State of Ohio
Environmental Protection Agency

Division of Surface Water

Biological and Water Quality Study of the Upper Tuscarawas River

Summit County

December 9, 2005

Bob Taft, Governor
Joseph P. Koncelik, Director

Biological and Water Quality Study of the Tuscarawas River

Killian Latex Property
2005

Summit County, Ohio

December 9, 2005

OEPA Report EAS/2005-12-7

prepared for

State of Ohio Environmental Protection Agency
Division of Emergency and Remedial Response
Northeast District Office

prepared by

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

Bob Taft, Governor
State of Ohio

Joseph P. Koncelik, Director
Environmental Protection Agency

TABLE OF CONTENTS

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,

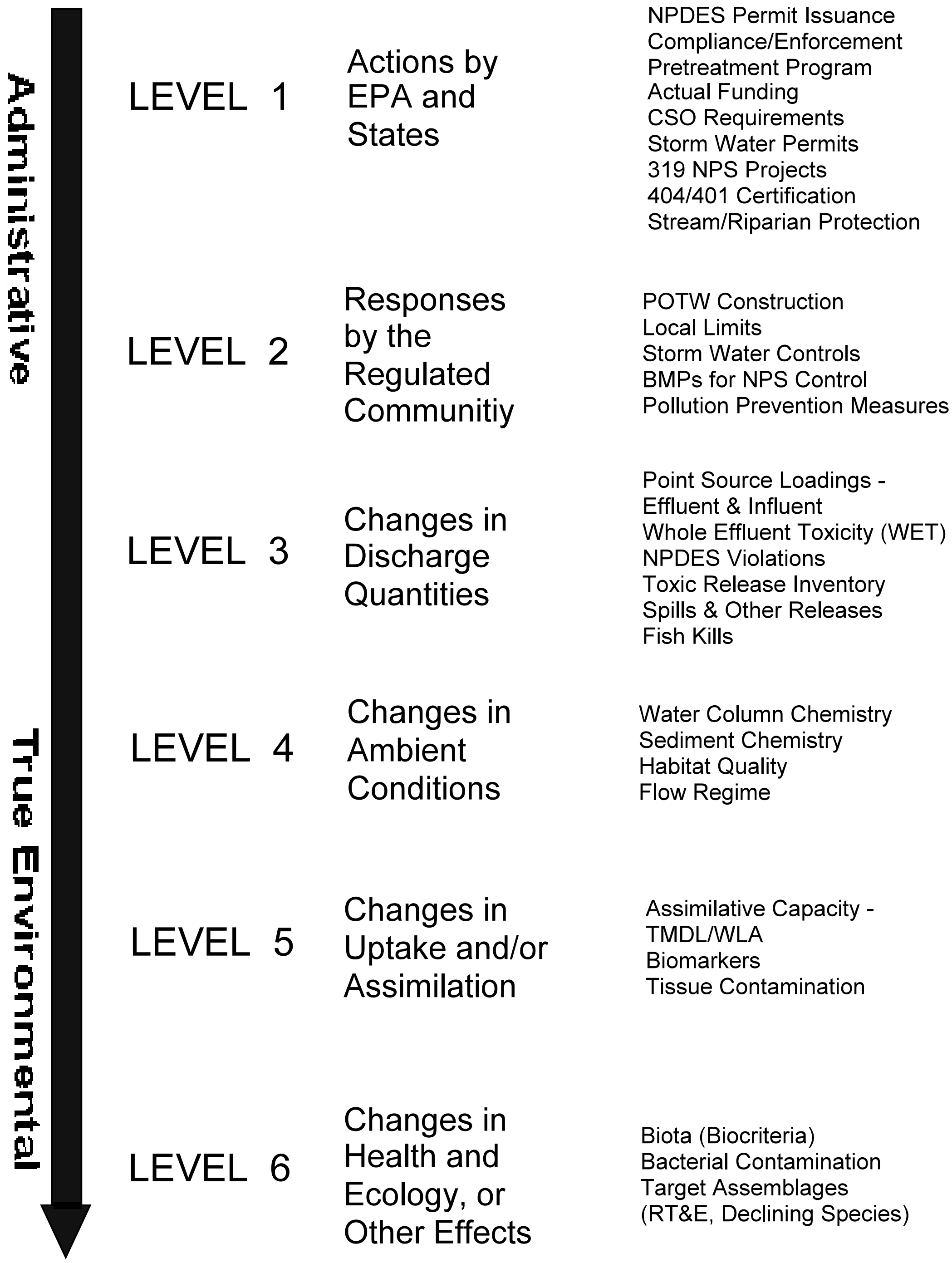

Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).

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 can be having a water depth of at least one meter over an area of at least 100 square feet or, lacking this, where frequent human contact is a reasonable expectation. If a water body does not meet either criterion, the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.,* fecal coliform, *E. coli)* and the criteria for each are specified in the Ohio WQS.

Attainment of recreation uses are evaluated based on monitored bacteria levels. The Ohio Water Quality Standards state that all waters should be free from any public health nuisance associated with raw or poorly treated sewage (Administrative Code 3745-1-04, Part F). Additional criteria (Administrative Code 3745-1-07) apply to waters that are designated as suitable for full body contact such as swimming (PCR- primary contact recreation) or for partial body contact such as wading (SCR- secondary contact recreation). These standards were developed to protect human health, because even though fecal coliform bacteria are relatively harmless in most cases, their presence indicates that the water has been contaminated with fecal matter.

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.

ACKNOWLEDGMENTS

The following Ohio EPA staff are acknowledged for their contribution to this report:
David Altfater, Mike Gray, Dennis Mishne, Nancy Zikmanis, Sue Netzly-Watkins, Bill Batin, and Victoria Sigler

Reviewers - Jeff DeShon, Marc Smith

INTRODUCTION

Brownfield Restoration Group requested technical assistance from Ohio EPA to conduct a Voluntary Action Program (VAP) compliant biocriteria study of the Tuscarawas River that crosses the Killian Latex, Inc. property, in accordance with OAC 3745-300-09 (F)(2). The study area included the Tuscarawas River immediately upstream and downstream from the Killian Latex property, along with assessing the river at the property. Killian Latex is located in southeastern Summit County, Ohio in Springfield Township. The property has been used commercially since 1910, and included tire manufacturing and production of natural latex items. During the late 1970s, property use included storage and treatment of hazardous, industrial (e.g. rubber companies) and institutional waste (e.g. hospitals, colleges). The operation currently manufactures latex products. The facility has an active NPDES permit, with a small discharge at the downstream end of the property area. The property currently houses Killian Latex, Inc. and Kiltex Corporation, both actively maintained business operations.

The Division of Surface Water evaluated surface water, sediment and biological conditions in the Tuscarawas River to assess the contribution of potential contaminants from the Killian Latex property.

Specific objectives of this evaluation were to:

1) Establish biological conditions in the Tuscarawas River in the vicinity of the Killian Latex property by evaluating fish and macroinvertebrate communities,

2) Evaluate surface water and sediment chemical quality in the Tuscarawas River, and

3) Determine the aquatic life use attainment status of the Tuscarawas River with regard to the Warmwater Habitat (WWH) aquatic life use designation codified in the Ohio Water Quality Standards.

SUMMARY

A total of 1.0 mile of the Tuscarawas River was assessed by the Ohio EPA in 2005. Based on the performance of the biological communities, the upper 0.4 mile section of the Tuscarawas River was in non-attainment of the Warmwater Habitat aquatic life use and the lower 0.6 miles were in partial attainment of the WWH use (Table 1). These impaired biological conditions were not associated with chemical constituents released under current conditions at the Killian Latex property or from the Killian NPDES permitted discharge. Chemical constituents measured in the Tuscarawas River (organics and metals) were below Ohio WQS criteria. However, nutrients and oxygen demanding parameters were not tested as part of this study, and could have been contributing factors to the reduced biological communities. Sediment concentrations were not at levels likely to cause ecological impairment to the biota of the Tuscarawas River within the study area.

Sampling during 2005 confirmed the appropriateness of the Warmwater Habitat aquatic life use designation for the Tuscarawas River. Presently, the Tuscarawas River in the study segment is listed as Warmwater Habitat in the Ohio Water Quality Standards (WQS).

RECOMMENDATIONS

Status of Aquatic Life Uses

The aquatic life use designation of Warmwater Habitat (WWH) for the Tuscarawas River has been confirmed in previous Ohio EPA biological and water quality studies. This study verified the WWH use designation for the Tuscarawas River.

Status of Non-Aquatic Life Uses

This study verified that the Primary Contact Recreation use is appropriate for the Tuscarawas River.

Table 1. Attainment status of the existing aquatic life use for the Tuscarawas River based on biological sampling conducted during July and August, 2005.

RIVER MILE Fish/Invert.	IBI	MIwb	ICI	QHEI	Attainment Status	Site Location
Tuscarawas River	*Erie-Ontario Lake Plain (EOLP) - WWH Use Designation*					
123.1 / 123.1	34 [ns]	5.7*	32 [ns]	70.5	NON	Upstream Killian Latex property
122.7 / 122.7	34 [ns]	6.0*	28*	62.5	PARTIAL	Adjacent Killian Latex property
122.5 / 122.5	34 [ns]	7.1*	18*	71.0	PARTIAL	Downstr. Killian Latex property

Ecoregion Biocriteria: Erie-Ontario Lake Plain (EOLP)

INDEX	WWH	EWH	MWH[a]
IBI-Wading	38	50	24
MIwb - Wading	7.9	9.4	6.2
ICI	34	46	22

[a] Modified Warmwater Habitat for channel modified areas.
* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
[ns] Nonsignificant departure from ecoregion biocriterion ($\leq$4 IBI and ICI units, $\leq$0.5 MIwb units).

Table 2. Sampling locations in the Tuscarawas River, 2005. Type of sampling included fish community (F), macroinvertebrate community (M), sediment (S) and surface water (W).

