Baseline Macroinvertebrate Study in the Ottawa River for the AquaBlok™ Demonstration Capping Project

Lucas County
Ohio

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Coordinator - Bernie Counts
Data Management - Jeff DeShon, Dennis Mishne, and Ed Rankin
Macroinvertebrate Data Analysis - Bernie Counts

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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.

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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.

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

Ohio EPA, Division of Surface Water
Monitoring and Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125-9231
(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 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,

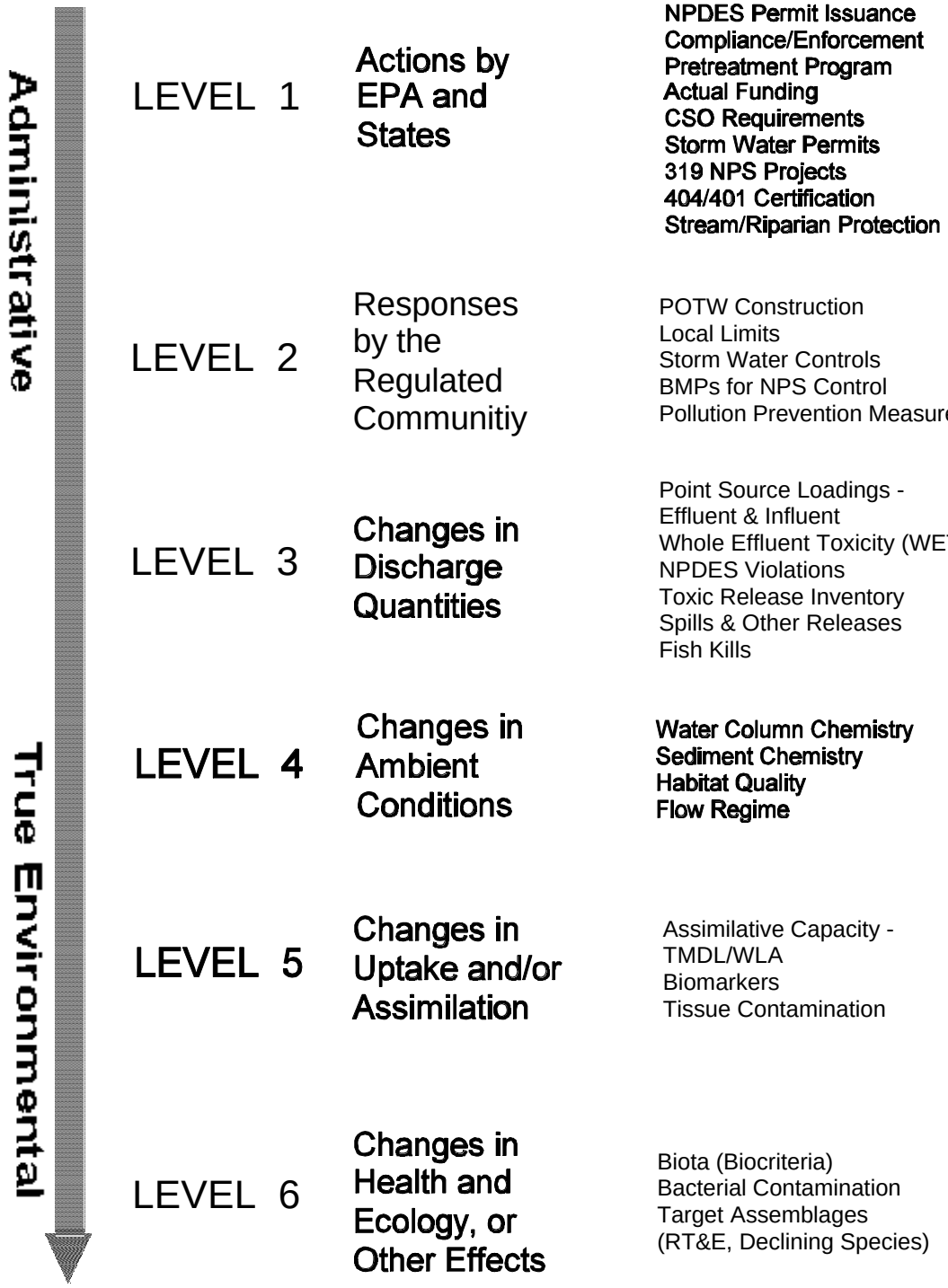

Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).

