Biological and Water Quality Study of Big Walnut Creek

D.E. Edwards Landfill
1996

Franklin County, Ohio

October 31, 1997

OEPA Technical Report MAS/1997-10-2

prepared for

State of Ohio Environmental Protection Agency
Division of Emergency and Remedial Response

prepared by

State of Ohio Environmental Protection Agency
Division of Surface Water
Monitoring and Assessment Section
1685 Westbelt Dr.
Columbus, Ohio 43228

TABLE OF CONTENTS **Page**

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 Ohio EPA 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. Division of Water Qual. Mont. & 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. Division of Water Qual. Mont. & 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. Division of 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. Division of 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. Division of Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.

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

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

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

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

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

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

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

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

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. 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 uses assigned under 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 the 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 into information and then synthesized into this 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 addressed as well.

The findings and conclusions of a biological water quality study may factor into regulatory actions taken by Ohio EPA (*e.g.*, NPDES permits, Director's Orders), and 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 biennial Ohio Water Resource Inventory (305[b] report).

Hierarchy of Indicators

A carefully conceived ambient monitoring approach, which uses cost-effective indicators comprised of ecological, chemical, toxicological measures, can ensure that all relevant pollution sources are judged objectively and 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. Such an integrated approach is outlined in Figure I and includes a hierarchical continuum from administrative to true environmental indicators. The six "levels" of indicators include: 1) actions taken by regulatory agencies (permitting, enforcement, grants); 2) responses by the regulated community (treatment works, pollution prevention); 3) changes in discharged quantities (pollutant loadings); 4) changes in ambient conditions (water quality, habitat); 5) changes in uptake and/or assimilation (tissue contamination, biomarkers, wasteload allocation); and, 6) changes in health, ecology, or other effects (ecological condition, pathogens). In this process the results of administrative activities (levels 1 and 2) can be linked to efforts to improve water quality (levels 3, 4, and 5) which should translate into the environmental "results" (level 6). Thus, the aggregate effect of billions of dollars spent on water pollution control since the early 1970s can now be determined with quantifiable measures of environmental condition.

Superimposed on this hierarchy is the concept of stressor, exposure, and response indicators. *Stressor* indicators generally include activities which have the potential to degrade the aquatic environment such as pollutant discharges (permitted and unpermitted), land use effects, and habitat modifications. *Exposure* indicators are those which measure the effects of stressors and

can include whole effluent toxicity tests, tissue residues, and biomarkers, each of which provides evidence of biological exposure to a stressor or bioaccumulative agent. *Response* indicators are generally composite measures of the cumulative effects of stress and exposure and include the more direct measures of community and population response and 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.

In 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 the water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data