Stream/ River Mile	Type of Sampling	Latitude	Longitude	Landmark
Tuscarawas River				
123.1	F,M,S,W	40 59 33.9	81 26 44.9	Upstream Killian Latex property; downstream Pressler Road
122.7	F,M,S,W	40 59 42.2	81 27 01	Adjacent Killian Latex property
122.5	F,M,S,W	40 59 43.6	81 27 8.5	Immediately downstream Killian Latex property

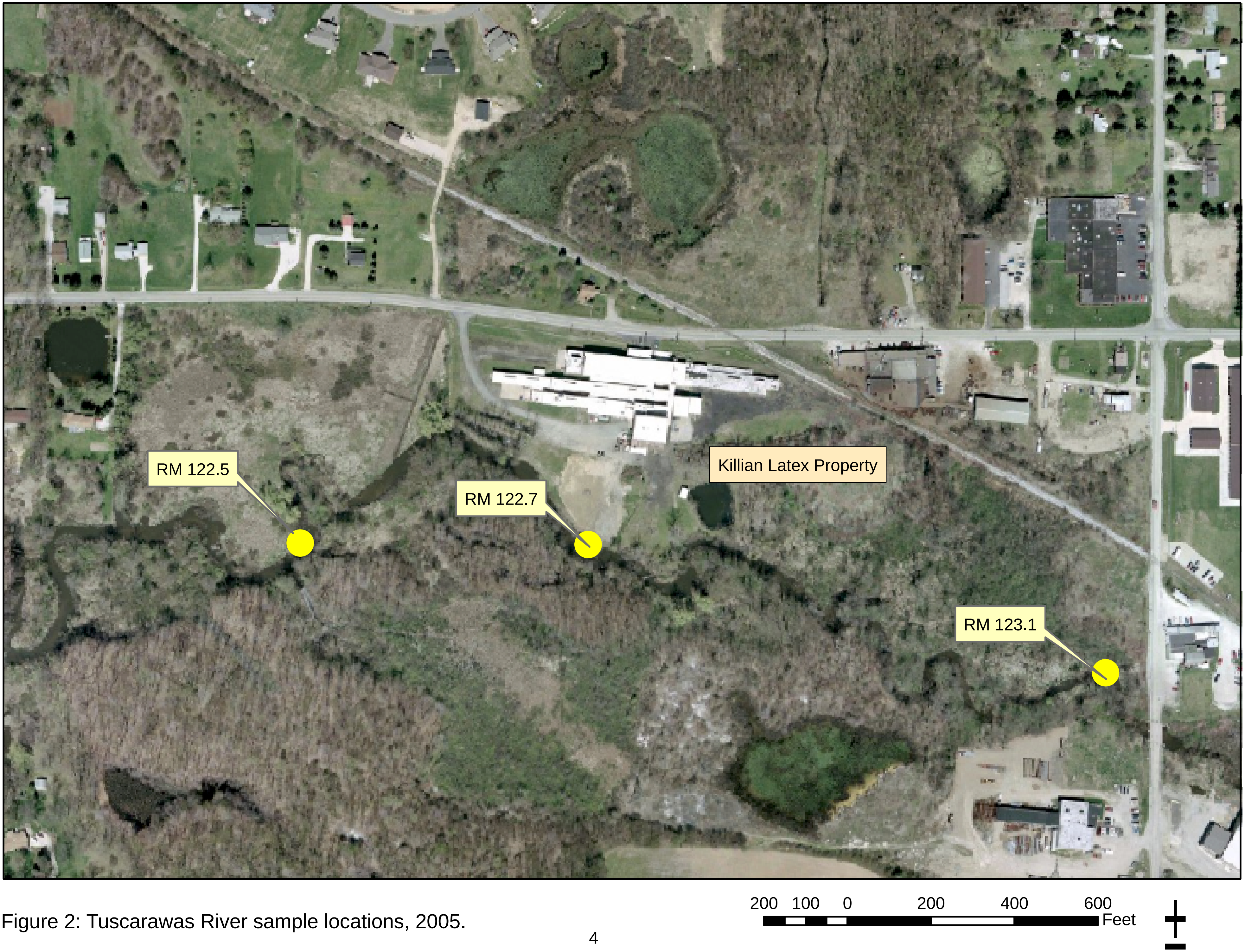

Figure 2: Tuscarawas River sample locations, 2005.

METHODS

All physical, chemical, 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 2003a) and Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a, 1987b, 1989a, 1989b), The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989, 1995) for aquatic habitat assessment, and the Ohio EPA Sediment Sampling Guide and Methodologies (Ohio EPA 2001). Sampling locations are listed in Table 2.

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 7-15). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Three attainment status results are possible at each sampling location - full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the biocriteria. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria. Non-attainment means that none of the applicable indices meet the biocriteria or one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (Table 1) is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by river mile, the applicable biological indices, the use attainment status (*i.e.*, full, partial, or non), the Qualitative Habitat Evaluation Index (QHEI), and a sampling location description.

Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the habitat characteristics used to determine the QHEI score which generally ranges from 20 to less than 100. The QHEI is used to evaluate the characteristics of a stream segment, as opposed to the characteristics of a single sampling site. As such, individual sites may have poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values greater than 60 are *generally* conducive to the existence of warmwater faunas whereas scores less than 45 generally cannot support a warmwater assemblage consistent with the WWH biological criteria. Scores greater than 75 frequently typify habitat conditions which have the ability to support exceptional warmwater faunas.

Sediment and Surface Water Assessment
Fine grain sediment samples were collected multi-incrementally in the upper 4 inches of bottom material at each Tuscarawas River location using decontaminated stainless steel scoops. Decontamination of sediment sampling equipment followed the procedures outlined in the Ohio EPA sediment sampling guidance manual (Ohio EPA 2001). Sediment incremental samples were homogenized in stainless steel pans (material for VOC analysis was not homogenized), transferred into glass jars with teflon lined lids, placed on ice (to maintain 4°C) in a cooler, and shipped to an Ohio EPA contract lab. Sediment data is reported on a dry weight basis. Surface water samples were collected directly into appropriate containers, preserved and delivered to an Ohio EPA contract lab. Surface water samples were evaluated using comparisons to Ohio Water Quality Standards criteria, reference conditions, or published literature. Sediment evaluations were conducted using guidelines established in MacDonald *et al.* (2000) and USEPA Region 5 Ecological Data Quality Levels - EDQLs (1998), along with a comparison of metals results to Ohio Sediment Reference Values (Ohio EPA 2003b).

Macroinvertebrate Community Assessment
Macroinvertebrates were collected from artificial substrates and from the natural habitats at the three Tuscarawas River sites. The artificial substrate collection provided quantitative data and consisted of a composite sample of five modified Hester-Dendy multiple-plate samplers colonized for six weeks. At the time of the artificial substrate collection, a qualitative multihabitat composite sample was also collected. This sampling effort consisted of an inventory of all observed macroinvertebrate taxa from the natural habitats at each site with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major macrohabitat types (e.g., riffle, run, pool, margin). Detailed discussion of macroinvertebrate field and laboratory procedures is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989a).

Fish Community Assessment
Fish were sampled twice at each site using pulsed DC electrofishing methods, with sampling distances of 180 - 200 meters at each site in the Tuscarawas River. Fish were processed in the field, and included identifying each individual to species, counting, weighing, and recording any external abnormalities. Discussion of the fish community assessment methodology used in this report is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989a).

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

Surface Water Quality
Chemical analyses were conducted on surface water samples collected on May 12 and August 16, 2005 from three locations in the Tuscarawas River (Table 3, Appendix Tables 1 and 2). Surface water samples were analyzed for total analyte list inorganics, pesticides, PCBs, volatile organic compounds, and semivolatile organic compounds. Parameters which were in exceedence of Ohio WQS criteria are reported in Table 3.

For the three Tuscarawas River sampling locations, each had one exceedence of the Ohio WQS aquatic life outside mixing zone average criterion for silver, with all values similar in concentration. All three silver values were estimated concentrations. Concentrations of all of the organic parameters tested (volatiles, semivolatiles, pesticides, and PCBs) were reported as non-detected. In addition, metals concentrations were very low, with over half of the tested parameters less than lab detection limits. Parameters with measurable concentrations were below applicable Ohio WQS aquatic life criteria. Nutrients, ammonia-N, dissolved oxygen(other than limited grab samples) and bacteriological parameters were not tested as part of this evaluation.

Sediment Chemistry
Sediment samples were collected at three locations in the Tuscarawas River by the Ohio EPA on May 12, 2005. All stream sampling locations are indicated by river mile in Figure 2. Samples were analyzed for volatile and semivolatile organic compounds, pesticides, PCBs, total analyte list inorganics, and percent solids. Specific chemical parameters tested and results are listed in Appendix Table 3.

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. In addition, sediment reference values (SRVs) for metals (Ohio EPA 2003) are presented in Table 4 for comparison to Tuscarawas River results.

Sediment collected from all three locations in the Tuscarawas River (upstream, adjacent, and downstream from the Killian Latex property) were not considered likely to be harmful to sediment-dwelling organisms (MacDonald *et.a*l. 2000). Semivolatile organic compounds, organochlorinated pesticides, and PCBs were not detected in the three sediment samples from the Tuscarawas River study area. Of the volatile organic analytes tested in sediment, only two parameters were measured above laboratory detection limits - acetone and 2-butanone. Both of these parameters were measured at all three sample locations, and all concentrations were estimated values. Both acetone and 2-butanone sediment results were below ecological screening levels. Additionally, both of these parameters are common lab contaminants. Four metal parameters were reported at levels above either TEC or EDQL screening levels. Silver concentrations were elevated both upstream, adjacent to, and downstream from Killian Latex, and these elevated levels were not associated with the Killian property. Arsenic levels in sediment exceeded TEC screening levels, but were below Ohio sediment reference values. Lead was elevated above the TEC screening level at the adjacent and downstream sampling site; the upstream site was below all screening levels. The two elevated lead values were marginally above the Ohio sediment reference values and far below the Probable Effects Concentration - a level above which harmful effects to biota are likely to occur. One zinc sediment measurement, at the downstream sample location, was above the TEC screening level. However, this concentration was below the Ohio sediment reference value. Metal sediment concentrations were not at levels likely to cause ecological impairment to the biota of the Tuscarawas River.

Physical Habitat For Aquatic Life

Physical habitat was evaluated in the Tuscarawas River at each fish sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 5.

QHEI scores for the Tuscarawas River sites ranged between 62.5 and 71.0. These scores reflect good river habitat and indicate the potential to support WWH biological communities. All three sampling locations were similar in the following habitat qualities: bottom substrates predominated by gravel and sand, normal to moderate siltation, moderate amounts of instream cover, and a natural stream channel. The most upstream sampling location was represented by more run and riffle areas compared with the adjacent and downstream locations. The most downstream location (RM 122.5) was partially influenced by water level fluctuations caused by a dam located at Tritts Millpond.

Fish Community Assessment

Fish communities were assessed at three locations in the Tuscarawas River (Figure 2, Table 6, Appendix Tables 6 and 7). Sampling locations were selected to assess contributions of contaminants from the Killian Latex property.

Fish communities ranged from poor to marginally good in the Tuscarawas River. Results from all three fish sampling locations indicated slight improvement from upstream to downstream, with no obvious trends associated with the Killian Latex property. IBI scores were in the marginally good range in the Tuscarawas River, with each site scoring 34. These IBI values were nonsignificant departures from the ecoregional biocriterion established for Warmwater Habitat (WWH) streams and rivers in Ohio (Table 1). Modified Index of Well-Being scores were in the poor to fair range, with values of 5.7, 6.0, and 7.0. These MIwb scores did not achieve the ecoregional biocriterion established for Warmwater Habitat (WWH) streams and rivers in Ohio. The large numbers of pollution tolerant white suckers and common carp contributed to the lower MIwb scores.

Macroinvertebrate Community Assessment

The macroinvertebrate communities at three Tuscarawas River sites were sampled in 2005 using qualitative (multi-habitat composite) and quantitative (artificial substrate) sampling protocols. Results are summarized in Table 7. The ICI metrics with the associated scores for the Erie-Ontario Lake Plain ecoregion and the raw data are attached as Appendix Tables 4 and 5 .