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 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.

Baseline Macroinvertebrate Study in the Ottawa River for the AquaBlok™ Demonstration Capping Project

(Lucas County Ohio)

INTRODUCTION

The Ohio EPA, Division of Surface Water, Monitoring and Assessment Section conducted a baseline (precapping) study of the macroinvertebrate community in the Ottawa River near the Unnamed Tributary in Toledo, Ohio. This is the area to be used in the AquaBlok™ demonstration sediment capping project. The baseline study was part of a full-scale benthic study required by the United States Army Corps of Engineers (USACE) for completion of the Ottawa River Restoration Project. Funds to cover the costs of conducting this baseline study were provided to the City of Toledo through the Ohio Lake Erie Office from the Lake Erie Protection Fund.

Specific objectives of this study were to:

1) determine the baseline condition of the benthic macroinvertebrate community in the upstream control section of the Ottawa River which will not be capped with the AquaBlok™material and compare the representativeness of the control section to the study areas,

2) determine baseline conditions of the benthic macroinvertebrate communities in each of three study areas (A, B, and C) which will be part of the demonstration of the use of AquaBlok™ material to encapsulate sediments in the Ottawa River.

SUMMARY

Macroinvertebrate Community

A total of four samples were collected from the Ottawa River in August, 1999. The artificial substrate samplers were submerged in the river water at an average depth of just over one foot for a six weeks colonization period. The samplers were fastened to cinder blocks placing them approximately six inches above the sediment. At the end of the six weeks deployment, the samplers were pulled and placed in plastic containers then preserved with formalin. At the time of sample retrieval, a qualitative sample was collected using kick nets and hand picking from all available habitat types. Due to the large amounts of organic debris on the river bottom, the use of a hand dredge, as stipulated in the draft study plan (HAI,1999), was impractical. Additional kick net samples were collected to compensate for this change in sampling protocols.

In the laboratory the samples were processed following the methods outlined in Ohio EPA (1989c). The raw data were entered into the OEPA, DSW, MAS database and analyzed using both the Invertebrate Community Index (ICI) with the drainage area set at a default 10,000 square miles and the Lacustuary Invertebrate Community Index (LICI) being developed at the Ohio EPA. Both indices indicated poor biological conditions and little variability between sampled sections. Summary of the ICI and LICI results and attainment status are presented in Table 1.

Table 1. Attainment status of the designated WWH aquatic life use using the existing ICI biocriterion and the proposed lacustuary biological criterion (under development) for the Ottawa River based on data collected from June -August, 1999. Attainment status is based on the WWH macroinvertebrate biocriterion for the Huron-Erie Lake Plain ecoregion for inland streams and rivers and Interim Criterion for Lake Erie Lacustuaries.

RIVER MILE Invertebrates	ICI	LICI	Use Attainment Status[a]	Comments
Ottawa River (04-300) 1999				
		Huron-Erie Lake Plain (HELP)		
6.1	8*	12*	(NON)	Poor
6.0	10*	14*	(NON)	Poor
5.9	8*	12*	(NON)	Poor
5.8	8*	10*	(NON)	Poor

Ecoregional Biological Criteria:

	Huron-Erie Lake Plain (HELP)		
INDEX	WWH	MWH[b]	WWH Lacustuary
ICI	34	22	
LICI (interim)			42

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

[a] Attainment status based on one organism group is parenthetically expressed.