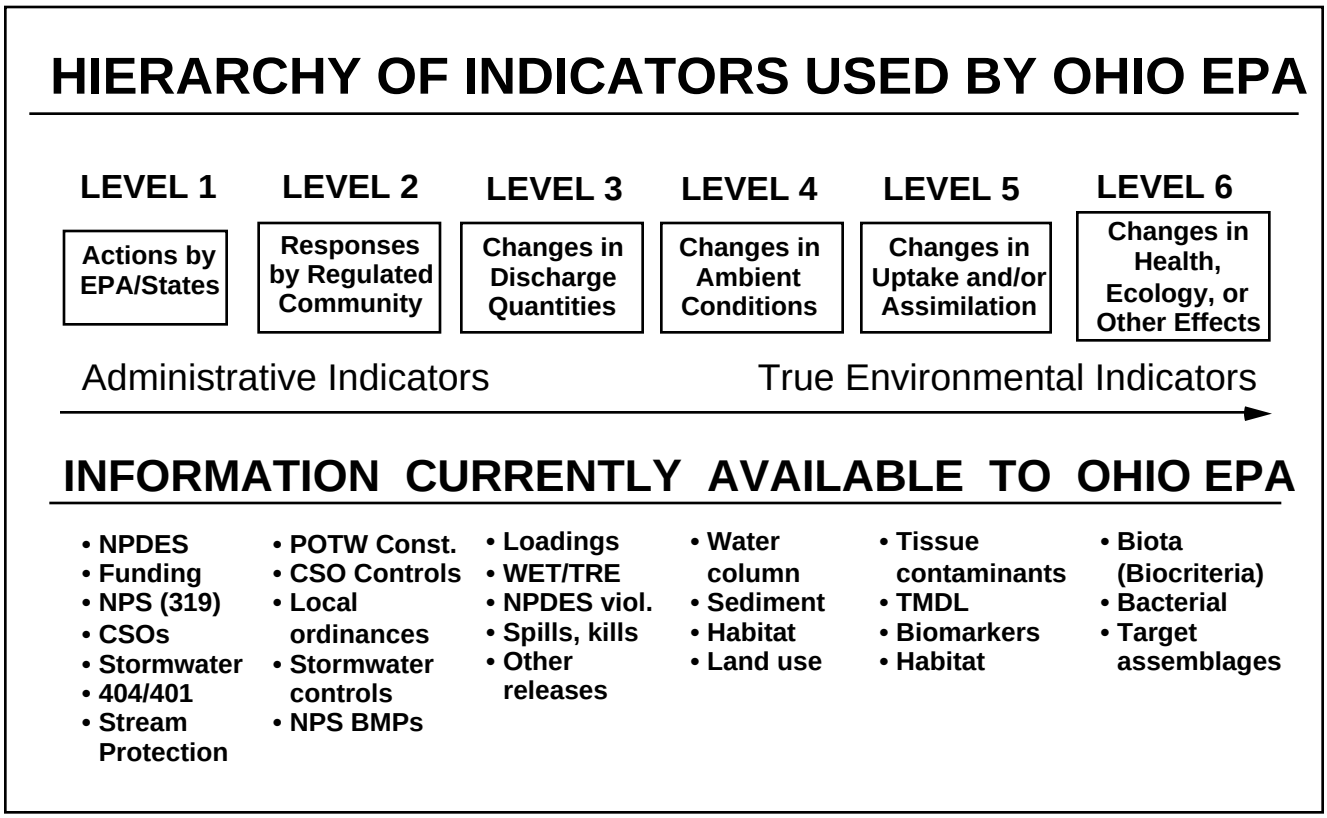


Figure I. Hierarchy of administrative and environmental indicators used by Ohio EPA for monitoring, assessment, reporting, and evaluating program effectiveness. This continuum is patterned after a model developed by U.S. EPA.

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 technical bulletins covering a variety of subjects.

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. Five different aquatic life uses are currently defined in the Ohio WQS:

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 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 streams (usually <3 mi.^{2} drainage area) which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such streams generally includes small streams in extensively urbanized areas, small streams which lie in watersheds with extensive drainage modifications, and/or small streams which completely lack water on a recurring annual basis (*i.e.*, true ephemeral streams).

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 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 two recreation uses which are the 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 as 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 not designating AWS in an urban area where livestock watering or pasturing does not take place. 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 outside of this report.

ACKNOWLEDGEMENTS

The following Ohio EPA staff are acknowledged for their significant contribution to this report.

Coordinator - David Altfater
Data Management - Dennis Mishne and Ed Rankin
Fish Data Analysis, Sediment - David Altfater
Macroinvertebrate Data Analysis - Bernie Counts
Reviewers - Jeff DeShon and Marc Smith

Support during field collections was provided by Diane Crosby, Kevin Kish, and Chris Matney.

Biological and Sediment Quality Study of Big Walnut Creek (Franklin County, Ohio)

Ohio Environmental Protection Agency
Division of Surface Water
Monitoring and Assessment Section
1685 Westbelt Drive
Columbus, Ohio 43228

INTRODUCTION

The Big Walnut Creek study area included the mainstem river from the Columbus Airport (RM 27) to East Broad Street (RM 23), with the major evaluation occurring in the area of the D.E. Edwards landfill (RM 25.3 - 25.6).

Specific objectives of this evaluation were to:

1) determine the extent of hazardous chemical constituents in sediment and surface water from Big Walnut Creek in the vicinity of D.E. Edwards landfill,

2) establish the present biological use condition in Big Walnut Creek adjacent to D.E. Edwards landfill,

3) identify the relative significance of D.E. Edwards landfill site contaminants on any demonstrated impairment of Big Walnut Creek biological communities,

4) determine the attainment status of the current WWH aquatic life use designation for Big Walnut Creek within the study area, and

5) follow-up on conditions documented in previous Ohio EPA studies.