The ICI scores for the three Tuscarawas River sites (RMs 123.1, 122.7, and 122.5) were 32, 28, and 18, respectively. The ICI score at the upstream site was a nonsignificant departure from the ecoregional WWH biocriterion (34) and reflected a marginally good macroinvertebrate community. Scores for the macroinvertebrate communities at the adjacent and downstream sites did not meet the WWH biocriterion. The lower ICI scores for the adjacent site and especially the downstream site appeared to be related to lower habitat quality. The stream channel was wider and deeper with lower stream velocity and a number of wetland characteristics. Bottom substrates were predominantly sand. The adjacent and downstream sites were lacking in substrates suitable for macroinvertebrate colonization, which contributed to the low metric score for the qualitative number of EPT taxa. Chemical contamination impacts from the Killian Latex property would likely be manifested in the macroinvertebrate community as an increase in tolerant taxa at the adjacent and downstream sites. However, the percentage of tolerant organisms were lower at the adjacent and downstream sites than the upstream site (Appendix Table 4). This was further evidence supporting the role of suboptimal habitat conditions and the resultant macroinvertebrate response.

Table 3. Exceedences of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters from the Tuscarawas River within the study area during 2005.

River Mile	Parameter (value)
Tuscarawas River	
123.1	Silver (2.45J*)
122.7	Silver (2.36J*)
122.5	Silver (2.25J*)

* Exceedence of Outside Mixing Zone Average criterion.
J The analyte was positively identified, but the quantitation was below the reporting limit.

Table 4. Chemical parameters measured above screening levels in sediment samples collected by Ohio EPA from the Tuscarawas River, May, 2005. Contamination levels were determined for parameters using either consensus-based sediment quality guidelines (MacDonald et.al. 2000), ecological screening levels for RCRA appendix IX constituents (USEPA 2003), or sediment reference values for metals listed in the Ohio EPA Ecological Risk Assessment Guidance (2003b).

Parameter	Tuscarawas River RM 123.1	Tuscarawas River RM 122.7	Tuscarawas River RM 122.5	Reference Levels SRVs
Silver (mg/kg)	0.993J [E]	0.938J [E]	1.18 [E]	0.43
Arsenic (mg/kg)	14 [T]	17.5 [T]	15.6 [T]	25
Lead (mg/kg)	17.8	52.7 [T]	47.5 [T]	47
Zinc (mg/kg)	81.5	110	151 [T]	160

J - The analyte was positively identified, but the quantitation was below the reporting limit (RL).
[T] - Above Threshold Effect Concentration (below which harmful effects are unlikely to occur; MacDonald *et.al.* 2000).
[P] - Above Probable Effect Concentration (above which harmful effects are likely to occur; MacDonald *et.al*. 2000).
[E] - Above Ecological Data Quality Level for RCRA appendix IX constituents (USEPA 1998).

Table 5. Qualitative Habitat Evaluation Index (QHEI) results for the Tuscarawas River, 2005.

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
(17-500) Tuscarawas River																																		
Year: 2005																																		
123.1	**70.5**	5.62	■	■		■	■	■	■	■	■	■	9						0		●			●	●				●	●		5	0.10	0.60
122.7	**62.5**	5.62	■	■				■			■		4						0		●			●	●			●	●	●		6	0.20	1.40
122.5	**71.0**	5.62	■	■		■		■		■	■	■	7						0		●			●	●			●	●	●		6	0.13	0.88

Table 6. Fish community summaries based on pulsed DC electrofishing sampling conducted by Ohio EPA in the Tuscarawas River from July and August, 2005. Relative numbers and weight for the Tuscarawas River sites are per 0.3 km.

Stream/ River Mile	Mean Number of Species	Total Number Species	Mean Relative Number	Mean Relative Weight (kg)	QHEI	Mean Modified Index of Well-Being	Mean Index of Biotic Integrity	Narrative Evaluation
Tuscarawas River (2005)								
123.1	14.5	17	323	37.31	70.5	5.7*	34 [ns]	Poor/MG
122.7	15.5	18	161	69.83	62.5	6.0*	34 [ns]	Fair/ MG
122.5	17.0	20	285	41.84	71.0	7.1*	34 [ns]	Fair/ MG

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)
(Ohio Administrative Code 3745-1-07, Table 7-15)

INDEX	WWH	EWH	MWH[a]
IBI-Wading	38	50	24
MIwb - Wading	7.9	9.4	5.8

[a] Modified Warmwater Habitat for channel modified areas.
* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
[ns] Nonsignificant departure from ecoregion biocriterion (≤4 IBI units, ≤0.5 MIwb units).
MG - Marginally good.

Table 7. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Tuscarawas River, 2005.

River Mile	Density Number/ft^2	Total Taxa	Quantitative Taxa	Qualitative Taxa	Qualitative EPT[a]	ICI	Evaluation
				WWH Use Designation			
Tuscarawas River							
123.1	244	56	41	31	9	32[ns]	Marg. Good
122.7	246	51	39	21	2	28*	Fair
122.5	142	43	31	21	3	18*	Fair

Ecoregion Biocriteria: Erie-Ontario Lake Plain (EOLP)
(Ohio Administrative Code 3745-1-07, Table 7-15)

INDEX	WWH	EWH	MWH[b]
ICI	34	46	22

[a] EPT= total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness, a measure of pollution sensitive organisms.
[b] Modified Warmwater Habitat for channel modified areas.
* Significant departure from ecoregional biocriterion; poor and very poor results are underlined.

REFERENCES

DeShon, J.D. 1995. Development and application of Ohio EPA's invertebrate community index (ICI), *in* W.S. Davis and T. Simon (eds.). Biological assessment and criteria: tools for risk-based planning and decision making. CRC Press/Lewis Publishers, Ann Arbor.

Fausch, D.O., Karr, J.R. and P.R. Yant. 1984. Regional application of an index of biotic integrity based on stream fish communities. Trans. Amer. Fish. Soc. 113:39-55.

Karr, J. R. 1991**.** Biological integrity: A long-neglected aspect of water resource management. Ecological Applications 1(1): 66-84.

Karr, J.R., K.D. Fausch, P.L. Angermier, P.R. Yant, and I.J. Schlosser. 1986. Assessing biological integrity in running waters: a method and its rationale. Ill. Nat. Hist. Surv. Spec. Publ. 5. 28 pp.

MacDonald, D., C. Ingersoll, T. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Arch. Environ. Contam. Toxical.: Vol.39, 20-31.

Miner R. and D. Borton. 1991. Considerations in the development and implementation of biocriteria, Water Quality Standards for the 21st Century, U.S. EPA, Offc. Science and Technology, Washington, D.C., 115.

Ohio Environmental Protection Agency. 2003a. Ecological risk assessment guidance manual. Feb. 2003. Division of Emergency and Remedial Response, Columbus, Ohio.

___ 2003b. Ohio EPA manual of surveillance methods and quaity assurance practices, updated edition. Division of Environmental Services, Columbus, Ohio.

___ 2001. Sediment sampling guide and methodologies, 2nd edition. Nov. 2001. Division of Surface Water, Columbus, Ohio.

___ 1987a. Biological criteria for the protection of aquatic life: Volume I. The role of biological data in water quality assessment. Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

___ 1987b. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

___ 1989b. Addendum to biological criteria for the protection of aquatic life: Users manual for biological field assessment of Ohio surface waters. Division of Water Quality Planning and Assessment, Surface Water Section, Columbus, Ohio.

___ 1989c. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Planning and Assessment, Columbus, Ohio.

Omernik, J.M. 1987. Ecoregions of the conterminous United States. Ann. Assoc. Amer. Geogr. 77(1): 118-125.

Rankin, E.T. 1995. The qualitative habitat evaluation index (QHEI). *In* W.S. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Risk-based Planning and Decision Making. CRC Press/Lewis Publishers, Ann Arbor.

Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Division of Water Quality Planning and Assessment, Columbus, Ohio.

Suter, G.W., II. 1993. A critique of ecosystem health concepts and indexes. Environmental Toxicology and Chemistry, 12: 1533-1539.

United States Environmental Protection Agency (1996). Ecotox thresholds. Office of Solid Waste and Emergency Response. EPA 540/F-95/038. January 1996.

United States Environmental Protection Agency (1998). Region 5, final technical approach for developing ecological data quality levels for RCRA Appendix IX constituents and other significant contaminants of ecological concern. April, 1998.

Whittier, T.R., D.P. Larsen, R.M. Hughes, C.M. Rohm, A.L. Gallant, and J.M. Omernik. 1987. The Ohio stream regionalization project: a compendium of results. EPA/600/3-87/025. 66 pp.

Yoder, C.O. 1989. The development and use of biological criteria for Ohio surface waters. U.S. EPA, Criteria and Standards Div., Water Quality Stds. 21st Century, 1989: 139-146.

Yoder, C. O. 1991**.** Answering some concerns about biological criteria based on experiences in Ohio, *in* G. H. Flock (ed.) Water quality standards for the 21st century. Proceedings of a National Conference, U. S. EPA, Office of Water, Washington, D.C.

Yoder, C.O. 1995. Policy issues and management applications of biological criteria, *in* W.S. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Risk-based Planning and Decision Making. CRC Press/Lewis Publishers, Ann Arbor.

Yoder, C.O. and E.T. Rankin. 1995. Biological response signatures and the area of degradation value: new tools for interpreting multi-metric data, *in* W.S. Davis and T. Simon (eds.). Biological Assessment and Criteria: Tools for Risk-based Planning and Decision Making. CRC Press/Lewis Publishers, Ann Arbor.

APPENDICES

Appendix Table 1. Results of chemical surface water sampling conducted by Ohio EPA in the Tuscarawas River on May 12, 2005. Less than values were reported by the lab as not detected at or above the method detection limit.

