.3	3.0	1.9	1.3
(%):	88.5	2.1	3.1	1.0	1.0	1.0	1.0	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Chagrin River, Todd Field (RM 4.0):

(μ):	68.1	48.5	28.5	15.7	9.0	5.3	3.0	1.9	1.3
(%):	87.9	1.1	3.3	1.1	1.1	2.2	1.1	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Appendix Table 1 (cont.).: Sediment particle size analysis for stream sediment samples collected in Chagrin River basin, 1995.

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Stream Station:
Particle Size (μ):
Sample Particle Size Percentage (%):
Type of Particle:

Aurora Branch Chagrin River, Ust McFarland Creek WWTP (RM 3.5):

(μ):	70.7	50.2	29.2	16.0	9.3	5.4	3.1	1.9	1.3
(%):	94.8	1.0	1.0	0.0	1.0	0.0	1.0	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Aurora Branch Chagrin River, Dst McFarland Creek WWTP (RM 3.4):

(μ):	71.9	51.1	29.5	16.2	9.3	5.4	3.1	1.9	1.3
(%):	98.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Aurora Branch Chagrin River, Geauga Lake Road (RM 5.6):

(μ):	69.4	49.1	28.5	15.6	9.1	5.3	3.0	1.9	1.3
(%):	94.8	0.0	1.3	0.0	1.3	0.0	0.0	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Aurora Branch Chagrin River, Dst Aurora Central WWTP (RM 11.1):

(μ):	68.6	48.8	28.3	15.6	9.1	5.3	3.0	1.9	1.3
(%):	92.9	1.2	1.2	1.2	1.2	1.2	0.0	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Silver Creek, Music Street (RM 5.07):

(μ):	68.9	49.4	28.9	15.9	9.3	5.4	3.1	1.9	1.3
(%):	87.5	2.8	2.8	1.4	2.8	0.0	1.4	0.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

Tributary to Chagrin River at RM 15.42 (RM 0.16, 15.42):

(μ):	68.6	48.7	28.7	15.8	9.2	5.4	3.1	1.9	1.3
(%):	89.7	1.0	3.1	1.0	2.0	1.0	0.0	1.0	0.0
Type:	sand	silt	silt	silt	silt	silt	clay	clay	clay

APPENDIX TABLE 2. Chagrin R. Basin Water Chemistry Data

A. 1995 chagrin river nutrients data (mainstem)

STORET #	
502400	CHAGRIN R. AT WILLOUGHBY - RIDGE RD.
D01S08	CHAGRIN R. NE OF MAYFIELD - ROGERS RD.
D01S09	CHAGRIN R. AT HUNTING VALLEY - FAIRMOUNT RD.
D01P07	CHAGRIN R. NW OF CHAGRIN FALLS - CHAGRIN BLVD.
D01P03	CHAGRIN R. 1 MI. W OF CHAGRIN FALLS - MILES RD.
D01S10	CHAGRIN R. DST CHAGRIN FALLS WWTP
D01W12	CHAGRIN R. JUST UST CHAGRIN FALLS WWTP
D01S11	CHAGRIN R. UPST CHAGRIN FALLS WWTP - MILES RD.
D01S12	CHAGRIN R. AT CHAGRIN FALLS - CITY PARK
D01S13	Ivex 001 OUTFALL TO CHAGRIN R.
D01W11	CHAGRIN R. AT CHAGRIN FALLS - DST 1ST DAM
D01P13	CHAGRIN R. UPST CHAGRIN FALLS WWTP - S.R. 87
D01W20	CHAGRIN R. FAIRMONT RD., RM 36.55

STORET #	RM	Date	Time	Type	COD mg/l	NO2+NO3 mg/l	NH3-N mg/l	TKN mg/l	T-Phos mg/l	TDS mg/l	TSS mg/l	Fec.Coli 100 ml	cBOD5 mg/l
502400	4.95	950125	940	G	28	0.78	0.09	0.5	0.05 K	498	15	270	
502400	4.95	950227	910	G	21	0.65	0.06	0.4	0.16	274	22	260	
502400	4.95	950315	945	G	13	0.5	0.05 K	0.2 K	0.05 K	340	19	86	
502400	4.95	950403	1105	G	10	0.34	0.05 K	0.3	0.05 K	432	5 K	10	
502400	4.95	950522	1210	G	15	0.14	0.05 K	0.4		310	13	70	
502400	4.95	950628	1245	G	25	0.34	0.05 K	0.3	0.05 K	445	54	300	
502400	4.95	950711	1040	G	18	0.16	0.05 K	0.4	0.05 K	378	38	270	
502400	4.95	950713	1200	G	10	0.1 K	0.05 K	0.2	0.05 K	352	18		
502400	4.95	950713	1200	DUP	10	0.1 K	0.05 K	0.2	0.05 K	322	13		
502400	4.95	950727	850	G	56	0.48	0.09	0.4	0.36		968	13000	
502400	4.95	950727	850	DUP	59	0.48	0.09	0.4	0.36		1210		
502400	4.95	950808	925	G								500	
502400	4.95	950810	1410	G	28	0.72	0.05 K	0.4	0.06	284	126		
502400	4.95	950810	1410	DUP	34	0.72	0.05 K	0.5	0.07	298	122		
502400	4.95	950817	850	G	23	0.7	0.05 K	0.4	0.06	290	91		
502400	4.95	950817	850	DUP	16	0.68	0.05 K	0.4	0.05	290	78		
502400	4.95	950907	900	G	10	0.1 K	0.05 K	0.3	0.05 K	412	26		
502400	4.95	950907	900	DUP	12	0.1 K	0.05 K	0.3	0.05 K	356	28		
502400	4.95	951011	1010	G	18	0.28	0.05 K	0.4	0.05 K	318	13		
D01S08	13.04	950713	1130	G	12	0.3	0.05 K	0.3	0.05 K	356	16		
D01S08	13.04	950727	915	G	33	0.57	0.06	0.4	0.08	254	167	1900	
D01S08	13.04	950808	955	G								300	
D01S08	13.04	950817	920	G	29	0.6	0.05 K	0.5	0.08	268	61		
D01S08	13.04	950907	930	G	12	0.37	0.05 K	0.3	0.05 K	416	30		
D01S09	20.95	950713	1320	G	12	0.5	0.05 K	0.4	0.05 K	350	14		
D01S09	20.95	950727	845	G	21	0.72	0.05 K	0.3	0.1	300	181	1100	
D01S09	20.95	950808	1015	G								250	
D01S09	20.95	950810	1330	G	25	0.37	0.05 K	0.5	0.08	246	25		

STORET #	RM	Date	Time	Type	COD	NO2+NO3	NH3-N	TKN	T-Phos	TDS	TSS	Fec.Coli	cBOD5
					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	100 ml	mg/l
D01S09	20.95	950817	950	G	29	0.59	0.05 K	0.6	0.09	261	62		
D01S09	20.95	950907	1045	G	10	0.95	0.05 K	0.3	0.05 K	408	13		
D01P07	25.3	950713	1250	G	12	0.9	0.05 K	0.4	0.05 K	341	8		
D01P07	25.3	950727	900	G	27	0.47	0.05 K	0.4	0.11	260	142	1900	
D01P07	25.3	950808	1100	G								330	
D01P07	25.3	950810	1300	G	19	0.79	0.05 K	0.3	0.05 K	340	48		
D01P07	25.3	950817	1055	G	21	0.65	0.05 K	0.6	0.11	270	65		
D01P07	25.3	950907	1105	G	10	1.47	0.05 K	0.3	0.05 K	404	20		
D01P03	26.8	950713	1105	G	10	0.9	0.05 K	0.3	0.05 K		24		
D01P03	26.8	950727	1050	G	30	0.39	0.05 K	0.4	0.13	206	133	2900	
D01P03	26.8	950808	1155	G								300	
D01P03	26.8	950810	1141	G	16	0.78	0.05 K	0.4	0.05 K	330	55		
D01P03	26.8	950817	1255	G	32	0.58	0.05 K	0.6	0.09	268	67		
D01P03	26.8	950907	1120	G	10	1.47	0.08	0.4	0.05 K	392	24		
D01W12	28.36	950713	950	G	15	0.1 K	0.05 K	0.3	0.05 K	270	14		
D01W12	28.36	950727	1120	G	39	0.24	0.05 K	0.4	0.12	180	119	3100	
D01W12	28.36	950808	1205	G								110	
D01W12	28.36	950810	1241	G	25	0.39	0.08	0.5	0.08	280	26		
D01W12	28.36	950817	1315	G	21	0.16	0.05 K	0.5	0.05 K	278	16		
D01W12	28.36	950907	1145	G	10	1.27	0.05 K	0.5	0.05	330	14		
D01S11	28.96	950713	1040	G	18	0.1 K	0.05 K	0.3	0.05 K	262	24		
D01S11	28.96	950727	1035	G	30	0.24	0.05 K	0.4	0.11	174	149	3700	
D01S11	28.96	950808	1145	G								130	
D01S11	28.96	950810	1135	G	19	0.37	0.12	0.5	0.06	276	26		
D01S11	28.96	950817	1240	G	29	0.15	0.05 K	0.5	0.05 K	256	25		
D01S11	28.96	950907	1130	G	10	0.7	0.05 K	0.4	0.05 K	286	12		
D01S12	29.8	950713	1140	G	15	0.1 K	0.05 K	0.3	0.05 K	246	19		
D01S12	29.8	950727	1015	G	30	0.23	0.05 K	0.4	0.14	184	110	9300	
D01S12	29.8	950808	1115	G								500	
D01S12	29.8	950810	1115	G	22	0.38	0.12	1	0.16	274	17		
D01S12	29.8	950817	1200	G	32	0.18	0 K	0.5	0.05 K	276	32		
D01S12	29.8	950904	1300	G	10	0.1 K	0.05 K	0.7	0.05 K	284	14		
D01S13	30.07	950713	1205	G	305	0.1 K	0.05 K	2.8	0.17	644	17		> 73
D01S13	30.07	950727	925	G		0.1 K	0.05 K	2.2	0.19	574	15		> 65
D01S13	30.07	950810	1010	G	411	0.1 K	26.7	31.4	6.05	756	36		292
D01S13	30.07	950817	1115	G	688	0.1 K	0.05 K	3.5	0.27	872	24		> 79
D01S13	30.07	950907	1230	G	418	0.1 K	0.05 K	1.6	0.07	714	34		> 82
D01W11	30.7	950713	1225	G	15	0.11	0.05 K	0.2	0.05 K	252	28		
D01W11	30.7	950727	950	G	39	0.23	0.05 K	0.4	0.15	178	252	5100	
D01W11	30.7	950808	1130	G								100	
D01W11	30.7	950810	1035	G	22	0.38	0.05 K	0.4	0.05 K	264	11		
D01W11	30.7	950817	1140	G	16	0.22	0.05 K	0.4	0.05 K	250	25		
D01W11	30.7	950907	1215	G	17	0.14	0.05 K	0.3	0.05 K	274	12		
D01P13	33.35	950713	1010	G	10	0.22	0.05 K	0.2	0.05 K	257	8		
D01P13	33.35	950727	1025	G	42	0.28	0.05 K	0.5	0.13	174	143		
D01P13	33.35	950810	920	G	16	0.31	0.05 K	0.4	0.05 K	254	15		

STORET #	RM	Date	Time	Type	COD	NO2+NO3	NH3-N	TKN	T-Phos	TDS	TSS	Fec.Coli	cBOD5
					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	100 ml	mg/l
D01P13	33.35	950817	1035	G	20	0.26	0.05 K	0.4	0.1	245	12		
D01P13	33.35	950907	1020	G	14	0.2	0.05 K	0.3	0.05 K	272	13		
D01W20	36.55	950713	1045	G	10	0.14	0.05 K	0.3	0.05 K	246	13		
D01W20	36.55	950727	1000	G	36	0.23	0.05 K	0.4	0.14	122	173	5200	
D01W20	36.55	950808	1030	G								400	
D01W20	36.55	950810	847	G	25	0.82	0.05 K	0.4	0.05 K	335	53		
D01W20	36.55	950817	1010	G	14	0.31	0.05 K	0.4	0.05 K	262	15		
D01W20	36.55	950907	1005	G	20	0.12	0.05 K	0.3	0.05 K	265	16		

APPENDIX TABLE 2. Chagrin R. Basin Water Chemistry Data

B. 1995 Chagrin River Nutrients Data (Aurora Br. & tributaries)

STORET #	
D01P18	AURORA BRANCH SW CHAGRIN FALLS - CHAGRIN R. RD
D01W18	AURORA BR. CHAGRIN R. HOLBROOK, RM 1.53
D01S22	AURORA BRANCH DST MCFARLAND CREEK WWTP
D01W19	AURORA BR. CHAGRIN R. UST McFAR.CR WWTP, RM 3.67
D01W15	AURORA BRANCH UPST GEAUGA LAKE RD.
D01S27	AURORA BRANCH N OF AURORA - UPST ST. RT. 306
D01W03	AURORA BRANCH DST AURORA CENTRAL WWTP
D01W01	AURORA BRANCH JUST UPST AURORA CENTRAL WWTP
D01P21	AURORA BRANCH 2 MI. E OF AURORA - S.R. 82
D01W21	UN TRIB TO CHAGRIN AT RM 15.42, RM 0.16
D01W23	SILVER CREEK, HITCHING POST LANE, RM 0.54
D01W22	SILVER CREEK, MUSIC ST, RM 5.07

STORET #	RM 1	Date	Time	Type	COD	NO2+NO3	NH3-N	TKN	T-Phos	TDS	TSS	Fec.Coli	Total N
					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	100 ml	mg/l
D01P18	0.3	950713	935	G	10	1.55	0.05 K	0.3	0.05 K	374	8		1.85
D01P18	0.3	950727	1130	G	18	0.93	0.05 K	0.3	0.11	286	57		1.23
D01P18	0.3	950803	1040	G								180	
D01P18	0.3	950817	1105	G	28	0.6	0.05 K	0.7	0.11	242	46	1200	1.3
D01P18	0.3	950831	1405	G	12	1.72	0.05 K	0.2	0.05 K	394	12	33	1.94
D01P18	0.3	950907	1337	G	11	1.31	0.05 K	0.3	0.05 K	402	8		1.61
D01W18	1.53	950713	920	G	10 K	1.95	0.05 K	0.3	0.07	390	16		2.25
D01W18	1.53	950727	1230	G	21	0.86	0.05 K	0.3	0.09	304	36		1.16
D01W18	1.53	950803	1045	G								140	
D01W18	1.53	950817	1120	G	29	0.61	0.05 K	0.6	0.12	266	81	940	1.21
D01W18	1.53	950831	1352	G	12	1.82	0.05 K	0.2	0.05 K	394	13	280	2.02
D01W18	1.53	950907	1350	G	20	1.29	0.25	0.5	0.05 K	420	9		1.79
D01S22	3.3	950713	905	G	10 K	2.08	0.05 K	0.3	0.08	386	8		2.38
D01S22	3.3	950727	1310	G	12	1.13	0.05 K	0.3	0.08	304	20		1.43
D01S22	3.3	950803	1105	G								90	
D01S22	3.3	950817	1200	G	29	0.95	0.05 K	0.7	0.12	280	42	690	1.65
D01S22	3.3	950831	1333	G	12	2.81	0.05 K	0.2 K	0.06	402	6	200	3.01
D01S22	3.3	950907	1430	G	12	1.13	0.35	0.5	0.05 K	362	8		1.63
D01W19	3.67	950713	850	G	10 K	0.6	0.05 K	0.2	0.05 K	344	8		0.8
D01W19	3.67	950727	1300	G	12	0.5	0.05 K	0.3	0.08	286	21		0.8
D01W19	3.67	950803	1055	G								93	
D01W19	3.67	950817	1145	G	41	0.42	0.05 K	0.6	0.11	260	52	900	1.02
D01W19	3.67	950831	1315	G	10 K	0.64	0.05 K	0.2 K	0.05 K	342	15	340	0.84
STORET #	RM 1	Date	Time	Type	COD	NO2+NO3	NH3-N	TKN	T-Phos	TDS	TSS	Fec.Coli	Total N
					mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	100 ml	mg/l

D01W19	3.67	950907	1410	G	10 K	0.89	0.05 K	0.2 K	0.05 K	336	6		1.09
D01W15	5.52	950713	920	G	10 K	0.97	0.05 K	0.3	0.06	350	25		1.27
D01W15	5.52	950727	1120	G	16	0.66	0.05 K	0.3	0.14	276	16		0.96
D01W15	5.52	950803	1225	G								170	
D01W15	5.52	950817	1315	G	35	0.45	0.05 K	0.6	0.11	286	44	670	1.05
D01W15	5.52	950831	1246	G	10 K	1.06	0.05 K	0.2 K	0.2	338	5 K	80	1.26
D01W15	5.52	950907	1030	G	14	1	0.05 K	0.2 K	0.05 K	334	5 K		1.2
D01S27	9	950713	905	G	10 K	2.27	0.07	0.5	0.1	452	16		2.77
D01S27	9	950727	1140	G	21	0.75	0.05 K	0.6	0.11	308	26		1.35
D01S27	9	950803	1245	G								400	
D01S27	9	950817	1345	G	32	0.57	0.07	0.8	0.1	274	56	3100	1.37
D01S27	9	950831	1205	G	10 K	2.65	0.05 K	0.2 K	0.08	435	5 K	500	2.85
D01S27	9	950907	1005	G	10 K	4.29	0.05 K	0.3	0.09	498	5 K		4.59
D01W03	11.1	950713	830	G	10 K	3.16	0.47	1	0.24	470	20		4.16
D01W03	11.1	950727	1155	G	18	1.23	0.26	0.7	0.15	334	49		1.95
D01W03	11.1	950803	1300	G								8300	
D01W03	11.1	950817	1415	G	38	0.76	0.11	1	0.14	270	52	48300	1.76
D01W03	11.1	950831	1142	G	18	5.44	0.2	0.6	0.18	500	6	100	6.04
D01W03	11.1	950907	946	G	12	6.08	0.07	0.6	0.21	788	5		6.68
D01W01	11.3	950713	845	G	21	0.12	0.94	1.6	0.23	492	19		1.72
D01W01	11.3	950727	1145	G	30	0.2	0.3	1	0.13	308	64		1.2
D01W01	11.3	950803	1255	G								89000	
D01W01	11.3	950817	1405	G	41	0.25	0.17	1	0.14	250	46	7300	1.25
D01W01	11.3	950831	1130	G								1000	
D01W01	11.3	950907	928	G	12	0.13	0.05 K	0.2	0.05 K	656	8.5		0.33
D01P21	16.09	950824	1240	G	24	0.22	0.05 K	0.4	0.05 K	344	12		0.62
D01P21	16.09	950828	1240	G								670	
D01P21	16.09	950831	1102	G	18	0.14	0.05 K	0.3	0.05 K	336	18		0.44
D01P21	16.09	950831	1115	G								170	
D01P21	16.09	950907	855	G	17	0.1	0.05 K	0.2	0.05 K	356	11		0.3
D01W21	0.16	950803	945	G								40	
D01W21	0.16	950817	913	G	18	0.57	0.05 K	0.2	0.05 K	240	25	76	
D01W21	0.16	950831	920	G	12	0.43	0.05 K	0.2 K	0.05 K	268	5 K	270	
D01W21	0.16	950907	1215	G	14	0.36	0.05 K	0.2 K	0.05 K	258	5 K		
D01W23	0.54	950713	1030	G	10 K	0.15	0.05 K	0.2	0.05 K	228	10		
D01W23	0.54	950727	1015	G	24	0.23	0.05 K	0.3	0.07	200	40		
D01W23	0.54	950803	1145	G								90	
D01W23	0.54	950817	955	G	12	0.19	0.05 K	0.4	0.07	218	10	130	
D01W23	0.54	950831	1000	G	24	0.1	0.05 K	0.2 K	0.05 K	234	10	170	
D01W23	0.54	950907	1147	G	10 K	0.18	0.05 K	0.2 K	0.05 K	234	8		
D01W22	5.07	950713	945	G	10 K	0.27	0.05 K	0.2 K	0.05 K	270	5 K		
D01W22	5.07	950727	1050	G	10 K	0.21	0.05 K	0.2	0.05 K	296	12		
D01W22	5.07	950803	1205	G								80	
D01W22	5.07	950817	1025	G	10 K	0.17	0.05 K	0.2	0.05 K	264	5	91	
D01W22	5.07	950831	1030	G	10 K	0.33	0.05	0.2 K	0.05 K	292	6	150	
D01W22	5.07	950907	1123	G	12	0.28	0.05 K	0.2 K	0.05 K	278	5 K		

APPENDIX TABLE 2. Chagrin R. Basin Water Chemistry Data

C. 1995 Chagrin River metals data (mainstem)

STORET #	
502400	CHAGRIN R. AT WILLOUGHBY - RIDGE RD.
D01S08	CHAGRIN R. NE OF MAYFIELD - ROGERS RD.
D01S09	CHAGRIN R. AT HUNTING VALLEY - FAIRMOUNT RD.
D01P07	CHAGRIN R. NW OF CHAGRIN FALLS - CHAGRIN BLVD.
D01P03	CHAGRIN R. 1 MI. W OF CHAGRIN FALLS - MILES RD.
D01S10	CHAGRIN R. DST CHAGRIN FALLS WWTP
D01W12	CHAGRIN R. JUST UPST CHAGRIN FALLS WWTP
D01S11	CHAGRIN R. UPST CHAGRIN FALLS WWTP - MILES RD.
D01S12	CHAGRIN R. AT CHAGRIN FALLS - CITY PARK
D01S13	Ivex 001 OUTFALL TO CHAGRIN R.
D01W11	CHAGRIN R. AT CHAGRIN FALLS - DST 1ST DAM
D01P13	CHAGRIN R. UPST CHAGRIN FALLS WWTP - S.R. 87
D01W20	CHAGRIN R. FAIRMONT RD., RM 36.55

STORET #	RM	Date	Time	Type	Field Cond. uhos/cm	D.O. mg/l	Field pH s.u.	temp oC.	flow cfs	Cd ug/l	Ca mg/l	Cu ug/l	Pb ug/l	Zn ug/l	Hard. mg/l
502400	4.95	950125	940	G	485	13.2	8.5	0.5		0.2k	50	10K	2K	51	170
502400	4.95	950227	910	G	740	11	8.5	0.5		0.2k	27	10K	2K	12	96
502400	4.95	950315	945	G	415	11.5	8.15	7		0.2k	50	10K	2K	10K	170
502400	4.95	950403	1105	G	490	13.4	8.1	5.75	439	0.2k	58	10K	2K	10K	207
502400	4.95	950522	1210	G	460	9.4	7.7	17.5	407	0.2k	59	10K	2K	18	201
502400	4.95	950628	1245	G	700	8.4	8.4	24.5	340	0.2k	63	10K	2K	21	223
502400	4.95	950711	1040	G	596	9.4	8.19	22		0.2k	60	10K	2K	10K	207
502400	4.95	950713	1200	G	620	8.9	8	26		0.2k	58	10K	2K	10K	211
502400	4.95	950713	1200	Dup						0.2k	58	10K	2K	10K	211
502400	4.95	950727	850	G	305	7.6	7.8	22.5	1438	0.4	41	33	23	157	160
502400	4.95	950727	850	Dup						0.4	41	35	23	161	164
502400	4.95	950810	1410	G	464	8	8.3	24.5	539	0.2k	43	10	3	37	149
502400	4.95	950810	1410	Dup						0.2k	42	10K	4	29	146
502400	4.95	950817	850	G	460	7.6	8.4	24.5		0.2k	52	10K	2K	18	179
502400	4.95	950817	850	Dup	460	7.6	8.4	24.5		0.2k	52	10K	2K	19	179
502400	4.95	950907	900	G	610	7.6	8.2	21.8	155	0.2k	58	10K	2K	23	211
502400	4.95	950907	900	Dup						0.2	58	10K	2K	11	215
502400	4.95	951011	1010	G	431	9.4	8	13	274	0.2k	60	10K	2K	12	207
D01S08	13.04	950713	1130	G	620	11.2	8.1	26		0.2k	59	10K	2K	10K	205
D01S08	13.04	950727	915	G	380	8.1	8	22.6		0.2k	42	10K	4	30	146
D01S08	13.04	950817	920	G	420	7.3	8.2	24.5		0.2k	45	10K	2	16	154
D01S08	13.04	950907	930	G	605	8	8.2	20.1		0.2k	59	10K	2K	10K	209
D01S09	20.95	950713	1320	G	622	12	8.97	28		0.2k	59	10K	2	10K	209
D01S09	20.95	950727	845	G	495	7.4	8	23		0.2k	53	10K	5	27	186
D01S09	20.95	950810	1330	G	504	8.8	8.2	21.5		0.2k	46	10K	2K	10K	160
D01S09	20.95	950817	950	G	405	7.3	8.2	24		0.2k	43	10K	5	17	149

D01S09	20.95	950907	1045	G	680	8	8.2	20		0.2k	60	10K	2K	10K	216
D01P07	25.3	950713	1250	G	612	9.5	8.6	26.1		0.2k	59	10K	2K	10K	209
D01P07	25.3	950727	900	G	389	7.6	8.1	23		0.2k	40	10K	3	27	141
D01P07	25.3	950810	1300	G	482	8.6	8.2	21		0.2k	51	10K	2K	11	181
D01P07	25.3	950817	1055	G	420	7.4	8.1	24		0.2k	46	10K	2K	24	156
D01P07	25.3	950907	1105	G	595	7.2	8.2	20		0.2	63	10K	2K	16	223
D01P03	26.8	950713	1105	G	571	9.3		24.3		0.2k	57	10K	2K	10	200
D01P03	26.8	950727	1050	G	330	7.8	8.1	23		0.2k	35	40	4	34	124
D01P03	26.8	950810	1141	G	470	8.5	8.2	21.5		0.2k	52	10K	2K	10	183
D01P03	26.8	950817	1255	G	440	7.8	8.3	25.9		0.2k	46	10K	2	18	160
D01P03	26.8	950907	1120	G	600	8.3		20.5		0.5	57	10K	2K	15	204
D01W12	28.36	950713	950	G	454	8.1	8.32	23.3		0.2k	49	10K	2K	10K	172
D01W12	28.36	950727	1120	G	271	8	8.1	23		0.2k	31	10K	5	33	110
D01W12	28.36	950810	1241	G	432	8.7	8.3	21.5		0.2k	47	10K	2K	15	163
D01W12	28.36	950817	1315	G	440	8	8.3	26.5		0.2k	49	10K	2K	18	168
D01W12	28.36	950907	1145	G	465	7.6	8	20.1		0.7	51	10K	2K	11	181
D01S11	28.96	950713	1040	G	448	8.3	8.45	24		0.2k	50	10K	2K	10K	178
D01S11	28.96	950727	1035	G	276	8.4	8.2	22.5		0.2k	30	10K	4	29	104
D01S11	28.96	950810	1135	G	427	8.5	8.2	21		0.2k	46	10K	2K	10K	160
D01S11	28.96	950817	1240	G	435	7.4	8.3	26		0.2k	47	10K	2K	12	163
D01S11	28.96	950907	1130	G	420	7.8	8.2	20.9		0.2k	50	10K	2K	11	178
D01S12	29.8	950713	1140	G	459	7.8	8.51	31		0.2k	49	10K	7	10K	176
D01S12	29.8	950727	1015	G	266	9.1	8	22		0.3	30	10K	3	27	104
D01S12	29.8	950810	1115	G	424	8.4	8.1	21.5		0.2k	46	10K	2K	10K	160
D01S12	29.8	950817	1200	G	440	6.8	8.1	26.1		0.2k	46	10K	2K	20	160
D01S12	29.8	950904	1300	G	430	6	7.9	22		0.2k	49	10K	2K	18	176
D01S13	30.07	950713	1205	G	1070	6.4	7.81	33.5		0.2k	47	10K	2K	13	154
D01S13	30.07	950727	925	G	927	6.8	7.9	36.7	0.31	0.3	30	10K	2K	38	100
D01S13	30.07	950810	1010	G	1330	4.4	7.7	35.5		0.2k	32	10K	2K	58	109
D01S13	30.07	950817	1115	G	1015	5.5	7.9	39		0.3	34	13	3	79	114
D01S13	30.07	950907	1230	G	910	6.7	8.1	33.5		0.2k	34	10K	2	31	118
D01W11	30.7	950713	1225	G	428	9	8.55	23.9		0.2k	49	10K	2	10K	176
D01W11	30.7	950727	950	G	266	7.1	7.9	22		0.2k	31	10K	5	36	110
D01W11	30.7	950810	1035	G	390	8	8.1	20.5		0.2k	44	10K	2K	10K	151
D01W11	30.7	950817	1140	G	405	7.5	8.2	24.5		0.2k	47	10K	2K	14	163
D01W11	30.7	950907	1215	G	385	8.4	8.2	19.4		0.2k	49	10K	2K	10K	176
D01P13	33.35	950713	1010	G	440	8.1	7.8	22		0.2k	50	10K	3	20	174
D01P13	33.35	950727	1025	G	250	7.5	7.8	22		0.2k	29	10K	4	31	101
D01P13	33.35	950810	920	G	379	7.6	8	20		0.2k	46	10K	2K	14	160
D01P13	33.35	950817	1035	G	400	6.8	8.1	24		0.2k	46	10K	2K	17	160
D01P13	33.35	950907	1020	G	375	7.7	8.1	19		0.2k	50	10K	2K	18	178
D01W20	36.55	950713	1045	G	435	8.2	7.7	22		0.2	50	10K	2K	10K	125
D01W20	36.55	950727	1000	G	235	7.4	7.7	22.5		0.2k	27	10K	5	27	92
D01W20	36.55	950810	847	G	374	7.4	8	19.5		0.2k	51	10K	8	11	177
D01W20	36.55	950817	1010	G	400	7	8.1	23.5		0.2k	47	10K	2K	15	163
D01W20	36.55	950907	1005	G	355	7.1	8.1	18.5		0.2k	127	10K	2K	90	432

