Biological, Fish Tissue, and Sediment Study of the Ottawa River

Dura Avenue Landfill
2002

Lucas County, Ohio

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State of Ohio Environmental Protection Agency
Division of Surface Water
Lazarus Government Center
122 South Front Street
Columbus, Ohio 43215

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NOTICE TO USERS

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

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

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

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

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

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

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

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

Since the publication of the preceding guidance documents, the following new publications by the Ohio EPA have become available. These publications should also be consulted as they represent the latest information and analyses used by the Ohio EPA to implement the biological criteria.

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

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

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

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

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

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

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

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

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 6-10 different study areas with an aggregate total of 350-400 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,

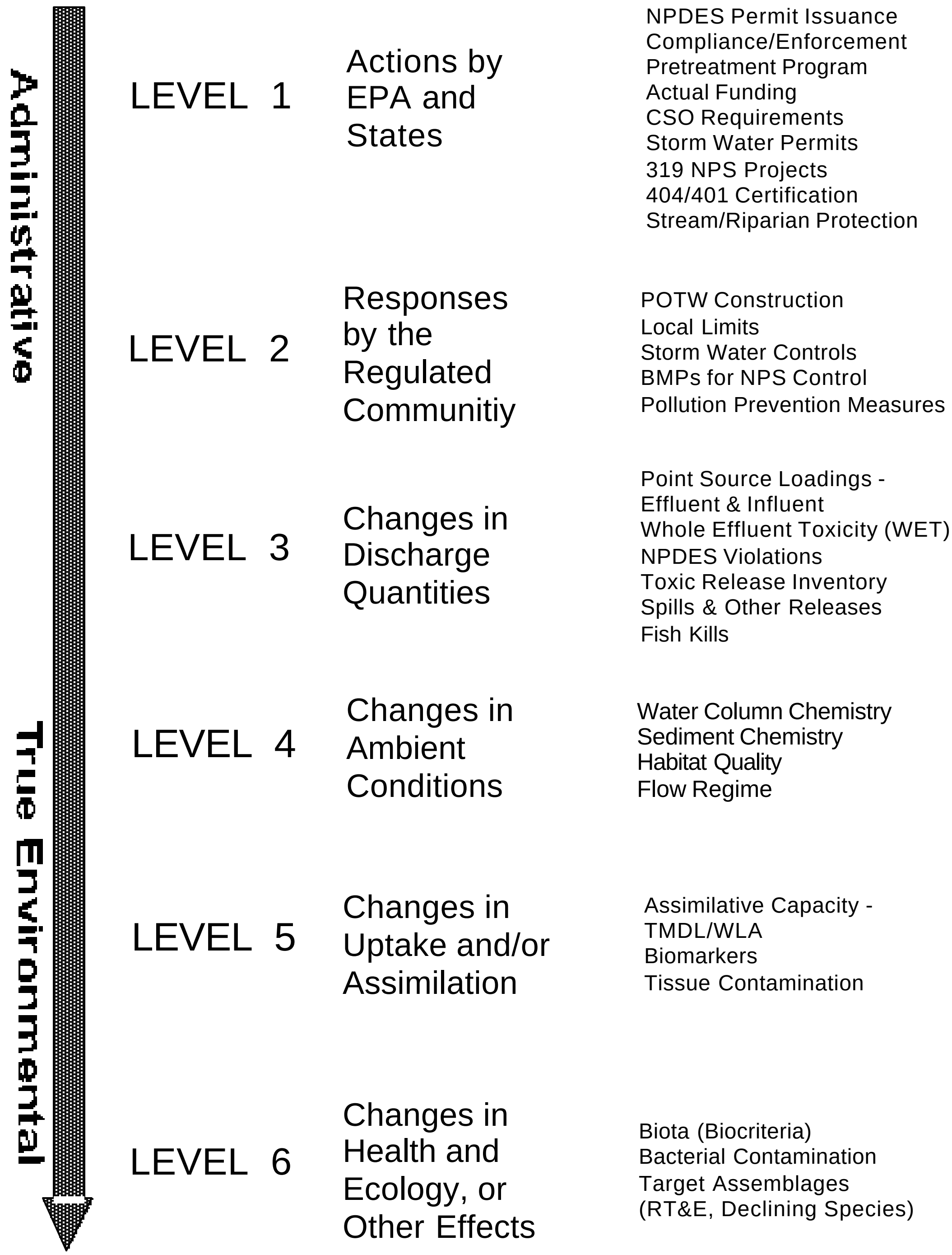

Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).

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

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

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed 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 and are detailed in other documents.

ACKNOWLEDGEMENTS

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Macroinvertebrate Data Analysis - Mike Gray
Reviewers - Jeff DeShon, Marc Smith

Biological, Fish Tissue, and Sediment Study of the Ottawa River and Sibley Creek (Lucas County, Ohio)

Ohio Environmental Protection Agency
Division of Surface Water
Ecological Assessment Section
4675 Homer Ohio Land
Groveport, Ohio 43125

INTRODUCTION

The Ottawa River study area included the mainstem from the first railroad trestle upstream from Dura Avenue Landfill (RM 6.0) to Stickney Avenue (RM 5.0) and Sibley Creek from Lagrange Street (RM 0.8) to the mouth.

Specific objectives of this evaluation were to:

1) determine the attainment status of the Warmwater Habitat aquatic life use designation for the Ottawa River and the Limited Resource Water use for Sibley Creek within the study area, and

2) follow-up on biological, sediment, and fish tissue conditions documented in the previous Ohio EPA study from 1996.

The Ottawa River watershed is in the Huron-Erie Lake Plain (HELP) ecoregion. The aquatic life use in the Ottawa River currently is Warmwater Habitat (WWH) and the use designation for Sibley Creek is Limited Resource Water (LRW) based on data collected in 1993 and 1996. The Ottawa River in the lower nine miles exhibits lacustuary conditions. A lacustuary is defined as a transition zone in a river that flows into a large freshwater lake and is continuously affected by the water levels in the lake. At lacustuary sampling locations, the fish and macroinvertebrate communities were assessed using lacustuary biocriteria being developed by the Ohio EPA.

SUMMARY / CONCLUSIONS

Ottawa River

Based on the performance of the biological communities, the entire one mile of the Ottawa River study area was in non-attainment of the Warmwater Habitat aquatic life use (Table 2). The non-attainment was caused by poor fish and poor/very poor macroinvertebrate community results. The urbanized condition of the Ottawa River within the study segment (combined sewer overflows), poor river habitat (reduced or absent current, homogeneous fine substrates, reduced instream cover), and elevated sediment contaminants contributed to the impaired biological communities. Some improvement in fish community condition was noted at RMs 5.5 and 5.3, compared with 1996 results. In addition, three fish species (suckers) considered moderately tolerant of pollution were collected in low numbers during 2002. These species were not collected in the Ottawa River during 1996. Although macroinvertebrate community performance was poor and very poor during 2002, changes in the makeup of the communities, relative to past results, indicated a lessening of toxic impacts and an overriding impairment from nutrient enrichment.

Sediment samples collected from the four Ottawa River locations had total PCB levels which exceeded the *Probable Effect Concentration* (PEC), indicating a level above which harmful biological effects are likely to be observed. Matrix interference problems precluded an assessment of semivolatile organic compounds measured in the sediment. An evaluation of PCB trends (PCB 1242) in the Ottawa River over the last ten years did not reveal significant declines in concentration in the river between RMs 5.0 and 6.0.

Fish fillet samples from the Ottawa River during 2002 had total PCB concentrations indicative of slightly elevated to highly elevated levels. No obvious longitudinal trends were noted in PCB levels of fillet samples between upstream, adjacent to Dura Ave. Landfill, or downstream sites. Whole body PCB concentrations were measured in pumpkinseed sunfish from the Ottawa River. Whole body total PCBs ranged between 1.20 and 5.20 mg/kg, with the lowest values occurring adjacent to the Dura Ave. Landfill. An evaluation of results between 1996 and 2002 indicated a decline in PCB 1242 levels in common carp fillet samples.

Sibley Creek

Based on the performance of the biological communities, the upper section and lower 0.1 mile of Sibley Creek was in non-attainment of the Limited Resource Water aquatic life benchmarks (Table 2). The non-attainment was caused by very poor fish and macroinvertebrate community results. Acutely toxic conditions existed in Sibley Creek at RM 0.8, where fish were nearly absent during both sampling passes. The biological non-attainment near the mouth (RM 0.1 - adjacent to Dura Ave. Landfill) appeared largely associated with poor quality stream habitat. This site lacked water depth sufficient to maintain an adequate fish population. Results from RM 0.2, adjacent to the Dura landfill, fully attained the Limited Resource Water use.

Sediment samples collected from Sibley Creek upstream and adjacent to Dura Ave. Landfill had total PCB and lead levels which exceeded the *Probable Effect Concentration* (PEC), indicating a level above which harmful biological effects are likely to be observed. Matrix interference problems precluded an assessment of semivolatile organic compounds measured in the sediment. Below the surface layer of silt and muck, the bottom sediments of Sibley Creek at RM 0.8 are heavily saturated with a black material with a creosote odor. Disturbance of the bottom sediments released an oily substance that created an extensive oil sheen on the surface of the water. These conditions were observed further downstream at RMs 0.2 and 0.1, although to a lesser extent. These conditions were noted during sampling in 1996.

Table 1. Sampling locations from the Ottawa River study area, 2002. Type of sampling included fish community (F), macroinvertebrate community (M), fish tissue (T), and sediment(S).

Stream/ River Mile	Type of Sampling	Latitude	Longitude	Landmark	County	USGS 7.5 min. Quad. Map
Ottawa River						
5.8/ 5.78[a]	F,M,T,S	41.69407	83.53502	Near RR Bridge/ River left, Ust.Dura landfill	Lucas	Toledo, OH
5.5/ 5.48[a]	F,M,T,S	41.69656	83.53144	Adj. IRM barrier wall/ River left	Lucas	Toledo, OH
5.3/ 5.28[a]	F,M,T,S	41.69869	83.52978	Adj. lower Dura landfill/ Ust. landfill overflow channel River left	Lucas	Toledo, OH
5.0/ 5.00[a]	F,M,T,S	41.70308	83.52826	Stickney Ave. River left	Lucas	Toledo, OH
Sibley Creek						
0.8/ 0.82[a]	F,M,S	41.69560	83.54730	Lagrange Rd.	Lucas	Toledo, OH
0.2	F,M	41.69649	83.53669	Adj. Dura landfill	Lucas	Toledo, OH
0.1/0.05[a]	F,M,S	41.69574	83.53414	Near mouth/ Adj. Dura landfill	Lucas	Toledo, OH

[a] First river mile is the biological site, second river mile is the exact sediment grab location.