Stream	**Tuscarawas River**	**Tuscarawas Creek**	**Tuscarawas Creek**
River Mile	**123.1**	**122.7**	**122.5**
Date Sampled	5/12/2005	5/12/2005	5/12/2005
Time Sampled	11:50 AM	11:10 AM	10:25 AM
TAL Metals (ug/l)			
Mercury	<0.1	<0.1	<0.1
Aluminum	241	241	285
Silver	2.45J [a]	2.36J [a]	2.25J [a]
Arsenic	<2	<2	<2
Barium	90.3	89.1	86.2
Beryllium	<0.25	<0.25	<0.25
Calcium	99,800	96,800	93,000
Cadmium	<0.25	<0.25	<0.25
Cobalt	<2.5	<2.5	<2.5
Chromium	<2.5	<2.5	<2.5
Copper	<5	<5	<5
Iron	635	664	702
Potassium	2,870	2,750	2,650
Magnesium	22,300	21,300	20,400
Manganese	214	231	221
Sodium	64,100	62,500	59,500
Nickel	<5	<5	<5
Lead	3.28J	3.36J	3.06J
Vanadium	<5	<5	<5
Zinc	<5	<5	<5
Antimony	<0.5	<0.5	<0.5
Selenium	ND (3)	ND (3)	ND (3)
Thallium	<0.1	<0.1	<0.1
Volatile Organic Analytes (ug/l)			
Acetone	<2.5	<2.5	<2.5
Benzene	<0.125	<0.125	<0.125
Bromobenzene	<0.125	<0.125	<0.125
Bromochloromethane	<0.20	<0.20	<0.20
Bromodichloromethane	<0.25	<0.25	<0.25
Bromoform	<0.54	<0.54	<0.54
Bromomethane	<0.5	<0.5	<0.5
2-Butanone	<2.5	<2.5	<2.5
n-Butylbenzene	<0.25	<0.25	<0.25
sec-Butylbenzene	<0.25	<0.25	<0.25
tert-Butylbenzene	<0.25	<0.25	<0.25
Carbon disulfide	<0.5	<0.5	<0.5
Carbon tetrachloride	<0.25	<0.25	<0.25
Chlorobenzene	<0.125	<0.125	<0.125
Chlorodibromomethane	<0.25	<0.25	<0.25
Chloroethane	<0.5	<0.5	<0.5

Appendix Table 1. Continued.

Stream	**Tuscarawas River**	**Tuscarawas Creek**	**Tuscarawas Creek**
River Mile	**123.1**	**122.7**	**122.5**
Date Sampled	5/12/2005	5/12/2005	5/12/2005
Time Sampled	11:50 AM	11:10 AM	10:25 AM
Volatile Organic Analytes (ug/l)			
2-Chloroethyl vinyl ether	<10	<10	<10
Chloroform	<0.125	<0.125	<0.125
Chloromethane	<0.25	<0.25	<0.25
2-Chlorotoluene	<0.125	<0.125	<0.125
4-Chlorotoluene	<0.25	<0.25	<0.25
1,2-Dibromo-3-chloropropane	<1.0	<1.0	<1.0
1,2-Dibromomethane	<0.25	<0.25	<0.25
Dibromomethane	<0.25	<0.25	<0.25
1,2-Dichlorobenzene	<0.125	<0.125	<0.125
1,3-Dichlorobenzene	<0.25	<0.25	<0.25
1,4-Dichlorobenzene	<0.125	<0.125	<0.125
Dichlorodifluoromethane	<0.25	<0.25	<0.25
1,1-Dichloroethane	<0.125	<0.125	<0.125
1,2-Dichloroethane	<0.25	<0.25	<0.25
1,1-Dichloroethene	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene	<0.25	<0.25	<0.25
trans-1,2-Dichloroethene	<0.25	<0.25	<0.25
1,2-Dichloropropane	<0.125	<0.125	<0.125
1,3-Dichloropropane	<0.20	<0.20	<0.20
2,2-Dichloropropane	<0.25	<0.25	<0.25
cis-1,3-Dichloropropene	<0.25	<0.25	<0.25
trans-1,3-Dichloropropene	<0.5	<0.5	<0.5
1,1-Dichloropropene	<0.25	<0.25	<0.25
Ethylbenzene	<0.25	<0.25	<0.25
n-Hexane	<0.56	<0.56	<0.56
2-Hexanone	<2.5	<2.5	<2.5
Hexachlorobutadiene	<0.25	<0.25	<0.25
Isopropylbenzene	<0.25	<0.25	<0.25
p-Isopropyltoluene	<0.25	<0.25	<0.25
4-Methyl-2-pentanone	<2.5	<2.5	<2.5
Methylene chloride	<0.25	<0.25	<0.25
Naphthalene	<0.20	<0.20	<0.20
n-Propylbenzene	<0.125	<0.125	<0.125
Styrene	<0.125	<0.125	<0.125
1,1,1,2-Tetrachloroethane	<0.25	<0.25	<0.25
1,1,2,2-Tetrachloroethane	<0.125	<0.125	<0.125
Tetrachloroethene	<0.25	<0.25	<0.25
Toluene	<0.25	<0.25	<0.25
1,2,3-Trichlorobenzene	<0.125	<0.125	<0.125
1,2,4-Trichlorobenzene	<0.20	<0.20	<0.20
1,1,1-Trichloroethane	<0.25	<0.25	<0.25
1,1,2-Trichloroethane	<0.25	<0.25	<0.25
Trichloroethene	<0.25	<0.25	<0.25
Trichlorofluoromethane	<0.25	<0.25	<0.25
1,2,3-Trichloropropane	<0.75	<0.75	<0.75
1,2,4-Trimethylbenzene	<0.25	<0.25	<0.25
1,3,5-Trimethylbenzene	<0.25	<0.25	<0.25

Appendix Table 1. Continued.

Stream	**Tuscarawas River**	**Tuscarawas Creek**	**Tuscarawas Creek**
River Mile	**123.1**	**122.7**	**122.5**
Date Sampled	5/12/2005	5/12/2005	5/12/2005
Time Sampled	11:50 AM	11:10 AM	10:25 AM
Volatile Organic Analytes (ug/l)			
Vinyl acetate	<2.5	<2.5	<2.5
Vinyl chloride	<0.25	<0.25	<0.25
o-Xylene	<0.25	<0.25	<0.25
m-,p-Xylene	<0.5	<0.5	<0.5
Semi-volatile Organic Analytes (ug/l)			
Phenol	<2.5	<2.5	<2.5
bis-(2-Chloroethyl) ether	<2.5	<2.5	<2.5
2-Chlorophenol	<2.5	<2.5	<2.5
1,3-Dichlorobenzene	<2.5	<2.5	<2.5
1,4-Dichlorobenzene	<2.5	<2.5	<2.5
Benzyl alcohol	<2.5	<2.5	<2.5
1,2-Dichlorobenzene	<2.5	<2.5	<2.5
2-Methylphenol	<2.5	<2.5	<2.5
3-,4-Methylphenol	<2.5	<2.5	<2.5
bis(2-Chloroisopropyl) ether	<2.5	<2.5	<2.5
N-Nitroso-di-n-propylamine	<2.5	<2.5	<2.5
Hexachloroethane	<2.5	<2.5	<2.5
Nitrobenzene	<2.5	<2.5	<2.5
Isophorone	<2.5	<2.5	<2.5
2-Nitrophenol	<2.5	<2.5	<2.5
2,4-Dimethylphenol	<2.5	<2.5	<2.5
Benzoic acid	<12.5	<12.5	<12.5
bis(2-Chloroethoxy)methane	<2.5	<2.5	<2.5
2,4-Dichlorophenol	<2.5	<2.5	<2.5
1,2,4-Trichlorobenzene	<2.5	<2.5	<2.5
Naphthalene	<2.5	<2.5	<2.5
4-Chloroaniline	<2.5	<2.5	<2.5
Hexachlorobutadiene	<2.5	<2.5	<2.5
4-Chloro-3-methylphenol	<2.5	<2.5	<2.5
2-Methylnaphthalene	<2.5	<2.5	<2.5
Hexachlorocyclopentadiene	<2.5	<2.5	<2.5
2,4,6-Trichlorophenol	<2.5	<2.5	<2.5
2,4,5-Trichlorophenol	<2.5	<2.5	<2.5
2-Chloronaphthalene	<2.5	<2.5	<2.5
2-Nitroaniline	<12.5	<12.5	<12.5
Dimethylphthalate	<2.5	<2.5	<2.5
Acenaphthylene	<2.5	<2.5	<2.5
2,6-Dinitrotoluene	<2.5	<2.5	<2.5
3-Nitroaniline	<12.5	<12.5	<12.5
Acenaphthene	<2.5	<2.5	<2.5
2,4-Dinitrophenol	<12.5	<12.5	<12.5
4-Nitrophenol	<12.5	<12.5	<12.5
Dibenzofuran	<2.5	<2.5	<2.5

Appendix Table 1. Continued.

Stream	Tuscarawas River	Tuscarawas Creek	Tuscarawas Creek
River Mile	**123.1**	**122.7**	**122.5**
Date Sampled	5/12/2005	5/12/2005	5/12/2005
Time Sampled	11:50 AM	11:10 AM	10:25 AM
Semi-volatile Organic Analytes (ug/l)			
2,4-Dinitrotoluene	<2.5	<2.5	<2.5
Diethylphthalate	<2.5	<2.5	<2.5
4-Chlorophenyl-phenyl ether	<2.5	<2.5	<2.5
Fluorene	<2.5	<2.5	<2.5
4-Nitroaniline	<12.5	<12.5	<12.5
4,6-Dinitro-2-methylphenol	<12.5	<12.5	<12.5
N-Nitrosodiphenylamine	<2.5	<2.5	<2.5
4-Bromophenyl-phenylether	<2.5	<2.5	<2.5
Hexachlorobenzene	<2.5	<2.5	<2.5
Pentachlorophenol	<12.5	<12.5	<12.5
Phenanthrene	<2.5	<2.5	<2.5
Anthracene	<2.5	<2.5	<2.5
Di-N-butylphthalate	<2.5	<2.5	<2.5
Fluoranthene	<2.5	<2.5	<2.5
Pyrene	<2.5	<2.5	<2.5
Butylbenzylphthalate	<2.5	<2.5	<2.5
3,3'-Dichlorobenzidine	<2.5	<2.5	<2.5
Benzo(a)anthracene	<2.5	<2.5	<2.5
Chrysene	<2.5	<2.5	<2.5
bis(2-Ethylhexyl) phthalate	<3.0	<3.0	<3.0
Di-n-octylphthalate	<2.5	<2.5	<2.5
Benzo(b)fluoranthene	<2.5	<2.5	<2.5
Benzo(k)fluoranthene	<2.5	<2.5	<2.5
Benzo(a)pyrene	<2.5	<2.5	<2.5
Indeno(1,2,3-cd)pyrene	<2.5	<2.5	<2.5
Dibenzo(a,h)anthracene	<2.5	<2.5	<2.5
Benzo(g,h,i)perylene	<2.5	<2.5	<2.5
PCBs (ug/l)			
Aroclor 1016	<0.25	<0.25	<0.25
Aroclor 1221	<0.25	<0.25	<0.25
Aroclor 1232	<0.25	<0.25	<0.25
Aroclor 1242	<0.25	<0.25	<0.25
Aroclor 1248	<0.25	<0.25	<0.25
Aroclor 1254	<0.25	<0.25	<0.25
Aroclor 1260	<0.25	<0.25	<0.25
Pesticides (ug/l)			
4,4'-DDD	<0.01	<0.01	<0.01
4,4'-DDE	<0.01	<0.01	<0.01
4,4'-DDT	<0.01	<0.01	<0.01
Aldrin	<0.01	<0.01	<0.01
alpha-BHC	<0.01	<0.01	<0.01

Appendix Table 1. Continued.