[b] Modified Warmwater Habitat-Channel modified.

RECOMMENDATIONS

Follow-up sampling should be conducted in the upstream control and each of the three study areas after a period of two years (2001) and again after five years (2004). This will provide ample time for organisms to establish a presence in the areas encapsulated with AquaBlok™ and determine if the different capping designs provide for differing quality of benthic communities.

METHODS

All chemical, physical, aquatic habitat, 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), 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). Chemical, physical, aquatic habitat, and biological sampling locations are listed in Table 5.

Determining Use Attainment Status

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-14). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multi metric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Numerical endpoints are stratified by ecoregion, use designation, and stream or river size. Three attainment status results are possible at each sampling location - full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the Ohio WQS 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), 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 7-14). 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 multi metric indices patterned after an original IBI described by Karr (1981) and Fausch *et al.* (1984). The ICI was developed by Ohio EPA (1987b) and further described by DeShon (1995). The MIwb is a measure of fish community abundance and diversity using numbers and weight information and is a modification of the original Index of Well-Being originally applied to fish community information from the Wabash River (Gammon 1976; Gammon *et al.* 1981).

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

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, analyses of macroinvertebrate data collected from the natural substrates was supplemented using an assessment tool currently in the field validation phase. This method relies on tolerance values derived for each taxon, based upon the abundance data for that taxon from artificial substrate (quantitative) samples collected throughout Ohio. To determine the tolerance value of a given taxon, ICI scores at all locations where the taxon has been collected are weighted by its abundance on the artificial substrates. The mean of the weighted ICI scores for the taxon results in a value which represents its relative level of tolerance on the 0 to 60 scale of the ICI. For the qualitative collections in the Ottawa 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 Ottawa 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.

Causal Associations

Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine the use attainment status and assigning probable causes and sources of impairment. The identification of impairment in rivers and streams is straightforward - the numerical biological criteria are used to judge aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria, within a weight of evidence framework, has been extensively discussed elsewhere (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, land use data, and biological results (Yoder and Rankin 1995). Thus the assignment of principal causes and sources of impairment in this report represent the association of impairments (based on response indicators) with stressor and exposure indicators. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified, or have been experimentally or statistically linked together. The ultimate measure of success in water resource management is the restoration of lost or damaged ecosystem attributes including aquatic community structure and function. While there have been criticisms of misapplying the metaphor of ecosystem "health" compared to human patient "health" (Suter 1993), in this document we are referring to the process for evaluating biological integrity and causes or sources associated with observed impairments, not whether human health and ecosystem health are analogous concepts.

RESULTS AND DISCUSSION

Macroinvertebrate Community

In 1999 macroinvertebrate communities were sampled in the Ottawa River at four locations. The sampling was to establish baseline conditions in an area to be used as an in-situ remedial sediment encapsulation demonstration. The USACE required benthic community monitoring as part of the permitting process for this demonstration. The resulting data were analyzed using both the ICI and the LICI being developed at the Ohio EPA.

The condition of the macroinvertebrate communities at the upstream control sites and the three study sites (A, B, and C) were assessed based on the results from artificial substrate samplers. All four sites indicated communities in the poor range (ICI score 8, 10, 8 and 8 respectively; LICI scores 12, 14, 12, and 10 respectively); none attained the benchmark biocriteria for the WWH use designation. Community performance expectations were influenced by the lacustuary conditions of reduced or absent current and homogeneous substrates. All samples were predominated by pollution tolerant organisms making up 74.3%, 83.3%, 84%, and 86.7%, respectively, of the samples. Aquatic worms (Oligochaeta) were the most numerous organisms at each site. The upstream control site appears to be representative of the entire area and will serve as a good comparison for possible changes in the test sites.

Table 2. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Ottawa River, 1999.