The Big Walnut Creek watershed is located in the Eastern Corn Belt Plains (ECBP) ecoregion. Big Walnut Creek is currently assigned the Warmwater Habitat (WWH) aquatic life use.

SUMMARY / CONCLUSIONS

- Biological sampling in Big Walnut Creek adjacent to and downstream from the D.E. Edwards landfill revealed communities of fish and macroinvertebrates reflective of good to exceptional conditions, and achieving the ecoregional biocriteria. The D. E. Edwards landfill did not appear to have a negative influence on the fish and macroinvertebrate communities of Big Walnut Creek.

- Runway expansion activities at the Columbus Airport contributed to excessive sedimentation and embedding of bottom substrates in Big Walnut Creek. Sampling results revealed some influence on instream biological communities from excessive soil runoff partly associated with the Columbus Airport runway expansion project. Pool areas in Big Walnut Creek immediately downstream from the runway had heavily embedded bottom substrates, and this was particularly evident after a large storm moved through the airport area on August 8, 1996. Excessive embeddedness appeared to contribute to the reduced fish community observed at RM 26.2.

- The sediment results from Big Walnut Creek did not indicate substantially increased levels of chemicals adjacent to and downstream from the D.E. Edwards landfill. Results upstream and downstream from the D.E. Edwards landfill were comparable and were not considered excessively elevated.

- Water quality results from 1995 and 1996 sampling of Big Walnut Creek revealed one cadmium and six iron concentrations exceeding the applicable 30-day average warmwater habitat Ohio water quality criterion. The cadmium sample was collected in Big Walnut Creek at the confluence of the D.E. Edwards North Ditch. All other parameters and samples were either below warmwater habitat water quality criteria (for parameters with criteria), considered low with no difference betweeen upstream and downstream samples, or near or below the parameter laboratory detection limit. Aside from the one cadmium value, all other parameters were reflective of good water quality. Of the over 100 volatile and semivolatile organic chemical compounds, PCBs, and pesticides tested in surface water, only two parameters (methylene chloride and acetone) were above laboratory detection limits; both compounds were less than the 30-day average WWH water quality criterion.

RECOMMENDATIONS

- Improved stormwater runoff controls and construction site BMPs need to be implemented for any current and future construction activities at the Columbus Airport. Long-term maintenance of a good to exceptional biological community in Big Walnut Creek depends on reducing soil contributions to the stream.

Table 1. Sampling locations in the Big Walnut Creek study area, 1996. 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	County	USGS 7.5 min. Quad. Map
Big Walnut Creek						
27.4	F,M	40°00'02"	82°52'20"	Ust. Columbus Airport Deicing Tributary	Franklin	New Albany/ Reynoldsburg, OH
27.35	W,S	39°59'58"	82°52'16"	Ust. Columbus Airport Deicing Tributary	Franklin	New Albany/ Reynoldsburg, OH
27.11	W,S	39°59'49"	82°52'06"	Hamilton Road	Franklin	Reynoldsburg, OH
27.0	F,M	39°59'47"	82°51'57"	Dst. Hamilton Rd.	Franklin	Reynoldsburg, OH
26.2	F,M,S	39°59'30"	82°51'40"	Adj. Columbus Airport Golf Course	Franklin	Reynoldsburg, OH
25.7	F,S	39°59'16"	82°52'01"	Ust. DE Edwards Landfill	Franklin	Reynoldsburg, OH
25.6	M	39°59'10"	82°51'59"	Ust. DE Edwards Landfill	Franklin	Reynoldsburg, OH
25.57	S	39°59'09"	82°51'57"	Confluence with North Ditch	Franklin	Reynoldsburg, OH
25.5	F,M	39°59'05"	82°51'55"	Adj. DE Edwards Landfill	Franklin	Reynoldsburg, OH
25.4	S	39°59'04"	82°51'54"	Adj. DE Edwards Landfill	Franklin	Reynoldsburg, OH
25.33	S	39°58'59"	82°51'49"	Confluence with South Ditch	Franklin	Reynoldsburg, OH
25.2	F,M	39°58'50"	82°51'54"	Dst. DE Edwards Landfill	Franklin	Reynoldsburg, OH
24.8	W,S	39°58'38"	82°51'56"	East Broad Street	Franklin	Reynoldsburg, OH
Columbus Airport Tributary						
27.29, 0.10	F,W,S	39°59'55"	82°52'21"	Near mouth	Franklin	Reynoldsburg, OH