APPENDIX TABLE 2. Chagrin R. Basin Water Chemistry Data

D. 1995 Chagrin River metals data (Aurora Branch & tributaries)

STORET #

D01P18	AURORA BRANCH SW CHAGRIN FALLS - CHAGRIN R. RD
D01W18	AURORA BR. CHAGRIN R. HOLBROOK, RM 1.53
D01S22	AURORA BRANCH DST MCFARLAND CREEK WWTP
D01W19	AURORA BR. CHAGRIN R. UST McFAR.CR WWTP, RM 3.67
D01W15	AURORA BRANCH UPST GEAUGA LAKE RD.
D01S27	AURORA BRANCH N OF AURORA - UPST ST. RT. 306
D01W03	AURORA BRANCH DST AURORA CENTRAL WWTP
D01W01	AURORA BRANCH JUST UPST AURORA CENTRAL WWTP
D01P21	AURORA BRANCH 2 MI. E OF AURORA - S.R. 82
D01W21	UN TRIB TO CHAGRIN AT RM 15.42, RM 0.16
D01W23	SILVER CREEK, HITCHING POST LANE, RM 0.54
D01W22	SILVER CREEK, MUSIC ST, RM 5.07

STORET #	RM	Date	Time	Type	Field Cond. uhos/cm	D.O. mg/l	Field pH s.u.	temp oC.	Flow cfs	Cd ug/l	Ca mg/l	Cu ug/l	Pb ug/l	Zn ug/l	Hard. mg/l
D01P18	0.13	950713	935	G	520	9.4	8.54	21		0.2k	63	10K	2K	10K	223
D01P18	0.13	950727	1130	G	482	8.6	8.4	23		0.2k	51	10K	2K	10K	177
D01P18	0.13	950817	1105	G	424	8.1	8.2	23.4		0.2k	47	10K	2K	13	163
D01P18	0.13	950831	1405	G	741	10.6	8.7	26.1		0.2k	64	10K	2K	10K	234
D01P18	0.13	950907	1337	G	662	10.2	8.5	21.2		0.2k	62	10K	2K	10K	225
D01W18	1.53	950713	920	G	571	7.9	8.12	21.8		0.2k	63	10K	2K	10	223
D01W18	1.53	950727	1230	G	480	7.7	8.1	23.4		0.2k	50	10K	2K	11	174
D01W18	1.53	950817	1120	G	440	7.4	8	23.6		0.2k	48	10K	2K	16	165
D01W18	1.53	950831	1352	G	710	10.4	8.3	25.3		0.2k	66	10K	2K	10K	239
D01W18	1.53	950907	1350	G	665	10.2	8	20.5		0.2k	65	10K	2K	10K	232
D01S22	3.3	950713	905	G	612	8.9	8.11	20.7		0.2k	64	10K	2K	10K	226
D01S22	3.3	950727	1310	G	520	8.7	8.3	25		0.2k	54	10K	2K	10K	188
D01S22	3.3	950817	1200	G	460	8	8.1	25		0.2k	48	10K	2K	17	165
D01S22	3.3	950831	1333	G	725	11.2	8.3	24.3		0.2k	65	10K	2K	46	232
D01S22	3.3	950907	1430	G	615	10.3	8.2	20		0.2k	64	10K	2K	14	230
D01W19	3.67	950713	850	G	561	8.5	8.13	20.7		0.2k	65	10K	2K	10K	236
D01W19	3.67	950727	1300	G	515	8.7	8.2	24.4		0.2k	53	10K	2K	10K	186
D01W19	3.67	950817	1145	G	432	8.2	8.1	24.2		0.2k	47	10K	2K	13	163
D01W19	3.67	950831	1315	G	595	10.6	8.4	24.1		0.2k	65	10K	2K	10K	236
D01W19	3.67	950907	1410	G	535	10.5	8.1	19.8		0.2k	66	10K	2K	10K	239
D01W15	5.52	950713	920	G	515	9.4	8	19.4		0.2k	65	10K	2K	10K	236
D01W15	5.52	950727	1120	G	410	8.9	8.3	22.3		0.2k	58	10K	2K	10K	202
D01W15	5.52	950817	1315	G	424	8.3	8.3	25.3		0.2k	47	10K	2K	16	163
D01W15	5.52	950831	1246	G	545	11.3	8.6	23		0.2k	66	10K	2K	10K	243
D01W15	5.52	950907	1030	G	515	9.4	8.2	18		0.2k	65	10K	2K	10K	241
D01S27	9	950713	905	G	620	8.1	7.7	18.4		0.2k	79	10K	2K	10K	284
D01S27	9	950727	1140	G	490	7.9	8	22.5		0.2k	56	10K	2K	10	193

D01S27	9	950817	1345	G	450	7.3	8	24.3	0.2k	48	10K	2K	17	165
D01S27	9	950831	1205	G	708	10.2	8.2	20.8	0.2k	80	10K	2K	10K	294
D01S27	9	950907	1005	G	720	8.9	8	17.1	0.2k	84	10K	2K	10K	309
D01W03	11.1	950713	830	G	618	3.8	7	18.9	0.2k	80	10K	2K	10K	290
D01W03	11.1	950727	1155	G	550	7.2	7.9	23	0.2k	55		2K	12	191
D01W03	11.1	950817	1415	G	450	6.8	7.9	25.8	0.2k	47	10K	2K	15	163
D01W03	11.1	950831	1142	G		6.1	7.8	20.8	0.2k	85	10K	2K	12	319
D01W03	11.1	950907	946	G	771	7	7.8	18.1	0.2k	85	10K	2K	13	319
D01W01	11.3	950713	845	G	712	4.8	7.4	19.4	0.2k	79	10K	2K	10K	284
D01W01	11.3	950727	1145	G	490	7.4	8	23.7	0.2k	54	10K	2K	25	184
D01W01	11.3	950817	1405	G	432	7.4	8	26	0.2k	44	10K	2K	23	151
D01W01	11.3	950831	1126	G		6.7	7.9	21.5	0.2k	78	10K	2K	10K	294
D01W01	11.3	950907	928	G	575	7.2	8	17.9	0.2k	80	10K	2K	10K	307
D01P21	16.09	950824	1240	G	526	8.2	8.1	25.5	0.2k	64	10K		10K	238
D01P21	16.09	950831	1102	G	525	7.9	8.1	21.2	0.2k	72	10K	2K	10K	270
D01P21	16.09	950907	855	G	525	7.7	8	18.2	0.2k	78	34	2K	38	298
D01W21	0.16	950817	913	G	392	8	8.1	21.2	0.2k	46	10K	2K	10K	160
D01W21	0.16	950831	920	G	432	8.3	8.3	20	0.2k	52	10K	2K	10K	183
D01W21	0.16	950907	1215	G	412	9.6	8.4	18.4	0.2k	49	10K	2K	11	176
D01W23	0.54	950713	1030	G	390	7	7.7	22	0.2k	49	10K	2K	10K	176
D01W23	0.54	950727	1015	G	295	7.2	7.8	22.7	0.2k	38	10K	2K	10K	132
D01W23	0.54	950817	955	G	369	6.4	7.8	24	0.3	45	10K	2K	11	162
D01W23	0.54	950831	1000	G	392	6.7	7.9	22	0.2	48	10K	2K	10K	173
D01W23	0.54	950907	1147	G	385	6.9	7.9	19.8	0.2k	50	10K	2K	19	178
D01W22	5.07	950713	945	G	435	8.2	7.9	18.8	0.2k	64	10K	2K	10K	226
D01W22	5.07	950727	1050	G	370	7.9	7.9	21.9	0.2k	56	10K	2K	10K	193
D01W22	5.07	950817	1025	G	432	7.5	7.9	21	0.2k	63	10K	2K	11	223
D01W22	5.07	950831	1030	G	453	7.75	8	18.9	0.2k	71	10K	2K	10K	247
D01W22	5.07	950907	1123	G	432	8.5	8	17	0.2k	68	10K	2K	10K	240

Appendix Table 3. Biological Data (Fish and Macroinvertebrates) collected in the Chagrin River basin, 1995-96

Summary IBI Report for Fish Collected in Chagrin River Basin, 1995 -96.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Percent of Individuals: Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)		IBI	Modified Iwb
Chagrin River - (15001)																		
Year: 95																		
36.40	D	08/03/95	36	16(3)	2(3)	2(3)	1(1)	4(3)	52(5)	6(5)	3(5)	5.1(5)	60(5)	0.0(5)	1040(5)		48	8.8
36.40	D	09/27/95	36	17(3)	3(3)	2(3)	1(1)	4(3)	37(5)	8(5)	8(5)	3.2(3)	46(3)	0.0(5)	1092(5)		44	8.6
33.40	D	08/03/95	54	13(3)	2(3)	2(3)	1(1)	4(3)	45(5)	11(5)	11(5)	10.2(5)	70(5)	0.0(5)	455(3)		46	8.2
33.40	D	09/26/95	54	16(3)	3(3)	2(3)	1(1)	4(3)	37(5)	9(5)	8(5)	21.2(5)	50(3)	0.0(5)	824(5)		46	8.9
30.60	D	08/16/95	56	15(3)	3(3)	2(3)	1(1)	3(3)	28(3)	30(3)	29(3)	5.5(5)	41(3)	0.0(5)	377(3)		38	7.8
30.60	D	09/26/95	56	18(3)	3(3)	2(3)	1(1)	3(3)	15(1)	56(1)	55(1)	1.1(3)	23(1)	0.0(5)	1284(5)		30	8.5
30.08	D	08/16/95	57	6(1)	4(5)	0(1)	0(1)	0(1)	5(1)	18(5)	18(5)	0.0(1)	82(5)	0.0(5)	108(1)	*	32	5.9
30.08	D	09/26/95	57	6(1)	4(5)	0(1)	0(1)	0(1)	0(1)	2(5)	0(5)	2.0(3)	98(5)	0.0(5)	288(3)		36	7.1
30.00	D	08/16/95	57	16(3)	5(5)	2(3)	1(1)	2(1)	30(3)	31(3)	21(3)	6.6(5)	69(5)	0.0(5)	95(1)	*	38	7.4
30.00	D	09/26/95	57	19(3)	7(5)	2(3)	1(1)	2(1)	19(3)	57(1)	56(1)	4.0(3)	39(3)	0.0(5)	192(1)		30	7.6
28.90	D	08/16/95	58	12(3)	2(3)	1(1)	2(1)	2(1)	65(5)	6(5)	4(5)	13.5(5)	78(5)	0.0(5)	314(3)		42	7.5
28.90	D	09/25/95	58	15(3)	3(3)	2(3)	3(3)	2(1)	62(5)	14(5)	11(5)	10.8(5)	76(5)	0.4(5)	359(3)		46	8.0
28.00	D	08/16/95	59	15(3)	4(5)	2(3)	1(1)	3(3)	48(5)	26(3)	25(3)	6.6(5)	59(5)	0.0(5)	186(1)		42	7.6
28.00	D	09/20/95	59	22(5)	7(5)	2(3)	2(1)	3(3)	65(5)	18(5)	16(5)	5.3(5)	75(5)	0.2(5)	507(3)		50	7.6
26.50	D	08/17/95	119	12(3)	3(3)	2(1)	2(1)	1(1)	42(5)	8(5)	6(5)	4.2(3)	86(5)	0.0(5)	230(3)		40	7.0
26.50	D	09/25/95	119	12(3)	1(1)	2(1)	3(3)	2(1)	45(5)	2(5)	0(5)	6.7(5)	85(5)	0.0(5)	483(3)		42	7.8
24.20	D	08/15/95	123	15(3)	4(5)	2(1)	3(3)	1(1)	63(5)	5(5)	3(5)	12.3(5)	82(5)	0.0(5)	221(3)		46	7.2
24.20	D	09/20/95	123	18(3)	5(5)	2(1)	2(1)	2(1)	60(5)	9(5)	6(5)	6.8(5)	84(5)	0.5(5)	281(3)		44	7.2
19.40	D	08/15/95	154	12(3)	0(1)	1(1)	2(1)	2(1)	65(5)	7(5)	7(5)	8.1(5)	75(5)	0.0(5)	258(3)		40	7.1
19.40	D	09/20/95	154	20(3)	5(5)	2(1)	3(3)	3(3)	40(5)	36(3)	35(1)	11.1(5)	52(3)	0.0(5)	276(3)		40	7.6
13.10	D	08/17/95	166	12(3)	0(1)	2(1)	3(3)	3(3)	60(5)	1(5)	1(5)	0.0(1)	91(5)	0.0(5)	254(3)		40	6.2

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

				Number of					Percent of Individuals									
River Mile	Type	Date	Drainage area (sq mi)	Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)		IBI	Modified Iwb
13.10	D	09/26/95	166	21(3)	3(3)	4(3)	4(3)	3(3)	23(3)	4(5)	4(5)	59.0(5)	37(3)	0.0(5)	1012(5)		46	8.4
4.80	D	08/17/95	246	13(3)	0(1)	2(1)	3(3)	1(1)	27(3)	2(5)	32(3)	1.3(3)	49(3)	0.0(5)	224(3)		34	7.2
4.80	D	09/26/95	246	21(3)	0(1)	3(3)	5(3)	3(3)	37(5)	14(5)	20(3)	1.7(3)	65(5)	0.0(5)	623(3)		42	9.0
Aurora Branch - (15005)																		
Year: 95																		
5.60	D	08/09/95	31	14(3)	2(3)	2(3)	2(3)	2(1)	33(3)	27(5)	6(5)	0.0(1)	21(1)	0.0(5)	1271(5)		38	7.9
5.60	D	09/19/95	31	12(3)	0(1)	2(3)	2(3)	2(1)	56(5)	35(3)	7(5)	0.0(1)	36(3)	0.0(5)	1695(5)		38	8.3
3.50	D	08/15/95	48	13(3)	2(3)	2(3)	2(1)	2(1)	75(5)	43(3)	36(1)	0.0(1)	48(3)	0.0(5)	405(3)		32	6.2
3.50	D	09/19/95	48	14(3)	1(1)	2(3)	2(1)	2(1)	34(3)	16(5)	5(5)	0.2(1)	25(1)	0.0(5)	1574(5)		34	8.0
3.45	D	08/15/95	48	11(3)	1(1)	1(1)	2(1)	2(1)	30(3)	7(5)	4(5)	0.0(1)	32(3)	0.0(5)	1224(5)		34	6.9
3.45	D	09/19/95	48	12(3)	0(1)	2(3)	2(1)	2(1)	33(3)	10(5)	7(5)	0.0(1)	31(3)	0.0(5)	4632(5)		36	8.8
3.40	D	08/15/95	48	18(3)	3(3)	2(3)	2(1)	2(1)	43(5)	23(5)	15(5)	0.6(1)	36(3)	0.0(5)	572(3)		38	7.4
3.40	D	09/19/95	48	16(3)	3(3)	2(3)	2(1)	2(1)	51(5)	26(5)	20(3)	0.2(1)	42(3)	0.0(5)	1220(5)		38	8.3
1.60	D	08/08/95	55	16(3)	5(5)	2(3)	1(1)	2(1)	24(3)	14(5)	12(5)	1.5(3)	25(1)	0.2(5)	683(3)		38	7.4
1.60	D	09/19/95	55	19(3)	5(5)	2(3)	2(1)	2(1)	47(5)	19(5)	16(5)	2.8(3)	43(3)	0.0(5)	710(3)		42	8.4
0.30	D	08/08/95	57	21(5)	5(5)	2(3)	3(3)	3(3)	30(3)	18(5)	17(5)	6.1(5)	51(3)	0.1(3)	971(5)		48	9.2
0.30	D	09/19/95	57	18(3)	4(5)	2(3)	3(3)	3(3)	33(3)	4(5)	2(5)	4.9(3)	56(5)	0.0(5)	758(5)		48	8.3
Silver Creek - (15007)																		
Year: 95																		
1.70	E	08/08/95	20	14(3)	4(5)	2(3)	0(1)	3(3)	50(5)	23(5)	20(3)	37.5(5)	43(3)	0.0(5)	109(1)	*	42	7.2
1.70	D	09/27/95	20	18(5)	5(5)	2(3)	0(1)	3(3)	30(3)	39(3)	37(1)	30.9(5)	31(3)	0.0(5)	215(3)		40	7.9
0.50	D	08/08/95	20	16(3)	5(5)	2(3)	0(1)	3(3)	33(3)	14(5)	11(5)	39.1(5)	50(3)	1.1(3)	119(1)	*	40	7.5
0.50	D	09/27/95	20	17(5)	6(5)	2(3)	0(1)	3(3)	34(3)	24(5)	18(5)	36.3(5)	42(3)	0.0(5)	242(3)		46	7.9

na - Qualitative data, Modified Iwb not applicable.

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

				Number of						Percent of Individuals							
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	
Griswold Creek - (15-003)																	
Year: 96																	
6.70	F	08/30/96	1.5	12(5)	6(5)	2(3)	0(1)	1(3)	3(5)	63(1)	18(1)	55(3)	19(3)	0.0(5)	234(5)	40	
4.40	F	09/05/96	3.5	12(5)	7(5)	2(3)	2(3)	2(3)	5(5)	50(3)	9(5)	49(3)	22(3)	0.0(5)	464(5)	48	
0.90	F	10/07/96	6.9	12(3)	6(5)	1(1)	4(3)	2(3)	5(3)	71(1)	6(5)	52(3)	16(1)	0.0(5)	299(3)	36	
Year: 95																	
0.90	E	08/16/95	6.9	7(3)	3(3)	1(1)	2(1)	2(3)	3(3)	62(1)	6(5)	30(3)	8(1)	0.0(5)	376(3)	32	
Willey Creek - (15-004)																	
Year: 95																	
0.20	E	08/08/95	5.2	16(5)	6(5)	1(1)	5(5)	2(3)	5(5)	51(3)	16(3)	36(3)	19(3)	0.0(5)	325(3)	44	
Aurora Branch - (15-005)																	
Year: 96																	
14.50	E	08/01/96	8.9	16(5)	6(3)	1(1)	0(1)	1(1)	3(3)	78(1)	20(1)	64(1)	24(3)	0.0(5)	92(1)	26	▲
11.40	E	08/27/96	14.5	13(3)	7(5)	1(1)	1(1)	1(1)	4(3)	66(1)	14(5)	42(3)	14(1)	0.0(5)	194(1)	30	
11.40	E	06/21/96	14.5	9(3)	5(3)	1(1)	0(1)	0(1)	3(1)	62(1)	16(5)	43(3)	16(1)	0.0(5)	84(1)	26	
11.10	E	06/21/96	14.7	11(3)	6(3)	1(1)	1(1)	2(1)	4(3)	76(1)	30(3)	36(3)	8(1)	0.0(5)	104(1)	26	
11.10	E	08/27/96	14.7	14(3)	7(5)	1(1)	3(3)	2(1)	6(3)	62(1)	26(3)	30(5)	12(1)	0.0(5)	288(3)	34	
9.00	E	06/21/96	16.4	10(3)	5(3)	1(1)	2(1)	2(1)	5(3)	64(1)	10(5)	30(5)	7(1)	0.0(5)	177(1)	30	
9.00	E	08/27/96	16.4	12(3)	7(5)	1(1)	3(1)	2(1)	6(3)	46(3)	15(5)	13(5)	19(1)	0.0(5)	567(3)	36	
Year: 95																	
12.10	E	10/25/95	13.5	13(3)	6(3)	1(1)	1(1)	0(1)	4(3)	21(5)	13(5)	12(5)	22(1)	0.0(5)	1088(5)	38	
11.30	D	08/10/95	14.5	10(3)	5(3)	1(1)	1(1)	2(1)	4(3)	56(1)	21(3)	34(3)	41(3)	0.0(5)	114(1)	28	
11.30	D	09/18/95	14.5	12(3)	7(5)	1(1)	1(1)	0(1)	4(3)	57(1)	30(3)	42(3)	23(3)	0.0(5)	515(3)	32	

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

				Number of						Percent of Individuals							
River Mile	Type	Date	Drainage area (sq mi)	Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	
11.10	D	08/21/95	14.7	15(3)	7(5)	2(3)	2(1)	2(1)	5(3)	52(3)	20(3)	22(5)	24(3)	0.0(5)	456(3)	38	
11.10	D	09/18/95	14.7	14(3)	7(5)	1(1)	1(1)	1(1)	4(3)	55(1)	13(5)	30(5)	39(3)	0.1(5)	1184(5)	38	
9.00	D	08/10/95	16.4	14(3)	9(5)	2(3)	4(3)	2(1)	6(3)	32(3)	12(5)	13(5)	29(3)	0.0(5)	479(3)	42	
9.00	D	09/18/95	16.4	13(3)	7(5)	1(1)	3(1)	2(1)	5(3)	49(3)	19(3)	13(5)	9(1)	0.0(5)	788(5)	36	
McFarland Creek - (15-006)																	
Year: 95																	
0.10	E	08/16/95	10.8	13(3)	7(5)	1(1)	5(3)	2(3)	6(3)	17(5)	5(5)	12(5)	26(3)	0.0(5)	1250(5)	46	
Silver Creek - (15-007)																	
Year: 95																	
4.00	F	08/08/95	4.1	8(3)	3(3)	0(1)	1(1)	2(3)	3(3)	79(1)	9(5)	73(1)	22(3)	0.0(5)	36(1)*	30	
Trib to Chagrin 15.4 - (15-012)																	
Year: 95																	
0.40	F	08/07/95	1.7	7(3)	3(3)	1(1)	2(3)	2(5)	4(5)	53(3)	2(5)	27(5)	32(5)	0.0(5)	282(5)	48	
Trib to Chagrin 12.8 - (15-017)																	
Year: 95																	
0.20	E	08/07/95	1.8	2(1)	2(1)	1(1)	0(1)	0(1)	1(1)	100(1)	0(5)	56(1)	0(1)	0.0(5)	0(1)*	20	
Trib to Chagrin 22.8 - (15-018)																	
Year: 95																	
0.30	E	08/07/95	9.3	15(5)	7(5)	1(1)	6(5)	3(3)	6(5)	18(5)	10(5)	10(5)	22(3)	0.0(5)	516(3)	50	
Sunny Lake Outlet - (15-023)																	
Year: 96																	
0.10	E	08/01/96	3.3	10(3)	4(3)	0(1)	0(1)	1(1)	2(3)	75(1)	20(1)	80(1)	34(5)	0.0(5)	54(1)	26	▲

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Species List

River Code: **15-001** River Mile: **36.40**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 3946 sec Drain Area: 36.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/03/95 Thru: 09/27/95 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	3	2.25	0.20	0.21	1.45	92.67
NORTHERN HOG SUCKER	R	I	S	M	146	109.50	9.55	3.08	21.36	28.14
WHITE SUCKER	W	O	S	T	30	22.50	1.96	2.46	17.08	109.50
RIVER CHUB	N	I	N	I	80	60.00	5.23	1.74	12.03	28.93
CREEK CHUB	N	G	N	T	27	20.25	1.77	0.60	4.14	29.50
STRIPED SHINER	N	I	S		275	206.25	17.99	0.99	6.86	4.79
COMMON SHINER	N	I	S		76	57.00	4.97	0.37	2.58	6.51
SILVERJAW MINNOW	N	I	M		30	22.50	1.96	0.09	0.63	4.00
BLUNTNOSE MINNOW	N	O	C	T	51	38.25	3.34	0.10	0.70	2.65
CENTRAL STONEROLLER	N	H	N		550	412.50	35.97	1.15	7.96	2.78
ROCK BASS	S	C	C		36	27.00	2.35	1.26	8.71	46.53
SMALLMOUTH BASS	F	C	C	M	23	17.25	1.50	2.08	14.44	120.74
LARGEMOUTH BASS	F	C	C		1	0.75	0.07	0.01	0.08	15.00
BLUEGILL SUNFISH	S	I	C	P	3	2.25	0.20	0.03	0.19	12.00
PUMPKINSEED SUNFISH	S	I	C	P	6	4.50	0.39	0.05	0.35	11.17
JOHNNY DARTER	D	I	C		23	17.25	1.50	0.01	0.08	0.65
GREENSIDE DARTER	D	I	S	M	41	30.75	2.68	0.08	0.55	2.57
RAINBOW DARTER	D	I	S	M	111	83.25	7.26	0.10	0.70	1.22
FANTAIL DARTER	D	I	C		17	12.75	1.11	0.02	0.14	1.53
	Mile Total				1,529	1,146.75		14.43		
	Number of Species				19					
	Number of Hybrids				0					

Species List

River Code: **15-001** River Mile: **33.40**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 3918 sec Drain Area: 54.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/03/95 Thru: 09/26/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	106	79.50	11.21	5.56	20.65	69.97
WHITE SUCKER	W	O	S	T	29	21.75	3.07	3.41	12.67	156.90
COMMON CARP	G	O	M	T	2	1.50	0.21	7.03	26.10	4,687.50
RIVER CHUB	N	I	N	I	133	99.75	14.06	2.56	9.49	25.63
CREEK CHUB	N	G	N	T	4	3.00	0.42	0.02	0.08	6.75
STRIPED SHINER	N	I	S		45	33.75	4.76	0.23	0.85	6.78
COMMON SHINER	N	I	S		79	59.25	8.35	0.35	1.31	5.97
BLUNTNOSE MINNOW	N	O	C	T	59	44.25	6.24	0.14	0.51	3.08
CENTRAL STONEROLLER	N	H	N		144	108.00	15.22	0.88	3.27	8.15
CHANNEL CATFISH	F		C		1	0.75	0.11	0.04	0.16	56.00
ROCK BASS	S	C	C		119	89.25	12.58	1.63	6.06	18.27
SMALLMOUTH BASS	F	C	C	M	44	33.00	4.65	4.80	17.84	145.57
BLUEGILL SUNFISH	S	I	C	P	4	3.00	0.42	0.01	0.03	2.75
PUMPKINSEED SUNFISH	S	I	C	P	1	0.75	0.11	0.02	0.08	29.00
HYBRID X SUNFISH					1	0.75	0.11	0.01	0.04	16.00
JOHNNY DARTER	D	I	C		12	9.00	1.27	0.01	0.04	1.09
GREENSIDE DARTER	D	I	S	M	78	58.50	8.25	0.14	0.51	2.36
RAINBOW DARTER	D	I	S	M	43	32.25	4.55	0.05	0.18	1.47
FANTAIL DARTER	D	I	C		42	31.50	4.44	0.04	0.15	1.25
	Mile Total				946	709.50		26.94		
	Number of Species				18					
	Number of Hybrids				1					