RIVER MILE	Relative Density	Total Taxa	Quant Taxa	Qual Taxa	QCTV	ICI	LICI	Comments
Ottawa River (04-300) 1999								
				Huron Erie Lake Plain (HELP)				
6.1	1527	23	14	16	23.1	8[a]	12[b]	Poor
6.0	1262	23	15	15	24.9	10[a]	14[b]	Poor
5.9	1518	17	14	11	18.5	8[a]	12[b]	Poor
5.8	1101	21	12	14	22.8	8[a]	10[b]	Poor

[a] Significant departure from WWH biocriterion; poor results are underlined.

[b] Significant departure from interim lacustuary biocriterion; poor results are underlined.

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Appendix Table 1. Raw macroinvertebrate data by river mile for the Ottawa River study area, 1999.

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/03/1999 River Code: 04-300 River: Ottawa River RM: 6.10

Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	25
01801	*Turbellaria*	560
03600	*Oligochaeta*	4080
05800	*Caecidotea sp*	40 +
08250	*Orconectes (Procericambarus) rusticus*	+
08601	*Hydracarina*	8
22001	*Coenagrionidae*	8
45100	*Palmacorixa sp*	+
67000	*Helophorus sp*	+
77120	*Ablabesmyia mallochi*	+
78680	*Procladius (Psilotanypus) bellus*	120 +
82730	*Chironomus (C.) decorus group*	30 +
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	60
83050	*Dicrotendipes lucifer*	602 +
83051	*Dicrotendipes simpsoni*	1565 +
83300	*Glyptotendipes (G.) sp*	120 +
83330	*Glyptotendipes (G.) barbipes*	+
84315	*Phaenopsectra flavipes*	+
84520	*Polypedilum (Tripodura) halterale group*	+
94400	*Fossaria sp*	+
96120	*Menetus (Micromenetus) dilatatus*	336
96930	*Laevapex fuscus*	80 +

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 14 Total Taxa: 23

No. Qualitative Taxa: 16 ICI: **12**

Number of Organisms: 7634 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/03/1999 River Code: 04-300 River: Ottawa River RM: 6.00

Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	25
01801	*Turbellaria*	352 +
03600	*Oligochaeta*	3728 +
05800	*Caecidotea sp*	16
08601	*Hydracarina*	16
22001	*Coenagrionidae*	8 +
45100	*Palmacorixa sp*	+
45400	*Trichocorixa sp*	+
74501	*Ceratopogonidae*	+
78680	*Procladius (Psilotanypus) bellus*	43 +
81240	*Nanocladius (N.) distinctus*	150
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	21
83050	*Dicrotendipes lucifer*	300 +
83051	*Dicrotendipes simpsoni*	1137
83300	*Glyptotendipes (G.) sp*	214 +
84315	*Phaenopsectra flavipes*	+
84520	*Polypedilum (Tripodura) halterale group*	+
85500	*Paratanytarsus sp*	21
95100	*Physella sp*	240 +
96120	*Menetus (Micromenetus) dilatatus*	56
96930	*Laevapex fuscus*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 15 Total Taxa: 23

No. Qualitative Taxa: 15 ICI: **14**

Number of Organisms: 6327 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/03/1999 River Code: 04-300 River: Ottawa River RM: 5.90

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	25			
01801	*Turbellaria*	240 +			
03600	*Oligochaeta*	4800 +			
04664	*Helobdella stagnalis*	+			
05800	*Caecidotea sp*	1 +			
08601	*Hydracarina*	8			
22001	*Coenagrionidae*	3 +			
78655	*Procladius (Holotanypus) sp*	29			
78680	*Procladius (Psilotanypus) bellus*	29 +			
79020	*Tanypus neopunctipennis*	+			
81240	*Nanocladius (N.) distinctus*	29			
82730	*Chironomus (C.) decorus group*	+			
83040	*Dicrotendipes neomodestus*	29			
83050	*Dicrotendipes lucifer*	763			
83051	*Dicrotendipes simpsoni*	1496 +			
83300	*Glyptotendipes (G.) sp*	88 +			
95100	*Physella sp*	52 +			