Stream	Tuscarawas River	Tuscarawas Creek	Tuscarawas Creek
River Mile	**123.1**	**122.7**	**122.5**
Date Sampled	5/12/2005	5/12/2005	5/12/2005
Time Sampled	11:50 AM	11:10 AM	10:25 AM
Pesticides (ug/l)			
beta-BHC	<0.01	<0.01	<0.01
delta-BHC	<0.01	<0.01	<0.01
Dieldrin	<0.01	<0.01	<0.01
Endosulfan I	<0.01	<0.01	<0.01
Endosulfan II	<0.01	<0.01	<0.01
Endosulfan sulfate	<0.01	<0.01	<0.01
Endrin	<0.01	<0.01	<0.01
Endrin aldehyde	<0.01	<0.01	<0.01
gamma-BHC (Lindane)	<0.01	<0.01	<0.01
Heptachlor	<0.01	<0.01	<0.01
Heptachlor epoxide	<0.01	<0.01	<0.01
Methoxychlor	<0.01	<0.01	<0.01
Endrin ketone	<0.01	<0.01	<0.01
alpha Chlordane	<0.01	<0.01	<0.01
gamma Chlordane	<0.01	<0.01	<0.01
Toxaphene	<0.3	<0.3	<0.3

J - The analyte was positively identified, but the quantitation was below the reporting limit.

< - Not detected at or above the method detection limit (MDL value reported with the less than symbol).

a - Exceeds Outside Mixing Zone Average (OMZA) water quality criteria.

ND - not detected

Appendix Table 2. Results of chemical surface water sampling conducted by Ohio EPA in the Tuscarawas River on August 16, 2005. Less than values were reported by the lab as not detected at or above the method detection limit.

Stream	**Tuscarawas River**	**Tuscarawas Creek**	**Tuscarawas Creek**	**Tuscarawas Creek**
River Mile	**123.1**	**122.7**	**122.7**	**122.5**
Date Sampled	8/16/2005	8/16/2005	8/16/2005	8/16/2005
Time Sampled	11:15AM	1:45PM	1:45PM	1:55PM
			Duplicate	
TAL Metals (ug/l)				
Mercury	<0.1	<0.1	<0.1	<0.1
Aluminum	250	457	319	295
Silver	<5	<5	<5	<5
Arsenic	2.83J	2.93J	3.47J	2.63J
Barium	103	107	106	105
Beryllium	<0.25	<0.25	<0.25	<0.25
Calcium	99,600	100,000	102,000	101,000
Cadmium	<0.25	<0.25	<0.25	<0.25
Cobalt	<2.5	<2.5	<2.5	<2.5
Chromium	<2.5	<2.5	<2.5	<2.5
Copper	<2.5	<2.5	<2.5	<2.5
Iron	621	1,030	693	662
Potassium	3,270	3,400	3,390	3,350
Magnesium	21,500	21,100	21,600	21,600
Manganese	151	235	165	163
Sodium	59,100	57,800	59800	58,800
Nickel	<5	<5	<5	<5
Lead	3.23J	3.98J	3.49J	3.19J
Vanadium	<5	<5	<5	<5
Zinc	<5	6.39J	<5	<5
Antimony	<50	<50	<50	<50
Selenium	ND (1.5)	ND (1.5)	ND (1.5)	ND (1.5)
Thallium	<100	<100	<100	<100
Semi-volatile Organic Analytes (ug/l)				
Phenol	<2.55	<2.5	<2.55	<2.58
bis-(2-Chloroethyl) ether	<2.55	<2.5	<2.55	<2.58
2-Chlorophenol	<2.55	<2.5	<2.55	<2.58
1,3-Dichlorobenzene	<2.55	<2.5	<2.55	<2.58
1,4-Dichlorobenzene	<2.55	<2.5	<2.55	<2.58
Benzyl alcohol	<2.55	<2.5	<2.55	<2.58
1,2-Dichlorobenzene	<2.55	<2.5	<2.55	<2.58
2-Methylphenol	<2.55	<2.5	<2.55	<2.58
3-,4-Methylphenol	<2.55	<2.5	<2.55	<2.58
bis(2-Chloroisopropyl) ether	<2.55	<2.5	<2.55	<2.58
N-Nitroso-di-n-propylamine	<2.55	<2.5	<2.55	<2.58
Hexachloroethane	<2.55	<2.5	<2.55	<2.58
Nitrobenzene	<2.55	<2.5	<2.55	<2.58
Isophorone	<2.55	<2.5	<2.55	<2.58
2-Nitrophenol	<2.55	<2.5	<2.55	<2.58

Appendix Table 2. Continued.

Stream	**Tuscarawas River**	**Tuscarawas Creek**	**Tuscarawas Creek**	**Tuscarawas Creek**
River Mile	**123.1**	**122.7**	**122.7**	**122.5**
Date Sampled	8/16/2005	8/16/2005	8/16/2005	8/16/2005
Time Sampled	11:15AM	1:45PM	1:45PM	1:55PM
			Duplicate	
Semi-volatile Organic Analytes (ug/l)				
2,4-Dimethylphenol	<2.55	<2.5	<2.55	<2.58
Benzoic acid	<12.8	<12.5	<12.8	<12.9
bis(2-Chloroethoxy)methane	<2.55	<2.5	<2.55	<2.58
2,4-Dichlorophenol	<2.55	<2.5	<2.55	<2.58
1,2,4-Trichlorobenzene	<2.55	<2.5	<2.55	<2.58
Naphthalene	<2.55	<2.5	<2.55	<2.58
4-Chloroaniline	<2.55	<2.5	<2.55	<2.58
Hexachlorobutadiene	<2.55	<2.5	<2.55	<2.58
4-Chloro-3-methylphenol	<2.55	<2.5	<2.55	<2.58
2-Methylnaphthalene	<2.55	<2.5	<2.55	<2.58
Hexachlorocyclopentadiene	<2.55	<2.5	<2.55	<2.58
2,4,6-Trichlorophenol	<2.55	<2.5	<2.55	<2.58
2,4,5-Trichlorophenol	<2.55	<2.5	<2.55	<2.58
2-Chloronaphthalene	<2.55	<2.5	<2.55	<2.58
2-Nitroaniline	<12.8	<12.5	<12.8	<12.9
Dimethylphthalate	<2.55	<2.5	<2.55	<2.58
Acenaphthylene	<2.55	<2.5	<2.55	<2.58
2,6-Dinitrotoluene	<2.55	<2.5	<2.55	<2.58
3-Nitroaniline	<12.8	<12.5	<12.8	<12.9
Acenaphthene	<2.55	<2.5	<2.55	<2.58
2,4-Dinitrophenol	<12.8	<12.5	<12.8	<12.9
4-Nitrophenol	<12.8	<12.5	<12.8	<12.9
Dibenzofuran	<2.55	<2.5	<2.55	<2.58
2,4-Dinitrotoluene	<2.55	<2.5	<2.55	<2.58
Diethylphthalate	<2.55	<2.5	<2.55	<2.58
4-Chlorophenyl-phenyl ether	<2.55	<2.5	<2.55	<2.58
Fluorene	<2.55	<2.5	<2.55	<2.58
4-Nitroaniline	<12.8	<12.5	<12.8	<12.9
4,6-Dinitro-2-methylphenol	<12.8	<12.5	<12.8	<12.9
N-Nitrosodiphenylamine	<2.55	<2.5	<2.55	<2.58
4-Bromophenyl-phenylether	<2.55	<2.5	<2.55	<2.58
Hexachlorobenzene	<2.55	<2.5	<2.55	<2.58
Pentachlorophenol	<12.8	<12.5	<12.8	<12.9
Phenanthrene	<2.55	<2.5	<2.55	<2.58
Anthracene	<2.55	<2.5	<2.55	<2.58
Di-N-butylphthalate	<2.55	<2.5	<2.55	<2.58
Fluoranthene	<2.55	<2.5	<2.55	<2.58
Pyrene	<2.55	<2.5	<2.55	<2.58
Butylbenzylphthalate	<2.55	<2.5	<2.55	<2.58
3,3'-Dichlorobenzidine	<2.55	<2.5	<2.55	<2.58
Benzo(a)anthracene	<2.55	<2.5	<2.55	<2.58
Chrysene	<2.55	<2.5	<2.55	<2.58

Appendix Table 2. Continued.

Stream	**Tuscarawas River**	**Tuscarawas Creek**	**Tuscarawas Creek**	**Tuscarawas Creek**
River Mile	**123.1**	**122.7**	**122.7**	**122.5**
Date Sampled	8/16/2005	8/16/2005	8/16/2005	8/16/2005
Time Sampled	11:15AM	1:45PM	1:45PM	1:55PM
			Duplicate	
Semi-volatile Organic Analytes (ug/l)				
bis(2-Ethylhexyl) phthalate	<3.06	<3.0	<3.06	<3.09
Di-n-octylphthalate	<2.55	<2.5	<2.55	<2.58
Benzo(b)fluoranthene	<2.55	<2.5	<2.55	<2.58
Benzo(k)fluoranthene	<2.55	<2.5	<2.55	<2.58
Benzo(a)pyrene	<2.55	<2.5	<2.55	<2.58
Indeno(1,2,3-cd)pyrene	<2.55	<2.5	<2.55	<2.58
Dibenzo(a,h)anthracene	<2.55	<2.5	<2.55	<2.58
Benzo(g,h,i)perylene	<2.55	<2.5	<2.55	<2.58
Field Parameters				
Dissolved oxygen (mg/l)	8.7	9.46	9.46	9.14
pH (S.U)	7.97	7.94	7.94	7.81
Conductivity (umhos/cm)	690	724	724	800
Temperature (^{o}C)	19.3	20.8	20.8	20.7

J - The analyte was positively identified, but the quantitation was below the reporting limit.

< - Not detected at or above the method detection limit (MDL value reported with the less than symbol).

ND - Not detected. Method detection limit in parentheses.

Appendix Table 3. Results of Ohio EPA sediment sampling conducted in the Tuscarawas River, May 12, 2005. NA - not applicable. Shaded values exceed applicable TEC or EDQL screening levels.