Species List

River Code: **15-001** River Mile: **30.60**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 4643 sec Drain Area: 56.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/16/95 Thru: 09/26/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	180	135.00	7.77	1.95	23.84	14.42
WHITE SUCKER	W	O	S	T	95	71.25	4.10	0.43	5.21	5.97
RIVER CHUB	N	I	N	I	158	118.50	6.82	0.88	10.76	7.41
CREEK CHUB	N	G	N	T	23	17.25	0.99	0.04	0.53	2.51
COMMON SHINER	N	I	S		36	27.00	1.55	0.19	2.28	6.91
SAND SHINER	N	I	M	M	8	6.00	0.35	0.01	0.06	0.83
SILVERJAW MINNOW	N	I	M		57	42.75	2.46	0.09	1.10	2.09
BLUNTNOSE MINNOW	N	O	C	T	1,080	810.00	46.61	1.04	12.69	1.28
CENTRAL STONEROLLER	N	H	N		482	361.50	20.80	1.54	18.87	4.26
YELLOW BULLHEAD		I	C	T	12	9.00	0.52	0.41	5.07	46.00
ROCK BASS	S	C	C		10	7.50	0.43	0.26	3.15	34.30
SMALLMOUTH BASS	F	C	C	M	31	23.25	1.34	0.72	8.84	31.03
LARGEMOUTH BASS	F	C	C		1	0.75	0.04	0.37	4.50	490.00
BLUEGILL SUNFISH	S	I	C	P	9	6.75	0.39	0.10	1.28	15.44
PUMPKINSEED SUNFISH	S	I	C	P	3	2.25	0.13	0.02	0.20	7.33
JOHNNY DARTER	D	I	C		31	23.25	1.34	0.03	0.38	1.32
RAINBOW DARTER	D	I	S	M	73	54.75	3.15	0.06	0.74	1.10
FANTAIL DARTER	D	I	C		28	21.00	1.21	0.04	0.53	2.04
	Mile Total				2,317	1,737.75		8.17		
	Number of Species				18					
	Number of Hybrids				0					

Species List

River Code: **15-001** River Mile: **30.08**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 1390 sec Drain Area: 57.0 sq mi Dist Fished: 0.10 km No of Passes: 2	Sample Date: **1995** Date Range: 08/16/95 Thru: 09/26/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
COMMON SHINER	N	I	S		1	3.00	1.41	0.15	1.35	50.00
BLUNTNOSE MINNOW	N	O	C	T	4	12.00	5.63	0.01	0.08	0.75
BROWN BULLHEAD		I	C	T	1	3.00	1.41	0.57	5.15	191.00
WHITE CRAPPIE	S	I	C		13	39.00	18.31	1.87	16.80	47.92
BLACK CRAPPIE	S	I	C		12	36.00	16.90	2.01	18.03	55.70
SMALLMOUTH BASS	F	C	C	M	1	3.00	1.41	0.09	0.78	29.00
BLUEGILL SUNFISH	S	I	C	P	8	24.00	11.27	0.99	8.90	41.25
PUMPKINSEED SUNFISH	S	I	C	P	31	93.00	43.66	5.44	48.90	58.48
	Mile Total				71	213.00		11.12		
	Number of Species				8					
	Number of Hybrids				0					

Species List

River Code: **15-001** River Mile: **30.00**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 4380 sec Drain Area: 57.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/16/95 Thru: 09/26/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	31	23.25	7.91	3.15	28.72	135.32
WHITE SUCKER	W	O	S	T	2	1.50	0.51	0.42	3.79	276.50
COMMON CARP	G	O	M	T	1	0.75	0.26	1.80	16.43	2,400.00
GOLDEN SHINER	N	I	M	T	1	0.75	0.26	0.02	0.15	21.00
RIVER CHUB	N	I	N	I	6	4.50	1.53	0.09	0.79	19.00
CREEK CHUB	N	G	N	T	1	0.75	0.26	0.00	0.04	6.00
COMMON SHINER	N	I	S		32	24.00	8.16	0.53	4.84	22.09
BLUNTNOSE MINNOW	N	O	C	T	185	138.75	47.19	0.30	2.77	2.19
CENTRAL STONEROLLER	N	H	N		4	3.00	1.02	0.02	0.16	6.00
YELLOW BULLHEAD		I	C	T	8	6.00	2.04	0.92	8.44	154.00
WHITE CRAPPIE	S	I	C		4	3.00	1.02	0.19	1.71	62.50
BLACK CRAPPIE	S	I	C		1	0.75	0.26	0.04	0.33	48.00
ROCK BASS	S	C	C		2	1.50	0.51	0.15	1.40	102.00
SMALLMOUTH BASS	F	C	C	M	10	7.50	2.55	0.73	6.70	97.80
LARGEMOUTH BASS	F	C	C		4	3.00	1.02	0.86	7.87	287.50
WARMOUTH SF	S	C	C		2	1.50	0.51	0.07	0.60	43.50
GREEN SUNFISH	S	I	C	T	3	2.25	0.77	0.04	0.34	16.67
BLUEGILL SUNFISH	S	I	C	P	21	15.75	5.36	0.37	3.42	23.76
PUMPKINSEED SUNFISH	S	I	C	P	47	35.25	11.99	1.20	10.92	33.94
JOHNNY DARTER	D	I	C		6	4.50	1.53	0.02	0.18	4.40
RAINBOW DARTER	D	I	S	M	19	14.25	4.85	0.05	0.42	3.16
FANTAIL DARTER	D	I	C		2	1.50	0.51	0.00	0.01	1.00
	Mile Total				392	294.00		10.95		
	Number of Species				22					
	Number of Hybrids				0					

Species List

River Code: **15-001** River Mile: **28.90**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 4490 sec Drain Area: 58.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/16/95 Thru: 09/25/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	147	110.25	29.34	8.19	22.91	74.29
WHITE SUCKER	W	O	S	T	2	1.50	0.40	0.31	0.86	204.00
COMMON CARP	G	O	M	T	8	6.00	1.60	16.92	47.34	2,819.79
RIVER CHUB	N	I	N	I	33	24.75	6.59	0.39	1.08	15.64
ROSYFACE SHINER	N	I	S	I	1	0.75	0.20	0.00	0.00	2.00
COMMON SHINER	N	I	S		124	93.00	24.75	0.75	2.11	8.10
BLUNTNOSE MINNOW	N	O	C	T	28	21.00	5.59	0.05	0.14	2.36
CENTRAL STONEROLLER	N	H	N		15	11.25	2.99	0.06	0.17	5.36
YELLOW BULLHEAD		I	C	T	11	8.25	2.20	0.96	2.69	116.56
STONECAT MADTOM		I	C	I	5	3.75	1.00	0.13	0.36	34.00
ROCK BASS	S	C	C		6	4.50	1.20	0.23	0.63	50.00
SMALLMOUTH BASS	F	C	C	M	54	40.50	10.78	6.83	19.11	168.64
GREEN SUNFISH	S	I	C	T	4	3.00	0.80	0.04	0.12	14.75
PUMPKINSEED SUNFISH	S	I	C	P	15	11.25	2.99	0.66	1.84	58.53
GR'N SF X PUMPKINS'D					4	3.00	0.80	0.11	0.30	35.25
GREENSIDE DARTER	D	I	S	M	34	25.50	6.79	0.11	0.32	4.44
RAINBOW DARTER	D	I	S	M	10	7.50	2.00	0.01	0.03	1.40
	Mile Total				501	375.75		35.74		
	Number of Species				16					
	Number of Hybrids				1					

Species List

River Code: **15-001** River Mile: **28.00**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 8640 sec Drain Area: 59.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/16/95 Thru: 09/20/95 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	0.17	0.08	0.30	100.00
NORTHERN HOG SUCKER	R	I	S	M	93	69.75	16.06	4.04	16.09	57.92
WHITE SUCKER	W	O	S	T	5	3.75	0.86	0.19	0.75	50.20
COMMON CARP	G	O	M	T	9	6.75	1.55	14.83	59.03	2,196.67
RIVER CHUB	N	I	N	I	9	6.75	1.55	0.15	0.59	21.78
ROSYFACE SHINER	N	I	S	I	4	3.00	0.69	0.01	0.03	2.75
COMMON SHINER	N	I	S		196	147.00	33.85	0.92	3.68	6.29
SAND SHINER	N	I	M	M	5	3.75	0.86	0.01	0.06	3.80
BLUNTNOSE MINNOW	N	O	C	T	95	71.25	16.41	0.13	0.50	1.75
CENTRAL STONEROLLER	N	H	N		23	17.25	3.97	0.05	0.22	3.13
COMMON SH X ROSYFACE SH		I			1	0.75	0.17	0.01	0.06	19.00
YELLOW BULLHEAD		I	C	T	7	5.25	1.21	0.82	3.28	156.71
WHITE CRAPPIE	S	I	C		1	0.75	0.17	0.04	0.18	59.00
BLACK CRAPPIE	S	I	C		5	3.75	0.86	0.14	0.58	38.40
ROCK BASS	S	C	C		14	10.50	2.42	0.99	3.92	93.79
SMALLMOUTH BASS	F	C	C	M	15	11.25	2.59	1.86	7.40	165.11
LARGEMOUTH BASS	F	C	C		1	0.75	0.17	0.00	0.02	6.00
WARMOUTH SF	S	C	C		2	1.50	0.35	0.05	0.19	31.00
GREEN SUNFISH	S	I	C	T	1	0.75	0.17	0.01	0.05	18.00
BLUEGILL SUNFISH	S	I	C	P	14	10.50	2.42	0.06	0.25	6.07
PUMPKINSEED SUNFISH	S	I	C	P	18	13.50	3.11	0.46	1.83	34.01
HYBRID X SUNFISH					6	4.50	1.04	0.18	0.72	40.00
JOHNNY DARTER	D	I	C		4	3.00	0.69	0.01	0.02	1.50
GREENSIDE DARTER	D	I	S	M	32	24.00	5.53	0.06	0.25	2.59
RAINBOW DARTER	D	I	S	M	18	13.50	3.11	0.01	0.05	0.89
	Mile Total				579	434.25		25.12		
	Number of Species				23					
	Number of Hybrids				2					

Species List

River Code: **15-001** River Mile: **26.50**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 4829 sec Drain Area: 119.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/17/95 Thru: 09/25/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	175	131.25	35.43	8.66	49.35	65.95
WHITE SUCKER	W	O	S	T	8	6.00	1.62	1.12	6.39	186.75
COMMON CARP	G	O	M	T	1	0.75	0.20	0.03	0.20	46.00
RIVER CHUB	N	I	N	I	184	138.00	37.25	2.29	13.06	16.61
ROSYFACE SHINER	N	I	S	I	2	1.50	0.40	0.00	0.03	3.00
COMMON SHINER	N	I	S		17	12.75	3.44	0.25	1.40	19.18
BLUNTNOSE MINNOW	N	O	C	T	2	1.50	0.40	0.01	0.03	3.50
CENTRAL STONEROLLER	N	H	N		33	24.75	6.68	0.62	3.54	25.09
YELLOW BULLHEAD		I	C	T	5	3.75	1.01	0.19	1.07	50.20
STONECAT MADTOM		I	C	I	19	14.25	3.85	0.43	2.46	30.26
ROCK BASS	S	C	C		1	0.75	0.20	0.04	0.25	57.00
SMALLMOUTH BASS	F	C	C	M	28	21.00	5.67	3.74	21.33	178.12
GREEN SUNFISH	S	I	C	T	3	2.25	0.61	0.06	0.35	27.33
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.20	0.01	0.04	9.00
PUMPKINSEED SUNFISH	S	I	C	P	1	0.75	0.20	0.01	0.05	12.00
GREENSIDE DARTER	D	I	S	M	12	9.00	2.43	0.08	0.46	8.83
RAINBOW DARTER	D	I	S	M	2	1.50	0.40	0.00	0.01	1.50
	Mile Total				494	370.50		17.54		
	Number of Species				17					
	Number of Hybrids				0					

Species List

River Code: **15-001** River Mile: **24.20**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 6060 sec Drain Area: 123.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/15/95 Thru: 09/20/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	155	116.25	43.18	10.26	68.17	88.27
WHITE SUCKER	W	O	S	T	3	2.25	0.84	0.42	2.81	187.67
RIVER CHUB	N	I	N	I	50	37.50	13.93	0.75	4.98	19.98
ROSYFACE SHINER	N	I	S	I	1	0.75	0.28	0.00	0.01	2.00
COMMON SHINER	N	I	S		32	24.00	8.91	0.47	3.14	19.69
SAND SHINER	N	I	M	M	4	3.00	1.11	0.00	0.01	0.67
BLUNTNOSE MINNOW	N	O	C	T	14	10.50	3.90	0.02	0.16	2.21
CENTRAL STONEROLLER	N	H	N		7	5.25	1.95	0.02	0.16	4.57
YELLOW BULLHEAD		I	C	T	3	2.25	0.84	0.18	1.23	82.00
STONECAT MADTOM		I	C	I	11	8.25	3.06	0.11	0.71	12.91
BLACK CRAPPIE	S	I	C		1	0.75	0.28	0.01	0.10	19.00
ROCK BASS	S	C	C		7	5.25	1.95	0.36	2.40	68.71
SMALLMOUTH BASS	F	C	C	M	23	17.25	6.41	2.09	13.86	120.96
LARGEMOUTH BASS	F	C	C		3	2.25	0.84	0.02	0.10	6.67
GREEN SUNFISH	S	I	C	T	5	3.75	1.39	0.04	0.29	11.60
BLUEGILL SUNFISH	S	I	C	P	4	3.00	1.11	0.06	0.37	18.25
PUMPKINSEED SUNFISH	S	I	C	P	4	3.00	1.11	0.08	0.53	26.50
GR'N SF X PUMPKINS'D					1	0.75	0.28	0.02	0.11	21.00
HYBRID X SUNFISH					2	1.50	0.56	0.03	0.20	20.00
GREENSIDE DARTER	D	I	S	M	26	19.50	7.24	0.10	0.67	5.19
RAINBOW DARTER	D	I	S	M	3	2.25	0.84	0.00	0.02	1.50
	Mile Total				359	269.25		15.05		
	Number of Species				19					
	Number of Hybrids				2					

Species List

River Code: **15-001** River Mile: **19.40**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 3900 sec Drain Area: 154.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/15/95 Thru: 09/20/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	75	56.25	15.86	4.20	47.79	74.67
WHITE SUCKER	W	O	S	T	8	6.00	1.69	0.04	0.44	6.50
COMMON CARP	G	O	M	T	1	0.75	0.21	0.43	4.93	578.00
RIVER CHUB	N	I	N	I	18	13.50	3.81	0.52	5.89	38.31
ROSYFACE SHINER	N	I	S	I	5	3.75	1.06	0.01	0.10	2.20
STRIPED SHINER	N	I	S		47	35.25	9.94	0.44	5.06	12.61
COMMON SHINER	N	I	S		6	4.50	1.27	0.02	0.20	4.00
SPOTFIN SHINER	N	I	M		1	0.75	0.21	0.00	0.05	6.00
SAND SHINER	N	I	M	M	2	1.50	0.42	0.00	0.04	2.00
SILVERJAW MINNOW	N	I	M		4	3.00	0.85	0.01	0.10	2.75
BLUNTNOSE MINNOW	N	O	C	T	106	79.50	22.41	0.10	1.12	1.23
CENTRAL STONEROLLER	N	H	N		22	16.50	4.65	0.05	0.62	3.29
YELLOW BULLHEAD		I	C	T	1	0.75	0.21	0.03	0.30	35.00
STONECAT MADTOM		I	C	I	2	1.50	0.42	0.00	0.03	2.00
BLACK CRAPPIE	S	I	C		1	0.75	0.21	0.02	0.27	32.00
ROCK BASS	S	C	C		7	5.25	1.48	0.11	1.28	21.43
SMALLMOUTH BASS	F	C	C	M	39	29.25	8.25	2.60	29.58	88.85
LARGEMOUTH BASS	F	C	C		1	0.75	0.21	0.01	0.09	10.00
GREEN SUNFISH	S	I	C	T	1	0.75	0.21	0.00	0.02	2.00
BLUEGILL SUNFISH	S	I	C	P	13	9.75	2.75	0.02	0.27	2.38
PUMPKINSEED SUNFISH	S	I	C	P	3	2.25	0.63	0.04	0.46	17.67
JOHNNY DARTER	D	I	C		17	12.75	3.59	0.01	0.14	0.94
GREENSIDE DARTER	D	I	S	M	53	39.75	11.21	0.08	0.90	2.00
RAINBOW DARTER	D	I	S	M	40	30.00	8.46	0.03	0.37	1.08
	Mile Total				473	354.75		8.79		
	Number of Species				24					
	Number of Hybrids				0					

Species List

River Code: **15-001** River Mile: **13.10**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 4620 sec Drain Area: 166.0 sq mi Dist Fished: 0.49 km No of Passes: 2	Sample Date: **1995** Date Range: 08/17/95 Thru: 09/26/95 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	5	3.00	0.46	1.20	13.48	400.00
GOLDEN REDHORSE	R	I	S	M	4	2.40	0.37	0.67	7.48	277.25
NORTHERN HOG SUCKER	R	I	S	M	162	99.43	15.17	3.01	33.83	30.40
WHITE SUCKER	W	O	S	T	11	6.63	1.01	0.56	6.28	84.55
COMMON CARP	G	O	M	T	1	0.60	0.09	0.75	8.43	1,250.00
RIVER CHUB	N	I	N	I	154	93.85	14.32	1.35	15.14	14.39
EMERALD SHINER	N	I	S		5	3.00	0.46	0.01	0.13	4.00
ROSYFACE SHINER	N	I	S	I	24	14.50	2.21	0.01	0.16	0.96
STRIPED SHINER	N	I	S		94	56.93	8.68	0.55	6.15	9.63
SPOTFIN SHINER	N	I	M		18	10.80	1.65	0.02	0.24	1.94
SAND SHINER	N	I	M	M	2	1.23	0.19	0.00	0.02	1.50
BLUNTNOSE MINNOW	N	O	C	T	22	13.23	2.02	0.04	0.48	3.27
CENTRAL STONEROLLER	N	H	N		21	13.00	1.98	0.21	2.35	16.14
STRIPED SH X ROSYFACE SH		I			1	0.60	0.09	0.00	0.04	6.00
YELLOW BULLHEAD		I	C	T	4	2.40	0.37	0.18	1.99	73.75
STONECAT MADTOM		I	C	I	8	4.93	0.75	0.11	1.22	22.25
ROCK BASS	S	C	C		516	309.60	47.23	0.01	0.15	0.04
SMALLMOUTH BASS	F	C	C	M	3	1.80	0.27	0.16	1.75	86.67
BLUEGILL SUNFISH	S	I	C	P	7	4.20	0.64	0.01	0.13	2.86
PUMPKINSEED SUNFISH	S	I	C	P	2	1.20	0.18	0.01	0.13	10.00
BLACKSIDE DARTER	D	I	S		2	1.25	0.19	0.00	0.03	2.50
JOHNNY DARTER	D	I	C		1	0.60	0.09	0.00	0.01	2.00
GREENSIDE DARTER	D	I	S	M	7	4.25	0.65	0.02	0.25	5.29
RAINBOW DARTER	D	I	S	M	10	6.13	0.93	0.01	0.11	1.60
	Mile Total				1,084	655.53		8.90		
	Number of Species				23					
	Number of Hybrids				1					

Species List

River Code: **15-001** River Mile: **4.80**	Stream: **Chagrin River** Basin: Chagrin River Time Fished: 3660 sec Drain Area: 246.0 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/17/95 Thru: 09/26/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		77	57.75	12.18	2.63	23.22	45.45
BLACK REDHORSE	R	I	S	I	6	4.50	0.95	1.32	11.65	292.67
GOLDEN REDHORSE	R	I	S	M	10	7.50	1.58	1.20	10.61	160.00
NORTHERN HOG SUCKER	R	I	S	M	132	99.00	20.89	3.21	28.40	32.44
WHITE SUCKER	W	O	S	T	1	0.75	0.16	0.04	0.33	49.00
RIVER CHUB	N	I	N	I	91	68.25	14.40	1.12	9.92	16.43
LONGNOSE DACE	N	I	S	R	2	1.50	0.32	0.01	0.07	5.00
CREEK CHUB	N	G	N	T	1	0.75	0.16	0.00	0.01	2.00
ROSYFACE SHINER	N	I	S	I	15	11.25	2.37	0.03	0.23	2.33
STRIPED SHINER	N	I	S		33	24.75	5.22	0.17	1.49	6.79
COMMON SHINER	N	I	S		2	1.50	0.32	0.01	0.07	5.00
SPOTFIN SHINER	N	I	M		14	10.50	2.22	0.03	0.23	2.50
SAND SHINER	N	I	M	M	54	40.50	8.54	0.06	0.49	1.37
BLUNTNOSE MINNOW	N	O	C	T	66	49.50	10.44	0.13	1.11	2.54
CENTRAL STONEROLLER	N	H	N		84	63.00	13.29	0.84	7.40	13.27
CHANNEL CATFISH	F		C		1	0.75	0.16	0.02	0.19	28.00
STONECAT MADTOM		I	C	I	12	9.00	1.90	0.15	1.32	16.58
WHITE PERCH	E		M		2	1.50	0.32	0.04	0.33	24.50
SMALLMOUTH BASS	F	C	C	M	8	6.00	1.27	0.11	0.96	18.00
LARGEMOUTH BASS	F	C	C		2	1.50	0.32	0.04	0.33	25.00
GREENSIDE DARTER	D	I	S	M	14	10.50	2.22	0.13	1.18	12.64
RAINBOW DARTER	D	I	S	M	3	2.25	0.47	0.01	0.08	4.00
FANTAIL DARTER	D	I	C		1	0.75	0.16	0.00	0.01	2.00
FRESHWATER DRUM			M	P	1	0.75	0.16	0.05	0.40	60.00
	Mile Total				632	474.00		11.31		
	Number of Species				24					
	Number of Hybrids				0					

Species List

River Code: **15-003** River Mile: **6.70**	Stream: **Griswold Creek** Basin: Chagrin River Time Fished: Drain Area: 1.5 sq mi Dist Fished: 0.20 km No of Passes: 1	Sample Date: **1996** Date Range: 08/30/96 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S	T	43	64.50	10.29			
GOLDEN SHINER	N	I	M	T	7	10.50	1.67			
BLACKNOSE DACE	N	G	S	T	30	45.00	7.18			
CREEK CHUB	N	G	N	T	143	214.50	34.21			
COMMON SHINER	N	I	S		13	19.50	3.11			
FATHEAD MINNOW	N	O	C	T	33	49.50	7.89			
CENTRAL STONEROLLER	N	H	N		77	115.50	18.42			
LARGEMOUTH BASS	F	C	C		11	16.50	2.63			
GREEN SUNFISH	S	I	C	T	6	9.00	1.44			
BLUEGILL SUNFISH	S	I	C	P	3	4.50	0.72			
JOHNNY DARTER	D	I	C		46	69.00	11.00			
BROOK STICKLEBACK		I	C		6	9.00	1.44			
	Mile Total				418	627.00				
	Number of Species				12					
	Number of Hybrids				0					

Species List

River Code: **15-003** River Mile: **4.40**	Stream: **Griswold Creek** Basin: Chagrin River Time Fished: Drain Area: 3.5 sq mi Dist Fished: 0.20 km No of Passes: 1	Sample Date: **1996** Date Range: 09/05/96 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S	T	50	75.00	8.17			
BLACKNOSE DACE	N	G	S	T	40	60.00	6.54			
CREEK CHUB	N	G	N	T	206	309.00	33.66			
REDSIDE DACE	N	I	S	I	6	9.00	0.98			
COMMON SHINER	N	I	S		30	45.00	4.90			
FATHEAD MINNOW	N	O	C	T	1	1.50	0.16			
BLUNTNOSE MINNOW	N	O	C	T	6	9.00	0.98			
CENTRAL STONEROLLER	N	H	N		164	246.00	26.80			
LARGEMOUTH BASS	F	C	C		13	19.50	2.12			
BLUEGILL SUNFISH	S	I	C	P	2	3.00	0.33			
JOHNNY DARTER	D	I	C		86	129.00	14.05			
RAINBOW DARTER	D	I	S	M	8	12.00	1.31			
	Mile Total				612	918.00				
	Number of Species				12					
	Number of Hybrids				0					

Species List

River Code: **15-003** River Mile: **0.90**	Stream: **Griswold Creek** Basin: Chagrin River Time Fished: 1800 sec Drain Area: 6.9 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1995** Date Range: 08/16/95 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	27	54.00	5.52	0.08	4.28	1.53
BLACKNOSE DACE	N	G	S	T	136	272.00	27.81	0.69	35.75	2.55
CREEK CHUB	N	G	N	T	138	276.00	28.22	0.44	22.67	1.59
CENTRAL STONEROLLER	N	H	N		149	298.00	30.47	0.66	33.85	2.20
LARGEMOUTH BASS	F	C	C		2	4.00	0.41	0.02	1.03	5.00
JOHNNY DARTER	D	I	C		9	18.00	1.84	0.01	0.31	0.33
RAINBOW DARTER	D	I	S	M	28	56.00	5.73	0.04	2.11	0.74
	Mile Total				489	978.00		1.94		
	Number of Species				7					
	Number of Hybrids				0					

Species List

River Code: **15-003** River Mile: **0.90**	Stream: **Griswold Creek** Basin: Chagrin River Time Fished: Drain Area: 6.9 sq mi Dist Fished: 0.20 km No of Passes: 1	Sample Date: **1996** Date Range: 10/07/96 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	21	31.50	3.09			
WHITE SUCKER	W	O	S	T	38	57.00	5.60			
RIVER CHUB	N	I	N	I	1	1.50	0.15			
BLACKNOSE DACE	N	G	S	T	156	234.00	22.97			
CREEK CHUB	N	G	N	T	285	427.50	41.97			
COMMON SHINER	N	I	S		5	7.50	0.74			
BLUNTNOSE MINNOW	N	O	C	T	1	1.50	0.15			
CENTRAL STONEROLLER	N	H	N		85	127.50	12.52			
SMALLMOUTH BASS	F	C	C	M	2	3.00	0.29			
LARGEMOUTH BASS	F	C	C		2	3.00	0.29			
JOHNNY DARTER	D	I	C		66	99.00	9.72			
RAINBOW DARTER	D	I	S	M	17	25.50	2.50			
	Mile Total				679	1,018.50				
	Number of Species				12					
	Number of Hybrids				0					

Species List

River Code: **15-004** River Mile: **0.20**	Stream: **Willey Creek** Basin: Chagrin River Time Fished: 2100 sec Drain Area: 5.2 sq mi Dist Fished: 0.17 km No of Passes: 1	Sample Date: **1995** Date Range: 08/08/95 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
NORTHERN HOG SUCKER	R	I	S	M	4	7.06	1.08	0.34	6.75	48.00
WHITE SUCKER	W	O	S	T	44	77.65	11.83	0.77	15.37	9.95
COMMON CARP	G	O	M	T	2	3.53	0.54	0.34	6.85	97.50
RIVER CHUB	N	I	N	I	1	1.77	0.27	0.01	0.28	8.00
BLACKNOSE DACE	N	G	S	T	9	15.88	2.42	0.08	1.51	4.78
CREEK CHUB	N	G	N	T	98	172.94	26.34	1.60	31.90	9.26
COMMON SHINER	N	I	S		4	7.06	1.08	0.07	1.33	9.50
BLUNTNOSE MINNOW	N	O	C	T	12	21.18	3.23	0.09	1.75	4.17
CENTRAL STONEROLLER	N	H	N		133	234.71	35.75	0.74	14.72	3.15
YELLOW BULLHEAD		I	C	T	1	1.77	0.27	0.09	1.71	49.00
STONECAT MADTOM		I	C	I	2	3.53	0.54	0.16	3.23	46.00
LARGEMOUTH BASS	F	C	C		1	1.77	0.27	0.01	0.14	4.00
GREEN SUNFISH	S	I	C	T	22	38.82	5.91	0.35	7.03	9.09
BLUEGILL SUNFISH	S	I	C	P	1	1.77	0.27	0.07	1.33	38.00
PUMPKINSEED SUNFISH	S	I	C	P	2	3.53	0.54	0.11	2.17	31.00
HYBRID X SUNFISH					2	3.53	0.54	0.07	1.47	21.00
JOHNNY DARTER	D	I	C		3	5.29	0.81	0.01	0.16	1.50
RAINBOW DARTER	D	I	S	M	31	54.71	8.33	0.11	2.25	2.07
	Mile Total				372	656.47		5.02		
	Number of Species				17					
	Number of Hybrids				1					