Table 2. Aquatic life use attainment status for Big Walnut Creek and the Columbus Airport Tributary based on data collected during August - October, 1996.

RIVER MILE Fish/Invert.	IBI	Modified Iwb	ICI	QHEI[a]	Attainment Status[b]	Comment
Big Walnut Creek						
Eastern Corn Belt Plains - WWH Use Designation (Existing)						
27.4/27.4	45	8.8	38	83.0	FULL	Upstream Columbus Airport
27.0/27.0	44	8.8	38	76.0	FULL	Dst. Columbus Airport Trib.
26.2/26.2	37ns	7.6*	42	74.5	PARTIAL	Large pool habitat
25.7/25.6	50	8.4	44	80.5	FULL	Ust. DE Edwards Landfill
25.5/25.5	42	8.0ns	48	79.0	FULL	Adj. DE Edwards Landfill
25.2/25.2	48	9.0	42	86.5	FULL	Dst. DE Edwards Landfill
Columbus Airport Tributary						
0.1/-	26*	NA	-	45.5	**(NON)**	Active construction area

Ecoregion Biocriteria: *Eastern Corn Belt Plains (ECBP)*

INDEX	WWH	EWH	MWH[c]
IBI - Wading	40	50	24
IBI - Headwater	40	50	24
MIwb - Wading	8.3	9.4	6.2
ICI	36	46	22

* - Significant departure from ecoregion biocriterion; poor and very poor results are underlined.

ns - Nonsignificant departure from ecoregion biocriterion for WWH (≤4 IBI or ICI units; ≤0.5 MIwb units).

NA - Not applicable: MIwb not applicalbe in headwater reaches.

a - Qualitative Habitat Evaluation Index (QHEI) values based on Rankin (1989).

b - Attainment status based on one organism group is parenthetically expressed.

c - Modified Warmwater Habitat for channel modified areas.