Stream	**Tuscarawas River**	**Tuscarawas River**	**Tuscarawas River**			
River Mile	**123.1**	**122.7**	**122.5**	Sediment	MacDonald	
Date Sampled	5/12/2005	5/12/2005	5/12/2005	Reference	2000	USEPA
Time Sampled	12:00 PM	11:20 AM	10:35 AM	Values (SRV)	TEC	EDQLs
TAL Metals (mg/kg)						
Mercury	0.0379J	0.0549J	0.0464J	0.12	0.18	0.174
Aluminum	6,490	7,010	7,200	29,000	NA	NA
Silver	0.993J	0.938J	1.18	0.43	NA	0.5
Arsenic	14	17.5	15.6	25	9.79	5.9
Barium	115	112	131	190	NA	NA
Beryllium	0.349	0.379	0.422	0.8	NA	NA
Calcium	10,500	10,000	11,000	21,000	NA	NA
Cadmium	0.487	0.58	0.674	0.79	0.99	0.596
Cobalt	2.74	3.78	4.02	12	NA	50
Chromium	8.82	9.68	9.97	29	43.4	26
Copper	14.4	16.6	18.8	32	31.6	16
Iron	21,400	20,400	22,300	41,000	NA	NA
Potassium	615	672	664	6,800	NA	NA
Magnesium	2040	2070	2060	7,100	NA	NA
Manganese	853	756	950	1,500	NA	NA
Sodium	171	181	197	NA	NA	NA
Nickel	11.9	13.1	14.4	33	22.7	16
Lead	17.8	52.7	47.5	47	35.8	31
Vanadium	12.7	13.7	13.9	40	NA	NA
Zinc	81.5	110	151	160	121	120
Antimony	<0.219	0.254J	<0.246	1.3	NA	NA
Selenium	3.96	2.72	2.6	1.7	NA	NA
Thallium	0.164J	0.456	0.427	4.7	NA	NA
Volatile Organic Analytes (ug/kg)						
Acetone	44.3J	38.6J	59.5J	NA	NA	453.37
Benzene	<1.18	<1.22	<1.23	NA	NA	141.57
Bromobenzene	<1.18	<1.22	<1.23	NA	NA	NA
Bromochloromethane	<1.18	<1.22	<1.23	NA	NA	NA
Bromodichloromethane	<1.18	<1.22	<1.23	NA	NA	1.13
Bromoform	<1.18	<1.22	<1.23	NA	NA	996.27
Bromomethane	<2.37	<2.44	<2.46	NA	NA	NA
2-Butanone	11.1J	9.81J	15.9J	NA	NA	136.96
n-Butylbenzene	<1.18	<1.22	<1.23	NA	NA	NA
sec-Butylbenzene	<1.18	<1.22	<1.23	NA	NA	NA
tert-Butylbenzene	<1.18	<1.22	<1.23	NA	NA	NA
Carbon disulfide	<1.18	<1.22	<1.23	NA	NA	133.97
Carbon tetrachloride	<1.18	<1.22	<1.23	NA	NA	35.73
Chlorobenzene	<1.18	<1.22	<1.23	NA	NA	61.94
Chlorodibromomethane	<1.18	<1.22	<1.23	NA	NA	267.61
Chloroethane	<2.37	<2.44	<2.46	NA	NA	58600
2-Chloroethyl vinyl ether	<1.18	<1.22	<1.23	NA	NA	NA
Chloroform	<1.18	<1.22	<1.23	NA	NA	27
Chloromethane	<4.73	<4.88	<4.92	NA	NA	NA
2-Chlorotoluene	<1.18	<1.22	<1.23	NA	NA	NA
4-Chlorotoluene	<1.18	<1.22	<1.23	NA	NA	NA

Appendix Table 3. Continued.

Stream	**Tuscarawas River**	**Tuscarawas River**	**Tuscarawas River**			
River Mile	**123.1**	**122.7**	**122.5**	Sediment	MacDonald	
Date Sampled	5/12/2005	5/12/2005	5/12/2005	Reference	2000	USEPA
Time Sampled	12:00 PM	11:20 AM	10:35 AM	Values (SRV)	TEC	EDQLs
Volatile Organic Analytes (ug/kg)						
Dichlorodifluoromethane	<2.37	<2.44	<2.46	NA	NA	1.33
1,1-Dichloroethane	<2.37	<2.44	<2.46	NA	NA	0.575
1,2-Dichloroethane	<1.18	<1.22	<1.23	NA	NA	54.18
1,1-Dichloroethene	<1.18	<1.22	<1.23	NA	NA	23.27
cis-1,2-Dichloroethene	<1.18	<1.22	<1.23	NA	NA	NA
trans-1,2-Dichloroethene	<1.18	<1.22	<1.23	NA	NA	208.94
1,2-Dichloropropane	<1.18	<1.22	<1.23	NA	NA	351.61
1,3-Dichloropropane	<1.18	<1.22	<1.23	NA	NA	NA
2,2-Dichloropropane	<1.18	<1.22	<1.23	NA	NA	NA
cis-1,3-Dichloropropene	<1.18	<1.22	<1.23	NA	NA	2.96
trans-1,3-Dichloropropene	<1.18	<1.22	<1.23	NA	NA	2.96
1,1-Dichloropropene	<1.18	<1.22	<1.23	NA	NA	NA
Ethylbenzene	<1.18	<1.22	<1.23	NA	NA	0.1
n-Hexane	<1.18	<1.22	<1.23	NA	NA	NA
2-Hexanone	<5.92	<6.10	<6.15	NA	NA	1010
Hexachlorobutadiene	<1.18	<1.22	<1.23	NA	NA	1380
Isopropylbenzene	<1.18	<1.22	<1.23	NA	NA	NA
p-Isopropyltoluene	<1.18	<1.22	<1.23	NA	NA	NA
4-Methyl-2-pentanone	<5.92	<6.10	<6.15	NA	NA	544.37
Methylene chloride	<2.37	<2.44	<2.46	NA	NA	1260
Naphthalene	<1.18	<1.22	<1.23	NA	NA	34.6
n-Propylbenzene	<1.18	<1.22	<1.23	NA	NA	NA
Styrene	<1.18	<1.22	<1.23	NA	NA	444.96
1,1,1,2-Tetrachloroethane	<1.18	<1.22	<1.23	NA	NA	10.89
1,1,2,2-Tetrachloroethane	<1.18	<1.22	<1.23	NA	NA	29.08
Tetrachloroethene	<1.18	<1.22	<1.23	NA	NA	195.83
Toluene	<1.18	<1.22	<1.23	NA	NA	52500
1,2,3-Trichlorobenzene	<1.18	<1.22	<1.23	NA	NA	NA
1,2,4-Trichlorobenzene	<1.18	<1.22	<1.23	NA	NA	NA
1,1,1-Trichloroethane	<1.18	<1.22	<1.23	NA	NA	246.85
1,1,2-Trichloroethane	<1.18	<1.22	<1.23	NA	NA	673.51
Trichloroethene	<1.18	<1.22	<1.23	NA	NA	179.56
Trichlorofluoromethane	<2.37	<2.44	<2.46	NA	NA	3.07
1,2,3-Trichloropropane	<1.51	<1.56	<1.57	NA	NA	8.35
1,2,4-Trimethylbenzene	<1.18	<1.22	<1.23	NA	NA	NA
1,3,5-Trimethylbenzene	<1.18	<1.22	<1.23	NA	NA	NA
Vinyl acetate	<2.37	<2.44	<2.46	NA	NA	12.95
Vinyl chloride	<2.37	<2.44	<2.46	NA	NA	2
o-Xylene	<1.18	<1.22	<1.23	NA	NA	1880
m-,p-Xylene	<1.18	<1.22	<1.23	NA	NA	1880
Semi-volatile Organic Analytes (ug/kg)						
Phenol	<971	<1010	<992	NA	NA	27.26
bis-(2-Chloroethyl) ether	<971	<1010	<992	NA	NA	211.96
2-Chlorophenol	<971	<1010	<992	NA	NA	11.7
1,3-Dichlorobenzene	<971	<1010	<992	NA	NA	3010
1,4-Dichlorobenzene	<971	<1010	<992	NA	NA	1450
Benzyl alcohol	<971	<1010	<992	NA	NA	33.94
1,2-Dichlorobenzene	<971	<1010	<992	NA	NA	231.32
2-Methylphenol	<971	<1010	<992	NA	NA	0.826

Appendix Table 2. Continued.

Stream	**Tuscarawas River**	**Tuscarawas River**	**Tuscarawas River**			
River Mile	**123.1**	**122.7**	**122.5**	Sediment	MacDonald	
Date Sampled	5/12/2005	5/12/2005	5/12/2005	Reference	2000	USEPA
Time Sampled	12:00 PM	11:20 AM	10:35 AM	Values (SRV)	TEC	EDQLs
Semi-volatile Organic Analytes (ug/kg)						
2-Nitrophenol	<971	<1010	<992	NA	NA	7.77
2,4-Dimethylphenol	<971	<1010	<992	NA	NA	304.53
Benzoic acid	<3890	<4030	<3970	NA	NA	NA
bis(2-Chloroethoxy)methane	<971	<1010	<992	NA	NA	349.71
2,4-Dichlorophenol	<971	<1010	<992	NA	NA	133.63
1,2,4-Trichlorobenzene	<971	<1010	<992	NA	NA	11700
Naphthalene	<971	<1010	<992	NA	176	34.6
4-Chloroaniline	<971	<1010	<992	NA	NA	146.08
Hexachlorobutadiene	<971	<1010	<992	NA	NA	1380
4-Chloro-3-methylphenol	<971	<1010	<992	NA	NA	388.18
2-Methylnaphthalene	<971	<1010	<992	NA	NA	20.2
Hexachlorocyclopentadiene	<971	<1010	<992	NA	NA	900.74
2,4,6-Trichlorophenol	<971	<1010	<992	NA	NA	84.84
2,4,5-Trichlorophenol	<971	<1010	<992	NA	NA	85.56
2-Chloronaphthalene	<971	<1010	<992	NA	NA	417.23
2-Nitroaniline	<3890	<4030	<3970	NA	NA	0.222
Dimethylphthalate	<971	<1010	<992	NA	NA	24.95
Acenaphthylene	<971	<1010	<992	NA	NA	5.87
2,6-Dinitrotoluene	<971	<1010	<992	NA	NA	20.62
3-Nitroaniline	<3890	<4030	<3970	NA	NA	0.222
Acenaphthene	<971	<1010	<992	NA	NA	6.71
2,4-Dinitrophenol	<3890	<4030	<3970	NA	NA	1.33
4-Nitrophenol	<3890	<4030	<3970	NA	NA	7.78
Dibenzofuran	<971	<1010	<992	NA	NA	1520
2,4-Dinitrotoluene	<971	<1010	<992	NA	NA	75.13
Diethylphthalate	<971	<1010	<992	NA	NA	8.04
4-Chlorophenyl-phenyl ether	<971	<1010	<992	NA	NA	656.12
Fluorene	<971	<1010	<992	NA	77.4	21.2
4-Nitroaniline	<3890	<4030	<3970	NA	NA	0.222
4,6-Dinitro-2-methylphenol	<3890	<4030	<3970	NA	NA	10.38
N-Nitrosodiphenylamine	<971	<1010	<992	NA	NA	155.24
4-Bromophenyl-phenylether	<971	<1010	<992	NA	NA	1.55
Hexachlorobenzene	<971	<1010	<992	NA	NA	20
Pentachlorophenol	<3890	<4030	<3970	NA	NA	30100
Phenanthrene	<971	<1010	<992	NA	204	41.9
Anthracene	<971	<1010	<992	NA	57.2	46.9
Di-N-butylphthalate	<971	<1010	<992	NA	NA	110.5
Fluoranthene	<971	<1010	<992	NA	423	111.3
Pyrene	<971	<1010	<992	NA	195	53
Butylbenzylphthalate	<971	<1010	<992	NA	NA	4190
3,3'-Dichlorobenzidine	<1940	<2010	<1980	NA	NA	28.22
Benzo(a)anthracene	<971	<1010	<992	NA	108	31.7
Chrysene	<971	<1010	<992	NA	166	57.1
bis(2-Ethylhexyl) phthalate	<971	<1010	<992	NA	NA	182
Di-n-octylphthalate	<971	<1010	<992	NA	NA	40600
Benzo(b)fluoranthene	<971	<1010	<992	NA	NA	10400

Appendix Table 2. Continued.