Table 2. Attainment status of existing or recommended aquatic life uses for the Ottawa River and Sibley Creek based on data collected from July - August, 2002 and 1996. Attainment status is based on applicable fish and macroinvertebrate biocriteria for the Huron-Erie Lake Plain ecoregion of Ohio for inland streams and rivers and Interim Criterion for Lake Erie Lacustuaries.

RIVER MILE Fish/Invert.	IBI (LIBI)	MIwb (MIwb)	ICI[a] (LICI)	QHEI[b]	Attainment Status	Comment
Ottawa River (2002)			*WWH Lacustuarine Zone Interim Criteria*			
5.8/5.8	24.5*	6.2*	6*	41.5	NON	Upstream Dura Landfill
5.5/5.5	21*	6.7	8*	34.0	NON	Adjacent Dura IRM wall
5.3/5.3	21.5*	6.7	6*	41.0	NON	Adj. lower Dura Landfill
5.0/5.0	21*	6.2*	12*	40.0	NON	Dst. Dura Landfill
Ottawa River (1996)						
5.7/5.7	22*	6.3*	6*	44.5	NON	Upstream Dura Landfill
5.5/5.5	22*	6.4*	8*	41.0	NON	Adjacent Dura IRM wall
5.3/5.3	18*	5.0*	6*	41.5	NON	Adj. lower Dura Landfill
Sibley Creek (2002)		*Huron-Erie Lake Plain - LRW Use Designation*				
0.8/0.8	12*	NA	VP*	36.5	NON	Upstream Dura Landfill
0.2/0.2	24	NA	P	25.5	FULL	Adj. Dura Landfill
0.1/0.1	12*	NA	P	26.0	NON	Adj. Dura Landfill
Sibley Creek (1996)						
0.8/0.8	12*	NA	VP*	40.0	NON	No fish present
0.1/0.1	19	NA	P	36.5	FULL	Adjacent Dura Landfill

Ecoregion Biocriteria: *Huron-Erie Lake Plain (HELP)*
(Applicable Stream Criteria from OAC 3745-1-07, Table 7-15)

INDEX	WWH	EWH	MWH[c]	LRW[d]
IBI - Headwater	28	50	20	18
LICI-Interim Final Lacustuary	42			
LICI-Interim Intermediate Lacustuary	34			
LIBI - Interim Lacustuary	42			
MIwb - Interim Lacustuary	8.6			

* - Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
NA - Not applicable.
a - The qualitative narrative evaluation is based on best professional judgment utilizing sample attributes such as taxa richness, EPT richness, and predominant organisms and is used when quantitative data is not available to calculate the Invertebrate Community Index (ICI) scores (P- Poor, VP- Very Poor).
b - Qualitative Habitat Evaluation Index (QHEI) values based on Rankin (1989).
c - Modified Warmwater Habitat for channel modified areas.
d - Limited Resource Water benchmarks based on best professional judgment driven by the need to protect against acutely toxic (very poor) stream conditions.

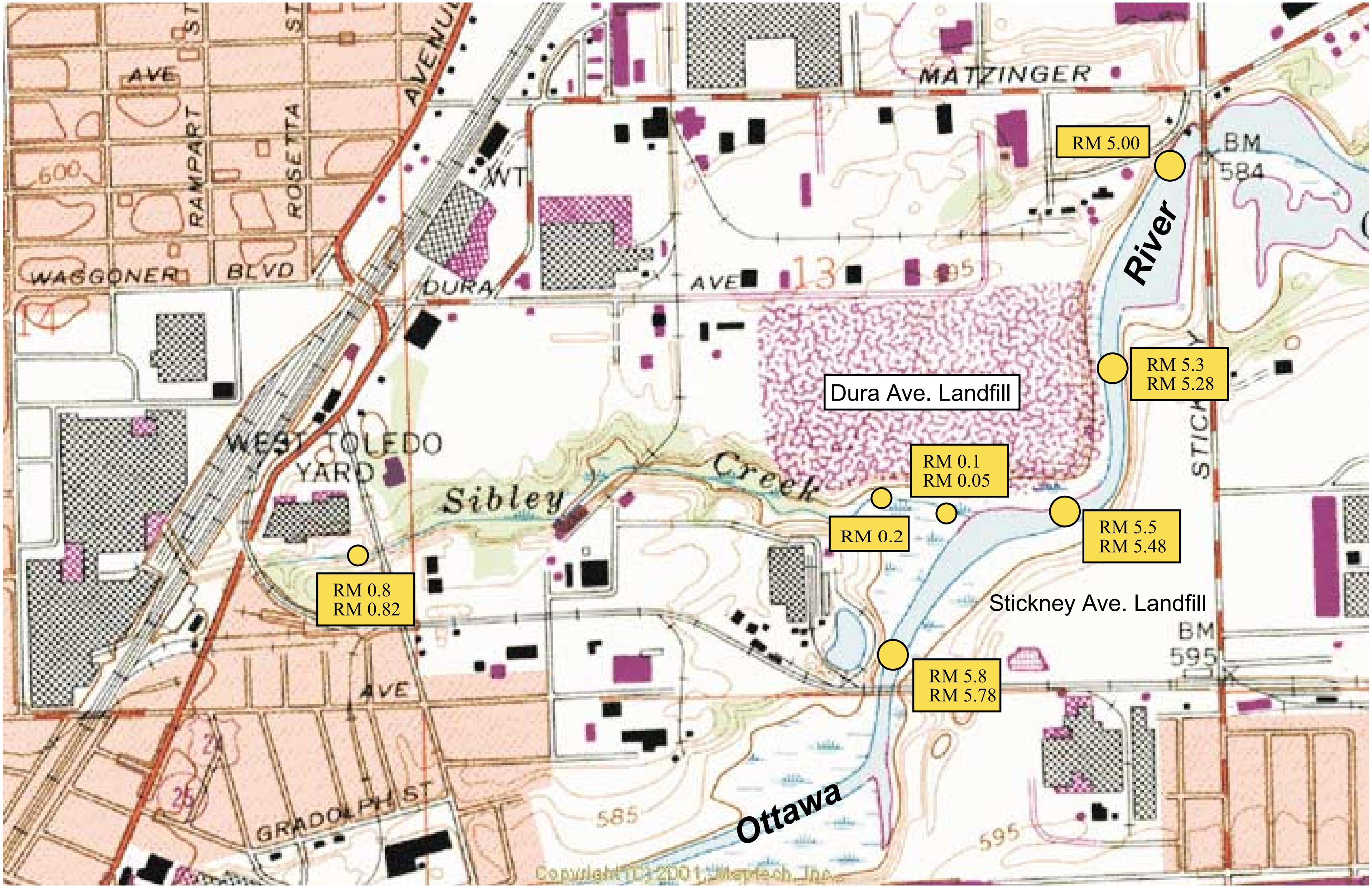

Figure 2. Map of the Ottawa River and Sibley Creek study area showing sampling locations, 2002.

METHODS

All chemical, physical, and biological field, laboratory, data processing, and data analysis methodologies and procedures follow those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 1989a) and Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a, 1987b, 1989b, 1989c), and The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989) for aquatic habitat assessment. Fish and macroinvertebrate communities were sampled during the summer of 2002 at four locations on the Ottawa River from river miles (RM) 5.8 to 5.0 and three locations on Sibley Creek at RMs 0.8, 0.2, and 0.1 (Table 1, Figure 1). Sediment samples were collected by Ohio EPA at four locations on the Ottawa River and two locations on Sibley Creek. Fish tissue samples were collected from the Ottawa River at the same locations as fish community results.

Determining Use Attainment Status

The attainment status of aquatic life uses (i.e., full, partial, and non) is decided by using the biological criteria codified in the Ohio Water Quality Standards (WQS; Ohio Administrative Code [OAC] 3745-1-07, Table 7-14). The biological community performance measures used include the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), based on fish community characteristics, and the Invertebrate Community Index (ICI) which is based on macroinvertebrate community characteristics. The IBI and ICI are multimetric indices patterned after an original IBI described by Karr (1981) and Fausch *et al*. (1984). The ICI was developed by Ohio EPA (1987b) and further described by DeShon (1995). The MIwb is a measure of fish community abundance and diversity using numbers and weight information and is a modification of the original Index of Well-Being originally applied to fish community information from the Wabash River (Gammon 1976; Gammon *et al*. 1981).

Performance expectations for the principal aquatic life uses in the Ohio WQS (Warmwater Habitat [WWH], Exceptional Warmwater Habitat [EWH], and Modified Warmwater Habitat [MWH]) were developed using the regional reference site approach (Hughes *et al*. 1986; Omernik 1987). This fits the practical definition of biological integrity as the biological performance of the natural habitats within a region (Karr and Dudley 1981). Attainment of the aquatic life use is full if all three indices (or those available) meet the applicable biocriteria, partial if at least one index does not attain and performance is at least fair, and nonattainment if all indices fail to attain or any index indicates poor or very poor performance. Partial and non-attainment indicate that the receiving water is impaired and does not meet the designated use criteria specified by the Ohio WQS.

Habitat Assessment

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

Macroinvertebrate Community Assessment
Macroinvertebrates in the Ottawa River were sampled quantitatively for a six-week period from July 17, 2002 to August 28, 2002 using multiple-plate, artificial substrate samplers (modified Hester/Dendy) with a qualitative assessment of the available natural substrates collected at the time of artificial substrate retrieval. A qualitative assessment of the macroinvertebrate communities of Sibley Creek was conducted on August 27 and 28, 2002.