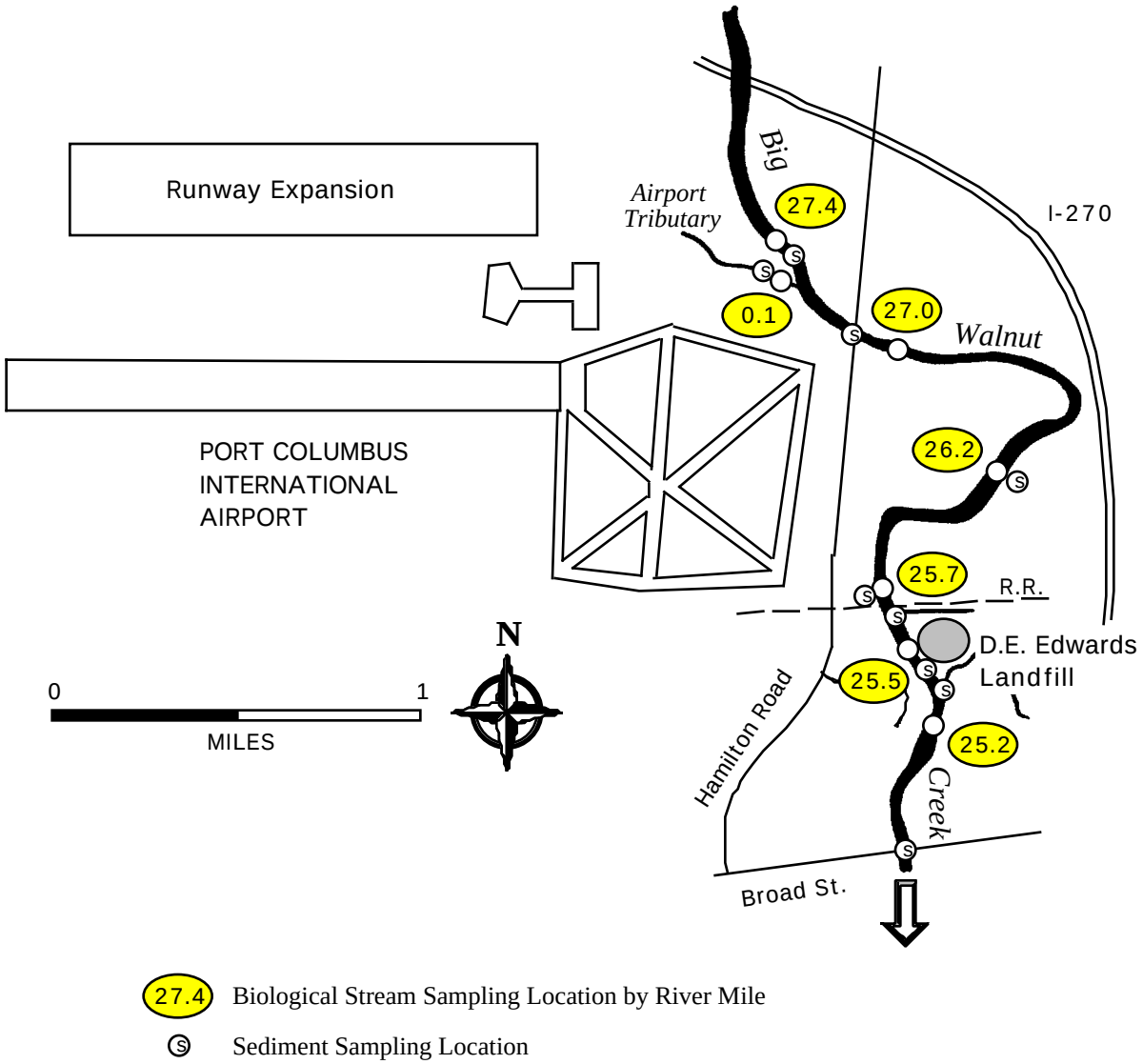
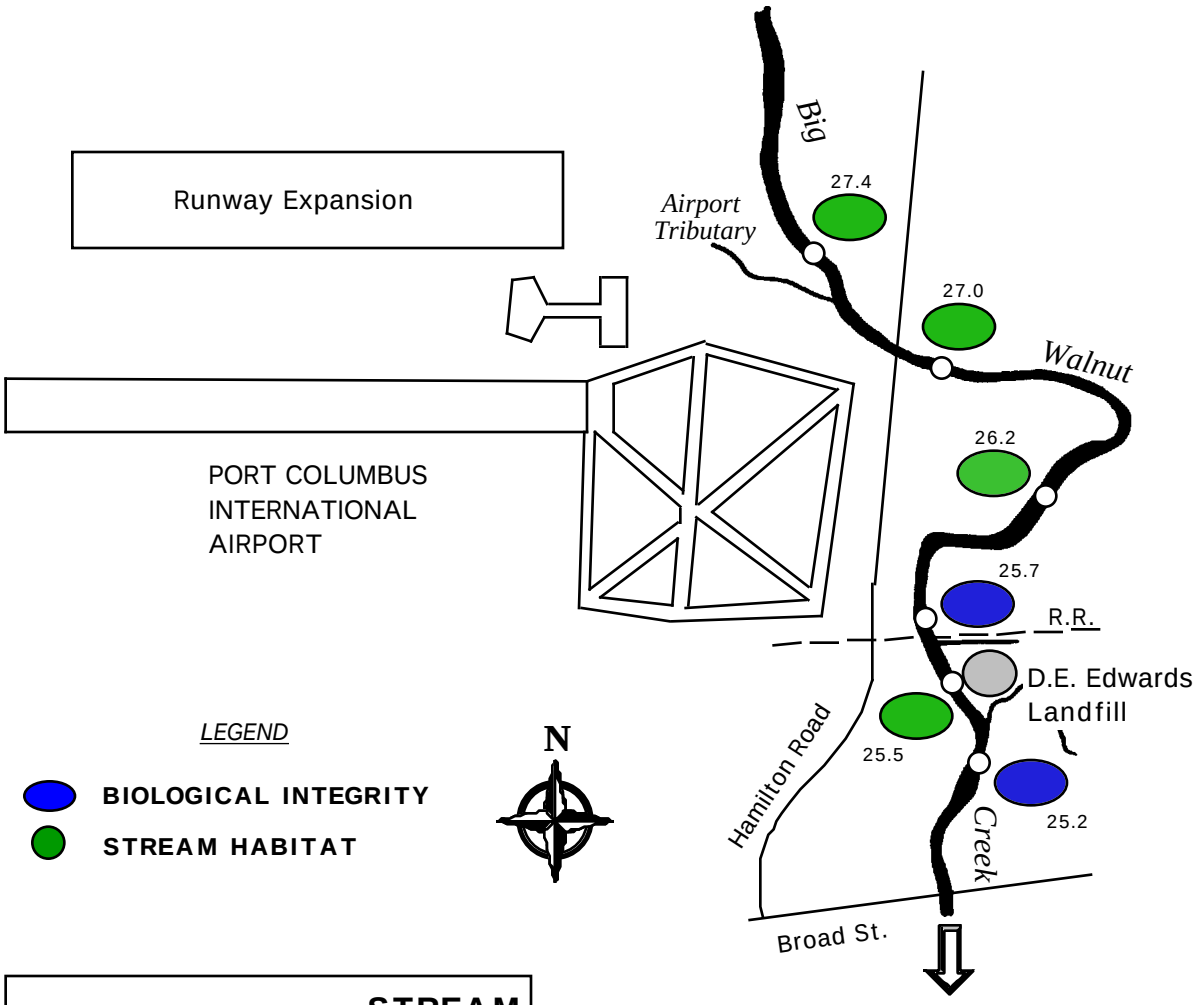
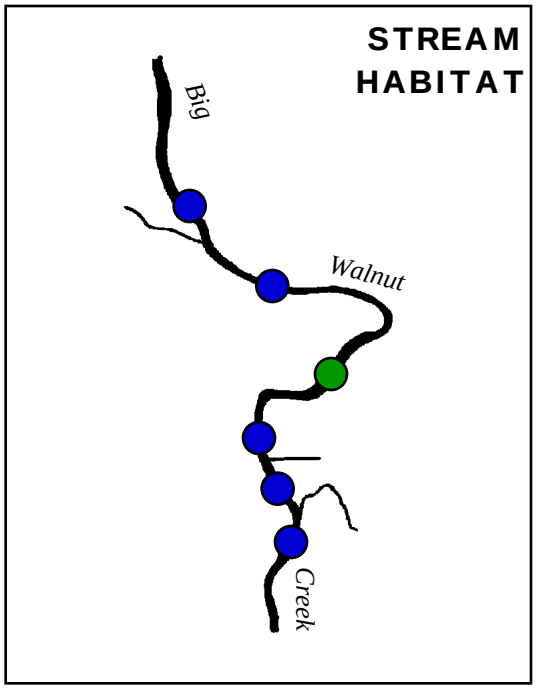