Stream	**Tuscarawas River**	**Tuscarawas River**	**Tuscarawas River**			
River Mile	**123.1**	**122.7**	**122.5**	Sediment	MacDonald	
Date Sampled	5/12/2005	5/12/2005	5/12/2005	Reference	2000	USEPA
Time Sampled	12:00 PM	11:20 AM	10:35 AM	Values (SRV)	TEC	EDQLs
Semi-volatile Organic Analytes (ug/kg)						
Benzo(k)fluoranthene	<971	<1010	<992	NA	NA	240
Benzo(a)pyrene	<971	<1010	<992	NA	150	31.9
Indeno(1,2,3-cd)pyrene	<971	<1010	<992	NA	NA	200
Dibenzo(a,h)anthracene	<971	<1010	<992	NA	33	6.22
Benzo(g,h,i)perylene	<971	<1010	<992	NA	NA	170
PCBs (ug/kg)						
Aroclor 1016	<19.3	<19.8	<20.1	NA	59.8a	34.1a
Aroclor 1221	<19.3	<19.8	<20.1	NA	59.8a	34.1a
Aroclor 1232	<19.3	<19.8	<20.1	NA	59.8a	34.1a
Aroclor 1242	<19.3	<19.8	<20.1	NA	59.8a	34.1a
Aroclor 1248	<19.3	<19.8	<20.1	NA	59.8a	34.1a
Aroclor 1254	<19.3	<19.8	<20.1	NA	59.8a	34.1a
Aroclor 1260	<19.3	<19.8	<20.1	NA	59.8a	34.1a
Pesticides (ug/kg)						
alpha-BHC	<15.5	<15.8	<16.1	NA	NA	6
beta-BHC	<15.5	<15.8	<16.1	NA	NA	5
delta-BHC	<15.5	<15.8	<16.1	NA	NA	71500
gamma-BHC (Lindane)	<15.5	<15.8	<16.1	NA	2.37	0.94
Heptachlor	<15.5	<15.8	<16.1	NA	NA	0.6
Aldrin	<15.5	<15.8	<16.1	NA	NA	2
Heptachlor epoxide	<15.5	<15.8	<16.1	NA	2.47	0.6
Endosulfan I	<15.5	<15.8	<16.1	NA	NA	0.175
Dieldrin	<15.5	<15.8	<16.1	NA	1.9	2
4,4'-DDE	<15.5	<15.8	<16.1	NA	3.16	595.87
Endrin	<15.5	<15.8	<16.1	NA	2.22	2.67
Endosulfan II	<15.5	<15.8	<16.1	NA	NA	0.104
4,4'-DDD	<15.5	<15.8	<16.1	NA	4.88	5.53
Endosulfan sulfate	<15.5	<15.8	<16.1	NA	NA	34.6
4,4'-DDT	<15.5	<15.8	<16.1	NA	4.16	17.5
Methoxychlor	<15.5	<15.8	<16.1	NA	NA	3.59
Endrin ketone	<15.5	<15.8	<16.1	NA	NA	NA
Endrin aldehyde	<15.5	<15.8	<16.1	NA	NA	3200
alpha Chlordane	<15.5	<15.8	<16.1	NA	3.24	4.5
gamma Chlordane	<15.5	<15.8	<16.1	NA	3.24	4.5
Toxaphene	<782	<801	<815	NA	NA	0.109
Other						
Percent Solids	42.2	41	40.6	NA	NA	NA

J - The analyte was positively identified, but the quantitation was below the reporting limit (RL).

< - Not detected at or above the method detection limit (MDL value reported with the less than symbol).

a - Guideline is based on total PCBs.

Appendix Table 4. ICI results for the Tuscarawas River 2005.

River Mile	Drainage Area (sq mi)	Number of Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Percent: Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Organisms	Qual. EPT	Eco-region	ICI
Tuscarawas River (17-500)													
Year: 2005													
123.10	28.0	41(6)	3(2)	8(6)	26(6)	7.2(2)	7.1(4)	6.9(2)	78.3(0)	39.8(0)	9(4)	3	32
122.70	28.0	39(6)	2(0)	5(6)	22(6)	3.2(2)	11.5(6)	12.5(2)	70.1(0)	24.6(0)	2(0)	3	28
122.50	28.0	31(4)	2(0)	1(2)	21(6)	4.2(2)	3.3(2)	8.5(2)	82.4(0)	30.4(0)	3(0)	3	18

Appendix Table 5. Macroinvertebrate results collected by the Ohio EPA from the upper Tuscarawas River, 2005.

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/16/2005 River Code: 17-500 RM: 123.10 Site: Tuscarawas River Pressler Rd.

Taxa Code	Taxa	Quant/Qual	
03600	*Oligochaeta*	353	+
05800	*Caecidotea sp*		+
06201	*Hyalella azteca*		+
11120	*Baetis flavistriga*	9	
11130	*Baetis intercalaris*	59	+
11200	*Callibaetis sp*		+
13400	*Stenacron sp*	2	+
21200	*Calopteryx sp*		+
21300	*Hetaerina sp*		+
22001	*Coenagrionidae*		+
23600	*Aeshna sp*		+
45400	*Trichocorixa sp*		+
50804	*Lype diversa*	2	
51600	*Polycentropus sp*		+
52200	*Cheumatopsyche sp*	27	+
52430	*Ceratopsyche morosa group*	22	+
52440	*Ceratopsyche slossonae*	5	+
52450	*Ceratopsyche sparna*	1	
52530	*Hydropsyche depravata group*	5	+
53501	*Hydroptilidae*	4	
57900	*Pycnopsyche sp*	3	+
60400	*Gyrinus sp*		+
60900	*Peltodytes sp*		+
68901	*Macronychus glabratus*	4	+
69400	*Stenelmis sp*	2	
71100	*Hexatoma sp*		+
72700	*Anopheles sp*		+
74100	*Simulium sp*		+
77500	*Conchapelopia sp*	17	
78450	*Nilotanypus fimbriatus*	4	
80420	*Cricotopus (C.) bicinctus*	17	+
80430	*Cricotopus (C.) tremulus group*	25	
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	4	
81465	*Orthocladius (O.) carlatus*	4	
81632	*Parakiefferiella n.sp 2*	17	
81650	*Parametriocnemus sp*	8	
81825	*Rheocricotopus (Psilocricotopus) robacki*	47	
82141	*Thienemanniella xena*	18	
82710	*Chironomus (C.) sp*	4	
82820	*Cryptochironomus sp*	8	+
83840	*Microtendipes pedellus group*	21	
84116	*Paracladopelma nereis*	4	
84210	*Paratendipes albimanus or P. duplicatus*	4	
84300	*Phaenopsectra obediens group*	4	+
84450	*Polypedilum (Uresipedilum) flavum*	93	+
84460	*Polypedilum (P.) fallax group*	8	
84540	*Polypedilum (Tripodura) scalaenum group*	93	
84700	*Stenochironomus sp*	4	
84750	*Stictochironomus sp*		+
85261	*Cladotanytarsus vanderwulpi group Type 1*	4	
85500	*Paratanytarsus sp*	4	+
85625	*Rheotanytarsus sp*	21	+
85800	*Tanytarsus sp*	21	+
85821	*Tanytarsus glabrescens group sp 7*	17	
87540	*Hemerodromia sp*	1	
96900	*Ferrissia sp*	7	

No. Quantitative Taxa: 41 Total Taxa: 56

No. Qualitative Taxa: 31 ICI: **32**

Number of Organisms: 977 Qual EPT: 9

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/16/2005 River Code: 17-500 RM: 122.70 Site: Tuscarawas River adj. Killian Latex

Taxa Code	Taxa	Quant	Qual
03600	*Oligochaeta*	109	+
04686	*Placobdella papillifera*	1	
05800	*Caecidotea sp*	2	
06201	*Hyalella azteca*		+
06700	*Crangonyx sp*	1	
08250	*Orconectes (Procericambarus) rusticus*	1	
11130	*Baetis intercalaris*	22	
13400	*Stenacron sp*	17	
21300	*Hetaerina sp*	2	+
22001	*Coenagrionidae*		+
45100	*Palmacorixa sp*		+
45400	*Trichocorixa sp*		+
50804	*Lype diversa*	4	
52200	*Cheumatopsyche sp*	117	+
52430	*Ceratopsyche morosa group*	6	
52440	*Ceratopsyche slossonae*	9	
52530	*Hydropsyche depravata group*	6	
57900	*Pycnopsyche sp*		+
60800	*Haliplus sp*		+
60900	*Peltodytes sp*		+
68601	*Ancyronyx variegata*		+
68700	*Dubiraphia sp*	1	
68901	*Macronychus glabratus*	9	+
69400	*Stenelmis sp*	21	
72700	*Anopheles sp*		+
74100	*Simulium sp*		+
77500	*Conchapelopia sp*	22	
78450	*Nilotanypus fimbriatus*	33	
80204	*Brillia flavifrons group*	11	
80370	*Corynoneura lobata*	4	
80410	*Cricotopus (C.) sp*	11	+
80420	*Cricotopus (C.) bicinctus*	44	
81210	*Nanocladius (N.) alternantherae*	11	+
81650	*Parametriocnemus sp*	11	
81825	*Rheocricotopus (Psilocricotopus) robacki*	154	
82141	*Thienemanniella xena*	20	
82710	*Chironomus (C.) sp*	11	
82820	*Cryptochironomus sp*		+
82880	*Cryptotendipes sp*		+
83840	*Microtendipes pedellus group*	88	+
84210	*Paratendipes albimanus or P. duplicatus*	22	
84450	*Polypedilum (Uresipedilum) flavum*	33	
84460	*Polypedilum (P.) fallax group*	44	
84470	*Polypedilum (P.) illinoense*	11	
84540	*Polypedilum (Tripodura) scalaenum group*	110	
84800	*Tribelos jucundum*	11	
85500	*Paratanytarsus sp*	66	
85625	*Rheotanytarsus sp*	66	+
85800	*Tanytarsus sp*	22	+
87540	*Hemerodromia sp*	13	
96900	*Ferrissia sp*	84	

No. Quantitative Taxa: 39 Total Taxa: 51

No. Qualitative Taxa: 21 ICI: **28**

Number of Organisms: 1230 Qual EPT: 2

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Collection Date: 08/16/2005 River Code: 17-500 RM: 122.50 Site: Tuscarawas River dst. Killian Latex