Fish Community Assessment
Fish were sampled in the Ottawa River using the boat method pulsed DC electrofishing gear, used at a frequency of two samples at each site. Fish were sampled in Sibley Creek at three locations using the wading method with a gasoline powered electrofishing unit (pulsed DC). Fish collections were made at each site from July to August, with sampling distances varying between 400 and 500 meters per location in the Ottawa River, and 100 meters per site in Sibley Creek.

Sediment Assessment
Fine grained sediment samples were collected in the upper four inches of bottom material at each location using either decontaminated stainless steel scoops or stainless steel Ekman dredge samplers. Collected sediment was placed into decontaminated clear glass jars with Teflon lined lids, placed on ice (to maintain 4°C) and delivered to a contract lab for the City of Toledo. Sample collection and decontamination procedures follow guidance provided in the Ohio EPA Sediment Sampling Guide and Methodologies, 2nd Edition (2001).

Fish Tissue
Fish tissue samples were collected from each of the four biological sampling locations on the Ottawa River. Both whole body and fillet samples were processed at each. Fish samples used for fillet analysis were filleted in the field using decontaminated stainless steel fillet knives. Filleted samples were wrapped in aluminum foil, placed in a sealed plastic bag, and placed on wet ice. Whole body fish samples were wrapped in aluminum foil, placed in a sealed plastic bag, and placed on wet ice. Sampling and decontamination protocols followed those listed in the Ohio EPA Fish Tissue Guidance Manual (1994); however, it is not necessary to clean aluminum foil which is used directly from the roll. All fish tissue samples were collected on August 28, 2002 and delivered on the same day to a contract lab in Toledo, Ohio.

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 arbiters of aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria in the role of principal arbiters within a weight-of-evidence framework has been extensively discussed else where (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed impairments relies on an interpretation of multiple lines-of-evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and the biological response signatures (Yoder and Rankin 1995) within the biological data itself. Thus the assignment of principal causes and sources of impairment in this report does not represent a true "cause and effect" analysis, but rather represents the association of impairments (based on response indicators) with stressor and exposure indicators whose links with the biosurvey data are based on previous research or experience with analogous situations and impacts. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified. The process is similar to making a medical diagnosis in which a doctor relies on multiple lines of evidence concerning patient health. Such diagnoses are based on previous research that experimentally or statistically linked symptoms and test results to specific diseases or pathologies. Thus a doctor relies on previous experience in interpreting symptoms (*i.e.*, multiple lines from test results) to establish a diagnosis, potential causes and/or sources of the malady, a prognosis, and a strategy for alleviating the symptoms of the disease or condition.

As in medical science, where the ultimate arbiter of success is the eventual recovery and the well-being of the patient, the ultimate measure of success in water resource management is restoration of lost or damaged ecosystem attributes including aquatic community structure and function. While there have been criticisms of misapplying the metaphor of ecosystem "health" compared to human patient "health" (Suter 1993) here we are referring to the process for identifying biological integrity and causes/sources associated with observed impairment, not whether human health and ecosystem health are analogous concepts.

RESULTS AND DISCUSSION

Sediment Chemistry

Surficial sediment samples were collected from four locations on the Ottawa River and two on Sibley Creek in August, 2002. Sediment data were evaluated using guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et.al*. 2000), and USEPA Region 5, RCRA Appendix IX compounds - Ecological Data Quality Levels (EDQLs) (USEPA 1998). The consensus-based sediment guidelines define two levels of ecotoxic effects. A *Threshold Effect Concentration* (TEC) is a level of sediment chemical quality below which harmful effects are unlikely to be observed. A *Probable Effect Concentration* (PEC) indicates a level above which harmful effects are likely to be observed. Ecological data quality levels (EDQLs) are initial screening levels used by USEPA to evaluate RCRA site constituents. This tiered approach to evaluating sediment is consistent with OAC 3745-300-09.

Lead levels in sediment from Sibley Creek exceeded the *Probable Effect Concentration* at both sampling locations (Table 3). The highest concentration (650 mg/kg) occurred upstream from Dura landfill at Lagrange Road.

All sediment samples collected from the Ottawa River and Sibley Creek exceeded the PEC for total PCBs. Two PCB aroclors (1242 and 1260) were detected in the sediment samples, with PCB-1242 measured in the highest concentrations.

Semivolatile organic compounds were tested in sediment collected from all Ottawa River and Sibley Creek stations. However, due to matrix interference associated with sample contamination, high detection limits were reported. Of the semivolatile chemicals tested, only bis(2-ethylhexyl)phthalate was reported above a detectable level, and this was only for one sample. A precise evaluation of this group of chemical compounds was not possible, due to the high detection limits reported.

Over the last ten years, sediments were sampled in the Ottawa River in 1996 (Ohio EPA 1998), 1998, 1999, 2000, and 2002 . During this time period, PCB-1242 values ranged between 0.057 mg/kg and 8.4 mg/kg, with the highest concentrations occurring between RMs 5.0 and 6.0. An evaluation of PCB-1242 trends over the last ten years did not reveal significant declines in concentration in the river between RMs 5.0 and 6.0 (Figure 3). Extremely elevated levels of PCB-1242 (56, 66, and 1,200 mg/kg) were recorded in a drainage ditch that was a tributary to the Ottawa River at RM 5.97 and in the Ottawa River at RM 5.97 (Ohio EPA 1991). The drainage ditch received storm water runoff and discharges of industrial wastewater. Remedial measures have been taken in the tributary and in the Ottawa River at the tributary confluence.

Table 3. Chemical compounds detected in sediment samples collected from the Ottawa River and Sibley Creek, 2002. A complete list of chemicals measured with results is listed in Appendix Table 1.

	Sediment Sampling Locations (By River Mile)						
	Ottawa River					**Sibley Creek**	
Parameter	**5.78**	**5.48**	**5.48**	**5.28**	**5.00**	**0.82**	**0.05**
Metals (mg/kg)							
Arsenic	5.2	5.1	6	5.1	4.5	21^{TEC}	10^{TEC}
Lead	110^{TEC}	97^{TEC}	95^{TEC}	110^{TEC}	62^{TEC}	650^{PEC}	220^{PEC}
Semivolatile Organic Compounds (mg/kg)							
bis(2-ethylhexyl)phthalate	<16.5	<16.5	<16.5	<16.5	<16.5	<66	44.2^{EDQL}
PCBs (mg/kg)							
PCB-1242	0.82	8.7	8.1	1.3	3.1	0.69	33
PCB-1260	0.1	0.14	0.14	0.13	0.24	2.8	1.6
Total PCBs (calculated)	0.92^{PEC}	8.84^{PEC}	8.24^{PEC}	1.43^{PEC}	3.34^{PEC}	3.49^{PEC}	34.6^{PEC}
Pesticides (mg/kg)							
4,4'-DDE	0.03^{TEC}	0.04^{PEC}	0.04^{PEC}	0.03^{TEC}	0.02^{TEC}	<0.1	0.23^{PEC}
4,4'-DDD	0.02^{TEC}	0.02^{TEC}	0.02^{TEC}	0.02^{TEC}	0.01^{TEC}	<0.1	0.14^{PEC}
4,4'-DDT	0.01^{TEC}	0.02^{TEC}	0.02^{TEC}	0.02^{TEC}	0.02^{TEC}	<0.1	0.18^{PEC}

^{TEC} Value at or above the threshold effect concentration (MacDonald *et al.* 2000).
^{PEC} Value at or above the probable effect concentration (MacDonald *et al.* 2000).
^{EDQL} Value at or above the ecological data quality level (USEPA Region 5 1998).

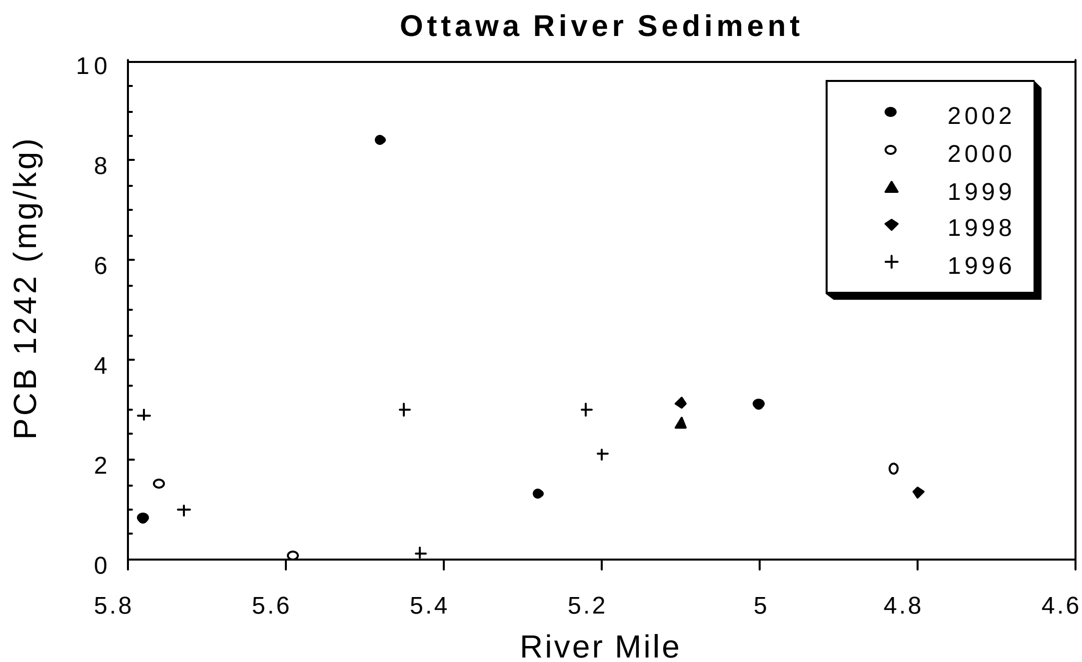

Figure 3. Scatter plot of PCB 1242 sediment levels from results reported for 1996, 1998, 1999, 2000, and 2002 for the Ottawa River in the vicinity of Dura Ave. Landfill.

Physical Habitat for Aquatic Life

Physical habitat was evaluated in the Ottawa River and Sibley Creek at each biological sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 4.