Figure 1. Map of the Big Walnut Creek study area showing principal streams, landmarks, the D.E. Edwards landfill, and Ohio EPA biological sampling locations, 1996.





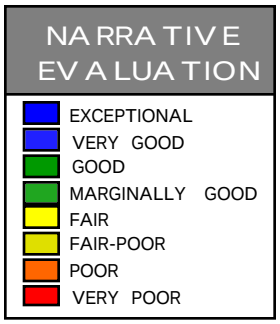


Figure 2. Biological and stream habitat conditions in the Big Walnut Creek study area, 1996.

METHODS

All chemical, physical, and biological field, laboratory, data processing, and data analysis methodologies and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 1989a) and Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a, 1987b, 1989b, 1989c), and The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989) for aquatic habitat assessment. Fish and macroinvertebrate communities were sampled during the summer and fall of 1996 at six locations on Big Walnut Creek from river mile (RM) 27.4 to RM 25.2 and on the Columbus Airport Tributary at RM 0.1 (Table 1, Figure 1). Sediment samples were collected by Ohio EPA at eight locations on Big Walnut Creek (RMs 27.3 to 24.9), and one location on the Columbus Airport Tributary (RM 0.1). Surface water samples were collected at three locations in Big Walnut Creek (RMs 27.35 to 22.80) and one location from the Columbus Airport Tributary (RM 0.10).

Determining Use Attainment Status

The attainment status of aquatic life uses (*i.e.*, full, partial, and non) is determined by using the biological criteria codified in the Ohio Water Quality Standards (WQS; Ohio Administrative Code [OAC] 3745-1-07, Table 7-17). The biological community performance measures which are used include the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb), based on fish community characteristics, and the Invertebrate Community Index (ICI) which is based on macroinvertebrate community characteristics. The IBI and ICI are multimetric indices patterned after an original IBI described by Karr (1981) and Fausch *et al.* (1984). The ICI was developed by Ohio EPA (1987b) and further described by DeShon (1995). The MIwb is a measure of fish community abundance and diversity using numbers and weight information and is a modification of the original Index of Well-Being originally applied to fish community information from the Wabash River (Gammon 1976; Gammon *et al.* 1981).

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

Habitat Assessment

Physical habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995). Various attributes of the habitat are scored based on the overall importance of each to the maintenance of viable, diverse, and functional aquatic faunas. The type(s) and quality of substrates, amount and quality of instream cover, channel morphology, extent and quality of riparian vegetation, pool, run, and riffle development and quality, and gradient are some of the metrics used to determine the QHEI score which generally ranges from 20 to 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. Scores greater than 75 frequently typify habitat conditions which have the ability to support exceptional warmwater faunas.

Macroinvertebrate Community Assessment

Macroinvertebrates in Big Walnut Creek were sampled quantitatively for a six-week period from August 7, 1996 to September 23, 1996 using multiple-plate, artificial substrate samplers (modified Hester/Dendy) in conjunction with a qualitative assessment of the available natural substrates collected at the time of artificial substrate retrieval.

Fish Community Assessment

Fish were sampled using the wading method pulsed DC electrofishing gear, used at a frequency of two samples at each Big Walnut Creek site. Fish collections were made at each site from August to October, with sampling distances varying between 200 and 220 meters per location. One sample pass was conducted on the Columbus Airport Tributary at RM 0.1, and the distance sampled was 150 meters.

Causal Associations

Using the results, conclusions, and recommendations of this report requires an understanding of the methodology used to determine the use attainment status and assigning probable causes and sources of impairment. The identification of impairment in rivers and streams is straightforward - the numerical biological criteria are the principal arbiter of aquatic life use attainment and impairment (partial and non-attainment). The rationale for using the biological criteria in the role of principal arbiter within a weight of evidence framework has been extensively discussed elsewhere (Karr *et al.* 1986; Karr 1991; Ohio EPA 1987a,b; Yoder 1989; Miner and Borton 1991; Yoder 1991; Yoder 1995). Describing the causes and sources associated with observed impairments relies on an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and the biological response signatures (Yoder and Rankin 1995) within the biological data itself. Thus the assignment of principal causes and sources of impairment in this report do not represent a true "cause and effect" analysis, but rather represent the association of impairments (based on response indicators) with stressor and exposure indicators whose links with the biosurvey data are based on previous research or experience with analogous situations and impacts. The reliability of the identification of probable causes and sources is increased where many such prior associations have been identified. The process is similar to making a medical diagnosis in which a doctor relies on multiple lines of evidence concerning patient health. Such diagnoses are based on previous research which experimentally or statistically linked symptoms and test results to specific diseases or pathologies. Thus a doctor relies on previous experience in interpreting symptoms (*i.e.*, multiple lines from test results) to establish a diagnosis, potential causes and/or sources of the malady, a prognosis, and a strategy for alleviating the symptoms of the disease or condition. As in medical science, where the ultimate arbiter of success is the eventual recovery and the well-being of the patient, the ultimate measure of success in water resource management is restoration of lost or damaged ecosystem attributes including aquatic community structure and function. While there have been criticisms of misapplying the metaphor of ecosystem "health" compared to human patient "health" (Suter 1993) here we are referring to the process for identifying biological integrity and causes/sources associated with observed impairment, not whether human health and ecosystem health are analogous concepts.