No. Quantitative Taxa: 14 Total Taxa: 17
No. Qualitative Taxa: 11 ICI: **12**
Number of Organisms: 7592 Qual EPT: 0

Ohio EPA/DSW Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 08/03/1999 River Code: 04-300 River: Ottawa River RM: 5.80

Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	25
01801	*Turbellaria*	248
03360	*Plumatella sp*	+
03600	*Oligochaeta*	3920 +
05800	*Caecidotea sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
45400	*Trichocorixa sp*	+
60900	*Peltodytes sp*	+
78655	*Procladius (Holotanypus) sp*	17
78680	*Procladius (Psilotanypus) bellus*	134
81240	*Nanocladius (N.) distinctus*	50
82730	*Chironomus (C.) decorus group*	+
83040	*Dicrotendipes neomodestus*	33
83050	*Dicrotendipes lucifer*	201 +
83051	*Dicrotendipes simpsoni*	787 +
83300	*Glyptotendipes (G.) sp*	50 +
84020	*Parachironomus carinatus*	+
84520	*Polypedilum (Tripodura) halterale group*	+
95100	*Physella sp*	15 +
96100	*Menetus (Micromenetus) sp*	24
96930	*Laevapex fuscus*	+

Taxa Code	Taxa	Quant/Qual

No. Quantitative Taxa: 12 Total Taxa: 21
No. Qualitative Taxa: 14 ICI: **10**
Number of Organisms: 5504 Qual EPT: 0

Appendix Table 2. Lacustuary Invertebrate Community Index (LICI) metrics and scores for the Ottawa River study area, 1999.

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: 1999													
6.10	**67.8**	**14(2)**	**1(0)**	**6(0)**	**0.0(0)**	**91.9(0)**	**0.1(2)**	**99.9(0)**	**53.5(4)**	**499(4)**	**0(0)**	**1**	**12**
6.00	**66.7**	**15(2)**	**1(0)**	**7(2)**	**0.0(0)**	**93.6(0)**	**0.3(2)**	**99.5(0)**	**58.9(4)**	**377(4)**	**0(0)**	**1**	**14**
5.90	**65.6**	**14(2)**	**1(0)**	**7(2)**	**0.0(0)**	**98.1(0)**	**0.1(2)**	**100(0)**	**63.2(2)**	**493(4)**	**0(0)**	**1**	**12**
5.80	**64.4**	**12(2)**	**0(0)**	**7(2)**	**0.0(0)**	**96.1(0)**	**0.0(0)**	**100(0)**	**71.2(2)**	**254(4)**	**0(0)**	**1**	**10**

[a] Percent of total gatherers as individuals excluding zebra mussels *(Dreissena polymorpha).*

[b] Percent of dipterans as individuals excluding the midge tribe Tanytarsini.

Appendix Table 3. Invertebrate Community Index (ICI) metrics and scores for the Ottawa River study area, 1999.

Ottawa River AquaBlok Project

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 Organisms			
OTTAWA RIVER (04-300)													
Year: 1999													
6.10	10000.0	14(2)	0(0)	0(0)	6(6)	0.0(0)	0.0(0)	0.0(0)	99.9(0)	74.3(0)	0(0)	1	8
6.00	10000.0	15(2)	0(0)	0(0)	7(6)	0.0(0)	0.0(0)	0.3(2)	99.5(0)	83.3(0)	0(0)	1	10
5.90	10000.0	14(2)	0(0)	0(0)	7(6)	0.0(0)	0.0(0)	0.0(0)	99.8(0)	84.0(0)	0(0)	1	8
5.80	10000.0	12(2)	0(0)	0(0)	7(6)	0.0(0)	0.0(0)	0.0(0)	99.9(0)	86.7(0)	0(0)	1	8