Stream morphology in the Ottawa River within the study area consists of lacustuary flow conditions influenced by Maumee Bay. Bottom substrates are predominated by muck and silt, with lesser amounts of sand, boulders, detritus, and artificial riprap. No riffles or runs occur within the Ottawa River study area. Qualitative Habitat Evaluation Index (QHEI) scores for the Ottawa River within the study area range between 34.0 and 41.5. These scores were indicative of poor stream and riparian habitat. Habitat scores were comparable between sites sampled in 1996 and 2002, except for RM 5.5. A decline in the QHEI score from 41 in 1996 to 34 in 2002 was largely related to reduced cover types and amount caused by the remedial work completed at the Stickney Ave. Landfill.

Sibley Creek was evaluated near the mouth (RM 0.1), adjacent to the Dura Ave. Landfill further upstream at RM 0.2, and at RM 0.8. Sibley Creek is a small stream, with shallow pools and very shallow riffles (less than 5 cm in depth). Bottom substrates are predominated by muck, silt, and sand, with smaller amounts of gravel and artificial riprap. The stream bottom is extensively embedded with fine-grained material, resulting in reduced cover for aquatic organisms. The stream channel is recovering from past modifications at all three locations. The QHEI scores were 25.5, 26.0, and 36.5, with modified warmwater habitat stream attributes predominating. Stream habitat quality was considered poor at the upstream site (QHEI = 36.5) and very poor adjacent to the landfill. The low scores adjacent to the landfill were associated with very shallow water depths, in both pool and riffle areas, and poor quality substrates.

Below the surface layer of silt and muck, the bottom sediments of Sibley Creek at RM 0.8 are heavily saturated with a black material with a creosote odor. Disturbance of the bottom sediments released an oily substance that created an extensive oil sheen on the surface of the water. These conditions were observed further downstream at RMs 0.2 and 0.1, although to a lesser extent.

Table 4. Qualitative Habitat Evaluation Index (QHEI) scores in the Ottawa River and Sibley Creek, 2002.

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 Overall Embeddedness	Max Depth > 40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	MWH Attributes, High Influence: Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max Depth < 40 cm (WD, HW)	**Total H.I. MWH Attributes**	MWH Attributes, Moderate Influence: Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent and Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.I. MWH Attributes**	**(MWH H.I.+1)/(WWH+1) Ratio**	**(MWH M.I.+1)/(WWH+1) Ratio**
(04-300) Ottawa River																																		
Year: 2002																																		
5.8	**41.5**	0.10	■					■			■		3		◆				1		■			■	■			■	■		■	6	0.50	2.00
5.5	**34.0**	0.10	■								■		2		◆		◆		2		■			■	■	■		■	■		■	7	1.00	3.33
5.3	**41.0**	0.10	■					■			■		3		◆				1		■			■	■			■	■		■	6	0.50	2.00
5.0	**40.0**	0.10	■					■			■		3		◆		◆		2		■			■	■			■	■		■	6	0.75	2.25
(04-310) Sibley Creek																																		
Year: 2002																																		
0.8	**36.5**	16.67									■		1	◆	◆	◆	◆		4	■	■			■	■	■		■	■		■	8	2.50	6.50
0.2	**25.5**	5.36											0	◆	◆	◆	◆	◆	5	■	■			■	■			■	■		■	7	6.00	*.**
0.1	**26.0**	5.36											0	◆	◆	◆	◆	◆	5	■	■			■	■			■	■		■	7	6.00	*.**

Macroinvertebrate Community

In 2002, macroinvertebrate communities were sampled in the Ottawa River at four locations and Sibley Creek at three locations. The sampling locations are summarized in Table 1. The Ottawa River data were analyzed using the Lacustuary Invertebrate Community Index (LICI) being developed at the Ohio EPA. Summarized results of the macroinvertebrate data are compiled in Tables 5 and 6. LICI metrics and scores and raw data tables by river mile are attached as Appendix Tables 2 and 3. Included in Table 5 are historical Ohio EPA macroinvertebrate data collected in 2001, 2000, 1999,1996, 1993 and 1986.

Ottawa River
The condition of the macroinvertebrate communities upstream (RM 5.8), adjacent (RMs 5.5 and 5.3), and downstream (RM 5.0) from the Dura Avenue Landfill were assessed based on results from artificial substrate samplers. All four sites indicated communities in the very poor to poor range (LICI scores 6, 8, 6, and 12 respectively), with none reflecting attainment of the WWH use designation. Community performance expectations were influenced by lacustuary conditions of reduced or absent current and homogeneous substrate. The samples were predominated by the midge genus *Glyptotendipes* followed by aquatic worms with high organism densities. This differs from past results (1992, 1986) when aquatic worms predominated the samples and pollution tolerant midges although present were not the predominant organism. Although community performances remain poor and very poor, changes in the makeup of the communities, relative to past results, indicated a lessening of toxic impacts and an overriding impairment from nutrient enrichment. Additional stressors on the communities included the effects of contaminated sediment and combined sewer overflow discharges.

Sibley Creek
Qualitative samples were collected from Sibley Creek adjacent to the Dura Avenue Landfill (RMs 0.1 and 0.2) and upstream from Lagrange Street (RM 0.8). The macroinvertebrate community at RMs 0.1 and 0.2 indicated poor conditions with 19 and 18 taxa respectively collected; communities were predominated by pollution tolerant midges. All taxa from these sites were pollution tolerant. The site at RM 0.8 indicated very poor conditions with only four taxa collected. The predominant organism was the pollution tolerant midge Polypedilum illinoense. The contaminated sediments observed during sampling of the RM 0.8 site is the likely cause of the severe impairment of the macroinvertebrate community.

Table 5. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Ottawa River during 2002, 2001, 1999, 1996, 1992, and 1986.

Stream/ River Mile	Relative Density	Total Taxa	Quantitative Taxa	Qualitative Taxa	Qualitative EPT[a]	LICI	Evaluation[b]
Ottawa River (2002)							
5.8	2495	15	9	8	0	6*	Very Poor
5.5	2563	13	12	5	0	8*	Very Poor
5.3	3070	7	7	3	0	6*	Very Poor
5.0	1698	24	17	11	0	12*	Poor
Ottawa River (2001)							
6.1	1183	33	22	23	0	10*	Very Poor
6.0	451	29	23	10	0	14*	Poor
5.8	387	23	15	9	0	10*	Very Poor
Ottawa River (2000)							
6.1	593	21	18	9	0	14*	Poor
5.2	640	29	18	20	0	16*	Poor
Ottawa River (1999)							
6.1	1527	23	14	16	0	10*	Very Poor
6.0	1265	23	15	15	0	12*	Poor
5.9	1518	17	14	11	0	10*	Very Poor
5.8	1101	21	12	14	0	10*	Very Poor
Ottawa River (1996)							
5.7	1730	23	11	15	0	6*	Very Poor
5.5	2275	21	12	14	0	8*	Very Poor
5.3	5910	21	14	14	0	6*	Very Poor
Ottawa River (1992)							
6.4	472	25	19	9	0	12*	Poor
4.9	391	17	14	5	0	10*	Very Poor
Ottawa River (1986)							
6.9	551	29	21	16	0	12*	Poor
4.9	388	20	16	10	0	16*	Poor

Ecoregion Biocriteria: Huron-Erie Lake Plain (HELP)
(from OAC 3745-1-07, Table 7-16)

INDEX	WWH	EWH	MWH[c]	LRW[d]	WWH Lacustuary
ICI	36	46	22	8	-
LICI (interim final)					42
LICI (interim intermediate)					34

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

[b] The qualitative narrative evaluation is based on best professional judgement utilizing sample attributes such as taxa richness, EPT richness, and predominant organisms and is used when quantitative data is not available to calculate the Invertebrate Community Index (ICI) scores.

[c] Modified Warmwater Habitat for channel modified areas.

[d] Limited Resource Water.

* Significant departure from interim lacustuary biocriterion; poor and very poor results are underlined.

Table 6. Summary of qualitative macroinvertebrate data collected from natural substrates in Sibley Creek, 2002, 1996, and 1993.

Stream/ River Mile	No. Qualitative Taxa	Qualitative EPT[a]	Relative Density[b]	Predominant Organisms	Narrative Evaluation[c]
Sibley Creek (2002)					
0.8	4	0	Moderate	Midges	Very Poor
0.2	18	0	Moderate	Snails	Poor
0.1	19	0	Moderate	Snails	Poor
Sibley Creek (1996)					
0.8	3	0	Very Low	Dragonflies	Very Poor
0.1	18	0	Low	Midges	Poor
Sibley Creek (1993)					
0.8	4	0	Very Low	Dragonflies	Very Poor

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

[b] Based on field observations.

[c] The qualitative narrative evaluation is based on best professional judgment utilizing sample attributes such as taxa richness, EPT richness, and predominant organisms and is used when quantitative data is not available to calculate the Invertebrate Community Index (ICI) scores.

Fish Community

A total of 1,582 fish representing 27 species and three hybrids were collected from the Ottawa River within the study area between July and August 2002. The sampling effort included a cumulative distance electrofished of 2.95 km at three locations (Table 7). Relative numbers and species collected per location are presented in Appendix Table 4, and LIBI/IBI metric results are presented in Appendix Table 5. Ottawa River sampling locations were evaluated using interim lacustuary biocriteria and Sibley Creek was evaluated using LRW benchmarks.

Ottawa River
Fish communities were sampled in the Ottawa River at four locations; one upstream from the Dura Ave. Landfill, one adjacent to the remedial barrier wall, one adjacent to the Dura Ave. Landfill downstream from the remedial barrier wall, and one downstream from the Dura Ave. Landfill. The fish communities from all four sampling locations exhibited biological degradation. The lacustuary IBI (LIBI: 21-24.5) and MIwb (6.1-6.7) scores were in the poor to fair range and all four sites were not achieving the applicable biocriteria. Collectively, fish communities within the Ottawa River study area showed an improvement between 1996 and 2002. Improvement in the MIwb and IBI scores at RM 5.3 was particularly evident. Three sucker species considered moderately tolerant of pollution were collected in low numbers during 2002. These species were not collected in the Ottawa River during 1996.