Species List

River Code: **15-005** River Mile: **14.50**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 4500 sec Drain Area: 8.9 sq mi Dist Fished: 0.30 km No of Passes: 1	Sample Date: **1996** Date Range: 08/01/96 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	2	2.00	0.48	0.02	0.15	9.50
GRASS PICKEREL		P	M	P	3	3.00	0.72	0.21	1.66	70.00
WHITE SUCKER	W	O	S	T	46	46.00	10.98	5.38	42.64	116.96
COMMON CARP	G	O	M	T	4	4.00	0.95	1.74	13.79	435.00
GOLDEN SHINER	N	I	M	T	13	13.00	3.10	0.18	1.44	14.00
BLACKNOSE DACE	N	G	S	T	2	2.00	0.48	0.03	0.21	13.00
CREEK CHUB	N	G	N	T	210	210.00	50.12	3.10	24.57	14.76
COMMON SHINER	N	I	S		12	12.00	2.86	0.14	1.13	11.83
BLUNTNOSE MINNOW	N	O	C	T	33	33.00	7.88	0.24	1.87	7.15
CENTRAL STONEROLLER	N	H	N		11	11.00	2.63	0.14	1.13	13.00
YELLOW BULLHEAD		I	C	T	16	16.00	3.82	0.82	6.46	50.94
WHITE CRAPPIE	S	I	C		4	4.00	0.95	0.16	1.28	40.50
LARGEMOUTH BASS	F	C	C		9	9.00	2.15	0.05	0.38	5.33
GREEN SUNFISH	S	I	C	T	1	1.00	0.24	0.02	0.16	20.00
BLUEGILL SUNFISH	S	I	C	P	24	24.00	5.73	0.26	2.04	10.75
PUMPKINSEED SUNFISH	S	I	C	P	3	3.00	0.72	0.06	0.49	20.67
HYBRID X SUNFISH					1	1.00	0.24	0.02	0.17	22.00
JOHNNY DARTER	D	I	C		25	25.00	5.97	0.05	0.41	2.08
	Mile Total				419	419.00		12.62		
	Number of Species				17					
	Number of Hybrids				1					

Species List

River Code: **15-005** River Mile: **12.10**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 2721 sec Drain Area: 13.5 sq mi Dist Fished: 0.16 km No of Passes: 1	Sample Date: **1995** Date Range: 10/25/95 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
NORTHERN HOG SUCKER	R	I	S	M	1	1.88	0.14	0.21	1.37	114.00
WHITE SUCKER	W	O	S	T	62	116.25	8.45	1.69	10.82	14.52
BLACKNOSE DACE	N	G	S	T	5	9.38	0.68	0.05	0.33	5.40
CREEK CHUB	N	G	N	T	50	93.75	6.81	1.71	10.96	18.23
COMMON SHINER	N	I	S		142	266.25	19.35	2.37	15.18	8.89
FATHEAD MINNOW	N	O	C	T	1	1.88	0.14	0.01	0.05	4.00
BLUNTNOSE MINNOW	N	O	C	T	29	54.38	3.95	0.23	1.48	4.24
CENTRAL STONEROLLER	N	H	N		425	796.88	57.90	8.37	53.64	10.50
COMMON SH X CREEK CHUB					1	1.88	0.14	0.04	0.26	22.00
YELLOW BULLHEAD		I	C	T	1	1.88	0.14	0.50	3.20	266.00
GREEN SUNFISH	S	I	C	T	6	11.25	0.82	0.07	0.46	6.33
BLUEGILL SUNFISH	S	I	C	P	1	1.88	0.14	0.00	0.03	2.00
PUMPKINSEED SUNFISH	S	I	C	P	9	16.88	1.23	0.30	1.92	17.78
GR'N SF X PUMPKINS'D					1	1.88	0.14	0.05	0.31	26.00
	Mile Total				734	1,376.25		15.60		
	Number of Species				12					
	Number of Hybrids				2					

Species List

River Code: **15-005** River Mile: **11.40**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 1000 sec Drain Area: 14.5 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1996** Date Range: 06/21/96 Thru: 08/27/96 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
GRASS PICKEREL		P	M	P	2	1.50	0.38	0.32	5.48	210.00
WHITE SUCKER	W	O	S	T	53	39.75	10.11	2.77	48.26	69.79
BLACKNOSE DACE	N	G	S	T	68	51.00	12.98	0.10	1.72	1.94
CREEK CHUB	N	G	N	T	194	145.50	37.02	1.33	23.11	9.13
SILVER SHINER	N	I	S	I	3	2.25	0.57	0.00	0.04	1.00
COMMON SHINER	N	I	S		51	38.25	9.73	0.33	5.76	8.65
FATHEAD MINNOW	N	O	C	T	3	2.25	0.57	0.00	0.08	2.00
BLUNTNOSE MINNOW	N	O	C	T	19	14.25	3.63	0.05	0.83	3.32
CENTRAL STONEROLLER	N	H	N		106	79.50	20.23	0.70	12.19	8.81
BROWN BULLHEAD		I	C	T	2	1.50	0.38	0.04	0.69	26.00
LARGEMOUTH BASS	F	C	C		3	2.25	0.57	0.02	0.26	6.67
BLUEGILL SUNFISH	S	I	C	P	15	11.25	2.86	0.07	1.24	6.33
REDEAR SUNFISH	E	I	C		2	1.50	0.38	0.02	0.36	13.50
JOHNNY DARTER	D	I	C		3	2.25	0.57	0.00	0.03	0.67
	Mile Total				524	393.00		5.75		
	Number of Species				14					
	Number of Hybrids				0					

Species List

River Code: **15-005** River Mile: **11.30**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 3300 sec Drain Area: 14.5 sq mi Dist Fished: 0.35 km No of Passes: 2	Sample Date: **1995** Date Range: 08/10/95 Thru: 09/18/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	1	0.75	0.10	0.09	1.11	113.00
WHITE SUCKER	W	O	S	T	93	74.50	10.29	2.59	33.75	33.36
GOLDEN SHINER	N	I	M	T	1	0.75	0.10	0.01	0.09	9.00
BLACKNOSE DACE	N	G	S	T	50	40.25	5.56	0.12	1.54	2.96
CREEK CHUB	N	G	N	T	171	135.00	18.65	1.70	22.09	12.13
COMMON SHINER	N	I	S		173	138.00	19.06	1.51	19.69	11.03
FATHEAD MINNOW	N	O	C	T	9	6.75	0.93	0.03	0.35	3.89
BLUNTNOSE MINNOW	N	O	C	T	161	122.75	16.95	0.35	4.56	2.87
CENTRAL STONEROLLER	N	H	N		195	149.00	20.58	0.90	11.69	6.02
LARGEMOUTH BASS	F	C	C		3	2.25	0.31	0.01	0.19	6.33
GREEN SUNFISH	S	I	C	T	37	29.75	4.11	0.15	2.01	5.00
PUMPKINSEED SUNFISH	S	I	C	P	22	18.75	2.59	0.18	2.36	9.84
GR'N SF X PUMPKINS'D					3	2.50	0.35	0.04	0.46	14.33
JOHNNY DARTER	D	I	C		1	1.00	0.14	0.00	0.01	1.00
RAINBOW DARTER	D	I	S	M	2	2.00	0.28	0.01	0.13	5.00
	Mile Total				922	724.00		7.67		
	Number of Species				14					
	Number of Hybrids				1					

Species List

River Code: **15-005** River Mile: **11.10**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 4800 sec Drain Area: 14.7 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/21/95 Thru: 09/18/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	1	0.75	0.04	0.16	0.52	210.00
WHITE SUCKER	W	O	S	T	271	203.25	11.42	15.39	51.12	75.74
GOLDEN SHINER	N	I	M	T	1	0.75	0.04	0.01	0.02	8.00
BLACKNOSE DACE	N	G	S	T	376	282.00	15.84	1.20	3.97	4.24
CREEK CHUB	N	G	N	T	511	383.25	21.53	4.93	16.37	12.86
REDSIDE DACE	N	I	S	I	1	0.75	0.04	0.00	0.01	6.00
COMMON SHINER	N	I	S		695	521.25	29.29	5.93	19.68	11.37
FATHEAD MINNOW	N	O	C	T	18	13.50	0.76	0.05	0.15	3.44
BLUNTNOSE MINNOW	N	O	C	T	61	45.75	2.57	0.14	0.45	2.98
CENTRAL STONEROLLER	N	H	N		297	222.75	12.52	1.61	5.36	7.24
COMMON SH X ROSYFACE SH		I			1	0.75	0.04	0.01	0.02	7.00
STRIPED SH X CREEK CHUB		I			2	1.50	0.08	0.02	0.06	12.50
YELLOW BULLHEAD		I	C	T	2	1.50	0.08	0.02	0.05	10.50
BLACK BULLHEAD		I	C	P	1	0.75	0.04	0.06	0.19	76.00
LARGEMOUTH BASS	F	C	C		15	11.25	0.63	0.06	0.21	5.53
GREEN SUNFISH	S	I	C	T	40	30.00	1.69	0.21	0.69	6.95
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.04	0.00	0.00	2.00
PUMPKINSEED SUNFISH	S	I	C	P	32	24.00	1.35	0.28	0.94	11.85
GR'N SF X PUMPKINS'D					1	0.75	0.04	0.01	0.03	11.00
JOHNNY DARTER	D	I	C		28	21.00	1.18	0.03	0.09	1.35
RAINBOW DARTER	D	I	S	M	18	13.50	0.76	0.02	0.05	1.11
	Mile Total				2,373	1,779.75		30.11		
	Number of Species				18					
	Number of Hybrids				3					

Species List

River Code: **15-005** River Mile: **11.10**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 1281 sec Drain Area: 14.7 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1996** Date Range: 06/21/96 Thru: 08/27/96 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
NORTHERN HOG SUCKER	R	I	S	M	2	1.50	0.25	0.03	0.21	18.50
WHITE SUCKER	W	O	S	T	207	155.25	26.20	10.65	80.58	68.61
GOLDEN SHINER	N	I	M	T	1	0.75	0.13	0.01	0.10	18.00
BLACKNOSE DACE	N	G	S	T	86	64.50	10.89	0.17	1.25	2.56
CREEK CHUB	N	G	N	T	222	166.50	28.10	1.22	9.21	7.31
SILVER SHINER	N	I	S	I	16	12.00	2.03	0.01	0.09	1.00
COMMON SHINER	N	I	S		11	8.25	1.39	0.06	0.44	6.91
FATHEAD MINNOW	N	O	C	T	1	0.75	0.13	0.00	0.02	3.00
BLUNTNOSE MINNOW	N	O	C	T	9	6.75	1.14	0.03	0.22	4.22
CENTRAL STONEROLLER	N	H	N		181	135.75	22.91	0.62	4.71	4.58
BROWN BULLHEAD		I	C	T	3	2.25	0.38	0.16	1.18	69.00
BLUEGILL SUNFISH	S	I	C	P	13	9.75	1.65	0.08	0.64	8.62
REDEAR SUNFISH	E	I	C		3	2.25	0.38	0.04	0.30	17.33
PUMPKINSEED SUNFISH	S	I	C	P	11	8.25	1.39	0.12	0.94	15.00
JOHNNY DARTER	D	I	C		22	16.50	2.78	0.02	0.13	1.05
RAINBOW DARTER	D	I	S	M	2	1.50	0.25	0.00	0.02	1.50
	Mile Total				790	592.50		13.22		
	Number of Species				16					
	Number of Hybrids				0					

Species List

River Code: **15-005** River Mile: **9.00**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 3300 sec Drain Area: 16.4 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/10/95 Thru: 09/18/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	7	5.25	0.47	0.23	1.60	42.79
WHITE SUCKER	W	O	S	T	219	164.25	14.65	6.91	49.15	42.05
GOLDEN SHINER	N	I	M	T	1	0.75	0.07	0.01	0.09	16.00
RIVER CHUB	N	I	N	I	3	2.25	0.20	0.06	0.41	25.67
BLACKNOSE DACE	N	G	S	T	285	213.75	19.06	0.74	5.23	3.44
CREEK CHUB	N	G	N	T	113	84.75	7.56	1.24	8.84	14.66
REDSIDE DACE	N	I	S	I	1	0.75	0.07	0.01	0.04	8.00
COMMON SHINER	N	I	S		101	75.75	6.76	0.61	4.31	7.99
FATHEAD MINNOW	N	O	C	T	6	4.50	0.40	0.03	0.19	5.83
BLUNTNOSE MINNOW	N	O	C	T	27	20.25	1.81	0.10	0.68	4.70
CENTRAL STONEROLLER	N	H	N		610	457.50	40.80	3.99	28.42	8.73
LARGEMOUTH BASS	F	C	C		1	0.75	0.07	0.00	0.03	6.00
PUMPKINSEED SUNFISH	S	I	C	P	5	3.75	0.33	0.03	0.21	7.60
JOHNNY DARTER	D	I	C		50	37.50	3.34	0.05	0.34	1.29
RAINBOW DARTER	D	I	S	M	66	49.50	4.41	0.07	0.48	1.36
Mile Total					1,495	1,121.25		14.05		
Number of Species					15					
Number of Hybrids					0					

Species List

River Code: **15-005** River Mile: **9.00**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 1271 sec Drain Area: 16.4 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1996** Date Range: 06/21/96 Thru: 08/27/96 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
NORTHERN HOG SUCKER	R	I	S	M	5	3.75	0.48	0.15	1.89	40.80
WHITE SUCKER	W	O	S	T	104	78.00	10.06	2.73	33.48	34.94
COMMON CARP	G	O	M	T	1	0.75	0.10	0.00	0.04	4.00
BLACKNOSE DACE	N	G	S	T	270	202.50	26.11	0.70	8.65	3.48
CREEK CHUB	N	G	N	T	130	97.50	12.57	1.06	12.96	10.82
SILVER SHINER	N	I	S	I	45	33.75	4.35	0.03	0.33	0.78
COMMON SHINER	N	I	S		50	37.50	4.84	0.42	5.19	11.26
FATHEAD MINNOW	N	O	C	T	1	0.75	0.10	0.00	0.02	2.00
BLUNTNOSE MINNOW	N	O	C	T	32	24.00	3.09	0.09	1.06	3.56
CENTRAL STONEROLLER	N	H	N		332	249.00	32.11	2.90	35.60	11.64
LARGEMOUTH BASS	F	C	C		3	2.25	0.29	0.01	0.16	5.67
PUMPKINSEED SUNFISH	S	I	C	P	1	0.75	0.10	0.00	0.04	4.00
JOHNNY DARTER	D	I	C		23	17.25	2.22	0.02	0.19	0.87
RAINBOW DARTER	D	I	S	M	37	27.75	3.58	0.04	0.44	1.30
Mile Total					1,034	775.50		8.14		
Number of Species					14					
Number of Hybrids					0					

Species List

River Code: **15-005** River Mile: **5.60**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 4200 sec Drain Area: 31.4 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/09/95 Thru: 09/19/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	39	29.25	1.35	0.62	4.82	21.28
WHITE SUCKER	W	O	S	T	111	83.25	3.83	0.94	7.30	11.34
RIVER CHUB	N	I	N	I	194	145.50	6.69	1.60	12.37	10.99
BLACKNOSE DACE	N	G	S	T	668	501.00	23.05	1.68	13.02	3.36
CREEK CHUB	N	G	N	T	64	48.00	2.21	0.32	2.47	6.64
ROSYFACE SHINER	N	I	S	I	21	15.75	0.72	0.04	0.29	2.38
COMMON SHINER	N	I	S		149	111.75	5.14	0.54	4.14	4.79
FATHEAD MINNOW	N	O	C	T	6	4.50	0.21	0.01	0.09	2.33
BLUNTNOSE MINNOW	N	O	C	T	72	54.00	2.48	0.17	1.30	3.10
CENTRAL STONEROLLER	N	H	N		1,099	824.25	37.92	6.60	51.09	8.01
BLUEGILL SUNFISH	S	I	C	P	1	0.75	0.03	0.00	0.03	6.00
PUMPKINSEED SUNFISH	S	I	C	P	2	1.50	0.07	0.04	0.30	26.00
JOHNNY DARTER	D	I	C		102	76.50	3.52	0.12	0.92	1.54
RAINBOW DARTER	D	I	S	M	370	277.50	12.77	0.24	1.87	0.87
Mile Total					2,898	2,173.50		12.92		
Number of Species					14					
Number of Hybrids					0					

Species List

River Code: **15-005** River Mile: **3.50**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 4500 sec Drain Area: 48.8 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/15/95 Thru: 09/19/95 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
LEAST BROOK LAMPREY		F	N		3	2.25	0.17	0.03	0.31	13.33
NORTHERN HOG SUCKER	R	I	S	M	68	51.00	3.96	1.12	11.51	21.97
WHITE SUCKER	W	O	S	T	154	115.50	8.96	0.26	2.71	2.28
COMMON CARP	G	O	M	T	3	2.25	0.17	4.83	49.60	2,146.33
RIVER CHUB	N	I	N	I	11	8.25	0.64	0.13	1.34	15.73
BLACKNOSE DACE	N	G	S	T	126	94.50	7.33	0.11	1.17	1.20
CREEK CHUB	N	G	N	T	41	30.75	2.39	0.13	1.31	4.15
ROSYFACE SHINER	N	I	S	I	25	18.75	1.45	0.04	0.41	2.13
COMMON SHINER	N	I	S		248	186.00	14.43	1.00	10.28	5.38
BLUNTNOSE MINNOW	N	O	C	T	75	56.25	4.36	0.15	1.49	2.57
CENTRAL STONEROLLER	N	H	N		774	580.50	45.03	1.72	17.67	2.96
COMMON SH X ROSYFACE SH		I			1	0.75	0.06	0.00	0.03	3.00
LARGEMOUTH BASS	F	C	C		2	1.50	0.12	0.01	0.06	4.00
GREEN SUNFISH	S	I	C	T	1	0.75	0.06	0.00	0.05	6.00
PUMPKINSEED SUNFISH	S	I	C	P	10	7.50	0.58	0.07	0.72	9.30
JOHNNY DARTER	D	I	C		19	14.25	1.11	0.01	0.14	0.99
RAINBOW DARTER	D	I	S	M	158	118.50	9.19	0.12	1.24	1.01
Mile Total					1,719	1,289.25		9.74		
Number of Species					16					
Number of Hybrids					1					

Species List

River Code: **15-005** River Mile: **3.45**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 1560 sec Drain Area: 48.8 sq mi Dist Fished: 0.10 km No of Passes: 2	Sample Date: **1995** Date Range: 08/15/95 Thru: 09/19/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	28	84.00	2.60	1.07	5.04	12.68
WHITE SUCKER	W	O	S	T	14	42.00	1.30	1.83	8.66	43.57
COMMON CARP	G	O	M	T	1	3.00	0.09	4.58	21.65	1,525.00
RIVER CHUB	N	I	N	I	4	12.00	0.37	0.16	0.77	13.50
BLACKNOSE DACE	N	G	S	T	16	48.00	1.49	0.08	0.37	1.63
CREEK CHUB	N	G	N	T	15	45.00	1.40	0.57	2.70	12.67
ROSYFACE SHINER	N	I	S	I	4	12.00	0.37	0.02	0.09	1.50
COMMON SHINER	N	I	S		222	666.00	20.65	3.75	17.73	5.63
FATHEAD MINNOW	N	O	C	T	1	3.00	0.09	0.01	0.03	2.00
BLUNTNOSE MINNOW	N	O	C	T	51	153.00	4.74	0.51	2.42	3.34
CENTRAL STONEROLLER	N	H	N		643	1,929.00	59.81	8.21	38.85	4.26
GREEN SUNFISH	S	I	C	T	1	3.00	0.09	0.05	0.21	15.00
JOHNNY DARTER	D	I	C		15	45.00	1.40	0.05	0.24	1.13
RAINBOW DARTER	D	I	S	M	60	180.00	5.58	0.27	1.26	1.48
Mile Total					1,075	3,225.00		21.14		
Number of Species					14					
Number of Hybrids					0					

Species List

River Code: **15-005** River Mile: **3.40**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 4320 sec Drain Area: 48.8 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/15/95 Thru: 09/19/95 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
LEAST BROOK LAMPREY		F	N		3	2.25	0.19	0.04	0.30	17.67
NORTHERN HOG SUCKER	R	I	S	M	46	34.50	2.90	1.70	12.83	49.20
WHITE SUCKER	W	O	S	T	135	101.25	8.52	4.15	31.35	40.98
COMMON CARP	G	O	M	T	5	3.75	0.32	2.32	17.51	617.80
RIVER CHUB	N	I	N	I	10	7.50	0.63	0.08	0.62	10.84
BLACKNOSE DACE	N	G	S	T	46	34.50	2.90	0.08	0.61	2.33
CREEK CHUB	N	G	N	T	52	39.00	3.28	0.38	2.86	9.71
ROSYFACE SHINER	N	I	S	I	31	23.25	1.96	0.06	0.42	2.40
COMMON SHINER	N	I	S		417	312.75	26.33	1.33	10.02	4.24
FATHEAD MINNOW	N	O	C	T	3	2.25	0.19	0.00	0.02	1.00
BLUNTNOSE MINNOW	N	O	C	T	146	109.50	9.22	0.28	2.13	2.57
CENTRAL STONEROLLER	N	H	N		549	411.75	34.66	2.19	16.51	5.31
COMMON SH X ROSYFACE SH		I			1	0.75	0.06	0.01	0.05	9.00
COMMON SH X CREEK CHUB					1	0.75	0.06	0.00	0.03	6.00
ROCK BASS	S	C	C		2	1.50	0.13	0.38	2.88	253.50
LARGEMOUTH BASS	F	C	C		3	2.25	0.19	0.01	0.06	3.67
GREEN SUNFISH	S	I	C	T	3	2.25	0.19	0.01	0.06	3.67
BLUEGILL SUNFISH	S	I	C	P	10	7.50	0.63	0.02	0.17	2.90
PUMPKINSEED SUNFISH	S	I	C	P	18	13.50	1.14	0.11	0.83	8.11
YELLOW PERCH			M		1	0.75	0.06	0.02	0.18	31.00
JOHNNY DARTER	D	I	C		13	9.75	0.82	0.01	0.08	1.03
RAINBOW DARTER	D	I	S	M	89	66.75	5.62	0.07	0.51	1.00
Mile Total					1,584	1,188.00		13.23		
Number of Species					20					
Number of Hybrids					2					

Species List

River Code: **15-005** River Mile: **1.60**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 4200 sec Drain Area: 55.5 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/08/95 Thru: 09/19/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	109	81.75	9.81	4.07	26.09	49.83
WHITE SUCKER	W	O	S	T	83	62.25	7.47	1.39	8.89	22.29
COMMON CARP	G	O	M	T	3	2.25	0.27	5.22	33.43	2,320.00
RIVER CHUB	N	I	N	I	4	3.00	0.36	0.10	0.64	33.25
BLACKNOSE DACE	N	G	S	T	2	1.50	0.18	0.00	0.01	1.00
CREEK CHUB	N	G	N	T	4	3.00	0.36	0.02	0.11	5.50
ROSYFACE SHINER	N	I	S	I	7	5.25	0.63	0.01	0.08	2.29
COMMON SHINER	N	I	S		166	124.50	14.94	0.97	6.19	7.76
BLUNTNOSE MINNOW	N	O	C	T	73	54.75	6.57	0.16	1.05	3.00
CENTRAL STONEROLLER	N	H	N		538	403.50	48.42	1.13	7.21	2.79
YELLOW BULLHEAD		I	C	T	11	8.25	0.99	1.13	7.25	137.18
BLACK CRAPPIE	S	I	C		1	0.75	0.09	0.04	0.23	48.00
ROCK BASS	S	C	C		8	6.00	0.72	0.73	4.65	121.00
LARGEMOUTH BASS	F	C	C		14	10.50	1.26	0.30	1.89	28.14
WARMOUTH SF	S	C	C		2	1.50	0.18	0.01	0.04	4.50
GREEN SUNFISH	S	I	C	T	7	5.25	0.63	0.11	0.70	20.71
BLUEGILL SUNFISH	S	I	C	P	20	15.00	1.80	0.12	0.77	8.05
PUMPKINSEED SUNFISH	S	I	C	P	6	4.50	0.54	0.09	0.58	20.00
YELLOW PERCH			M		1	0.75	0.09	0.01	0.05	10.00
JOHNNY DARTER	D	I	C		20	15.00	1.80	0.01	0.08	0.85
RAINBOW DARTER	D	I	S	M	32	24.00	2.88	0.01	0.08	0.49
	Mile Total				1,111	833.25		15.62		
	Number of Species				21					
	Number of Hybrids				0					

Species List

River Code: **15-005** River Mile: **0.30**	Stream: **Aurora Branch** Basin: Chagrin River Time Fished: 4380 sec Drain Area: 57.5 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/08/95 Thru: 09/19/95 Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
NORTHERN HOG SUCKER	R	I	S	M	169	126.75	12.84	8.14	21.52	64.19
WHITE SUCKER	W	O	S	T	37	27.75	2.81	0.91	2.41	32.78
COMMON CARP	G	O	M	T	5	3.75	0.38	10.43	27.57	2,780.00
RIVER CHUB	N	I	N	I	276	207.00	20.97	3.21	8.48	15.50
BLACKNOSE DACE	N	G	S	T	1	0.75	0.08	0.00	0.00	2.00
CREEK CHUB	N	G	N	T	2	1.50	0.15	0.01	0.02	5.00
ROSYFACE SHINER	N	I	S	I	7	5.25	0.53	0.01	0.03	1.86
COMMON SHINER	N	I	S		167	125.25	12.69	1.17	3.10	9.35
SAND SHINER	N	I	M	M	3	2.25	0.23	0.01	0.02	2.67
BLUNTNOSE MINNOW	N	O	C	T	108	81.00	8.21	0.24	0.65	3.01
CENTRAL STONEROLLER	N	H	N		397	297.75	30.17	2.69	7.12	9.04
COMMON SH X ROSYFACE SH		I			1	0.75	0.08	0.01	0.02	11.00
COMMON SH X RIVER CHUB		I			2	1.50	0.15	0.04	0.11	27.50
YELLOW BULLHEAD		I	C	T	8	6.00	0.61	1.14	3.01	189.63
STONECAT MADTOM		I	C	I	7	5.25	0.53	0.19	0.51	36.29
WHITE CRAPPIE	S	I	C		4	3.00	0.30	0.19	0.51	63.75
ROCK BASS	S	C	C		3	2.25	0.23	0.16	0.42	69.67
SMALLMOUTH BASS	F	C	C	M	66	49.50	5.02	8.84	23.38	178.59
LARGEMOUTH BASS	F	C	C		5	3.75	0.38	0.15	0.41	40.80
GREEN SUNFISH	S	I	C	T	3	2.25	0.23	0.04	0.11	18.00
BLUEGILL SUNFISH	S	I	C	P	5	3.75	0.38	0.09	0.22	22.60
LONGEAR SUNFISH	S	I	C	M	3	2.25	0.23	0.09	0.24	40.00
PUMPKINSEED SUNFISH	S	I	C	P	1	0.75	0.08	0.01	0.02	10.00
JOHNNY DARTER	D	I	C		5	3.75	0.38	0.00	0.01	0.80
GREENSIDE DARTER	D	I	S	M	15	11.25	1.14	0.04	0.11	3.56
RAINBOW DARTER	D	I	S	M	16	12.00	1.22	0.02	0.04	1.34
	Mile Total				1,316	987.00		37.81		
	Number of Species				24					
	Number of Hybrids				2					