Taxa Code	Taxa	Quant	Qual
03600	*Oligochaeta*	107	
05800	*Caecidotea sp*	16	+
06201	*Hyalella azteca*		+
06700	*Crangonyx sp*	7	
08250	*Orconectes (Procericambarus) rusticus*		+
11130	*Baetis intercalaris*	17	+
11200	*Callibaetis sp*		+
13400	*Stenacron sp*	1	
17200	*Caenis sp*		+
42700	*Belostoma sp*		+
43570	*Neoplea sp*		+
45100	*Palmacorixa sp*		+
45400	*Trichocorixa sp*		+
52200	*Cheumatopsyche sp*	14	
68700	*Dubiraphia sp*	1	
68901	*Macronychus glabratus*	1	+
69400	*Stenelmis sp*	5	+
72340	*Dixella sp*		+
74100	*Simulium sp*		+
77120	*Ablabesmyia mallochi*	6	
77500	*Conchapelopia sp*	3	
77800	*Helopelopia sp*	3	
78401	*Natarsia species A (sensu Roback, 1978)*	3	
78450	*Nilotanypus fimbriatus*	3	
81825	*Rheocricotopus (Psilocricotopus) robacki*	3	
82730	*Chironomus (C.) decorus group*	6	
82820	*Cryptochironomus sp*	9	
82880	*Cryptotendipes sp*		+
83000	*Dicrotendipes sp*	6	
83300	*Glyptotendipes (G.) sp*	15	+
83840	*Microtendipes pedellus group*	24	+
84210	*Paratendipes albimanus or P. duplicatus*	46	
84300	*Phaenopsectra obediens group*	27	+
84450	*Polypedilum (Uresipedilum) flavum*	3	
84460	*Polypedilum (P.) fallax group*	6	
84470	*Polypedilum (P.) illinoense*	3	+
84540	*Polypedilum (Tripodura) scalaenum group*	46	
85230	*Cladotanytarsus mancus group*		+
85261	*Cladotanytarsus vanderwulpi group Type 1*	3	
85500	*Paratanytarsus sp*	6	
85800	*Tanytarsus sp*	27	
87540	*Hemerodromia sp*	1	
96900	*Ferrissia sp*	7	+

No. Quantitative Taxa: 31 Total Taxa: 43

No. Qualitative Taxa: 21 ICI: **18**

Number of Organisms: 425 Qual EPT: 3

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Number of: Sunfish species	Number of: Sucker species	Number of: Intolerant species	Number of: Darter species	Percent of Individuals: Simple Lithophils	Percent of Individuals: Tolerant fishes	Percent of Individuals: Omni-vores	Percent of Individuals: Top carnivores	Percent of Individuals: Insect-ivores	Percent of Individuals: DELT anomalies	Rel.No. minus tolerants /(0.3km)		IBI	Modified Iwb
Tuscarawas River - (17500)																		
Year: 2005																		
123.10	D	07/05/2005	28	15(3)	3(3)	2(3)	0(1)	4(5)	26(3)	55(1)	38(1)	2.7(3)	48(3)	0.0(5)	197(1)		32	6.2
123.10	D	08/16/2005	28	12(3)	2(3)	2(3)	0(1)	4(5)	45(5)	48(3)	43(1)	3.3(3)	52(3)	0.0(5)	107(1)		36	5.3
122.70	D	07/05/2005	28	14(3)	6(5)	2(3)	0(1)	1(1)	16(1)	46(3)	24(3)	8.7(5)	57(5)	3.0(1)	84(1)	*	32	6.0
122.70	D	08/16/2005	28	15(3)	5(5)	2(3)	0(1)	3(3)	21(3)	46(3)	41(1)	11.7(5)	41(3)	0.0(5)	90(1)	*	36	6.0
122.50	D	07/05/2005	28	18(3)	4(5)	2(3)	0(1)	4(5)	35(3)	65(1)	51(1)	4.9(3)	41(3)	1.0(3)	128(1)		32	6.9
122.50	D	08/16/2005	28	14(3)	3(3)	2(3)	0(1)	4(5)	29(3)	49(3)	39(1)	10.3(5)	48(3)	0.0(5)	104(1)		36	7.2

na - Qualitative data, Modified Iwb not applicable.

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 7. Fish results collected by the Ohio EPA from the upper Tuscarawas River, 2005.

Species List

River Code: **17-500**	Stream: **Tuscarawas River**	Sample Date: **2005**
River Mile: **123.10**	Location: Pressler Rd.	Date Range: 07/05/2005
Time Fished: 5700 sec	Drainage: 28.0 sq mi	Thru: 08/16/2005
Dist Fished: 0.36 km	Basin: Muskingum River No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Mudminnow		I	C	T	4	3.33	1.03	0.01	0.04	4.25
Northern Hog Sucker	R	I	S	M	9	7.50	2.33	0.49	1.31	65.00
White Sucker	W	O	S	T	54	45.00	13.95	2.88	7.73	64.09
Common Carp	G	O	M	T	13	10.83	3.36	31.83	85.33	2,938.46
Creek Chub	N	G	N	T	25	20.83	6.46	0.15	0.41	7.27
Bluntnose Minnow	N	O	C	T	86	71.67	22.22	0.22	0.60	3.10
Central Stoneroller	N	H	N		3	2.50	0.78	0.03	0.07	10.33
Largemouth Bass	F	C	C		10	8.33	2.58	0.95	2.54	113.58
Warmouth Sunfish	S	C	C		1	0.83	0.26	0.02	0.04	18.00
Green Sunfish	S	I	C	T	23	19.17	5.94	0.12	0.31	6.08
Bluegill Sunfish	S	I	C	P	3	2.50	0.78	0.07	0.20	29.33
Pumpkinseed Sunfish	S	I	C	P	1	0.83	0.26	0.01	0.02	8.00
Green Sf X Bluegill Sf					3	2.50	0.78	0.19	0.51	76.67
Johnny Darter	D	I	C		40	33.33	10.34	0.05	0.14	1.53
Greenside Darter	D	I	S	M	55	45.83	14.21	0.14	0.37	3.04
Rainbow Darter	D	I	S	M	5	4.17	1.29	0.01	0.04	3.20
Fantail Darter	D	I	C		41	34.17	10.59	0.06	0.15	1.66
Mottled Sculpin		I	C		11	9.17	2.84	0.08	0.21	8.36
	Mile Total				387	322.50		37.31		
	Number of Species				17					
	Number of Hybrids				1					

River Code: **17-500**	Stream: **Tuscarawas River**	Sample Date: **2005**
River Mile: **122.70**	Location: adj. Killian Latex	Date Range: 07/05/2005
Time Fished: 2635 sec	Drainage: 28.0 sq mi	Thru: 08/16/2005
Dist Fished: 0.40 km	Basin: Muskingum River No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Mudminnow		I	C	T	9	6.75	4.19	0.04	0.05	5.56
Grass Pickerel		P	M	P	6	4.50	2.79	0.39	0.55	85.50
Northern Hog Sucker	R	I	S	M	12	9.00	5.58	1.43	2.04	158.54
White Sucker	W	O	S	T	27	20.25	12.56	4.09	5.86	202.15
Common Carp	G	O	M	T	42	31.50	19.53	58.47	83.73	1,856.07
Creek Chub	N	G	N	T	2	1.50	0.93	0.00	0.01	2.50
Bluntnose Minnow	N	O	C	T	1	0.75	0.47	0.00	0.00	2.00
Yellow Bullhead		I	C	T	3	2.25	1.40	0.29	0.42	128.67
White Crappie	S	I	C		7	5.25	3.26	0.53	0.76	101.00
Black Crappie	S	I	C		1	0.75	0.47	0.20	0.29	272.00
Largemouth Bass	F	C	C		9	6.75	4.19	2.02	2.90	299.56
Warmouth Sunfish	S	C	C		7	5.25	3.26	0.62	0.88	117.14
Green Sunfish	S	I	C	T	15	11.25	6.98	0.17	0.24	15.00
Bluegill Sunfish	S	I	C	P	29	21.75	13.49	0.49	0.70	22.34
Pumpkinseed Sunfish	S	I	C	P	19	14.25	8.84	0.24	0.34	16.84
Green Sf X Bluegill Sf					13	9.75	6.05	0.77	1.10	78.69
Green Sf X Pumpkinseed					3	2.25	1.40	0.08	0.11	34.33
Johnny Darter	D	I	C		7	5.25	3.26	0.01	0.01	1.86
Greenside Darter	D	I	S	M	1	0.75	0.47	0.00	0.00	4.00
Fantail Darter	D	I	C		2	1.50	0.93	0.00	0.00	1.00
Mile Total					215	161.25		69.83		
Number of Species					18					
Number of Hybrids					2					

Species List

River Code: **17-500**	Stream: **Tuscarawas River**	Sample Date: **2005**
River Mile: **122.50**	Location: dst. Killian Latex	Date Range: 07/05/2005
Time Fished: 4980 sec	Drainage: 28.0 sq mi	Thru: 08/16/2005
Dist Fished: 0.40 km	Basin: Muskingum River No of Passes: 2	Sampler Type: D

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Mudminnow		I	C	T	5	3.75	1.32	0.03	0.06	7.20
Grass Pickerel		P	M	P	1	0.75	0.26	0.03	0.07	38.00
Northern Hog Sucker	R	I	S	M	20	15.00	5.26	2.04	4.88	136.04
White Sucker	W	O	S	T	86	64.50	22.63	6.49	15.51	100.58
Common Carp	G	O	M	T	17	12.75	4.47	24.81	59.29	1,945.59
Blacknose Dace	N	G	S	T	1	0.75	0.26	0.00	0.01	4.00
Creek Chub	N	G	N	T	7	5.25	1.84	0.03	0.08	6.00
Bluntnose Minnow	N	O	C	T	75	56.25	19.74	0.12	0.29	2.12
Central Stoneroller	N	H	N		1	0.75	0.26	0.00	0.00	1.00
Yellow Bullhead		I	C	T	2	1.50	0.53	0.33	0.79	220.00
White Crappie	S	I	C		4	3.00	1.05	0.23	0.56	77.50
Largemouth Bass	F	C	C		25	18.75	6.58	5.94	14.20	316.97
Green Sunfish	S	I	C	T	33	24.75	8.68	0.44	1.05	17.71
Bluegill Sunfish	S	I	C	P	33	24.75	8.68	0.85	2.03	34.24
Pumpkinseed Sunfish	S	I	C	P	12	9.00	3.16	0.13	0.32	14.83
Green Sf X Bluegill Sf					3	2.25	0.79	0.27	0.66	122.00
Johnny Darter	D	I	C		25	18.75	6.58	0.03	0.06	1.36
Greenside Darter	D	I	S	M	13	9.75	3.42	0.03	0.07	2.85
Rainbow Darter	D	I	S	M	5	3.75	1.32	0.01	0.02	2.20
Fantail Darter	D	I	C		9	6.75	2.37	0.02	0.04	2.22
Mottled Sculpin		I	C		3	2.25	0.79	0.02	0.05	8.67
	Mile Total				380	285.00		41.84		
	Number of Species				20					
	Number of Hybrids				1					