The physical condition of fish was monitored at each sampling site by recording the incidence of DELT (deformities, fin erosions, lesions/ulcers, and tumors) external anomalies. Biosurvey results collected by Ohio EPA from throughout the state show a high frequency of DELT anomalies to be an accurate indication of pollution stress usually caused by multiple sublethal stresses as the result of degraded water quality (*i.e*. often a combination of toxic impacts combined with marginal D.O. concentrations). Within Ohio, there are ample correlations between sites with chemically contaminated sediments (*e.g.* metals, PAHs), very high percent occurrence of DELT anomalies (>10-20%), and very low Index of Biotic Integrity and Modified Index of Well-Being scores (Yoder 1991). Elevated levels of DELT anomalies were recorded during 2002, with results ranging between 5.3% and 7.5%. These levels were substantially lower than results reported during 1996 (5.1% to 35.9%).

Sibley Creek
Fish communities were sampled at three locations in Sibley Creek, two adjacent to the Dura Ave. Landfill at RMs 0.1 and 0.2, and one upstream at Lagrange Street (RM 0.8). Acutely toxic conditions existed in Sibley Creek at RM 0.8, where fish were nearly absent during both sampling passes. Fish were absent from the Lagrange Street site during sampling conducted in 1993 and 1996 (Ohio EPA 1998). Improvement in the fish community occurred at RM 0.2, where a total of 12 species were collected. The IBI score at RM 0.2 (24) indicated a poor quality community, with pollution tolerant species predominating. Sibley Creek at RM 0.8 did not reach the benchmark for Limited Resource Water but with the improved performance at RM 0.2, it did achieve the LRW benchmark of 18. Sampling the fish community at RM 0.1 revealed a decline in biological performance, with an IBI score of 12. This decline appeared largely associated with poor quality stream habitat. The site at RM 0.1 lacked water depth sufficient to maintain an adequate fish population. Maximum pool depth was 15 cm (majority of pool depths were less than 5 cm) and riffle areas were less than 2 cm. At RM 0.2, one pool area with a maximum depth of 30 cm supported most of the fish collected.

Table 7. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in the Ottawa River study area from July - August, 2002. The number of samples collected at each location is listed with the sampling method. Relative number and weight are per 0.3 km for wading sites and per 1.0 km for boat sampling sites. Ohio EPA data results from 1996 are included in the table.

Stream RM	Sampling Method[a]	Mean # Species	Total # Species	Mean Relative Number	Mean Relative Weight(kg)	QHEI	Mean MIwb	Mean IBI/(LIBI)	Narrative Evaluation[b]
Ottawa River (2002)									
5.8	Boat-2	14.5	18	437	38.63	41.5	6.1*	24.5*	Poor
5.5	Boat-2	15.0	18	380	36.94	34.0	6.7*	21*	Fair/Poor
5.3	Boat-2	15.5	18	499	75.52	41.0	6.7*	21.5*	Fair/Poor
5.0	Boat-2	14.0	17	342	84.90	40.0	6.1*	21*	Poor
Ottawa River (1996)									
5.7	Boat-2	14.0	16	195	18.37	44.5	6.3*	21.5*	Poor
5.5	Boat-2	15.0	18	343	39.60	41.0	6.4*	21.5*	Poor
5.3	Boat-2	13.0	18	200	49.98	41.5	5.0*	17.5*	Very Poor/Poor
Sibley Creek (2002)									
0.8	Wading-2	1.0	2	6	NA	36.5	NA	12*	Very Poor
0.2	Wading-2	8.0	12	408	NA	25.5	NA	24	Poor
0.1	Wading-2	1.5	2	7.5	NA	26.0	NA	12*	Very Poor
Sibley Creek (1996)									
0.8	Wading-1	-	0	0	NA	40.0	NA	12*	Very Poor
0.1	Wading-2	8.5	10	428	NA	36.5	NA	19	Poor

Ecoregion Biocriteria: Huron-Erie Lake Plain (HELP)
(where applicable from OAC 3745-1-07, Table 7-16)

INDEX	WWH	EWH	MWH[c]	LRW[d]	WWH-Lacustuary
IBI - Headwater	28	50	20	18	
LIBI (interim)					42

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
NA Not applicable.
a Sampling method is followed by the number of sampling passes per site.
b Narrative evaluation is based on MIwb and IBI/LIBI scores.
c Modified Warmwater Habitat for channel modified areas.
d Limited Resource Water benchmarks based on best professional judgment driven by the need to protect against acutely toxic (very poor) stream conditions.

Fish Tissue

Fish tissue samples were collected from four locations on the Ottawa River during August, 2002 Twelve samples were analyzed for PCBs, organochlorinated pesticides, and percent lipids. The results are presented in Table 8.

The concentration of total PCB aroclors in fish fillet samples from the Ottawa River ranged between 0.17 mg/kg and 1.06 mg/kg. Any fish fillet sample exceeding 1.9 mg/kg PCBs is considered extremely elevated (Ohio EPA 1997). The concentration of total PCBs in samples from the Ottawa River were indicative of slightly elevated to highly elevated levels (Ohio EPA 1997). No obvious longitudinal trends were noted in PCB levels of fillet samples.

Whole body PCB concentrations were measured in pumpkinseed sunfish (composite samples) from all four Ottawa River biological monitoring stations. Total PCBs ranged between 1.20 and 5.20 mg/kg at the four locations, with the lowest values occurring adjacent to the Dura Ave. Landfill.

The ability of an organism to bioaccumulate lipophilic organic chemicals is assumed to be proportional to its lipid content (Ohio EPA 1994b). Since PCBs are lipophilic and lipid content varies between fish species and between individuals, lipid normalization is necessary to characterize relative site contamination by PCBs. Historical data of PCB 1242 in fish fillet and whole body samples from the Ottawa River in the vicinity of Dura landfill is presented in Table 9. The data is normalized to 1% lipid content. An evaluation of results between 1996 and 2002 indicates a decline in PCB 1242 levels in common carp fillet samples.

Table 8. PCB, pesticide, and lipid analyses of fish tissue collected from the Ottawa River on August 28, 2002. Evaluation of tissue levels from non elevated to extremely elevated is based on review guidelines provided by the Ohio Department of Health (1997).

	Sampling Location and Species - by River Mile					
	Pumpkinseed Sunfish WBC	Largemouth Bass SOF	Common Carp SFFC	Pumpkinseed Sunfish WBC	Largemouth Bass SOF	Common Carp SFFC
Parameter	**5.8**	**5.8**	**5.8**	**5.5**	**5.5**	**5.5**
PCBs (mg/kg)						
PCB-1016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1221	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1232	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1242	2.6	0.34	0.22	1.2	0.17	0.64
PCB-1248	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1254	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1260	0.17	<0.1	<0.1	0.14	<0.1	<0.1
Total PCBs (Calculated)	2.77	0.34[me]	0.22[se]	1.34	0.17[se]	0.64[me]
Pesticides (mg/kg)						
alpha-BHC	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
gamma-BHC (Lindane)	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
beta-BHC	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
delta-BHC	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Aldrin	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Heptachlor epoxide	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
alpha Endosulfan	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDE	0.07J	0.02J	<0.05	0.06	<0.05	0.02J
Dieldrin	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Endrin	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
4,4'-DDD	0.05J	<0.05	<0.05	0.04J	<0.05	0.01J
beta Endosulfan	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
4,4-DDT	0.05J	0.01J	<0.05	0.02J	<0.05	0.01J
Endrin aldehyde	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Endosulfan sulfate	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Methoxychlor	<0.1	<0.05	<0.05	<0.05	<0.05	<0.05
Toxaphene	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
Chlordane	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5
Percent Lipid	2.69	0.18	0.12	3.25	0.06	0.49

Table 8. Continued.

	Sampling Location and Species - by River Mile					
	Pumpkinseed Sunfish WBC	Largemouth Bass SOF	Common Carp SFFC	Pumpkinseed Sunfish WBC	Freshwater Drum SOF	Common Carp SFFC
Parameter	**5.3**	**5.3**	**5.3**	**5.0**	**5.0**	**5.0**
PCBs (mg/kg)						
PCB-1016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1221	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1232	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1242	1.2	0.39	0.64	4.9	0.87	0.82
PCB-1248	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1254	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
PCB-1260	<0.1	<0.1	0.21	0.30	0.16	0.24
Total PCBs (Calculated)	1.2	0.39[me]	0.85[me]	5.20	1.03[he]	1.06[he]
Pesticides (mg/kg)						
alpha-BHC	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
gamma-BHC (Lindane)	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
beta-BHC	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
Heptachlor	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
delta-BHC	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
Aldrin	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
Heptachlor epoxide	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
alpha Endosulfan	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
4,4'-DDE	0.02J	0.01J	0.03J	0.08J	0.04J	0.07
Dieldrin	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
Endrin	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
4,4'-DDD	0.01J	<0.05	0.01J	0.06J	0.02J	0.03J
beta Endosulfan	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
4,4-DDT	0.01J	<0.05	0.02J	0.05J	0.02J	0.03J
Endrin aldehyde	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
Endosulfan sulfate	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
Methoxychlor	<0.05	<0.05	<0.05	<0.10	<0.05	<0.05
Toxaphene	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Chlordane	<0.5	<0.5	<0.5	<1.0	<0.5	<0.5
Percent Lipid	0.74	0.14	1.10	2.08	1.32	2.76

1 WBC whole body composite sample.
2 SFFC skin off fillet composite sample.
3 SOF skin on fillet sample of a single fish.
J Estimated value. The analyte was detectable but below the limit of quantification.
se Slightly elevated.
me Moderately elevated.
he Highly elevated.

Table 9. Trends in PCB 1242 from fish tissue fillet and whole body samples collected in the Ottawa River, 1990 - 2002. Values are normalized to 1% lipid content and reported in mg/kg wet weight.