Species List

River Code: **15-006** River Mile: **0.10**	Stream: **McFarland Creek** Basin: Chagrin River Time Fished: 1800 sec Drain Area: 10.8 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1995** Date Range: 08/16/95 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
NORTHERN HOG SUCKER	R	I	S	M	32	64.00	4.27	0.36	7.06	5.59
WHITE SUCKER	W	O	S	T	10	20.00	1.33	0.23	4.46	11.30
RIVER CHUB	N	I	N	I	10	20.00	1.33	0.22	4.30	10.90
BLACKNOSE DACE	N	G	S	T	37	74.00	4.93	0.20	3.87	2.65
CREEK CHUB	N	G	N	T	54	108.00	7.20	1.21	23.88	11.20
ROSYFACE SHINER	N	I	S	I	6	12.00	0.80	0.02	0.36	1.50
COMMON SHINER	N	I	S		64	128.00	8.53	0.53	10.54	4.17
BLUNTNOSE MINNOW	N	O	C	T	24	48.00	3.20	0.12	2.33	2.46
CENTRAL STONEROLLER	N	H	N		433	866.00	57.73	2.04	40.21	2.35
LARGEMOUTH BASS	F	C	C		1	2.00	0.13	0.01	0.24	6.00
BLUEGILL SUNFISH	S	I	C	P	2	4.00	0.27	0.02	0.39	5.00
JOHNNY DARTER	D	I	C		10	20.00	1.33	0.02	0.39	1.00
RAINBOW DARTER	D	I	S	M	67	134.00	8.93	0.10	1.97	0.75
	Mile Total				750	1,500.00		5.07		
	Number of Species				13					
	Number of Hybrids				0					

Species List

River Code: **15-007** River Mile: **4.00**	Stream: **Silver Creek** Basin: Chagrin River Time Fished: 2400 sec Drain Area: 4.1 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1995** Date Range: 08/08/95 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GRASS PICKEREL		P	M	P	2	4.00	2.33	0.02	0.78	4.50
WHITE SUCKER	W	O	S	T	6	12.00	6.98	0.59	25.61	49.50
CREEK CHUB	N	G	N	T	57	114.00	66.28	1.20	51.75	10.53
COMMON SHINER	N	I	S		11	22.00	12.79	0.15	6.25	6.60
BLUNTNOSE MINNOW	N	O	C	T	2	4.00	2.33	0.02	0.78	4.50
YELLOW BULLHEAD		I	C	T	3	6.00	3.49	0.33	14.40	55.67
JOHNNY DARTER	D	I	C		4	8.00	4.65	0.01	0.26	0.75
RAINBOW DARTER	D	I	S	M	1	2.00	1.16	0.00	0.17	2.00
Mile Total					86	172.00		2.32		
Number of Species					8					
Number of Hybrids					0					

Species List

River Code: **15-007** River Mile: **1.70**	Stream: **Silver Creek** Basin: Chagrin River Time Fished: 4725 sec Drain Area: 11.1 sq mi Dist Fished: 0.37 km No of Passes: 2	Sample Date: **1995** Date Range: 08/08/95 Thru: 09/27/95 Sampler Type: E 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	1	0.75	0.30	0.01	0.05	8.00
GRASS PICKEREL		P	M	P	5	4.01	1.62	0.38	3.01	95.00
NORTHERN HOG SUCKER	R	I	S	M	52	41.25	16.66	1.82	14.42	43.27
WHITE SUCKER	W	O	S	T	23	18.84	7.61	3.44	27.27	182.61
COMMON SHINER	N	I	S		9	7.01	2.83	0.05	0.42	7.33
BLUNTNOSE MINNOW	N	O	C	T	81	61.28	24.75	0.11	0.89	1.79
CENTRAL STONEROLLER	N	H	N		3	2.25	0.91	0.08	0.59	33.33
YELLOW BULLHEAD		I	C	T	6	4.76	1.92	0.54	4.31	114.00
BLACK CRAPPIE	S	I	C		5	3.88	1.57	0.11	0.89	29.00
ROCK BASS	S	C	C		49	38.47	15.54	3.02	23.97	78.76
SMALLMOUTH BASS	F	C	C	M	24	18.53	7.48	2.43	19.24	128.75
LARGEMOUTH BASS	F	C	C		1	0.75	0.30	0.01	0.04	7.00
WARMOUTH SF	S	C	C		24	19.46	7.86	0.54	4.24	27.17
BLUEGILL SUNFISH	S	I	C	P	2	1.63	0.66	0.02	0.15	11.00
PUMPKINSEED SUNFISH	S	I	C	P	2	1.50	0.61	0.04	0.31	26.00
JOHNNY DARTER	D	I	C		1	0.75	0.30	0.00	0.01	2.00
GREENSIDE DARTER	D	I	S	M	2	1.63	0.66	0.01	0.05	3.50
RAINBOW DARTER	D	I	S	M	24	19.06	7.70	0.02	0.13	0.88
FANTAIL DARTER	D	I	C		2	1.76	0.71	0.00	0.02	1.00
	Mile Total				316	247.59		12.62		
	Number of Species				19					
	Number of Hybrids				0					

Species List

River Code: **15-007** River Mile: **0.50**	Stream: **Silver Creek** Basin: Chagrin River Time Fished: 4586 sec Drain Area: 13.3 sq mi Dist Fished: 0.40 km No of Passes: 2	Sample Date: **1995** Date Range: 08/08/95 Thru: 09/27/95 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
LEAST BROOK LAMPREY		F	N		8	6.00	2.63	0.06	0.34	10.13
GRASS PICKEREL		P	M	P	1	0.75	0.33	0.01	0.06	13.00
NORTHERN HOG SUCKER	R	I	S	M	44	33.00	14.47	1.99	11.06	60.34
WHITE SUCKER	W	O	S	T	42	31.50	13.82	7.57	42.08	240.46
COMMON SHINER	N	I	S		10	7.50	3.29	0.20	1.12	26.80
BLUNTNOSE MINNOW	N	O	C	T	6	4.50	1.97	0.01	0.05	2.00
YELLOW BULLHEAD		I	C	T	5	3.75	1.64	0.59	3.29	158.00
BLACK CRAPPIE	S	I	C		6	4.50	1.97	0.18	0.99	39.50
ROCK BASS	S	C	C		71	53.25	23.36	3.47	19.27	65.13
SMALLMOUTH BASS	F	C	C	M	23	17.25	7.57	2.72	15.09	157.43
LARGEMOUTH BASS	F	C	C		5	3.75	1.64	0.14	0.79	37.80
WARMOUTH SF	S	C	C		13	9.75	4.28	0.36	2.02	37.31
GREEN SUNFISH	S	I	C	T	11	8.25	3.62	0.09	0.49	10.64
BLUEGILL SUNFISH	S	I	C	P	15	11.25	4.93	0.18	1.01	16.13
PUMPKINSEED SUNFISH	S	I	C	P	28	21.00	9.21	0.39	2.15	18.43
B'GILL X PUMPKINSEED					1	0.75	0.33	0.02	0.13	31.00
JOHNNY DARTER	D	I	C		8	6.00	2.63	0.01	0.03	0.88
GREENSIDE DARTER	D	I	S	M	2	1.50	0.66	0.00	0.02	2.50
RAINBOW DARTER	D	I	S	M	5	3.75	1.64	0.00	0.02	1.00
	Mile Total				304	228.00		18.00		
	Number of Species				18					
	Number of Hybrids				1					

River Code: **15-012** River Mile: **0.40**	Stream: **Trib. to Chagrin R. (RM 15.42)** Basin: Chagrin River Time Fished: 1800 sec Drain Area: 1.7 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1995** Date Range: 08/07/95 Sampler Type: F

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
RAINBOW TROUT	E		N		4	8.00	1.33	0.67	25.07	83.75
NORTHERN HOG SUCKER	R	I	S	M	3	6.00	1.00	0.00	0.15	0.67
WHITE SUCKER	W	O	S	T	5	10.00	1.66	0.03	1.20	3.20
BLACKNOSE DACE	N	G	S	T	89	178.00	29.57	0.39	14.75	2.21
CREEK CHUB	N	G	N	T	66	132.00	21.93	0.84	31.36	6.35
CENTRAL STONEROLLER	N	H	N		42	84.00	13.95	0.48	18.11	5.76
JOHNNY DARTER	D	I	C		14	28.00	4.65	0.02	0.60	0.57
RAINBOW DARTER	D	I	S	M	78	156.00	25.91	0.23	8.76	1.50
	Mile Total				301	602.00		2.67		
	Number of Species				8					
	Number of Hybrids				0					

River Code: **15-017** River Mile: **0.20**	Stream: **Trib. to Chagrin R. (RM 14.88)** Basin: Chagrin River Time Fished: 1800 sec Drain Area: 1.8 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1995** Date Range: 08/07/95 Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BLACKNOSE DACE	N	G	S	T	35	70.00	44.30	0.12	11.37	1.69
CREEK CHUB	N	G	N	T	44	88.00	55.70	0.92	88.63	10.45
Mile Total					79	158.00		1.04		
Number of Species					2					
Number of Hybrids					0					

Species List

River Code: **15-018** River Mile: **0.30**	Stream: **Trib. to Chagrin R. (RM 22.81)** Basin: Chagrin River Time Fished: 2400 sec Drain Area: 9.3 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1995** Date Range: 08/07/95 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
NORTHERN HOG SUCKER	R	I	S	M	10	20.00	3.17	0.75	17.25	37.50
WHITE SUCKER	W	O	S	T	21	42.00	6.67	0.11	2.44	2.52
COMMON CARP	G	O	M	T	1	2.00	0.32	0.00	0.05	1.00
RIVER CHUB	N	I	N	I	8	16.00	2.54	0.30	6.99	19.00
BLACKNOSE DACE	N	G	S	T	8	16.00	2.54	0.02	0.55	1.50
CREEK CHUB	N	G	N	T	17	34.00	5.40	0.48	10.95	14.00
COMMON SHINER	N	I	S		13	26.00	4.13	0.22	5.06	8.46
SAND SHINER	N	I	M	M	4	8.00	1.27	0.03	0.69	3.75
BLUNTNOSE MINNOW	N	O	C	T	9	18.00	2.86	0.09	2.02	4.88
CENTRAL STONEROLLER	N	H	N		190	380.00	60.32	1.21	27.85	3.19
YELLOW BULLHEAD		I	C	T	1	2.00	0.32	0.04	0.92	20.00
STONECAT MADTOM		I	C	I	10	20.00	3.17	0.94	21.71	47.20
BLUEGILL SUNFISH	S	I	C	P	2	4.00	0.63	0.10	2.39	26.00
JOHNNY DARTER	D	I	C		6	12.00	1.90	0.02	0.39	1.40
GREENSIDE DARTER	D	I	S	M	4	8.00	1.27	0.01	0.30	1.67
RAINBOW DARTER	D	I	S	M	11	22.00	3.49	0.02	0.46	0.91
	Mile Total				315	630.00		4.35		
	Number of Species				16					
	Number of Hybrids				0					

Species List

River Code: **15-023** River Mile: **0.10**	Stream: **Sunny Lake Outlet** Basin: Chagrin River Time Fished: 3000 sec Drain Area: 3.3 sq mi Dist Fished: 0.15 km No of Passes: 1	Sample Date: **1996** Date Range: 08/01/96 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	1	2.00	0.93			
CREEK CHUB	N	G	N	T	46	92.00	42.59			
COMMON SHINER	N	I	S		3	6.00	2.78			
FATHEAD MINNOW	N	O	C	T	16	32.00	14.81			
BLUNTNOSE MINNOW	N	O	C	T	5	10.00	4.63			
YELLOW BULLHEAD		I	C	T	11	22.00	10.19			
BROWN BULLHEAD		I	C	T	2	4.00	1.85			
LARGEMOUTH BASS	F	C	C		3	6.00	2.78			
BLUEGILL SUNFISH	S	I	C	P	2	4.00	1.85			
JOHNNY DARTER	D	I	C		19	38.00	17.59			
	Mile Total				108	216.00				
	Number of Species				10					
	Number of Hybrids				0					

Summary of ICI scores for the Chagrin River watershed, 1995-96.

River Mile	Drainage Area (sq mi)	Number of				Percent:					Qual. EPT	Eco-region	ICI
		Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Taxa			
CHAGRIN RIVER (15-001)													
Year: 95													
36.60	36.0	51(6)	14(6)	3(4)	20(6)	20.6(4)	1.7(2)	38.2(6)	38.1(4)	10.3(4)	21(6)	3	48
36.20	37.0	46(6)	10(6)	5(6)	18(4)	19.9(4)	7.8(4)	52.8(6)	18.5(6)	3.3(6)	19(6)	3	54
33.40	54.0	48(6)	12(6)	3(4)	20(6)	10.4(2)	0.7(2)	63.7(6)	23.1(6)	5.5(6)	17(6)	3	50
30.00	57.0	31(4)	0(0)	1(2)	21(6)	0.0(0)	0.1(2)	2.1(2)	97.1(0)	64.9(0)	0(0)	3	16
26.70	119.0	34(4)	5(2)	6(6)	13(4)	41.6(6)	10.0(4)	18.7(4)	28.5(4)	1.6(6)	15(6)	3	46
25.50	124.0	37(4)	6(4)	6(6)	17(4)	17.9(4)	19.7(6)	16.8(2)	44.9(2)	12.7(2)	9(2)	3	36
13.00	166.0	32(4)	7(4)	4(4)	17(4)	20.7(4)	23.6(6)	12.0(2)	43.6(2)	5.0(4)	12(4)	3	38
12.50	168.0	41(6)	7(4)	4(4)	18(6)	18.1(4)	0.7(2)	24.2(4)	56.7(2)	10.6(2)	11(4)	3	38
4.10	246.0	30(4)	6(4)	4(4)	10(2)	5.0(2)	30.0(6)	30.0(4)	34.8(4)	0.5(6)	8(2)	3	38
AURORA BRANCH (15-005)													
Year: 95													
17.10	1.1	34(4)	1(0)	0(0)	18(4)	0.7(2)	0.0(0)	0.0(0)	96.0(0)	60.1(0)	1(0)	3	10
16.60	3.6	29(4)	2(0)	2(4)	18(4)	1.3(2)	2.5(6)	4.8(2)	90.5(0)	33.9(0)	2(0)	3	22
12.00	13.5	36(4)	1(0)	0(0)	32(6)	0.3(2)	0.0(0)	5.7(2)	94.0(0)	41.3(0)	8(4)	3	18
11.30	14.5	20(2)	0(0)	0(0)	17(4)	0.0(0)	0.0(0)	0.9(2)	98.5(0)	75.7(0)	1(0)	3	8
11.00	14.7	38(6)	3(2)	1(2)	25(6)	0.3(2)	0.3(2)	4.3(2)	95.1(0)	79.8(0)	5(2)	3	24
9.10	16.4	43(6)	5(4)	3(6)	28(6)	8.4(2)	2.7(4)	46.8(6)	41.3(4)	9.8(4)	17(6)	3	48
5.70	31.4	40(6)	10(6)	5(6)	20(6)	14.1(4)	38.8(6)	15.9(4)	30.6(4)	5.5(6)	22(6)	3	54
3.50	48.8	44(6)	7(4)	6(6)	23(6)	23.3(4)	21.8(6)	30.7(6)	23.5(6)	2.9(6)	14(6)	3	56
1.60	55.5	53(6)	13(6)	5(6)	23(6)	13.2(2)	1.4(2)	40.6(6)	43.9(4)	10.5(4)	17(6)	3	48
SILVER CREEK (15-007)													
Year: 96													
5.00	2.5	57(6)	9(6)	5(6)	32(6)	4.8(2)	1.3(6)	32.1(6)	59.5(2)	4.4(6)	15(6)	3	52
Year: 95													
3.90	4.1	50(6)	9(6)	4(6)	23(6)	37.5(6)	8.3(6)	14.0(4)	36.0(4)	5.0(6)	14(6)	3	56
1.90	11.1	44(6)	9(6)	8(6)	13(2)	2.8(2)	4.9(6)	63.4(6)	28.7(6)	7.5(6)	18(6)	3	52
0.50	13.3	44(6)	12(6)	4(6)	18(4)	10.7(2)	1.7(4)	67.7(6)	16.3(6)	2.5(6)	18(6)	3	52
TRIB. TO CHAGRIN R. (15-012)													
Year: 95													
0.30	1.7	61(6)	12(6)	7(6)	35(6)	16.7(4)	5.6(6)	8.0(2)	68.0(0)	16.6(4)	14(6)	3	46

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/03/96 River Code: 15-001 River: Chagrin River RM: 0.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
00653	*Eunapius fragilis*	+			
01200	*Cordylophora lacustris*	1			
01801	*Turbellaria*	560			
03600	*Oligochaeta*	712 +			
04685	*Placobdella ornata*	+			
04686	*Placobdella papillifera*	+			
05800	*Caecidotea sp*	+			
06810	*Gammarus fasciatus*	104 +			
08250	*Orconectes (Procericambarus) rusticus*	+			
17200	*Caenis sp*	33			
22001	*Coenagrionidae*	+			
22300	*Argia sp*	25 +			
44501	*Corixidae*	+			
51206	*Cyrnellus fraternus*	286			
68901	*Macronychus glabratus*	2			
77120	*Ablabesmyia mallochi*	84			
77130	*Ablabesmyia rhamphe group*	127			
77500	*Conchapelopia sp*	127			
78650	*Procladius sp*	84 +			
79085	*Telopelopia okoboji*	42			
81240	*Nanocladius (N.) distinctus*	42			
82820	*Cryptochironomus sp*	+			
83040	*Dicrotendipes neomodestus*	127			
83051	*Dicrotendipes simpsoni*	1307 +			
83300	*Glyptotendipes (G.) sp*	4091 +			
84020	*Parachironomus carinatus*	42			
84315	*Phaenopsectra flavipes*	+			
84520	*Polypedilum (Tripodura) halterale group*	42 +			
84540	*Polypedilum (Tripodura) scalaenum group*	84			
84888	*Xenochironomus xenolabis*	+			
85500	*Paratanytarsus sp*	42			
85814	*Tanytarsus glabrescens group*	84			
85840	*Tanytarsus guerlus group*	42			
95100	*Physella sp*	32 +			
96900	*Ferrissia sp*	9			
97710	*Dreissena polymorpha*	464 +			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 26 Total Taxa: 37

No. Qualitative Taxa: 20 ICI: **14**

Number of Organisms: 8595 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 15-001 River: Chagrin River RM: 36.60

Taxa Code	Taxa	Quant	Qual
01320	*Hydra sp*	45	
03600	*Oligochaeta*	91	+
05800	*Caecidotea sp*		+
08250	*Orconectes (Procericambarus) rusticus*		+
11120	*Baetis flavistriga*	15	+
11130	*Baetis intercalaris*	158	+
11650	*Procloeon sp (w/ hindwing pads)*	3	+
11651	*Procloeon sp (w/o hindwing pads)*	24	
11670	*Procloeon irrubrum*		+
12200	*Isonychia sp*	57	+
13000	*Leucrocuta sp*	32	+
13400	*Stenacron sp*	137	+
13521	*Stenonema femoratum*	10	+
13561	*Stenonema pulchellum*	59	+
13590	*Stenonema vicarium*	20	+
14950	*Leptophlebia sp or Paraleptophebia sp*	11	
15501	*Ephemerellidae*	17	
16200	*Eurylophella sp*	1	
17200	*Caenis sp*	1	+
18100	*Anthopotamus sp*		+
18600	*Ephemera sp*		+
21200	*Calopteryx sp*	2	+
22300	*Argia sp*	1	
23909	*Boyeria vinosa*		+
34130	*Acroneuria frisoni*	4	+
34410	*Paragnetina media*	2	+
47600	*Sialis sp*		+
48620	*Nigronia serricornis*	1	+
50804	*Lype diversa*	10	
51400	*Nyctiophylax sp*		+
52200	*Cheumatopsyche sp*	25	+
52430	*Ceratopsyche morosa group*	9	+
57400	*Neophylax sp*		+
57900	*Pycnopsyche sp*		+
58505	*Helicopsyche borealis*		+
60400	*Gyrinus sp*	8	
68075	*Psephenus herricki*	1	+
68601	*Ancyronyx variegata*	3	
68708	*Dubiraphia vittata group*	9	+
68901	*Macronychus glabratus*	7	+
69400	*Stenelmis sp*	1	+
71100	*Hexatoma sp*		+
77120	*Ablabesmyia mallochi*	38	
77750	*Hayesomyia senata or Thienemannimyia norena*		+
77800	*Helopelopia sp*	38	+
78450	*Nilotanypus fimbriatus*	8	
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	24	
80370	*Corynoneura lobata*	248	
81280	*Nanocladius (Plecopteracoluthus) n. sp*		+
81632	*Parakiefferiella n.sp 2*		+
82121	*Thienemanniella n.sp 3*	32	
82141	*Thienemanniella xena*	32	
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	51	
83300	*Glyptotendipes (G.) sp*	13	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*		+
83840	*Microtendipes pedellus group*	88	+
83900	*Nilothauma sp*	13	
84450	*Polypedilum (P.) convictum*	38	+
84460	*Polypedilum (P.) fallax group*	101	
84480	*Polypedilum (P.) laetum group*		+
84540	*Polypedilum (Tripodura) scalaenum group*	38	
84700	*Stenochironomus sp*	13	
84750	*Stictochironomus sp*		+
85263	*Cladotanytarsus vanderwulpi group Type 3*		+
85500	*Paratanytarsus sp*	13	
85625	*Rheotanytarsus exiguus group*	909	+
85800	*Tanytarsus sp*	38	
85814	*Tanytarsus glabrescens group*	51	
87540	*Hemerodromia sp*	16	
96900	*Ferrissia sp*	81	+
98600	*Sphaerium sp*		+

No. Quantitative Taxa: 51 Total Taxa: 72
No. Qualitative Taxa: 48 ICI: **48**
Number of Organisms: 2647 Qual EPT: 21

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/14/95 River Code: 15-001 River: Chagrin River RM: 36.20

Taxa Code	Taxa	Quant/Qual	
00653	*Eunapius fragilis*		+
01320	*Hydra sp*	16	
01801	*Turbellaria*	1	
03360	*Plumatella sp*		+
03600	*Oligochaeta*	37	+
06201	*Hyalella azteca*		+
08250	*Orconectes (Procericambarus) rusticus*		+
08601	*Hydracarina*	36	+
11120	*Baetis flavistriga*	26	
11130	*Baetis intercalaris*	256	+
11650	*Procloeon sp (w/ hindwing pads)*		+
11651	*Procloeon sp (w/o hindwing pads)*		+
11670	*Procloeon irrubrum*		+
12200	*Isonychia sp*	444	+
13000	*Leucrocuta sp*	16	+
13400	*Stenacron sp*	31	+
13521	*Stenonema femoratum*		+
13561	*Stenonema pulchellum*	135	+
13590	*Stenonema vicarium*	27	+
14950	*Leptophlebia sp or Paraleptophebia sp*	8	
15501	*Ephemerellidae*	19	
17200	*Caenis sp*	1	
18100	*Anthopotamus sp*		+
21200	*Calopteryx sp*	1	+
22001	*Coenagrionidae*		+
34130	*Acroneuria frisoni*	1	
34410	*Paragnetina media*	16	+
48620	*Nigronia serricornis*	2	+
50315	*Chimarra obscura*	4	+
50804	*Lype diversa*	2	
50906	*Psychomyia flavida*	3	+
51600	*Polycentropus sp*		+
52200	*Cheumatopsyche sp*	231	+
52430	*Ceratopsyche morosa group*	136	+
57400	*Neophylax sp*		+
58505	*Helicopsyche borealis*		+
60400	*Gyrinus sp*		+
67500	*Laccobius sp*		+
68025	*Ectopria sp*		+
68075	*Psephenus herricki*		+
68130	*Helichus sp*	1	
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	10	+
69200	*Optioservus sp*	1	+
69400	*Stenelmis sp*	18	+
70600	*Antocha sp*	2	
71100	*Hexatoma sp*		+
72700	*Anopheles sp*		+
74100	*Simulium sp*	34	
77120	*Ablabesmyia mallochi*		+
78450	*Nilotanypus fimbriatus*	48	
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	25	
80370	*Corynoneura lobata*	16	
80410	*Cricotopus (C.) sp*	57	
80420	*Cricotopus (C.) bicinctus*	29	+
80430	*Cricotopus (C.) tremulus group*	29	
81060	*Lopescladius sp*		+
81240	*Nanocladius (N.) distinctus*		+
81280	*Nanocladius (Plecopteracoluthus) n. sp*		+
81631	*Parakiefferiella n.sp 1*		+
81825	*Rheocricotopus (Psilocricotopus) robacki*	57	+
82101	*Thienemanniella n.sp 1*	80	+
82141	*Thienemanniella xena*	112	
82770	*Chironomus (C.) riparius group*		+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*		+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*		+
83840	*Microtendipes pedellus group*		+
84300	*Phaenopsectra obediens group*		+
84450	*Polypedilum (P.) convictum*	172	+
84460	*Polypedilum (P.) fallax group*	29	+
84470	*Polypedilum (P.) illinoense*		+
84540	*Polypedilum (Tripodura) scalaenum group*	29	
84750	*Stictochironomus sp*		+
85261	*Cladotanytarsus vanderwulpi group Type 1*	29	
85263	*Cladotanytarsus vanderwulpi group Type 3*		+
85625	*Rheotanytarsus exiguus group*	2471	+
85720	*Stempellinella n.sp nr. flavidula*		+
85814	*Tanytarsus glabrescens group*	57	+
85840	*Tanytarsus guerlus group*		+
86100	*Chrysops sp*		+
86401	*Atherix lantha*		+
87540	*Hemerodromia sp*	25	+

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/14/95 River Code: 15-001 River: Chagrin River RM: 36.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
95100	*Physella sp*	+			
96900	*Ferrissia sp*	63			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 46 Total Taxa: 86

No. Qualitative Taxa: 66 ICI: **54**

Number of Organisms: 4843 Qual EPT: 19

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 15-001 River: Chagrin River RM: 33.40

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	20
03360	*Plumatella sp*	2
03600	*Oligochaeta*	65 +
06201	*Hyalella azteca*	1
08250	*Orconectes (Procericambarus) rusticus*	+
08601	*Hydracarina*	+
11120	*Baetis flavistriga*	1 +
11130	*Baetis intercalaris*	44 +
11650	*Procloeon sp (w/ hindwing pads)*	4
11651	*Procloeon sp (w/o hindwing pads)*	18
12200	*Isonychia sp*	34 +
13000	*Leucrocuta sp*	36 +
13400	*Stenacron sp*	44 +
13521	*Stenonema femoratum*	10
13561	*Stenonema pulchellum*	174 +
13590	*Stenonema vicarium*	8
14950	*Leptophlebia sp or Paraleptophebia sp*	19
17200	*Caenis sp*	21 +
21200	*Calopteryx sp*	+
22300	*Argia sp*	+
23909	*Boyeria vinosa*	2 +
34130	*Acroneuria frisoni*	1
34410	*Paragnetina media*	3 +
34700	*Agnetina capitata complex*	+
47600	*Sialis sp*	+
50315	*Chimarra obscura*	+
50906	*Psychomyia flavida*	1
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	5 +
52430	*Ceratopsyche morosa group*	23 +
52450	*Ceratopsyche sparna*	+
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	+
68075	*Psephenus herricki*	1 +
68601	*Ancyronyx variegata*	1
68708	*Dubiraphia vittata group*	2 +
68901	*Macronychus glabratus*	54
69225	*Optioservus fastiditus*	+
69400	*Stenelmis sp*	15 +
70600	*Antocha sp*	1
71100	*Hexatoma sp*	+
77120	*Ablabesmyia mallochi*	33
77500	*Conchapelopia sp*	66
77750	*Hayesomyia senata or Thienemannimyia norena*	33
80310	*Cardiocladius obscurus*	+
80410	*Cricotopus (C.) sp*	100 +
81631	*Parakiefferiella n.sp 1*	+
82101	*Thienemanniella n.sp 1*	66
82730	*Chironomus (C.) decorus group*	33
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	133 +
84210	*Paratendipes albimanus or P. duplicatus*	33
84300	*Phaenopsectra obediens group*	33
84450	*Polypedilum (P.) convictum*	100 +
84888	*Xenochironomus xenolabis*	33
85261	*Cladotanytarsus vanderwulpi group Type 1*	33
85500	*Paratanytarsus sp*	33
85615	*Rheotanytarsus distinctissimus group*	1824 +
85625	*Rheotanytarsus exiguus group*	+
85752	*Sublettea coffmani*	133
85800	*Tanytarsus sp*	33
85814	*Tanytarsus glabrescens group*	365
85840	*Tanytarsus guerlus group*	100
87540	*Hemerodromia sp*	42
96900	*Ferrissia sp*	122

No. Quantitative Taxa: 48 Total Taxa: 66
No. Qualitative Taxa: 37 ICI: **50**
Number of Organisms: 3958 Qual EPT: 17

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 15-001 River: Chagrin River RM: 30.60

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
04935	*Erpobdella punctata punctata*	+
05800	*Caecidotea sp*	+
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
12924	*Heptagenia flavescens*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
13561	*Stenonema pulchellum*	+
21200	*Calopteryx sp*	+
21300	*Hetaerina sp*	+
22300	*Argia sp*	+
23909	*Boyeria vinosa*	+
34410	*Paragnetina media*	+
48410	*Corydalus cornutus*	+
48620	*Nigronia serricornis*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52450	*Ceratopsyche sparna*	+
52530	*Hydropsyche depravata group*	+
52540	*Hydropsyche dicantha*	+
66200	*Cymbiodyta sp*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	+
69275	*Optioservus trivittatus*	+
69400	*Stenelmis sp*	+
70600	*Antocha sp*	+
77500	*Conchapelopia sp*	+
77800	*Helopelopia sp*	+
80310	*Cardiocladius obscurus*	+
80430	*Cricotopus (C.) tremulus group*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	+
81250	*Nanocladius (N.) minimus*	+
82820	*Cryptochironomus sp*	+
83310	*Glyptotendipes (Trichotendipes) amplus*	+
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) convictum*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
84750	*Stictochironomus sp*	+
84888	*Xenochironomus xenolabis*	+
85625	*Rheotanytarsus exiguus group*	+
85814	*Tanytarsus glabrescens group*	+
86401	*Atherix lantha*	+
87540	*Hemerodromia sp*	+
96900	*Ferrissia sp*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 48
No. Qualitative Taxa: 48 ICI:
Number of Organisms: 0 Qual EPT: 10

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 07/18/95 River Code: 15-001 River: Chagrin River RM: 30.08 A

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03360	*Plumatella sp*	+
03600	*Oligochaeta*	+
05800	*Caecidotea sp*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
11650	*Procloeon sp (w/ hindwing pads)*	+
11651	*Procloeon sp (w/o hindwing pads)*	+
12200	*Isonychia sp*	+
13561	*Stenonema pulchellum*	+
17200	*Caenis sp*	+
22001	*Coenagrionidae*	+
43570	*Neoplea sp*	+
44501	*Corixidae*	+
52430	*Ceratopsyche morosa group*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	+
80430	*Cricotopus (C.) tremulus group*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	+
82220	*Tvetenia discoloripes group*	+
82730	*Chironomus (C.) decorus group*	+
83040	*Dicrotendipes neomodestus*	+
83051	*Dicrotendipes simpsoni*	+
84050	*Parachironomus "hirtalatus" (sensu Simpson & Bode, 1980)*	+
84430	*Polypedilum (P.) albicorne*	+
84450	*Polypedilum (P.) convictum*	+
84470	*Polypedilum (P.) illinoense*	+
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	+
85800	*Tanytarsus sp*	+
85814	*Tanytarsus glabrescens group*	+
95100	*Physella sp*	+
96002	*Helisoma anceps anceps*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 34

No. Qualitative Taxa: 34 ICI:

Number of Organisms: 0 Qual EPT: 8

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 15-001 River: Chagrin River RM: 30.08 B

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+			
82730	*Chironomus (C.) decorus group*	+			
83040	*Dicrotendipes neomodestus*	+			
83051	*Dicrotendipes simpsoni*	+			
84300	*Phaenopsectra obediens group*	+			
84470	*Polypedilum (P.) illinoense*	+			
85814	*Tanytarsus glabrescens group*	+			
95100	*Physella sp*	+			
96120	*Menetus (Micromenetus) dilatatus*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 10

No. Qualitative Taxa: 10 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 15-001 River: Chagrin River RM: 30.00

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	51
03600	*Oligochaeta*	1296 +
04935	*Erpobdella punctata punctata*	2 +
05800	*Caecidotea sp*	29
08250	*Orconectes (Procericambarus) rusticus*	+
22001	*Coenagrionidae*	+
23909	*Boyeria vinosa*	+
45400	*Trichocorixa sp*	+
45900	*Notonecta sp*	+
47600	*Sialis sp*	1 +
48620	*Nigronia serricornis*	+
52200	*Cheumatopsyche sp*	3
68708	*Dubiraphia vittata group*	+
69400	*Stenelmis sp*	21 +
72700	*Anopheles sp*	+
74501	*Ceratopogonidae*	8
77120	*Ablabesmyia mallochi*	17
77500	*Conchapelopia sp*	138 +
77750	*Hayesomyia senata or Thienemannimyia norena*	17
77800	*Helopelopia sp*	69 +
80410	*Cricotopus (C.) sp*	121
80420	*Cricotopus (C.) bicinctus*	138
80430	*Cricotopus (C.) tremulus group*	52 +
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	259 +
81240	*Nanocladius (N.) distinctus*	207
81250	*Nanocladius (N.) minimus*	17
82141	*Thienemanniella xena*	4
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	138 +
83051	*Dicrotendipes simpsoni*	17 +
84450	*Polypedilum (P.) convictum*	35 +
84460	*Polypedilum (P.) fallax group*	190 +
84470	*Polypedilum (P.) illinoense*	86 +
84540	*Polypedilum (Tripodura) scalaenum group*	+
85625	*Rheotanytarsus exiguus group*	17
85800	*Tanytarsus sp*	17
85814	*Tanytarsus glabrescens group*	35
86401	*Atherix lantha*	1
95100	*Physella sp*	144 +
96120	*Menetus (Micromenetus) dilatatus*	46
96930	*Laevapex fuscus*	27 +
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 31 Total Taxa: 42
No. Qualitative Taxa: 26 ICI: **16**
Number of Organisms: 3203 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 15-001 River: Chagrin River RM: 28.90

Taxa Code	Taxa	Quant/Qual
11118	*Baetis dubius*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
11651	*Procloeon sp (w/o hindwing pads)*	+
12200	*Isonychia sp*	+
12924	*Heptagenia flavescens*	+
13000	*Leucrocuta sp*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
13561	*Stenonema pulchellum*	+
22300	*Argia sp*	+
23909	*Boyeria vinosa*	+
34410	*Paragnetina media*	+
43570	*Neoplea sp*	+
50315	*Chimarra obscura*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52450	*Ceratopsyche sparna*	+
53501	*Hydroptilidae*	+
58505	*Helicopsyche borealis*	+
59500	*Oecetis sp*	+
60300	*Dineutus sp*	+
68075	*Psephenus herricki*	+
78450	*Nilotanypus fimbriatus*	+
80310	*Cardiocladius obscurus*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	+
82220	*Tvetenia discoloripes group*	+
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
84315	*Phaenopsectra flavipes*	+
84450	*Polypedilum (P.) convictum*	+
84460	*Polypedilum (P.) fallax group*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
84612	*Saetheria tylus*	+
84750	*Stictochironomus sp*	+
85263	*Cladotanytarsus vanderwulpi group Type 3*	+
85625	*Rheotanytarsus exiguus group*	+
85814	*Tanytarsus glabrescens group*	+
86401	*Atherix lantha*	+
96900	*Ferrissia sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 41
No. Qualitative Taxa: 41 ICI:
Number of Organisms: 0 Qual EPT: 18

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 15-001 River: Chagrin River RM: 28.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
05800	*Caecidotea sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
08601	*Hydracarina*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
11651	*Procloeon sp (w/o hindwing pads)*	+
13400	*Stenacron sp*	+
13561	*Stenonema pulchellum*	+
18100	*Anthopotamus sp*	+
21200	*Calopteryx sp*	+
22300	*Argia sp*	+
23909	*Boyeria vinosa*	+
34410	*Paragnetina media*	+
47600	*Sialis sp*	+
48410	*Corydalus cornutus*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52530	*Hydropsyche depravata group*	+
52540	*Hydropsyche dicantha*	+
53800	*Hydroptila sp*	+
68601	*Ancyronyx variegata*	+
68901	*Macronychus glabratus*	+
69275	*Optioservus trivittatus*	+
69400	*Stenelmis sp*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	+
77800	*Helopelopia sp*	+
80310	*Cardiocladius obscurus*	+
80420	*Cricotopus (C.) bicinctus*	+
80430	*Cricotopus (C.) tremulus group*	+
80440	*Cricotopus (C.) trifascia group*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	+
81690	*Paratrichocladius sp*	+
82220	*Tvetenia discoloripes group*	+
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
84420	*Polypedilum (P.) n.sp 1*	+
84450	*Polypedilum (P.) convictum*	+
84470	*Polypedilum (P.) illinoense*	+
84480	*Polypedilum (P.) laetum group*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	+
86401	*Atherix lantha*	+
87540	*Hemerodromia sp*	+
96900	*Ferrissia sp*	+
96930	*Laevapex fuscus*	+

No. Quantitative Taxa: 0 Total Taxa: 51
No. Qualitative Taxa: 51 ICI:
Number of Organisms: 0 Qual EPT: 12

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/30/95 River Code: 15-001 River: Chagrin River RM: 26.70

Taxa Code	Taxa	Quant/Qual
00653	*Eunapius fragilis*	+
01801	*Turbellaria*	6 +
03360	*Plumatella sp*	2 +
03600	*Oligochaeta*	28 +
05800	*Caecidotea sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
08601	*Hydracarina*	8
11120	*Baetis flavistriga*	404 +
11130	*Baetis intercalaris*	808 +
12200	*Isonychia sp*	+
12924	*Heptagenia flavescens*	+
13000	*Leucrocuta sp*	17 +
13400	*Stenacron sp*	15 +
13561	*Stenonema pulchellum*	70 +
21200	*Calopteryx sp*	8 +
22300	*Argia sp*	+
48410	*Corydalus cornutus*	+
48620	*Nigronia serricornis*	1
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	196 +
52430	*Ceratopsyche morosa group*	99 +
52440	*Ceratopsyche slossonae*	1
52450	*Ceratopsyche sparna*	2 +
52530	*Hydropsyche depravata group*	+
52540	*Hydropsyche dicantha*	17 +
53800	*Hydroptila sp*	2
54000	*Leucotrichia pictipes*	+
59100	*Ceraclea sp*	+
68075	*Psephenus herricki*	8 +
68601	*Ancyronyx variegata*	2 +
68901	*Macronychus glabratus*	15
69400	*Stenelmis sp*	+
71700	*Pilaria sp*	+
74100	*Simulium sp*	+
74501	*Ceratopogonidae*	+
77500	*Conchapelopia sp*	50
77800	*Helopelopia sp*	36 +
78450	*Nilotanypus fimbriatus*	48
80310	*Cardiocladius obscurus*	+
80370	*Corynoneura lobata*	92
80420	*Cricotopus (C.) bicinctus*	+
80430	*Cricotopus (C.) tremulus group*	+
81250	*Nanocladius (N.) minimus*	+
81690	*Paratrichocladius sp*	+
82141	*Thienemanniella xena*	56 +
82220	*Tvetenia discoloripes group*	+
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
84060	*Parachironomus pectinatellae*	+
84300	*Phaenopsectra obediens group*	13
84450	*Polypedilum (P.) convictum*	513 +
84460	*Polypedilum (P.) fallax group*	13
84540	*Polypedilum (Tripodura) scalaenum group*	13
84750	*Stictochironomus sp*	+
84888	*Xenochironomus xenolabis*	+
85625	*Rheotanytarsus exiguus group*	564 +
85800	*Tanytarsus sp*	13
85814	*Tanytarsus glabrescens group*	13
87400	*Stratiomys sp*	+
87540	*Hemerodromia sp*	14 +
95100	*Physella sp*	+
96900	*Ferrissia sp*	9 +
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 34 Total Taxa: 64
No. Qualitative Taxa: 51 ICI: **46**
Number of Organisms: 3156 Qual EPT: 15

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 15-001 River: Chagrin River RM: 25.50

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	1 +
03600	*Oligochaeta*	+
08250	*Orconectes (Procericambarus) rusticus*	1 +
08601	*Hydracarina*	16
11120	*Baetis flavistriga*	212 +
11130	*Baetis intercalaris*	836 +
12200	*Isonychia sp*	17
12924	*Heptagenia flavescens*	+
13000	*Leucrocuta sp*	1
13400	*Stenacron sp*	1
13561	*Stenonema pulchellum*	125 +
21200	*Calopteryx sp*	+
34410	*Paragnetina media*	1 +
47600	*Sialis sp*	+
48410	*Corydalus cornutus*	4 +
52200	*Cheumatopsyche sp*	343 +
52430	*Ceratopsyche morosa group*	426 +
52450	*Ceratopsyche sparna*	165 +
52530	*Hydropsyche depravata group*	82
52540	*Hydropsyche dicantha*	247 +
53800	*Hydroptila sp*	51
68075	*Psephenus herricki*	+
68601	*Ancyronyx variegata*	+
68901	*Macronychus glabratus*	25 +
69400	*Stenelmis sp*	16 +
70600	*Antocha sp*	17
72700	*Anopheles sp*	+
77120	*Ablabesmyia mallochi*	+
77800	*Helopelopia sp*	+
78140	*Labrundinia pilosella*	29
78450	*Nilotanypus fimbriatus*	144
80310	*Cardiocladius obscurus*	58 +
80370	*Corynoneura lobata*	160
80410	*Cricotopus (C.) sp*	29
80420	*Cricotopus (C.) bicinctus*	58
81250	*Nanocladius (N.) minimus*	29
81690	*Paratrichocladius sp*	58
82141	*Thienemanniella xena*	144
82220	*Tvetenia discoloripes group*	86
82770	*Chironomus (C.) riparius group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) convictum*	1354 +
84470	*Polypedilum (P.) illinoense*	778 +
84480	*Polypedilum (P.) laetum group*	+
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	1123 +
86401	*Atherix lantha*	1
87540	*Hemerodromia sp*	17
89501	*Ephydridae*	8
95100	*Physella sp*	+
96900	*Ferrissia sp*	11 +

No. Quantitative Taxa: 37 Total Taxa: 54
No. Qualitative Taxa: 35 ICI: **36**
Number of Organisms: 6674 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 15-001 River: Chagrin River RM: 13.00

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03045	*Fredericella indica*	+
03360	*Plumatella sp*	+
03600	*Oligochaeta*	141 +
05800	*Caecidotea sp*	+
08601	*Hydracarina*	8
11120	*Baetis flavistriga*	22 +
11130	*Baetis intercalaris*	376 +
11650	*Procloeon sp (w/ hindwing pads)*	+
11670	*Procloeon irrubrum*	+
12200	*Isonychia sp*	4
13000	*Leucrocuta sp*	10 +
13400	*Stenacron sp*	62 +
13521	*Stenonema femoratum*	+
13561	*Stenonema pulchellum*	114 +
15000	*Paraleptophlebia sp*	2
21200	*Calopteryx sp*	+
22300	*Argia sp*	+
24900	*Gomphus sp*	+
45100	*Palmacorixa sp*	+
48410	*Corydalus cornutus*	+
52200	*Cheumatopsyche sp*	469 +
52430	*Ceratopsyche morosa group*	181 +
52450	*Ceratopsyche sparna*	+
52530	*Hydropsyche depravata group*	7
52540	*Hydropsyche dicantha*	15 +
63300	*Hydroporus sp*	+
69400	*Stenelmis sp*	2
71900	*Tipula sp*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	10 +
77750	*Hayesomyia senata or Thienemannimyia norena*	10
77800	*Helopelopia sp*	52 +
78140	*Labrundinia pilosella*	+
78401	*Natarsia species A (sensu Roback, 1978)*	10
78450	*Nilotanypus fimbriatus*	36 +
79085	*Telopelopia okoboji*	10
80310	*Cardiocladius obscurus*	10
80370	*Corynoneura lobata*	4
80410	*Cricotopus (C.) sp*	10 +
81270	*Nanocladius (N.) spiniplenus*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
83310	*Glyptotendipes (Trichotendipes) amplus*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	42
84300	*Phaenopsectra obediens group*	31
84450	*Polypedilum (P.) convictum*	667 +
84520	*Polypedilum (Tripodura) halterale group*	83
84540	*Polypedilum (Tripodura) scalaenum group*	115 +
84750	*Stictochironomus sp*	+
85500	*Paratanytarsus sp*	10
85625	*Rheotanytarsus exiguus group*	302 +
85814	*Tanytarsus glabrescens group*	31
95100	*Physella sp*	+
96900	*Ferrissia sp*	1

No. Quantitative Taxa: 32 Total Taxa: 56
No. Qualitative Taxa: 40 ICI: **38**
Number of Organisms: 2847 Qual EPT: 12

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 15-001 River: Chagrin River RM: 12.50

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	1 +
03451	*Urnatella gracilis*	2
03600	*Oligochaeta*	118 +
05800	*Caecidotea sp*	1
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	13 +
11130	*Baetis intercalaris*	43 +
11651	*Procloeon sp (w/o hindwing pads)*	1
12200	*Isonychia sp*	1
13000	*Leucrocuta sp*	36 +
13400	*Stenacron sp*	139 +
13561	*Stenonema pulchellum*	106 +
21200	*Calopteryx sp*	1 +
22300	*Argia sp*	2 +
45400	*Trichocorixa sp*	+
48410	*Corydalus cornutus*	1 +
50315	*Chimarra obscura*	1 +
52200	*Cheumatopsyche sp*	1 +
52430	*Ceratopsyche morosa group*	2 +
52450	*Ceratopsyche sparna*	+
52540	*Hydropsyche dicantha*	+
53800	*Hydroptila sp*	10 +
59970	*Petrophila sp*	+
60400	*Gyrinus sp*	+
68901	*Macronychus glabratus*	1
69400	*Stenelmis sp*	1 +
70600	*Antocha sp*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	51
77500	*Conchapelopia sp*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	17
77800	*Helopelopia sp*	51 +
78450	*Nilotanypus fimbriatus*	4 +
80310	*Cardiocladius obscurus*	+
80370	*Corynoneura lobata*	116
80410	*Cricotopus (C.) sp*	17 +
82141	*Thienemanniella xena*	20
82820	*Cryptochironomus sp*	17 +
83040	*Dicrotendipes neomodestus*	34
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
83840	*Microtendipes pedellus group*	+
84300	*Phaenopsectra obediens group*	51
84430	*Polypedilum (P.) albicorne*	17
84450	*Polypedilum (P.) convictum*	135 +
84460	*Polypedilum (P.) fallax group*	51
84470	*Polypedilum (P.) illinoense*	17 +
84540	*Polypedilum (Tripodura) scalaenum group*	354 +
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	236 +
85814	*Tanytarsus glabrescens group*	236
86401	*Atherix lantha*	+
87540	*Hemerodromia sp*	10
95100	*Physella sp*	2 +
96900	*Ferrissia sp*	19 +
98600	*Sphaerium sp*	1

No. Quantitative Taxa: 41 Total Taxa: 55
No. Qualitative Taxa: 39 ICI: **38**
Number of Organisms: 1937 Qual EPT: 11

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 15-001 River: Chagrin River RM: 4.10

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	1 +
03451	*Urnatella gracilis*	8
03600	*Oligochaeta*	48
08250	*Orconectes (Procericambarus) rusticus*	+
08601	*Hydracarina*	32
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	357 +
11430	*Diphetor hageni*	1
12200	*Isonychia sp*	2
13000	*Leucrocuta sp*	1 +
13400	*Stenacron sp*	+
13561	*Stenonema pulchellum*	197 +
13590	*Stenonema vicarium*	10
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	8 +
23909	*Boyeria vinosa*	1
24900	*Gomphus sp*	+
48410	*Corydalus cornutus*	6 +
52200	*Cheumatopsyche sp*	2235 +
52430	*Ceratopsyche morosa group*	60 +
52540	*Hydropsyche dicantha*	1057
53800	*Hydroptila sp*	32 +
60300	*Dineutus sp*	+
67800	*Tropisternus sp*	+
68601	*Ancyronyx variegata*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	1 +
69400	*Stenelmis sp*	3 +
77500	*Conchapelopia sp*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	+
77800	*Helopelopia sp*	+
78450	*Nilotanypus fimbriatus*	51 +
80310	*Cardiocladius obscurus*	+
80370	*Corynoneura lobata*	96
80410	*Cricotopus (C.) sp*	101 +
80420	*Cricotopus (C.) bicinctus*	+
80430	*Cricotopus (C.) tremulus group*	51 +
81250	*Nanocladius (N.) minimus*	101
81270	*Nanocladius (N.) spiniplenus*	+
82101	*Thienemanniella n.sp 1*	96
82141	*Thienemanniella xena*	+
82710	*Chironomus (C.) sp*	+
82820	*Cryptochironomus sp*	+
84450	*Polypedilum (P.) convictum*	3336 +
84460	*Polypedilum (P.) fallax group*	+
85625	*Rheotanytarsus exiguus group*	3336 +
85814	*Tanytarsus glabrescens group*	51 +
86401	*Atherix lantha*	1
89716	*Limnophora discreta*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	9 +

No. Quantitative Taxa: 30 Total Taxa: 52
No. Qualitative Taxa: 40 ICI: **38**
Number of Organisms: 11289 Qual EPT: 8

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/08/95 River Code: 15-003 River: Griswold Creek RM: 0.10

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
13000	*Leucrocuta sp*	+
13400	*Stenacron sp*	+
21200	*Calopteryx sp*	+
22300	*Argia sp*	+
23909	*Boyeria vinosa*	+
50315	*Chimarra obscura*	+
50410	*Dolophilodes distinctus*	+
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52450	*Ceratopsyche sparna*	+
53501	*Hydroptilidae*	+
63300	*Hydroporus sp*	+
68075	*Psephenus herricki*	+
70600	*Antocha sp*	+
71100	*Hexatoma sp*	+
74100	*Simulium sp*	+
74501	*Ceratopogonidae*	+
77120	*Ablabesmyia mallochi*	+
77800	*Helopelopia sp*	+
80310	*Cardiocladius obscurus*	+
80410	*Cricotopus (C.) sp*	+
81650	*Parametriocnemus sp*	+
81690	*Paratrichocladius sp*	+
82141	*Thienemanniella xena*	+
82820	*Cryptochironomus sp*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84300	*Phaenopsectra obediens group*	+
84302	*Phaenopsectra punctipes*	+
84450	*Polypedilum (P.) convictum*	+
84460	*Polypedilum (P.) fallax group*	+
85625	*Rheotanytarsus exiguus group*	+
85814	*Tanytarsus glabrescens group*	+
89716	*Limnophora discreta*	+
95100	*Physella sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 39
No. Qualitative Taxa: 39 ICI:
Number of Organisms: 0 Qual EPT: 11

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/08/95 River Code: 15-004 River: Willey Creek RM: 0.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+			
03600	*Oligochaeta*	+			
06700	*Crangonyx sp*	+			
11120	*Baetis flavistriga*	+			
11130	*Baetis intercalaris*	+			
21200	*Calopteryx sp*	+			
50410	*Dolophilodes distinctus*	+			
52200	*Cheumatopsyche sp*	+			
52315	*Diplectrona modesta*	+			
52430	*Ceratopsyche morosa group*	+			
52450	*Ceratopsyche sparna*	+			
52530	*Hydropsyche depravata group*	+			
53800	*Hydroptila sp*	+			
70600	*Antocha sp*	+			
71910	*Tipula abdominalis*	+			
74100	*Simulium sp*	+			
77120	*Ablabesmyia mallochi*	+			
77500	*Conchapelopia sp*	+			
77750	*Hayesomyia senata or Thienemannimyia norena*	+			
80204	*Brillia flavifrons group*	+			
80310	*Cardiocladius obscurus*	+			
81650	*Parametriocnemus sp*	+			
82141	*Thienemanniella xena*	+			
82730	*Chironomus (C.) decorus group*	+			
82770	*Chironomus (C.) riparius group*	+			
83040	*Dicrotendipes neomodestus*	+			
84430	*Polypedilum (P.) albicorne*	+			
84450	*Polypedilum (P.) convictum*	+			
84460	*Polypedilum (P.) fallax group*	+			
84470	*Polypedilum (P.) illinoense*	+			
85625	*Rheotanytarsus exiguus group*	+			
85800	*Tanytarsus sp*	+			
85802	*Tanytarsus curticornis group*	+			
85814	*Tanytarsus glabrescens group*	+			
87540	*Hemerodromia sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 35
No. Qualitative Taxa: 35 ICI:
Number of Organisms: 0 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/01/96 River Code: 15-005 River: Aurora Branch RM: 14.50

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
06201	*Hyalella azteca*	+
08240	*Orconectes (Crokerinus) propinquus*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
12200	*Isonychia sp*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
14950	*Leptophlebia sp or Paraleptophebia sp*	+
23909	*Boyeria vinosa*	+
34130	*Acroneuria frisoni*	+
34700	*Agnetina capitata complex*	+
45100	*Palmacorixa sp*	+
45300	*Sigara sp*	+
48620	*Nigronia serricornis*	+
52200	*Cheumatopsyche sp*	+
52440	*Ceratopsyche slossonae*	+
52530	*Hydropsyche depravata group*	+
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	+
67000	*Helophorus sp*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	+
70501	*Tipulidae*	+
70600	*Antocha sp*	+
71100	*Hexatoma sp*	+
74100	*Simulium sp*	+
77500	*Conchapelopia sp*	+
78450	*Nilotanypus fimbriatus*	+
82200	*Tvetenia bavarica group*	+
82220	*Tvetenia discoloripes group*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
83840	*Microtendipes pedellus group*	+
84450	*Polypedilum (P.) convictum*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
84750	*Stictochironomus sp*	+
85201	*Cladotanytarsus species group A*	+
85840	*Tanytarsus guerlus group*	+
86401	*Atherix lantha*	+
87520	*Clinocera (Hydrodromia) sp*	+
87540	*Hemerodromia sp*	+
95100	*Physella sp*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 45
No. Qualitative Taxa: 45 ICI:
Number of Organisms: 0 Qual EPT: 13

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 15-005 River: Aurora Branch RM: 17.10

Taxa Code	Taxa	Quant/Qual
03000	*Ectoprocta*	1
03600	*Oligochaeta*	101 +
04653	*Glossiphonia complanata*	4 +
04664	*Helobdella stagnalis*	3
04935	*Erpobdella punctata punctata*	3
05800	*Caecidotea sp*	14 +
06201	*Hyalella azteca*	2 +
06700	*Crangonyx sp*	34 +
11200	*Callibaetis sp*	+
17200	*Caenis sp*	2
22001	*Coenagrionidae*	5 +
23600	*Aeshna sp*	2 +
27500	*Somatochlora sp*	+
42700	*Belostoma sp*	1 +
43300	*Ranatra sp*	+
45900	*Notonecta sp*	+
48200	*Chauliodes sp*	+
60800	*Haliplus sp*	+
60900	*Peltodytes sp*	+
62202	*Copelatus glyphicus*	+
63300	*Hydroporus sp*	+
63400	*Hydrovatus sp*	+
63600	*Hygrotus sp*	+
63900	*Laccophilus sp*	+
65800	*Berosus sp*	+
67800	*Tropisternus sp*	+
68700	*Dubiraphia sp*	2
71000	*Helius sp*	2
72900	*Culex sp*	4
74501	*Ceratopogonidae*	+
77500	*Conchapelopia sp*	10 +
78200	*Larsia sp*	4
78402	*Natarsia baltimoreus*	1
78650	*Procladius sp*	+
78702	*Psectrotanypus dyari*	+
79400	*Zavrelimyia sp*	7
82730	*Chironomus (C.) decorus group*	23 +
82770	*Chironomus (C.) riparius group*	1 +
83050	*Dicrotendipes lucifer*	6
83051	*Dicrotendipes simpsoni*	49 +
83158	*Endochironomus nigricans*	1
83600	*Kiefferulus (K.) dux*	4 +
84210	*Paratendipes albimanus or P. duplicatus*	1
84300	*Phaenopsectra obediens group*	1
84302	*Phaenopsectra punctipes*	1
84410	*Polypedilum (Pentapedilum) tritum*	3
84500	*Polypedilum (P.) trigonus*	1
87400	*Stratiomys sp*	1
94400	*Fossaria sp*	1 +
95100	*Physella sp*	+
96002	*Helisoma anceps anceps*	+
96264	*Planorbella (Pierosoma) pilsbryi*	1 +
96900	*Ferrissia sp*	2
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 34 Total Taxa: 54
No. Qualitative Taxa: 35 ICI: **10**
Number of Organisms: 298 Qual EPT: 1