	Sampling Location by River Mile						
Year/Fish	RM 5.9	RM 5.8	RM 5.7	RM 5.5	RM 5.3	RM 5.2	RM 5.0
FILLET							
2002							
Common carp		1.83		1.31	0.58		0.30
Largemouth bass		1.89		2.83	2.78		
Freshwater drum							0.66
1999							
Common carp	3.02[a]				1.51		
Largemouth bass	0.90[a]				1.05[a]		
White crappie	0.82[a]				1.05		
Yellow perch	1.21						
Goldfish	0.75				1.16		
Yellow bullhead	1.42				0.71		
Bluegill					0.19		
Green sunfish x Pumpkinseed	0.76						
1996							
Common carp			88.7	9.13	2.71		
Smallmouth bass				0.58			
Freshwater drum					0.06		
1990							
Common carp						6.34	
Channel catfish						1.50	
WHOLE BODY							
2002							
Pumpkinseed sunfish		0.97		0.37	1.62		2.35
2000							
Pumpkinseed sunfish	0.88				1.00		
Green sunfish	0.52				0.97		
Golden shiner	0.52						
1996							
Pumpkinseed sunfish			1.17	0.93			
Common carp			22.64	5.21	2.75		
Yellow perch					3.28		
1990							
Common carp						7.97	

[a] Mean value of two or more test results for the same species at the same location.

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Appendix Table 1. Results of Ohio EPA sediment sampling conducted in the Ottawa River and Sibley Creek, August 27 and 28, 2002.

Stream	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Sibley Creek**	**Sibley Creek**
River Mile	**5.78**	**5.48**	**5.48**	**5.28**	**5.00**	**0.82**	**0.05**
Date Sampled	08/28/02	08/28/02	08/28/02	08/28/02	08/28/02	08/27/02	08/27/02
Time Sampled	07:30 AM	07:45 AM	07:45 AM	08:00 AM	08:10 AM	03:30 PM	01:10 PM
Metals (mg/kg)			Duplicate				
Arsenic	5.2	5.1	6	5.1	4.5	21	10
Lead	110	97	95	110	62	650	220
Semi-volatile Organic Analytes (mg/kg)							
Acenaphthene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Acenaphthylene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Aniline	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Anthracene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Benzidine	<82.5	<82.0	<82.5	<82.5	<82.5	<330	<82.5
Benzo(a)anthracene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Benzo(a)pyrene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Benzo(b)fluoranthene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Benzo(k)fluoranthene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Benzo(g,h,i)perylene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
bis(2-Chloroethoxy)methane	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
bis-(2-Chloroethyl) ether	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
bis(2-chloromethyl)ether	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
bis(2-Chloroisopropyl) ether	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
bis(2-Ethylhexyl) phthalate	<16.5	<16.5	<16.5	<16.5	<16.5	<66	44.2
4-Bromophenyl-phenylether	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Butylbenzylphthalate	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Carbazole	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
4-Chloroaniline	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2-Chloronaphthalene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
4-Chlorophenyl-phenyl ether	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Chrysene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Cyclohexanone	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Dibenzo(a,h)anthracene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Dibenzofuran	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
1,2-Dichlorobenzene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
1,3-Dichlorobenzene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
1,4-Dichlorobenzene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
3,3'-Dichlorobenzidine	<33.0	<33.0	<33.0	<33.0	<33.0	<132	<33.0
Diethylphthalate	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Dimethylphthalate	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
7,12-Dimethylbenz(a)anthracene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Di-n-butylphthalate	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Di-n-octylphthalate	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
1,2-Diphenylhydrazine	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2,4-Dinitrotoluene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2,6-Dinitrotoluene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Diphenyl amine	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Fluoranthene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Fluorene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Hexachlorobenzene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Hexachlorobutadiene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5

Appendix Table 1. Continued.

Stream	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Sibley Creek**	**Sibley Creek**
River Mile	**5.78**	**5.48**	**5.48**	**5.28**	**5.00**	**0.82**	**0.05**
Date Sampled	08/28/02	08/28/02	08/28/02	08/28/02	08/28/02	08/27/02	08/27/02
Time Sampled	07:30 AM	07:45 AM	07:45 AM	08:00 AM	08:10 AM	03:30 PM	01:10 PM
Semi-volatile Organic Analytes (mg/kg)			Duplicate				
Hexachlorocyclopentadiene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Hexachloroethane	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Indene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Indeno(1,2,3-cd)pyrene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Isophorone	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
1-Methylnaphthalene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2-Methylnaphthalene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Naphthalene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2-Nitroaniline	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
3-Nitroaniline	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
4-Nitroaniline	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2-Nitropropane	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Nitrobenzene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
N-Nitroso-di-n-propylamine	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
N-Nitrosodimethylamine	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
N-Nitrosodiphenylamine	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Phenanthrene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Pyrene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Pyridine	<33.0	<33.0	<33.0	<33.0	<33.0	<132	<33.0
Quinoline	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
1,2,4-Trichlorobenzene	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Benzoic acid	<33.0	<33.0	<33.0	<33.0	<33.0	<132	<33.0
Benzyl alcohol	<33.0	<33.0	<33.0	<33.0	<33.0	<132	<33.0
4-Chloro-3-methylphenol	<33.0	<33.0	<33.0	<33.0	<33.0	<132	<33.0
2-Chlorophenol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2,4-Dichlorophenol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2,4-Dimethylphenol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2,4-Dinitrophenol	<82.5	<82.5	<82.5	<82.5	<82.5	<330	<82.5
4,6-Dinitro-2-methylphenol	<82.5	<82.5	<82.5	<82.5	<82.5	<330	<82.5
2-Nitrophenol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
4-Nitrophenol	<82.5	<82.5	<82.5	<82.5	<82.5	<330	<82.5
o-Cresol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
m&p-Cresol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
Pentachlorophenol	<82.5	<82.5	<82.5	<82.5	<82.5	<330	<82.5
Phenol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2,4,5-Trichlorophenol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
2,4,6-Trichlorophenol	<16.5	<16.5	<16.5	<16.5	<16.5	<66	<16.5
PCBs (mg/kg)							
Aroclor 1016	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1221	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1232	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1242	0.82	8.7	8.1	1.3	3.1	0.69	33
Aroclor 1248	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1254	<0.1	<0.1	<0.1	<0.1	<0.1	<0.5	<0.1
Aroclor 1260	0.1	0.14	0.14	0.13	0.24	2.8	1.6

Appendix Table 1. Continued.

Stream	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Ottawa River**	**Sibley Creek**	**Sibley Creek**
River Mile	**5.78**	**5.48**	**5.48**	**5.28**	**5.00**	**0.82**	**0.05**
Date Sampled	08/28/02	08/28/02	08/28/02	08/28/02	08/28/02	08/27/02	08/27/02
Time Sampled	07:30 AM	07:45 AM	07:45 AM	08:00 AM	08:10 AM	03:30 PM	01:10 PM
			Duplicate				
Pesticides (mg/kg)							
alpha-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
gamma-BHC (Lindane)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
beta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Heptachlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
delta-BHC	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Aldrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Heptachlor epoxide	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
alpha Endosulfan	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
4,4'-DDE	0.03	0.04	0.04	0.03	0.02	<0.1	0.23
Dieldrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Endrin	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
4,4'-DDD	0.02	0.02	0.02	0.02	0.01	<0.1	0.14
beta Endosulfan	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
4,4'-DDT	0.01	0.02	0.02	0.02	0.02	<0.1	0.18
Endrin aldehyde	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Endosulfan sulfate	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Methoxychlor	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1
Toxaphene	<0.1	<0.1	<0.1	<0.1	<0.1	<1.0	<1.0
Chlordane	<0.1	<0.1	<0.1	<0.1	<0.1	<1.0	<1.0

Appendix Table 2. Raw macroinvertebrate data by river mile for the Ottawa River study area, 2002.

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/27/2002 River Code: 04-300 RM: 5.80 Site: Ottawa River

Taxa Code	Taxa	Quant/Qual	
01200	*Cordylophora lacustris*	1	
01801	*Turbellaria*	67	
03360	*Plumatella sp*		+
03600	*Oligochaeta*	4449	
05800	*Caecidotea sp*	1	
22001	*Coenagrionidae*	147	+
45300	*Sigara sp*		+
45400	*Trichocorixa sp*		+
83051	*Dicrotendipes simpsoni*	1165	
83300	*Glyptotendipes (G.) sp*	6451	+
84470	*Polypedilum (P.) illinoense*		+
84520	*Polypedilum (Tripodura) halterale group*		+
94400	*Fossaria sp*		+
95100	*Physella sp*	1	
96900	*Ferrissia sp*	194	

No. Quantitative Taxa:	9	Total Taxa:	15
No. Qualitative Taxa:	8	ICI:	**6**
Number of Organisms:	12476	Qual EPT:	0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/27/2002 River Code: 04-300 RM: 5.50 Site: Ottawa River

Taxa Code	Taxa	Quant/Qual	
01200	*Cordylophora lacustris*	1	
01801	*Turbellaria*	2	
03360	*Plumatella sp*	1	
03600	*Oligochaeta*	5985	
05800	*Caecidotea sp*	1	+
22001	*Coenagrionidae*	131	
78655	*Procladius (Holotanypus) sp*	193	
82890	*Demeijerea sp*		+
83051	*Dicrotendipes simpsoni*	1447	
83300	*Glyptotendipes (G.) sp*	4920	+
95100	*Physella sp*	67	+
96120	*Menetus (Micromenetus) dilatatus*	67	+
96900	*Ferrissia sp*	2	

No. Quantitative Taxa: 12 Total Taxa: 13

No. Qualitative Taxa: 5 ICI: **8**

Number of Organisms: 12817 Qual EPT: 0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/27/2002 River Code: 04-300 RM: 5.30 Site: Ottawa River

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	642
03600	*Oligochaeta*	6096 +
22001	*Coenagrionidae*	1
81240	*Nanocladius (N.) distinctus*	93
83051	*Dicrotendipes simpsoni*	1481 +
83300	*Glyptotendipes (G.) sp*	7034 +
95100	*Physella sp*	3

No. Quantitative Taxa: 7 Total Taxa: 7

No. Qualitative Taxa: 3 ICI: **6**

Number of Organisms: 15350 Qual EPT: 0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/27/2002 River Code: 04-300 RM: 5.00 Site: Ottawa River

Taxa Code	Taxa	Quant	Qual
01200	*Cordylophora lacustris*	1	
01801	*Turbellaria*	36	
03360	*Plumatella sp*	1	
03600	*Oligochaeta*	3681	
04901	*Erpobdellidae*	1	
05800	*Caecidotea sp*	3	
08250	*Orconectes (Procericambarus) rusticus*		+
17200	*Caenis sp*	1	
22001	*Coenagrionidae*	1	+
22300	*Argia sp*	5	
45400	*Trichocorixa sp*		+
60300	*Dineutus sp*	1	
60900	*Peltodytes sp*		+
69400	*Stenelmis sp*	1	
78655	*Procladius (Holotanypus) sp*		+
80510	*Cricotopus (Isocladius) sylvestris group*		+
81200	*Nanocladius sp*	110	
83051	*Dicrotendipes simpsoni*	1381	
83158	*Endochironomus nigricans*		+
83300	*Glyptotendipes (G.) sp*	3205	+
84000	*Parachironomus sp*	55	+
94400	*Fossaria sp*		+
95100	*Physella sp*	2	+
96900	*Ferrissia sp*	3	

No. Quantitative Taxa: 17 Total Taxa: 24

No. Qualitative Taxa: 11 ICI: **12**

Number of Organisms: 8488 Qual EPT: 0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/27/2002 River Code: 04-310 RM: 0.80 Site: Sibley Creek Lagrange St.