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 15-005 River: Aurora Branch RM: 16.60

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	8
03600	*Oligochaeta*	82 +
04685	*Placobdella ornata*	+
04935	*Erpobdella punctata punctata*	1 +
06201	*Hyalella azteca*	14 +
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
13500	*Stenonema sp*	5
17200	*Caenis sp*	8
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	1 +
28001	*Libellulidae*	+
52200	*Cheumatopsyche sp*	25 +
52530	*Hydropsyche depravata group*	1 +
60400	*Gyrinus sp*	+
63700	*Ilybius sp*	+
67700	*Paracymus sp*	+
67800	*Tropisternus sp*	+
68130	*Helichus sp*	+
69400	*Stenelmis sp*	8
74501	*Ceratopogonidae*	12 +
77355	*Clinotanypus pinguis*	+
77500	*Conchapelopia sp*	206 +
77750	*Hayesomyia senata or Thienemannimyia norena*	+
78401	*Natarsia species A (sensu Roback, 1978)*	8
80370	*Corynoneura lobata*	5
80420	*Cricotopus (C.) bicinctus*	198 +
80430	*Cricotopus (C.) tremulus group*	25
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	8
81270	*Nanocladius (N.) spiniplenus*	8
81650	*Parametriocnemus sp*	16
82141	*Thienemanniella xena*	13
82820	*Cryptochironomus sp*	+
83050	*Dicrotendipes lucifer*	+
84440	*Polypedilum (P.) aviceps*	8
84450	*Polypedilum (P.) convictum*	231 +
84460	*Polypedilum (P.) fallax group*	8
84470	*Polypedilum (P.) illinoense*	58 +
84540	*Polypedilum (Tripodura) scalaenum group*	16
85500	*Paratanytarsus sp*	33
85625	*Rheotanytarsus exiguus group*	8 +
85800	*Tanytarsus sp*	8
96900	*Ferrissia sp*	1

No. Quantitative Taxa: 29 Total Taxa: 43
No. Qualitative Taxa: 26 ICI: **22**
Number of Organisms: 1023 Qual EPT: 2

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/29/95 River Code: 15-005 River: Aurora Branch RM: 12.00

Taxa Code	Taxa	Quant/Qual
00805	*Spongilla lacustris*	+
03040	*Fredericella sp*	+
03360	*Plumatella sp*	+
03600	*Oligochaeta*	101 +
08250	*Orconectes (Procericambarus) rusticus*	+
08280	*Orconectes (Gremicambarus) virilis*	1
08601	*Hydracarina*	+
12200	*Isonychia sp*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
14950	*Leptophlebia sp or Paraleptophebia sp*	1
48610	*Nigronia fasciatus*	+
48620	*Nigronia serricornis*	+
49200	*Climacia sp*	+
51206	*Cyrnellus fraternus*	+
52200	*Cheumatopsyche sp*	+
52440	*Ceratopsyche slossonae*	+
52530	*Hydropsyche depravata group*	+
57400	*Neophylax sp*	+
68901	*Macronychus glabratus*	+
69400	*Stenelmis sp*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	3
77500	*Conchapelopia sp*	15
77800	*Helopelopia sp*	44 +
78140	*Labrundinia pilosella*	2
78401	*Natarsia species A (sensu Roback, 1978)*	2
78402	*Natarsia baltimoreus*	11
79085	*Telopelopia okoboji*	2
80370	*Corynoneura lobata*	6
80420	*Cricotopus (C.) bicinctus*	5
80474	*Cricotopus (C.) or Paratrichocladius sp*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	12
81270	*Nanocladius (N.) spiniplenus*	3
81465	*Orthocladius (O.) carlatus*	6 +
81631	*Parakiefferiella n.sp 1*	3
81632	*Parakiefferiella n.sp 2*	11
81650	*Parametriocnemus sp*	2
81825	*Rheocricotopus (Psilocricotopus) robacki*	2
82730	*Chironomus (C.) decorus group*	6
82820	*Cryptochironomus sp*	+
83003	*Dicrotendipes fumidus*	5
83040	*Dicrotendipes neomodestus*	3
83300	*Glyptotendipes (G.) sp*	2
83840	*Microtendipes pedellus group*	5
84210	*Paratendipes albimanus or P. duplicatus*	2
84302	*Phaenopsectra punctipes*	2
84450	*Polypedilum (P.) convictum*	2 +
84460	*Polypedilum (P.) fallax group*	14
84470	*Polypedilum (P.) illinoense*	+
84480	*Polypedilum (P.) laetum group*	3 +
84540	*Polypedilum (Tripodura) scalaenum group*	2
84750	*Stictochironomus sp*	12
84800	*Tribelos jucundum*	3
85261	*Cladotanytarsus vanderwulpi group Type 1*	2
85814	*Tanytarsus glabrescens group*	8
85840	*Tanytarsus guerlus group*	8
86401	*Atherix lantha*	+
96900	*Ferrissia sp*	4 +

No. Quantitative Taxa: 36 Total Taxa: 59
No. Qualitative Taxa: 29 ICI: **18**
Number of Organisms: 315 Qual EPT: 8

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 15-005 River: Aurora Branch RM: 11.30

Taxa Code	Taxa	Quant/Qual		Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	159	+			
05800	*Caecidotea sp*		+			
08250	*Orconectes (Procericambarus) rusticus*		+			
11200	*Callibaetis sp*		+			
21200	*Calopteryx sp*		+			
27500	*Somatochlora sp*		+			
42700	*Belostoma sp*		+			
60900	*Peltodytes sp*		+			
67100	*Hydrobius sp*		+			
69400	*Stenelmis sp*	5	+			
71100	*Hexatoma sp*	2				
72160	*Psychoda sp*		+			
77500	*Conchapelopia sp*	64	+			
78401	*Natarsia species A (sensu Roback, 1978)*	9	+			
78402	*Natarsia baltimoreus*		+			
78450	*Nilotanypus fimbriatus*	9				
78702	*Psectrotanypus dyari*		+			
79400	*Zavrelimyia sp*	9				
82711	*Chironomus (C.) sp 1*	9	+			
82730	*Chironomus (C.) decorus group*	430	+			
82770	*Chironomus (C.) riparius group*		+			
82820	*Cryptochironomus sp*	27				
83040	*Dicrotendipes neomodestus*	9				
83300	*Glyptotendipes (G.) sp*	9				
83840	*Microtendipes pedellus group*	9				
84210	*Paratendipes albimanus or P. duplicatus*	46	+			
84300	*Phaenopsectra obediens group*	9				
84460	*Polypedilum (P.) fallax group*	128	+			
84470	*Polypedilum (P.) illinoense*		+			
84540	*Polypedilum (Tripodura) scalaenum group*	9				
84750	*Stictochironomus sp*	9	+			
85500	*Paratanytarsus sp*	9				
95100	*Physella sp*	1	+			
98600	*Sphaerium sp*		+			

No. Quantitative Taxa: 20 Total Taxa: 34
No. Qualitative Taxa: 24 ICI: **8**
Number of Organisms: 961 Qual EPT: 1

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 15-005 River: Aurora Branch RM: 11.00

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	+
03451	*Urnatella gracilis*	22
03600	*Oligochaeta*	3728 +
06700	*Crangonyx sp*	1
08250	*Orconectes (Procericambarus) rusticus*	2 +
12200	*Isonychia sp*	1
13400	*Stenacron sp*	1 +
13521	*Stenonema femoratum*	16 +
17200	*Caenis sp*	+
21200	*Calopteryx sp*	1 +
22001	*Coenagrionidae*	+
23909	*Boyeria vinosa*	+
48620	*Nigronia serricornis*	1
52200	*Cheumatopsyche sp*	17 +
52530	*Hydropsyche depravata group*	+
68708	*Dubiraphia vittata group*	+
69400	*Stenelmis sp*	2 +
74100	*Simulium sp*	
77120	*Ablabesmyia mallochi*	29 +
77500	*Conchapelopia sp*	87 +
77750	*Hayesomyia senata or Thienemannimyia norena*	+
77800	*Helopelopia sp*	58 +
78350	*Meropelopia sp*	29 +
80204	*Brillia flavifrons group*	58
80370	*Corynoneura lobata*	23
80420	*Cricotopus (C.) bicinctus*	87
80430	*Cricotopus (C.) tremulus group*	145 +
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	29
81690	*Paratrichocladius sp*	289
82730	*Chironomus (C.) decorus group*	897 +
82770	*Chironomus (C.) riparius group*	+
83040	*Dicrotendipes neomodestus*	58 +
83158	*Endochironomus nigricans*	+
83300	*Glyptotendipes (G.) sp*	29 +
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	29
83840	*Microtendipes pedellus group*	29
84210	*Paratendipes albimanus or P. duplicatus*	29
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (P.) convictum*	29 +
84460	*Polypedilum (P.) fallax group*	521 +
84470	*Polypedilum (P.) illinoense*	116 +
84540	*Polypedilum (Tripodura) scalaenum group*	58 +
84750	*Stictochironomus sp*	+
85261	*Cladotanytarsus vanderwulpi group Type 1*	29
85500	*Paratanytarsus sp*	87
85625	*Rheotanytarsus exiguus group*	58
85800	*Tanytarsus sp*	29
85814	*Tanytarsus glabrescens group*	87
95100	*Physella sp*	8 +
96900	*Ferrissia sp*	18 +

No. Quantitative Taxa: 38 Total Taxa: 49
No. Qualitative Taxa: 32 ICI: **24**
Number of Organisms: 6737 Qual EPT: 5

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 15-005 River: Aurora Branch RM: 9.10

Taxa Code	Taxa	Quant	Qual
00653	*Eunapius fragilis*		+
01801	*Turbellaria*		+
03045	*Fredericella indica*		+
03360	*Plumatella sp*		+
03600	*Oligochaeta*	20	+
08250	*Orconectes (Procericambarus) rusticus*		+
11120	*Baetis flavistriga*	8	+
11130	*Baetis intercalaris*		+
12200	*Isonychia sp*	22	+
13000	*Leucrocuta sp*		+
13400	*Stenacron sp*	93	+
13521	*Stenonema femoratum*	10	+
13590	*Stenonema vicarium*	8	+
21200	*Calopteryx sp*		+
22001	*Coenagrionidae*		+
23909	*Boyeria vinosa*		+
26100	*Cordulegaster sp*		+
34410	*Paragnetina media*		+
48610	*Nigronia fasciatus*	1	
48620	*Nigronia serricornis*	2	+
51400	*Nyctiophylax sp*		+
52200	*Cheumatopsyche sp*	36	+
52430	*Ceratopsyche morosa group*	5	+
52440	*Ceratopsyche slossonae*	4	+
52450	*Ceratopsyche sparna*		+
52530	*Hydropsyche depravata group*		+
53800	*Hydroptila sp*		+
57400	*Neophylax sp*		+
57900	*Pycnopsyche sp*		+
60900	*Peltodytes sp*		+
65800	*Berosus sp*		+
67800	*Tropisternus sp*		+
68708	*Dubiraphia vittata group*	1	+
69200	*Optioservus sp*	1	
69400	*Stenelmis sp*	9	+
71100	*Hexatoma sp*		+
71300	*Limonia sp*		+
74100	*Simulium sp*		+
77500	*Conchapelopia sp*	53	+
77800	*Helopelopia sp*	53	+
78450	*Nilotanypus fimbriatus*	32	
80370	*Corynoneura lobata*	12	
80410	*Cricotopus (C.) sp*		+
80430	*Cricotopus (C.) tremulus group*		+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	40	+
81690	*Paratrichocladius sp*		+
82101	*Thienemanniella n.sp 1*	4	
82121	*Thienemanniella n.sp 3*	4	
82200	*Tvetenia bavarica group*		+
82730	*Chironomus (C.) decorus group*	13	
82820	*Cryptochironomus sp*	13	+
83003	*Dicrotendipes fumidus*	13	
83040	*Dicrotendipes neomodestus*	13	
83300	*Glyptotendipes (G.) sp*	13	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	13	+
83840	*Microtendipes pedellus group*	106	
84210	*Paratendipes albimanus or P. duplicatus*	120	+
84300	*Phaenopsectra obediens group*		+
84440	*Polypedilum (P.) aviceps*	13	
84450	*Polypedilum (P.) convictum*	13	+
84460	*Polypedilum (P.) fallax group*	67	
84480	*Polypedilum (P.) laetum group*	13	
84750	*Stictochironomus sp*		+
85230	*Cladotanytarsus mancus group*	13	
85262	*Cladotanytarsus vanderwulpi group Type 2*	13	
85265	*Cladotanytarsus vanderwulpi group Type 5*	13	
85500	*Paratanytarsus sp*	200	
85615	*Rheotanytarsus distinctissimus group*		+
85625	*Rheotanytarsus exiguus group*	306	+
85752	*Sublettea coffmani*	13	
85800	*Tanytarsus sp*	120	
85802	*Tanytarsus curticornis group*	13	
85814	*Tanytarsus glabrescens group*	93	
85840	*Tanytarsus guerlus group*		+
86100	*Chrysops sp*		+
86401	*Atherix lantha*		+
95100	*Physella sp*		+
96900	*Ferrissia sp*	65	+
98600	*Sphaerium sp*		+

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 15-005 River: Aurora Branch RM: 9.10

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

No. Quantitative Taxa:	43	Total Taxa:	79
No. Qualitative Taxa:	57	ICI:	**48**
Number of Organisms:	1677	Qual EPT:	17

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/14/95 River Code: 15-005 River: Aurora Branch RM: 5.70

Taxa Code	Taxa	Quant/Qual
00653	*Eunapius fragilis*	+
01801	*Turbellaria*	+
03360	*Plumatella sp*	+
03600	*Oligochaeta*	4 +
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11010	*Acentrella sp*	8
11115	*Baetis tricaudatus*	+
11120	*Baetis flavistriga*	243 +
11130	*Baetis intercalaris*	28 +
11250	*Centroptilum sp (w/o hindwing pads)*	+
11430	*Diphetor hageni*	3
11650	*Procloeon sp (w/ hindwing pads)*	+
12200	*Isonychia sp*	71 +
13000	*Leucrocuta sp*	2 +
13400	*Stenacron sp*	2 +
13521	*Stenonema femoratum*	+
13561	*Stenonema pulchellum*	16
13590	*Stenonema vicarium*	3 +
17200	*Caenis sp*	1 +
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
23909	*Boyeria vinosa*	+
34410	*Paragnetina media*	8 +
34700	*Agnetina capitata complex*	+
44300	*Pelocoris sp*	+
47600	*Sialis sp*	+
48620	*Nigronia serricornis*	3 +
50906	*Psychomyia flavida*	+
52200	*Cheumatopsyche sp*	247 +
52430	*Ceratopsyche morosa group*	282 +
52440	*Ceratopsyche slossonae*	346 +
52450	*Ceratopsyche sparna*	146 +
52530	*Hydropsyche depravata group*	18 +
54000	*Leucotrichia pictipes*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	+
59970	*Petrophila sp*	+
68075	*Psephenus herricki*	+
68130	*Helichus sp*	+
68700	*Dubiraphia sp*	+
68901	*Macronychus glabratus*	3 +
69225	*Optioservus fastiditus*	+
69400	*Stenelmis sp*	+
70600	*Antocha sp*	1 +
71100	*Hexatoma sp*	+
74100	*Simulium sp*	24 +
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	7
78402	*Natarsia baltimoreus*	+
78450	*Nilotanypus fimbriatus*	24 +
80310	*Cardiocladius obscurus*	21 +
80370	*Corynoneura lobata*	64
80410	*Cricotopus (C.) sp*	21 +
80420	*Cricotopus (C.) bicinctus*	27 +
80430	*Cricotopus (C.) tremulus group*	21
81270	*Nanocladius (N.) spiniplenus*	7
81650	*Parametriocnemus sp*	14
81690	*Paratrichocladius sp*	14
82101	*Thienemanniella n.sp 1*	80 +
82141	*Thienemanniella xena*	96 +
82820	*Cryptochironomus sp*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
84440	*Polypedilum (P.) aviceps*	7 +
84450	*Polypedilum (P.) convictum*	234 +
84750	*Stictochironomus sp*	+
84888	*Xenochironomus xenolabis*	+
85625	*Rheotanytarsus exiguus group*	405 +
85814	*Tanytarsus glabrescens group*	21
86100	*Chrysops sp*	+
86401	*Atherix lantha*	2 +
87540	*Hemerodromia sp*	36
95100	*Physella sp*	+
96900	*Ferrissia sp*	115 +
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 40 Total Taxa: 76
No. Qualitative Taxa: 65 ICI: **54**
Number of Organisms: 2675 Qual EPT: 22

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/14/95 River Code: 15-005 River: Aurora Branch RM: 3.50

Taxa Code	Taxa	Quant/Qual
03369	*Plumatella repens*	+
03600	*Oligochaeta*	176
04685	*Placobdella ornata*	+
04687	*Placobdella parasitica*	2
05800	*Caecidotea sp*	+
06201	*Hyalella azteca*	+
08601	*Hydracarina*	16
11120	*Baetis flavistriga*	24 +
11130	*Baetis intercalaris*	721 +
11250	*Centroptilum sp (w/o hindwing pads)*	+
11650	*Procloeon sp (w/ hindwing pads)*	+
12200	*Isonychia sp*	637 +
13400	*Stenacron sp*	45 +
13521	*Stenonema femoratum*	+
13561	*Stenonema pulchellum*	342
13590	*Stenonema vicarium*	81 +
17200	*Caenis sp*	2 +
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
23909	*Boyeria vinosa*	+
24900	*Gomphus sp*	+
34410	*Paragnetina media*	8
48620	*Nigronia serricornis*	2
50315	*Chimarra obscura*	1 +
52200	*Cheumatopsyche sp*	476 +
52430	*Ceratopsyche morosa group*	1056 +
52440	*Ceratopsyche slossonae*	145 +
52530	*Hydropsyche depravata group*	52
53800	*Hydroptila sp*	1 +
68075	*Psephenus herricki*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	1
69400	*Stenelmis sp*	50 +
70600	*Antocha sp*	32
71100	*Hexatoma sp*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	26 +
78450	*Nilotanypus fimbriatus*	96 +
80370	*Corynoneura lobata*	288
80410	*Cricotopus (C.) sp*	79
80420	*Cricotopus (C.) bicinctus*	52 +
80430	*Cricotopus (C.) tremulus group*	52
81270	*Nanocladius (N.) spiniplenus*	+
81650	*Parametriocnemus sp*	79
82101	*Thienemanniella n.sp 1*	144
82141	*Thienemanniella xena*	52
82220	*Tvetenia discoloripes group*	26
82730	*Chironomus (C.) decorus group*	+
83040	*Dicrotendipes neomodestus*	26 +
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
84450	*Polypedilum (P.) convictum*	498 +
84470	*Polypedilum (P.) illinoense*	+
84540	*Polypedilum (Tripodura) scalaenum group*	26
84700	*Stenochironomus sp*	52
84750	*Stictochironomus sp*	+
85261	*Cladotanytarsus vanderwulpi group Type 1*	+
85500	*Paratanytarsus sp*	52 +
85615	*Rheotanytarsus distinctissimus group*	131
85625	*Rheotanytarsus exiguus group*	1599 +
85752	*Sublettea coffmani*	52
85800	*Tanytarsus sp*	52
85814	*Tanytarsus glabrescens group*	551 +
85840	*Tanytarsus guerlus group*	+
86401	*Atherix lantha*	3 +
87540	*Hemerodromia sp*	145
95100	*Physella sp*	+

No. Quantitative Taxa: 43 Total Taxa: 67
No. Qualitative Taxa: 45 ICI: **56**
Number of Organisms: 7951 Qual EPT: 14

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 07/17/95 River Code: 15-005 River: Aurora Branch RM: 3.45 A

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
05800	*Caecidotea sp*	+			
06700	*Crangonyx sp*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
11130	*Baetis intercalaris*	+			
11650	*Procloeon sp (w/ hindwing pads)*	+			
23909	*Boyeria vinosa*	+			
52200	*Cheumatopsyche sp*	+			
52430	*Ceratopsyche morosa group*	+			
52440	*Ceratopsyche slossonae*	+			
52450	*Ceratopsyche sparna*	+			
69400	*Stenelmis sp*	+			
74100	*Simulium sp*	+			
77120	*Ablabesmyia mallochi*	+			
83040	*Dicrotendipes neomodestus*	+			
84450	*Polypedilum (P.) convictum*	+			
84470	*Polypedilum (P.) illinoense*	+			
84750	*Stictochironomus sp*	+			
85261	*Cladotanytarsus vanderwulpi group Type 1*	+			
86401	*Atherix lantha*	+			

No. Quantitative Taxa: 0 Total Taxa: 19
No. Qualitative Taxa: 19 ICI:
Number of Organisms: 0 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 15-005 River: Aurora Branch RM: 3.45 B

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
11650	*Procloeon sp (w/ hindwing pads)*	+			
13400	*Stenacron sp*	+			
17200	*Caenis sp*	+			
21200	*Calopteryx sp*	+			
23909	*Boyeria vinosa*	+			
50601	*Psychomyiidae*	+			
52200	*Cheumatopsyche sp*	+			
52430	*Ceratopsyche morosa group*	+			
68700	*Dubiraphia sp*	+			
77800	*Helopelopia sp*	+			
78401	*Natarsia species A (sensu Roback, 1978)*	+			
82820	*Cryptochironomus sp*	+			
84210	*Paratendipes albimanus or P. duplicatus*	+			
84300	*Phaenopsectra obediens group*	+			
84750	*Stictochironomus sp*	+			
85625	*Rheotanytarsus exiguus group*	+			

No. Quantitative Taxa: 0 Total Taxa: 17

No. Qualitative Taxa: 17 ICI:

Number of Organisms: 0 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 15-005 River: Aurora Branch RM: 3.40

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
11120	*Baetis flavistriga*	+			
11130	*Baetis intercalaris*	+			
12200	*Isonychia sp*	+			
13400	*Stenacron sp*	+			
13521	*Stenonema femoratum*	+			
13561	*Stenonema pulchellum*	+			
21200	*Calopteryx sp*	+			
23909	*Boyeria vinosa*	+			
47600	*Sialis sp*	+			
52200	*Cheumatopsyche sp*	+			
52430	*Ceratopsyche morosa group*	+			
52440	*Ceratopsyche slossonae*	+			
52530	*Hydropsyche depravata group*	+			
53800	*Hydroptila sp*	+			
68075	*Psephenus herricki*	+			
68130	*Helichus sp*	+			
68708	*Dubiraphia vittata group*	+			
69200	*Optioservus sp*	+			
69400	*Stenelmis sp*	+			
71100	*Hexatoma sp*	+			
77800	*Helopelopia sp*	+			
80310	*Cardiocladius obscurus*	+			
81650	*Parametriocnemus sp*	+			
82220	*Tvetenia discoloripes group*	+			
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+			
84450	*Polypedilum (P.) convictum*	+			
84540	*Polypedilum (Tripodura) scalaenum group*	+			
84750	*Stictochironomus sp*	+			
85261	*Cladotanytarsus vanderwulpi group Type 1*	+			
85625	*Rheotanytarsus exiguus group*	+			
86401	*Atherix lantha*	+			
96900	*Ferrissia sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 34
No. Qualitative Taxa: 34 ICI:
Number of Organisms: 0 Qual EPT: 11

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/14/95 River Code: 15-005 River: Aurora Branch RM: 1.60

Taxa Code	Taxa	Quant	Qual
01320	*Hydra sp*	17	
03360	*Plumatella sp*		+
03600	*Oligochaeta*	273	
05800	*Caecidotea sp*	1	
08250	*Orconectes (Procericambarus) rusticus*	1	
11010	*Acentrella sp*		+
11118	*Baetis dubius*		+
11120	*Baetis flavistriga*		+
11130	*Baetis intercalaris*	7	+
11650	*Procloeon sp (w/ hindwing pads)*	2	+
11651	*Procloeon sp (w/o hindwing pads)*	9	
11670	*Procloeon irrubrum*	2	
12200	*Isonychia sp*	2	+
13000	*Leucrocuta sp*	40	+
13400	*Stenacron sp*	312	
13521	*Stenonema femoratum*	166	
13561	*Stenonema pulchellum*	239	
13590	*Stenonema vicarium*	73	+
14950	*Leptophlebia sp or Paraleptophebia sp*	1	
16200	*Eurylophella sp*	1	
17200	*Caenis sp*	111	+
21200	*Calopteryx sp*	9	+
22001	*Coenagrionidae*		+
22300	*Argia sp*	2	+
23909	*Boyeria vinosa*		+
34410	*Paragnetina media*	1	+
44501	*Corixidae*		+
50804	*Lype diversa*	1	
51400	*Nyctiophylax sp*		+
51600	*Polycentropus sp*	1	+
52200	*Cheumatopsyche sp*	69	+
52430	*Ceratopsyche morosa group*	28	+
52440	*Ceratopsyche slossonae*		+
52450	*Ceratopsyche sparna*		+
52530	*Hydropsyche depravata group*	3	
53800	*Hydroptila sp*		+
65800	*Berosus sp*		+
67800	*Tropisternus sp*		+
68601	*Ancyronyx variegata*	18	
68708	*Dubiraphia vittata group*	10	+
68901	*Macronychus glabratus*	25	+
69400	*Stenelmis sp*		+
70600	*Antocha sp*	16	
71100	*Hexatoma sp*		+
74100	*Simulium sp*		+
74501	*Ceratopogonidae*		+
77120	*Ablabesmyia mallochi*	63	+
77500	*Conchapelopia sp*		+
77800	*Helopelopia sp*	189	
78140	*Labrundinia pilosella*	64	
78450	*Nilotanypus fimbriatus*	32	
80370	*Corynoneura lobata*	80	
80410	*Cricotopus (C.) sp*	377	+
80420	*Cricotopus (C.) bicinctus*	189	+
80430	*Cricotopus (C.) tremulus group*	63	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	126	
81650	*Parametriocnemus sp*		+
82141	*Thienemanniella xena*	64	
82730	*Chironomus (C.) decorus group*	63	+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	629	+
83300	*Glyptotendipes (G.) sp*	186	
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*		+
83840	*Microtendipes pedellus group*	126	
84060	*Parachironomus pectinatellae*		+
84300	*Phaenopsectra obediens group*	63	
84450	*Polypedilum (P.) convictum*		+
84460	*Polypedilum (P.) fallax group*	63	
84470	*Polypedilum (P.) illinoense*		+
84540	*Polypedilum (Tripodura) scalaenum group*	186	
85500	*Paratanytarsus sp*	377	
85625	*Rheotanytarsus exiguus group*	63	+
85814	*Tanytarsus glabrescens group*	2200	+
85840	*Tanytarsus guerlus group*	314	+
87540	*Hemerodromia sp*	151	+
95100	*Physella sp*	18	+
96900	*Ferrissia sp*	157	

No. Quantitative Taxa: 53 Total Taxa: 77
No. Qualitative Taxa: 48 ICI: **48**
Number of Organisms: 7283 Qual EPT: 17

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/14/95 River Code: 15-005 River: Aurora Branch RM: 0.30

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
05800	*Caecidotea sp*	+
06700	*Crangonyx sp*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
11670	*Procloeon irrubrum*	+
12200	*Isonychia sp*	+
12924	*Heptagenia flavescens*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
13561	*Stenonema pulchellum*	+
22300	*Argia sp*	+
34410	*Paragnetina media*	+
47600	*Sialis sp*	+
48410	*Corydalus cornutus*	+
48620	*Nigronia serricornis*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52450	*Ceratopsyche sparna*	+
52530	*Hydropsyche depravata group*	+
52540	*Hydropsyche dicantha*	+
54000	*Leucotrichia pictipes*	+
59970	*Petrophila sp*	+
67500	*Laccobius sp*	+
68075	*Psephenus herricki*	+
74100	*Simulium sp*	+
80410	*Cricotopus (C.) sp*	+
80420	*Cricotopus (C.) bicinctus*	+
82141	*Thienemanniella xena*	+
82220	*Tvetenia discoloripes group*	+
82770	*Chironomus (C.) riparius group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
84450	*Polypedilum (P.) convictum*	+
85625	*Rheotanytarsus exiguus group*	+
85814	*Tanytarsus glabrescens group*	+
89501	*Ephydridae*	+
96900	*Ferrissia sp*	+
98600	*Sphaerium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 40
No. Qualitative Taxa: 40 ICI:
Number of Organisms: 0 Qual EPT: 15