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+			
04814	*Haemopis marmorata*	+			
84470	*Polypedilum (P.) illinoense*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0 Total Taxa: 4

No. Qualitative Taxa: 4 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/27/2002 River Code: 04-310 RM: 0.20 Site: Sibley Creek near mouth

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
04962	*Mooreobdella fervida*	+
08250	*Orconectes (Procericambarus) rusticus*	+
22001	*Coenagrionidae*	+
23501	*Aeshnidae*	+
28955	*Libellula lydia*	+
45000	*Hesperocorixa sp*	+
45400	*Trichocorixa sp*	+
45900	*Notonecta sp*	+
60900	*Peltodytes sp*	+
63900	*Laccophilus sp*	+
67800	*Tropisternus sp*	+
72900	*Culex sp*	+
78702	*Psectrotanypus dyari*	+
80510	*Cricotopus (Isocladius) sylvestris group*	+
84470	*Polypedilum (P.) illinoense*	+
94800	*Stagnicola sp*	+
95100	*Physella sp*	+

No. Quantitative Taxa: 0 Total Taxa: 18

No. Qualitative Taxa: 18 ICI:

Number of Organisms: 0 Qual EPT: 0

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/27/2002 River Code: 04-310 RM: 0.10 Site: Sibley Creek at mouth

Taxa Code	Taxa	Quant/Qual
03600	*Oligochaeta*	+
04664	*Helobdella stagnalis*	+
04687	*Placobdella parasitica*	+
04814	*Haemopis marmorata*	+
04935	*Erpobdella punctata punctata*	+
22001	*Coenagrionidae*	+
28955	*Libellula lydia*	+
45900	*Notonecta sp*	+
60900	*Peltodytes sp*	+
63900	*Laccophilus sp*	+
67700	*Paracymus sp*	+
67800	*Tropisternus sp*	+
72900	*Culex sp*	+
78655	*Procladius (Holotanypus) sp*	+
78702	*Psectrotanypus dyari*	+
84470	*Polypedilum (P.) illinoense*	+
94603	*Pseudosuccinea columella*	+
94800	*Stagnicola sp*	+
95100	*Physella sp*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 0 Total Taxa: 19

No. Qualitative Taxa: 19 ICI:

Number of Organisms: 0 Qual EPT: 0

Appendix Table 3. Lacustuary Invertebrate Community Index (ICI) scores in the Ottawa River, 2002.

River Mile	Percent Lacus-tuary	Number of: Total Taxa	Sensitive Taxa	Dipteran Taxa	Percent: Mayflies & Caddisflies	Gath-erers[a]	Sensitive Organisms	Other Diptera[b]	Predom Taxon	Diptera/ ft^2	Qual. EPT	Eco-region	LICI
Ottawa River (04-300)													
Year: 2002													
5.80	64.4	9(0)	0(0)	2(0)	0.0(0)	97.2(0)	0.0(0)	98.8(0)	51.7(4)	1523(2)	0(0)	1	6
5.50	60.0	12(2)	0(0)	3(0)	0.0(0)	96.4(0)	0.0(0)	99.0(0)	46.7(4)	1312(2)	0(0)	1	8
5.30	57.8	7(0)	0(0)	3(0)	0.0(0)	100(0)	0.0(0)	100(0)	45.8(4)	1722(2)	0(0)	1	6
5.00	55.6	17(2)	3(0)	4(0)	0.0(2)	99.8(0)	0.0(2)	99.9(0)	43.4(4)	950(2)	0(0)	1	12

[a] Percent of total gatherers as individuals excluding zebra mussels *(Dreissena polymorpha).*
[b] Percent of dipterans as individuals excluding the midge tribe Tanytarsini.

Appendix 4. Fish Species List for the Ottawa River study area, 2002

River Code: **04-300**	Stream: **Ottawa River**	Sample Date: **2002**
River Mile: **5.80**	Location:	Date Range: 07/17/2002
Time Fished: 3176 sec	Drainage: 160.0 sq mi	Thru: 08/28/2002
Dist Fished: 1.00 km	Basin: Maumee River No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		274	274.00	62.70	1.48	3.82	5.38
Golden Redhorse	R	I	S	M	1	1.00	0.23	0.24	0.63	243.00
White Sucker	W	O	S	T	9	9.00	2.06	0.48	1.23	52.89
Common Carp	G	O	M	T	22	22.00	5.03	28.95	74.94	1,315.91
Goldfish	G	O	M	T	12	12.00	2.75	1.92	4.98	160.17
Golden Shiner	N	I	M	T	6	6.00	1.37	0.06	0.17	10.67
Emerald Shiner	N	I	S		3	3.00	0.69	0.01	0.03	4.00
Spotfin Shiner	N	I	M		1	1.00	0.23	0.01	0.01	5.00
Bluntnose Minnow	N	O	C	T	5	5.00	1.14	0.02	0.04	3.27
Yellow Bullhead		I	C	T	1	1.00	0.23	0.23	0.60	230.00
White Bass	F	P	M		4	4.00	0.92	0.84	2.18	210.50
Rock Bass	S	C	C		1	1.00	0.23	0.02	0.05	20.00
Largemouth Bass	F	C	C		6	6.00	1.37	2.35	6.09	391.83
Green Sunfish	S	I	C	T	3	3.00	0.69	0.09	0.22	28.67
Bluegill Sunfish	S	I	C	P	2	2.00	0.46	0.01	0.03	6.00
Pumpkinseed Sunfish	S	I	C	P	72	72.00	16.48	1.39	3.59	19.27
Green Sf X Pumpkinseed					3	3.00	0.69	0.23	0.60	76.67
Hybrid X Sunfish					3	3.00	0.69	0.11	0.28	36.67
Yellow Perch			M		7	7.00	1.60	0.19	0.50	27.57
Logperch	D	I	S	M	2	2.00	0.46	0.01	0.02	4.00
	Mile Total				437	437.00		38.63		
	Number of Species				18					
	Number of Hybrids				2					

Appendix 4. Fish Species List for the Ottawa River study area, 2002

River Code: **04-300**	Stream: **Ottawa River**	Sample Date: **2002**
River Mile: **5.50**	Location:	Date Range: 07/17/2002
Time Fished: 2288 sec	Drainage: 166.0 sq mi	Thru: 08/28/2002
Dist Fished: 0.80 km	Basin: Maumee River No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		144	180.00	47.37	1.49	4.03	8.27
White Sucker	W	O	S	T	5	6.25	1.64	0.42	1.12	66.40
Common Carp	G	O	M	T	13	16.25	4.28	18.96	51.32	1,166.77
Goldfish	G	O	M	T	29	36.25	9.54	7.16	19.38	197.49
Golden Shiner	N	I	M	T	7	8.75	2.30	0.14	0.37	15.43
Emerald Shiner	N	I	S		1	1.25	0.33	0.00	0.01	3.00
Spotfin Shiner	N	I	M		1	1.25	0.33	0.01	0.02	5.00
Bluntnose Minnow	N	O	C	T	4	5.00	1.32	0.02	0.04	3.00
Yellow Bullhead		I	C	T	3	3.75	0.99	0.54	1.46	144.00
Black Bullhead		I	C	P	1	1.25	0.33	0.10	0.27	81.00
White Bass	F	P	M		2	2.50	0.66	0.20	0.55	81.50
Largemouth Bass	F	C	C		7	8.75	2.30	2.65	7.17	302.86
Green Sunfish	S	I	C	T	4	5.00	1.32	0.18	0.48	35.75
Bluegill Sunfish	S	I	C	P	12	15.00	3.95	0.89	2.40	59.00
Orangespotted Sunfish	S	I	C		2	2.50	0.66	0.06	0.16	23.50
Pumpkinseed Sunfish	S	I	C	P	52	65.00	17.11	1.90	5.14	29.20
Green Sf X Pumpkinseed					3	3.75	0.99	0.41	1.12	110.00
Hybrid X Sunfish					10	12.50	3.29	1.10	2.97	87.80
Yellow Perch			M		3	3.75	0.99	0.08	0.20	20.00
Freshwater Drum			M	P	1	1.25	0.33	0.66	1.78	526.00
	Mile Total				304	380.00		36.94		
	Number of Species				18					
	Number of Hybrids				2					

Appendix 4. Fish Species List for the Ottawa River study area, 2002

River Code: **04-300**	Stream: **Ottawa River**	Sample Date: **2002**
River Mile: **5.30**	Location:	Date Range: 07/17/2002
Time Fished: 3900 sec	Drainage: 166.0 sq mi	Thru: 08/28/2002
Dist Fished: 1.00 km	Basin: Maumee River No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		299	299.00	59.92	1.59	2.11	5.32
Bigmouth Buffalo	C	I	M		2	2.00	0.40	4.50	5.96	2,250.00
Shorthead Redhorse	R	I	S	M	1	1.00	0.20	0.21	0.28	208.00
White Sucker	W	O	S	T	2	2.00	0.40	0.13	0.17	64.50
Common Carp	G	O	M	T	38	38.00	7.62	58.42	77.37	1,537.44
Goldfish	G	O	M	T	14	14.00	2.81	2.20	2.92	157.29
Golden Shiner	N	I	M	T	12	12.00	2.40	0.10	0.13	8.17
Emerald Shiner	N	I	S		3	3.00	0.60	0.01	0.02	4.00
Fathead Minnow	N	O	C	T	1	1.00	0.20	0.00	0.00	2.00
Bluntnose Minnow	N	O	C	T	19	19.00	3.81	0.05	0.06	2.42
White Bass	F	P	M		2	2.00	0.40	0.46	0.61	230.00
Black Crappie	S	I	C		1	1.00	0.20	0.09	0.12	88.00
Largemouth Bass	F	C	C		14	14.00	2.81	2.81	3.71	200.36
Green Sunfish	S	I	C	T	5	5.00	1.00	0.14	0.19	28.80
Bluegill Sunfish	S	I	C	P	8	8.00	1.60	0.27	0.35	33.20
Pumpkinseed Sunfish	S	I	C	P	67	67.00	13.43	1.03	1.36	15.32
Green Sf X Hybrid					1	1.00	0.20	0.04	0.06	42.00
Hybrid X Sunfish					1	1.00	0.20	0.07	0.09	66.00
Yellow Perch			M		5	5.00	1.00	0.25	0.33	49.20
Freshwater Drum			M	P	4	4.00	0.80	3.16	4.18	790.00
	Mile Total				499	499.00		75.52		
	Number of Species				18					
	Number of Hybrids				2					

Appendix 4. Fish Species List for the Ottawa River study area, 2002

River Code: **04-300**	Stream: **Ottawa River**	Sample Date: **2002**
River Mile: **5.00**	Location:	Date Range: 07/17/2002
Time Fished: 3089 sec	Drainage: 166.0 sq mi	Thru: 08/28/2002
Dist Fished: 1.00 km	Basin: Maumee River No of Passes: 2	Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		182	182.00	53.22	0.91	1.07	5.00
Quillback Carpsucker	C	O	M		2	2.00	0.58	1.31	1.54	654.00
Shorthead Redhorse	R	I	S	M	1	1.00	0.29	0.04	0.05	40.00
White Sucker	W	O	S	T	7	7.00	2.05	0.20	0.24	28.71
Spotted Sucker	R	I	S		2	2.00	0.58	0.50	0.59	251.00
Common Carp	G	O	M	T	52	52.00	15.20	72.06	84.88	1,385.79
Goldfish	G	O	M	T	18	18.00	5.26	3.33	3.92	184.78
Golden Shiner	N	I	M	T	6	6.00	1.75	0.08	0.09	13.33
Emerald Shiner	N	I	S		1	1.00	0.29	0.00	0.00	4.00
Bluntnose Minnow	N	O	C	T	7	7.00	2.05	0.02	0.03	3.43
White Bass	F	P	M		3	3.00	0.88	0.54	0.64	180.00
Largemouth Bass	F	C	C		4	4.00	1.17	0.69	0.81	171.25
Green Sunfish	S	I	C	T	7	7.00	2.05	0.19	0.22	26.43
Bluegill Sunfish	S	I	C	P	6	6.00	1.75	0.12	0.14	20.00
Pumpkinseed Sunfish	S	I	C	P	29	29.00	8.48	0.55	0.65	18.96
Green Sf X Pumpkinseed					4	4.00	1.17	0.52	0.61	129.00
Yellow Perch			M		7	7.00	2.05	0.13	0.15	18.57
Freshwater Drum			M	P	4	4.00	1.17	3.71	4.37	928.50
Mile Total					342	342.00		84.90		
Number of Species					17					
Number of Hybrids					1					

Appendix 4. Fish Species List for the Ottawa River study area, 2002

River Code: **04-310**	Stream: **Sibley Creek**	Sample Date: **2002**
River Mile: **0.80**	Location: Lagrange St.	Date Range: 07/17/2002
Time Fished: 1620 sec	Drainage: 2.5 sq mi	Thru: 08/27/2002
Dist Fished: 0.20 km	Basin: Maumee River No of Passes: 2	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Fathead Minnow	N	O	C	T	3	4.50	75.00			
Green Sunfish	S	I	C	T	1	1.50	25.00			
	Mile Total				4	6.00				
	Number of Species				2					
	Number of Hybrids				0					

Appendix 4. Fish Species List for the Ottawa River study area, 2002

River Code: **04-310**	Stream: **Sibley Creek**	Sample Date: **2002**
River Mile: **0.20**	Location: near mouth	Date Range: 07/17/2002
Time Fished: 2280 sec	Drainage: 2.6 sq mi	Thru: 08/27/2002
Dist Fished: 0.20 km	Basin: Maumee River No of Passes: 2	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		2	3.00	0.74			
White Sucker	W	O	S	T	1	1.50	0.37			
Common Carp	G	O	M	T	9	13.50	3.31			
Goldfish	G	O	M	T	2	3.00	0.74			
Golden Shiner	N	I	M	T	1	1.50	0.37			
Creek Chub	N	G	N	T	7	10.50	2.57			
Fathead Minnow	N	O	C	T	73	109.50	26.84			
Bluntnose Minnow	N	O	C	T	77	115.50	28.31			
Central Stoneroller	N	H	N		5	7.50	1.84			
Black Bullhead		I	C	P	87	130.50	31.99			
Western Mosquitofish	E	I	N		2	3.00	0.74			
Largemouth Bass	F	C	C		6	9.00	2.21			
	Mile Total				272	408.00				
	Number of Species				12					
	Number of Hybrids				0					

Appendix 4. Fish Species List for the Ottawa River study area, 2002

River Code: **04-310**	Stream: **Sibley Creek**	Sample Date: **2002**
River Mile: **0.10**	Location: at mouth	Date Range: 07/17/2002
Time Fished: 2220 sec	Drainage: 2.6 sq mi	Thru: 08/27/2002
Dist Fished: 0.20 km	Basin: Maumee River No of Passes: 2	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Fathead Minnow	N	O	C	T	1	1.50	20.00			
Bluntnose Minnow	N	O	C	T	4	6.00	80.00			
	Mile Total				5	7.50				
	Number of Species				2					
	Number of Hybrids				0					

Appendix Table 5. Lacustuary Index of Biotic Integrity (LIBI) and Modified Index of Well-being (MIwb) scores in the Ottawa River, 2002.

				Number of					Percent of Individuals						Rel.No. minus tolerants		
River Mile	Type	Date	Drainage area (sq mi)	Total species	Centrarch. species	Sensitive species	Benthic species	Cyprinid species	Exotics	Tolerant fishes	Omni-vores	Top carnivores	Phyto-phils	DELT anomalies	/(1.0 km)	IBI	Modified Iwb
Ottawa River - (04-300)																	
Year: 2002																	
5.80	A	07/17/2002	160	11(3)	4(3)	0(0)	3(1)	3(3)	39(0)	56(0)	44(1)	7(1)	37.3(5)	8.8(0)	114(1) *	18	5.6
5.80	A	08/28/2002	160	14(3)	6(3)	2(1)	4(3)	3(3)	3(5)	25(5)	22(0)	7(1)	18.3(3)	1.9(3)	212(1)	31	6.7
5.50	A	07/17/2002	10000	11(3)	6(3)	0(0)	3(1)	3(3)	38(0)	48(0)	40(1)	5(1)	40.0(5)	9.7(0)	163(1) *	18	6.1
5.50	A	08/28/2002	10000	13(3)	6(3)	0(0)	4(3)	2(1)	8(5)	36(3)	26(1)	6(1)	18.0(3)	5.3(0)	238(1)	24	7.4
5.30	A	07/17/2002	10000	14(3)	5(3)	1(1)	2(1)	4(3)	33(1)	46(1)	41(1)	5(1)	43.8(5)	10.1(0)	158(1) *	21	6.4
5.30	A	08/28/2002	10000	13(3)	6(3)	0(0)	2(1)	2(1)	6(5)	45(3)	35(0)	10(1)	15.3(3)	3.8(1)	242(1)	22	7.0
5.00	A	07/17/2002	10000	13(3)	5(3)	1(1)	4(3)	3(3)	30(1)	53(0)	41(1)	3(1)	36.8(5)	9.2(0)	174(1) *	22	6.6
5.00	A	08/28/2002	10000	11(3)	5(3)	0(0)	3(1)	2(1)	17(3)	70(3)	68(0)	5(1)	6.3(1)	1.4(3)	146(1)	20	5.7

▲ - IBI is low end adjusted.

Appendix Table 5. Index of Biotic Integrity (IBI) scores in Sibley Creek, 2002.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Percent of Individuals: Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Sibley Creek - (04-310)																
Year: 2002																
0.80	E	07/17/2002	2.5	1(1)	1(1)	0(1)	0(1)	0(1)	0(1)	100(1)	100(1)	100(1)	0(1)	0.0(1)	0(1) * *	12
0.80	E	08/27/2002	2.5	1(1)	0(1)	0(1)	0(1)	0(1)	0(1)	100(1)	0(1)	100(1)	100(1)	0.0(1)	0(1) * *	12
0.20	E	07/17/2002	2.6	4(1)	2(1)	0(1)	0(1)	0(1)	0(1)	59(1)	57(1)	51(3)	39(5)	0.0(5)	63(1) *	22
0.20	E	08/27/2002	2.6	8(3)	4(3)	0(1)	0(1)	0(1)	1(1)	63(1)	61(1)	59(1)	32(5)	0.5(5)	243(3)	26
0.10	E	07/17/2002	2.6	1(1)	1(1)	0(1)	0(1)	0(1)	0(1)	100(1)	100(1)	100(1)	0(1)	0.0(1)	0(1) * *	12
0.10	E	08/27/2002	2.6	2(1)	2(1)	0(1)	0(1)	0(1)	0(1)	100(1)	100(1)	100(1)	0(1)	0.0(1)	0(1) * *	12

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.