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 15-006 River: McFarland Creek RM: 0.10

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
05800	*Caecidotea sp*	+			
06700	*Crangonyx sp*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
11130	*Baetis intercalaris*	+			
12200	*Isonychia sp*	+			
13400	*Stenacron sp*	+			
13521	*Stenonema femoratum*	+			
13590	*Stenonema vicarium*	+			
21200	*Calopteryx sp*	+			
50315	*Chimarra obscura*	+			
52200	*Cheumatopsyche sp*	+			
52430	*Ceratopsyche morosa group*	+			
69210	*Optioservus ampliatus*	+			
71100	*Hexatoma sp*	+			
77750	*Hayesomyia senata or Thienemannimyia norena*	+			
82820	*Cryptochironomus sp*	+			
83840	*Microtendipes pedellus group*	+			
84450	*Polypedilum (P.) convictum*	+			
84460	*Polypedilum (P.) fallax group*	+			
84470	*Polypedilum (P.) illinoense*	+			
84540	*Polypedilum (Tripodura) scalaenum group*	+			
84750	*Stictochironomus sp*	+			
85230	*Cladotanytarsus mancus group*	+			
85625	*Rheotanytarsus exiguus group*	+			
86401	*Atherix lantha*	+			

No. Quantitative Taxa: 0 Total Taxa: 26
No. Qualitative Taxa: 26 ICI:
Number of Organisms: 0 Qual EPT: 8

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/96 River Code: 15-007 River: Silver Creek RM: 5.00

Taxa Code	Taxa	Quant/Qual	
01801	*Turbellaria*	8	
03600	*Oligochaeta*	19	+
08240	*Orconectes (Crokerinus) propinquus*		+
11120	*Baetis flavistriga*	1	+
11130	*Baetis intercalaris*		+
13400	*Stenacron sp*	41	+
13521	*Stenonema femoratum*	5	+
13530	*Stenonema ithaca*	2	
13561	*Stenonema pulchellum*	25	+
13570	*Stenonema terminatum*	12	+
13590	*Stenonema vicarium*	5	+
14950	*Leptophlebia sp or Paraleptophebia sp*	28	
16700	*Tricorythodes sp*	1	
21200	*Calopteryx sp*		+
21300	*Hetaerina sp*		+
23905	*Boyeria grafiana*		+
23909	*Boyeria vinosa*	1	+
24900	*Gomphus sp*		+
34700	*Agnetina capitata complex*	3	+
47600	*Sialis sp*	2	
50410	*Dolophilodes distinctus*		+
50804	*Lype diversa*	9	
50906	*Psychomyia flavida*	8	
51400	*Nyctiophylax sp*	10	
51600	*Polycentropus sp*	4	
52200	*Cheumatopsyche sp*		+
52530	*Hydropsyche depravata group*		+
55300	*Ptilostomis sp*		+
57400	*Neophylax sp*		+
57900	*Pycnopsyche sp*		+
58505	*Helicopsyche borealis*		+
59001	*Leptoceridae*	1	
68075	*Psephenus herricki*		+
68601	*Ancyronyx variegata*	16	+
68700	*Dubiraphia sp*	33	
68901	*Macronychus glabratus*		+
69200	*Optioservus sp*		+
69400	*Stenelmis sp*	3	+
70700	*Dicranota sp*		+
71100	*Hexatoma sp*	1	+
71910	*Tipula abdominalis*		+
74100	*Simulium sp*		+
74501	*Ceratopogonidae*		+
77500	*Conchapelopia sp*		+
77750	*Hayesomyia senata or Thienemannimyia norena*	15	
77800	*Helopelopia sp*	30	
78402	*Natarsia baltimoreus*	30	
78450	*Nilotanypus fimbriatus*	40	
80370	*Corynoneura lobata*	176	
80420	*Cricotopus (C.) bicinctus*	15	
80430	*Cricotopus (C.) tremulus group*	15	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	46	
81250	*Nanocladius (N.) minimus*	15	
81270	*Nanocladius (N.) spiniplenus*	15	
81650	*Parametriocnemus sp*	61	
81825	*Rheocricotopus (Psilocricotopus) robacki*	76	+
82101	*Thienemanniella n.sp 1*	32	
82121	*Thienemanniella n.sp 3*	560	
82200	*Tvetenia bavarica group*		+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	30	
83840	*Microtendipes pedellus group*	15	
83860	*Microtendipes rydalensis*	91	
84210	*Paratendipes albimanus or P. duplicatus*		+
84300	*Phaenopsectra obediens group*		+
84460	*Polypedilum (P.) fallax group*	46	
84475	*Polypedilum (P.) ophioides*	15	
84480	*Polypedilum (P.) laetum group*	30	+
84700	*Stenochironomus sp*	46	
84750	*Stictochironomus sp*		+
85261	*Cladotanytarsus vanderwulpi group Type 1*	15	
85500	*Paratanytarsus sp*		+
85501	*Paratanytarsus n.sp 1*	61	
85615	*Rheotanytarsus distinctissimus group*	61	+
85625	*Rheotanytarsus exiguus group*	167	+
85711	*Stempellinella n.sp 1*	8	
85800	*Tanytarsus sp*	15	
85802	*Tanytarsus curticornis group*	15	
85814	*Tanytarsus glabrescens group*	426	
85840	*Tanytarsus guerlus group*	30	
86100	*Chrysops sp*		+
86200	*Tabanus sp*		+
86401	*Atherix lantha*		+

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/23/96 River Code: 15-007 River: Silver Creek RM: 5.00

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
87520	*Clinocera (Hydrodromia) sp*	+			
87540	*Hemerodromia sp*	20 +			
95100	*Physella sp*	8			
96002	*Helisoma anceps anceps*	1			
96264	*Planorbella (Pierosoma) pilsbryi*	+			
96900	*Ferrissia sp*	22 +			

No. Quantitative Taxa:	57	Total Taxa:	88
No. Qualitative Taxa:	49	ICI:	**52**
Number of Organisms:	2486	Qual EPT:	15

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 15-007 River: Silver Creek RM: 3.90

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
01801	*Turbellaria*	5
03600	*Oligochaeta*	25
04685	*Placobdella ornata*	+
08240	*Orconectes (Crokerinus) propinquus*	+
11120	*Baetis flavistriga*	7 +
11130	*Baetis intercalaris*	210 +
11150	*Labiobaetis propinquus*	7
11430	*Diphetor hageni*	52
12200	*Isonychia sp*	39 +
13400	*Stenacron sp*	50
13530	*Stenonema ithaca*	14
13540	*Stenonema mediopunctatum*	+
13590	*Stenonema vicarium*	294
14950	*Leptophlebia sp or Paraleptophebia sp*	80
15000	*Paraleptophlebia sp*	+
21200	*Calopteryx sp*	1 +
21300	*Hetaerina sp*	11
23909	*Boyeria vinosa*	1 +
24930	*Gomphus lividus*	+
32001	*Nemouridae*	4
34130	*Acroneuria frisoni*	+
34700	*Agnetina capitata complex*	5
35001	*Perlodidae*	4
47600	*Sialis sp*	1
48620	*Nigronia serricornis*	1 +
50301	*Chimarra aterrima*	16 +
50804	*Lype diversa*	1 +
51600	*Polycentropus sp*	3 +
52200	*Cheumatopsyche sp*	147 +
52530	*Hydropsyche depravata group*	+
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	+
58505	*Helicopsyche borealis*	+
68075	*Psephenus herricki*	+
68130	*Helichus sp*	+
68700	*Dubiraphia sp*	2
68901	*Macronychus glabratus*	43 +
69400	*Stenelmis sp*	11 +
74100	*Simulium sp*	+
74501	*Ceratopogonidae*	4
77500	*Conchapelopia sp*	38 +
77800	*Helopelopia sp*	45
78350	*Meropelopia sp*	8
78450	*Nilotanypus fimbriatus*	20 +
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	4
80370	*Corynoneura lobata*	20
81650	*Parametriocnemus sp*	8
81825	*Rheocricotopus (Psilocricotopus) robacki*	75 +
82121	*Thienemanniella n.sp 3*	28 +
82141	*Thienemanniella xena*	132 +
82820	*Cryptochironomus sp*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	8
83860	*Microtendipes rydalensis*	173
84116	*Paracladopelma nereis*	+
84460	*Polypedilum (P.) fallax group*	68
85261	*Cladotanytarsus vanderwulpi group Type 1*	+
85501	*Paratanytarsus n.sp 1*	8
85615	*Rheotanytarsus distinctissimus group*	15
85625	*Rheotanytarsus exiguus group*	203 +
85720	*Stempellinella n.sp nr. flavidula*	8
85800	*Tanytarsus sp*	8
85802	*Tanytarsus curticornis group*	8
85814	*Tanytarsus glabrescens group*	30
86100	*Chrysops sp*	+
86401	*Atherix lantha*	4 +
87540	*Hemerodromia sp*	49 +
96900	*Ferrissia sp*	8 +
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 50 Total Taxa: 69
No. Qualitative Taxa: 40 ICI: **56**
Number of Organisms: 2006 Qual EPT: 14

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/08/95 River Code: 15-007 River: Silver Creek RM: 1.90

Taxa Code	Taxa	Quant/Qual
00653	*Eunapius fragilis*	+
01200	*Cordylophora lacustris*	1
01320	*Hydra sp*	148
01801	*Turbellaria*	54 +
03600	*Oligochaeta*	1052 +
04664	*Helobdella stagnalis*	1
04935	*Erpobdella punctata punctata*	1
06201	*Hyalella azteca*	59 +
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	5
11130	*Baetis intercalaris*	5 +
11645	*Procloeon sp*	+
12200	*Isonychia sp*	4 +
13400	*Stenacron sp*	133 +
13521	*Stenonema femoratum*	37 +
13561	*Stenonema pulchellum*	15
13590	*Stenonema vicarium*	+
14950	*Leptophlebia sp or Paraleptophebia sp*	8
16200	*Eurylophella sp*	1
17200	*Caenis sp*	270 +
21200	*Calopteryx sp*	25 +
22001	*Coenagrionidae*	1 +
22300	*Argia sp*	+
25510	*Stylogomphus albistylus*	+
27307	*Epitheca (Epicordulia) princeps*	+
34700	*Agnetina capitata complex*	+
48410	*Corydalus cornutus*	+
48620	*Nigronia serricornis*	+
50315	*Chimarra obscura*	4 +
50804	*Lype diversa*	+
50906	*Psychomyia flavida*	151 +
51400	*Nyctiophylax sp*	1
51600	*Polycentropus sp*	1 +
52200	*Cheumatopsyche sp*	629 +
52430	*Ceratopsyche morosa group*	+
52530	*Hydropsyche depravata group*	30 +
53800	*Hydroptila sp*	+
54200	*Orthotrichia sp*	8
57400	*Neophylax sp*	+
59300	*Mystacides sp*	+
59500	*Oecetis sp*	8
60300	*Dineutus sp*	+
60900	*Peltodytes sp*	+
63900	*Laccophilus sp*	+
65800	*Berosus sp*	+
67700	*Paracymus sp*	+
68025	*Ectopria sp*	+
68075	*Psephenus herricki*	+
68702	*Dubiraphia bivittata*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	1 +
69275	*Optioservus trivittatus*	+
71100	*Hexatoma sp*	+
74100	*Simulium sp*	+
74673	*Atrichopogon websteri*	121
77120	*Ablabesmyia mallochi*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	136
77800	*Helopelopia sp*	136
80370	*Corynoneura lobata*	32
80410	*Cricotopus (C.) sp*	+
80420	*Cricotopus (C.) bicinctus*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	136
82121	*Thienemanniella n.sp 3*	512 +
82141	*Thienemanniella xena*	32 +
82820	*Cryptochironomus sp*	+
83002	*Dicrotendipes modestus*	+
83158	*Endochironomus nigricans*	136 +
84315	*Phaenopsectra flavipes*	+
84450	*Polypedilum (P.) convictum*	2046 +
84470	*Polypedilum (P.) illinoense*	+
84480	*Polypedilum (P.) laetum group*	+
85261	*Cladotanytarsus vanderwulpi group Type 1*	+
85615	*Rheotanytarsus distinctissimus group*	+
85625	*Rheotanytarsus exiguus group*	10366 +
85802	*Tanytarsus curticornis group*	+
85814	*Tanytarsus glabrescens group*	136
85840	*Tanytarsus guerlus group*	273
87540	*Hemerodromia sp*	14 +
93025	*Bithynia tentaculata*	+
93200	*Hydrobiidae*	+
94400	*Fossaria sp*	3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/08/95 River Code: 15-007 River: Silver Creek RM: 1.90

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
95100	*Physella sp*	11			
95907	*Gyraulus (Torquis) parvus*	33 +			
96900	*Ferrissia sp*	216 +			
98600	*Sphaerium sp*	+			
99100	*Pyganodon grandis*	+			
99160	*Anodontoides ferussacianus*	+			
99280	*Lasmigona costata*	+			

No. Quantitative Taxa: 44 Total Taxa: 90

No. Qualitative Taxa: 70 ICI: **52**

Number of Organisms: 16992 Qual EPT: 18

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 15-007 River: Silver Creek RM: 0.50

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	1
04685	*Placobdella ornata*	+
08250	*Orconectes (Procericambarus) rusticus*	+
08601	*Hydracarina*	+
11120	*Baetis flavistriga*	2
11130	*Baetis intercalaris*	95 +
11651	*Procloeon sp (w/o hindwing pads)*	2 +
11670	*Procloeon irrubrum*	+
12200	*Isonychia sp*	54 +
13000	*Leucrocuta sp*	7 +
13400	*Stenacron sp*	25 +
13521	*Stenonema femoratum*	2 +
13561	*Stenonema pulchellum*	33 +
13590	*Stenonema vicarium*	13 +
14950	*Leptophlebia sp or Paraleptophebia sp*	14
17200	*Caenis sp*	1
18100	*Anthopotamus sp*	1 +
21200	*Calopteryx sp*	2 +
34130	*Acroneuria frisoni*	2
34300	*Neoperla clymene complex*	+
34410	*Paragnetina media*	1 +
48620	*Nigronia serricornis*	4 +
50315	*Chimarra obscura*	1 +
52200	*Cheumatopsyche sp*	35 +
52430	*Ceratopsyche morosa group*	4 +
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	1 +
58505	*Helicopsyche borealis*	+
60400	*Gyrinus sp*	+
68075	*Psephenus herricki*	+
68130	*Helichus sp*	+
68708	*Dubiraphia vittata group*	1 +
68901	*Macronychus glabratus*	34 +
69275	*Optioservus trivittatus*	+
69400	*Stenelmis sp*	40 +
71100	*Hexatoma sp*	+
71900	*Tipula sp*	+
77001	*Tanypodinae*	+
77120	*Ablabesmyia mallochi*	17
77500	*Conchapelopia sp*	70 +
77800	*Helopelopia sp*	17
80370	*Corynoneura lobata*	56
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	17
81825	*Rheocricotopus (Psilocricotopus) robacki*	+
82121	*Thienemanniella n.sp 3*	24
82141	*Thienemanniella xena*	16
82220	*Tvetenia discoloripes group*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
83840	*Microtendipes pedellus group*	52 +
84210	*Paratendipes albimanus or P. duplicatus*	17
84450	*Polypedilum (P.) convictum*	+
84460	*Polypedilum (P.) fallax group*	35
84470	*Polypedilum (P.) illinoense*	17
84540	*Polypedilum (Tripodura) scalaenum group*	17
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	1425 +
85720	*Stempellinella n.sp nr. flavidula*	17
85802	*Tanytarsus curticornis group*	17
85814	*Tanytarsus glabrescens group*	70
85815	*Tanytarsus glabrescens group Type 1*	+
85840	*Tanytarsus guerlus group*	52
87540	*Hemerodromia sp*	17 +
96900	*Ferrissia sp*	6 +
98600	*Sphaerium sp*	1 +

No. Quantitative Taxa: 44 Total Taxa: 64
No. Qualitative Taxa: 45 ICI: **52**
Number of Organisms: 2335 Qual EPT: 18

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/29/95 River Code: 15-008 River: Beaver Creek RM: 2.40

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
04686	*Placobdella papillifera*	+
11250	*Centroptilum sp (w/o hindwing pads)*	+
13590	*Stenonema vicarium*	+
14950	*Leptophlebia sp or Paraleptophebia sp*	+
18600	*Ephemera sp*	+
21200	*Calopteryx sp*	+
23909	*Boyeria vinosa*	+
26100	*Cordulegaster sp*	+
45900	*Notonecta sp*	+
47600	*Sialis sp*	+
48620	*Nigronia serricornis*	+
50804	*Lype diversa*	+
51400	*Nyctiophylax sp*	+
52315	*Diplectrona modesta*	+
52530	*Hydropsyche depravata group*	+
55107	*Oligostomis pardalis*	+
56600	*Frenesia sp*	+
57400	*Neophylax sp*	+
57900	*Pycnopsyche sp*	+
63300	*Hydroporus sp*	+
67100	*Hydrobius sp*	+
68130	*Helichus sp*	+
69225	*Optioservus fastiditus*	+
69400	*Stenelmis sp*	+
70700	*Dicranota sp*	+
71100	*Hexatoma sp*	+
71700	*Pilaria sp*	+
71910	*Tipula abdominalis*	+
72340	*Dixella sp*	+
74100	*Simulium sp*	+
74501	*Ceratopogonidae*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	+
78650	*Procladius sp*	+
80370	*Corynoneura lobata*	+
80850	*Heterotrissocladius marcidus*	+
81650	*Parametriocnemus sp*	+
84440	*Polypedilum (P.) aviceps*	+
85501	*Paratanytarsus n.sp 1*	+
85615	*Rheotanytarsus distinctissimus group*	+
85720	*Stempellinella n.sp nr. flavidula*	+
86100	*Chrysops sp*	+
87190	*Odontomyia (Catatasina) sp*	+
95100	*Physella sp*	+
98200	*Pisidium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 46

No. Qualitative Taxa: 46 ICI:

Number of Organisms: 0 Qual EPT: 12

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 15-012 River: Trib. to Chagrin R. (RM 15.42) RM: 0.30

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	4
03600	*Oligochaeta*	139
08200	*Orconectes sp*	+
11115	*Baetis tricaudatus*	1 +
11120	*Baetis flavistriga*	86 +
11130	*Baetis intercalaris*	38 +
11430	*Diphetor hageni*	6
12200	*Isonychia sp*	19 +
13000	*Leucrocuta sp*	6 +
13400	*Stenacron sp*	16
13521	*Stenonema femoratum*	3 +
13561	*Stenonema pulchellum*	1
13590	*Stenonema vicarium*	4 +
14900	*Leptophlebia sp*	23 +
16200	*Eurylophella sp*	16
21200	*Calopteryx sp*	+
21300	*Hetaerina sp*	4
22001	*Coenagrionidae*	+
28208	*Erythemis simplicicollis*	+
33100	*Leuctra sp*	+
34120	*Acroneuria carolinensis*	+
42700	*Belostoma sp*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	1
48610	*Nigronia fasciatus*	+
50410	*Dolophilodes distinctus*	+
50804	*Lype diversa*	2
51600	*Polycentropus sp*	1
52200	*Cheumatopsyche sp*	24 +
52315	*Diplectrona modesta*	15 +
52430	*Ceratopsyche morosa group*	8
52431	*Ceratopsyche morosa*	2
52440	*Ceratopsyche slossonae*	21 +
60900	*Peltodytes sp*	+
63600	*Hygrotus sp*	+
68075	*Psephenus herricki*	9 +
68601	*Ancyronyx variegata*	4
69200	*Optioservus sp*	4
69400	*Stenelmis sp*	+
70600	*Antocha sp*	4
72700	*Anopheles sp*	+
74100	*Simulium sp*	10 +
74501	*Ceratopogonidae*	5
77120	*Ablabesmyia mallochi*	7
77500	*Conchapelopia sp*	64 +
77800	*Helopelopia sp*	64 +
78350	*Meropelopia sp*	14
78450	*Nilotanypus fimbriatus*	12
80351	*Corynoneura n.sp 1*	16 +
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	4
80370	*Corynoneura lobata*	48
81650	*Parametriocnemus sp*	78 +
81690	*Paratrichocladius sp*	14
81825	*Rheocricotopus (Psilocricotopus) robacki*	7
82101	*Thienemanniella n.sp 1*	24
82141	*Thienemanniella xena*	28 +
83840	*Microtendipes pedellus group*	7
83860	*Microtendipes rydalensis*	7
84210	*Paratendipes albimanus or P. duplicatus*	14
84300	*Phaenopsectra obediens group*	7 +
84430	*Polypedilum (P.) albicorne*	177
84440	*Polypedilum (P.) aviceps*	14 +
84460	*Polypedilum (P.) fallax group*	71
84470	*Polypedilum (P.) illinoense*	7 +
84475	*Polypedilum (P.) ophioides*	28
84480	*Polypedilum (P.) laetum group*	7
85501	*Paratanytarsus n.sp 1*	14
85615	*Rheotanytarsus distinctissimus group*	+
85625	*Rheotanytarsus exiguus group*	21 +
85800	*Tanytarsus sp*	21
85802	*Tanytarsus curticornis group*	14
85814	*Tanytarsus glabrescens group*	21
85840	*Tanytarsus guerlus group*	14
86401	*Atherix lantha*	1
87515	*Clinocera (C.) sp*	5
87540	*Hemerodromia sp*	4
89501	*Ephydridae*	+
95100	*Physella sp*	+

No. Quantitative Taxa: 61 Total Taxa: 78
No. Qualitative Taxa: 39 ICI: **46**
Number of Organisms: 1310 Qual EPT: 14

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/31/95 River Code: 15-017 River: Trib. to Chagrin R. (RM 14.88) RM: 0.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+			
03600	*Oligochaeta*	+			
06700	*Crangonyx sp*	+			
11120	*Baetis flavistriga*	+			
21200	*Calopteryx sp*	+			
52200	*Cheumatopsyche sp*	+			
52450	*Ceratopsyche sparna*	+			
52530	*Hydropsyche depravata group*	+			
74100	*Simulium sp*	+			
82141	*Thienemanniella xena*	+			
84315	*Phaenopsectra flavipes*	+			
84450	*Polypedilum (P.) convictum*	+			
84460	*Polypedilum (P.) fallax group*	+			

No. Quantitative Taxa: 0 Total Taxa: 13

No. Qualitative Taxa: 13 ICI:

Number of Organisms: 0 Qual EPT: 4

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/01/95 River Code: 15-018 River: Trib. to Chagrin R. (RM 22.81) RM: 0.20

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
05800	*Caecidotea sp*	+
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	+
13521	*Stenonema femoratum*	+
21200	*Calopteryx sp*	+
23909	*Boyeria vinosa*	+
50315	*Chimarra obscura*	+
52200	*Cheumatopsyche sp*	+
52430	*Ceratopsyche morosa group*	+
52450	*Ceratopsyche sparna*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	+
77800	*Helopelopia sp*	+
80370	*Corynoneura lobata*	+
80430	*Cricotopus (C.) tremulus group*	+
82820	*Cryptochironomus sp*	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*	+
84450	*Polypedilum (P.) convictum*	+
84750	*Stictochironomus sp*	+
85625	*Rheotanytarsus exiguus group*	+
96900	*Ferrissia sp*	+
98600	*Sphaerium sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 24
No. Qualitative Taxa: 24 ICI:
Number of Organisms: 0 Qual EPT: 6

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/01/95 River Code: 15-019 River: Trib. to Chagrin R. (RM RM: 0.10

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+			
03600	*Oligochaeta*	+			
06700	*Crangonyx sp*	+			
11120	*Baetis flavistriga*	+			
21200	*Calopteryx sp*	+			
22001	*Coenagrionidae*	+			
23909	*Boyeria vinosa*	+			
47600	*Sialis sp*	+			
52200	*Cheumatopsyche sp*	+			
52530	*Hydropsyche depravata group*	+			
72700	*Anopheles sp*	+			
74100	*Simulium sp*	+			
77500	*Conchapelopia sp*	+			
78601	*Pentaneura Type 1*	+			
81650	*Parametriocnemus sp*	+			
83040	*Dicrotendipes neomodestus*	+			
84210	*Paratendipes albimanus or P. duplicatus*	+			
84470	*Polypedilum (P.) illinoense*	+			
84540	*Polypedilum (Tripodura) scalaenum group*	+			
84750	*Stictochironomus sp*	+			
85500	*Paratanytarsus sp*	+			
85625	*Rheotanytarsus exiguus group*	+			
85800	*Tanytarsus sp*	+			
85814	*Tanytarsus glabrescens group*	+			
87540	*Hemerodromia sp*	+			
95100	*Physella sp*	+			
98600	*Sphaerium sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 27
No. Qualitative Taxa: 27 ICI:
Number of Organisms: 0 Qual EPT: 3

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/28/95 River Code: 15-022 River: Linton Creek RM: 0.10

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
11130	*Baetis intercalaris*	+			
12200	*Isonychia sp*	+			
13400	*Stenacron sp*	+			
21200	*Calopteryx sp*	+			
26100	*Cordulegaster sp*	+			
48620	*Nigronia serricornis*	+			
50410	*Dolophilodes distinctus*	+			
52430	*Ceratopsyche morosa group*	+			
52440	*Ceratopsyche slossonae*	+			
52450	*Ceratopsyche sparna*	+			
53300	*Glossosoma sp*	+			
57400	*Neophylax sp*	+			
69225	*Optioservus fastiditus*	+			
70600	*Antocha sp*	+			
71100	*Hexatoma sp*	+			
71900	*Tipula sp*	+			
77500	*Conchapelopia sp*	+			
78450	*Nilotanypus fimbriatus*	+			
80370	*Corynoneura lobata*	+			
80430	*Cricotopus (C.) tremulus group*	+			
81650	*Parametriocnemus sp*	+			
82101	*Thienemanniella n.sp 1*	+			
82200	*Tvetenia bavarica group*	+			
84000	*Parachironomus sp*	+			
84470	*Polypedilum (P.) illinoense*	+			
84750	*Stictochironomus sp*	+			
85625	*Rheotanytarsus exiguus group*	+			
86401	*Atherix lantha*	+			
87515	*Clinocera (C.) sp*	+			
87540	*Hemerodromia sp*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 31
No. Qualitative Taxa: 31 ICI:
Number of Organisms: 0 Qual EPT: 9

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/01/96 River Code: 15-023 River: Sunny Lake Outlet RM: 0.10

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	+			
01801	*Turbellaria*	+			
03600	*Oligochaeta*	+			
04935	*Erpobdella punctata punctata*	+			
08250	*Orconectes (Procericambarus) rusticus*	+			
13400	*Stenacron sp*	+			
42700	*Belostoma sp*	+			
50301	*Chimarra aterrima*	+			
52200	*Cheumatopsyche sp*	+			
52530	*Hydropsyche depravata group*	+			
57400	*Neophylax sp*	+			
77500	*Conchapelopia sp*	+			
78450	*Nilotanypus fimbriatus*	+			
81630	*Parakiefferiella sp*	+			
81650	*Parametriocnemus sp*	+			
83840	*Microtendipes pedellus group*	+			
84210	*Paratendipes albimanus or P. duplicatus*	+			
84450	*Polypedilum (P.) convictum*	+			
84460	*Polypedilum (P.) fallax group*	+			
84540	*Polypedilum (Tripodura) scalaenum group*	+			
85625	*Rheotanytarsus exiguus group*	+			
85800	*Tanytarsus sp*	+			
86401	*Atherix lantha*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 24
No. Qualitative Taxa: 24 ICI:
Number of Organisms: 0 Qual EPT: 5