RESULTS AND DISCUSSION

Sediment Chemistry

- Sediment samples were evaluated in part using guidelines established by the Ontario Ministry of the Environment (Persaud *et al.* 1993). The guidelines define two levels of ecotoxic effects and are based on the chronic, long term effects of contaminants on benthic organisms. A *Lowest Effect Level* is a level of sediment contamination that can be tolerated by the majority of benthic organisms, and a *Severe Effect Level* indicates a level at which pronounced disturbance of the sediment-dwelling community can be expected. The Severe Effect Level is the sediment concentration of a compound that would be detrimental to the majority of benthic species. When any parameters are at or above the Severe Effect Level guideline, the material tested is considered highly contaminated and will likely have a significant effect on benthic biological resources. Based on the guidelines noted above, all Big Walnut Creek sediment samples exceeded the Lowest Effect Level for numerous metals and/or polycyclic aromatic hydrocarbon (PAH) compounds (Table 3). The guidelines detailed in Persaud *et al.* (1993) do not include evaluations of volatile organic compounds, several PAHs and metals, and most non-PAH semivolatile organic compounds.

- The sediment results from Big Walnut Creek did not indicate substantially increased levels of chemicals adjacent to and downstream from D.E. Edwards Landfill. Results upstream and downstream from D.E. Edwards Landfill were comparable and were not considered excessively elevated. Concentrations of numerous polycyclic aromatic hydrocarbons, chromium, arsenic, and zinc were at some of the highest levels upstream from the D.E. Edwards Landfill. Volatile organic compounds and PCBs were not detected in any of the sediment samples.

- Particle size and total organic carbon were not reported with test results from 1995. These parameters can have a substantial influence on the reported concentrations of chemicals in a sample.

Table 3. Chemical compounds detected in sediment samples collected by Ohio EPA from Big Walnut Creek, April 26, 1995. Measurements in **bold** exceed the Lowest Effect Level as detailed in Persaud *et al.* 1993. Parameters exceeding the Severe Effect Level are indicated by underlined **bold** numbers. Parameters in *italics* do not have review guidelines established in Persaud *et al.* 1993.

Parameter	Big Walnut Creek Sediment (River Mile) 26.2	25.7	25.57	25.4	25.33	24.8
Metals - Total (mg/kg)						
Arsenic	**9.7**	**15.1**	**11.5**	**14**	**21.9**	**18.5**
Barium	167	119	138	163	132	190
Chromium	**243**	13.4	**224**	**243**	11.3	14.3
Iron	17,700	**22,500**	18,500	**20,200**	**22,700**	**27,300**
Lead	17	18.7	16.3	18.8	19.2	19.9
Zinc	95.5	**129**	**120**	113	**131**	**132**
Volatile Organic Compounds (ug/kg)			NONE DETECTED			
Semivolatile Organic Compounds (ug/kg)						
4-Methylphenol	<500	<380	<520	56J	<460	<440
2-Methylnaphthalene	<500	47J	<520	<500	<460	51J
Acenaphthene	<500	49J	<520	<500	<460	<440
Fluorene	<500	55J	65J	<500	<460	<440
N-nitrosodiphenylamine	<500	<380	<520	<500	51J	<440
Phenanthrene	170J	370J	**580**	**630**	250J	67J
Anthracene	<500	68J	74J	75J	<460	<440
Fluoranthene	320J	740	**1300**	**1600**	540	97J
Pyrene	270J	**560**	**960**	**1200**	400J	89J
Benzo(a)anthracene	140J	260J	**420J**	**470J**	140J	48J
Bis(2-ethylhexyl)phthalate	<500	92J	250J	780	170J	<440
Di-n-octylphthalate	<500	<380	91J	<500	<460	<440
Chrysene	170J	**340J**	**740**	**910**	270J	65J
Carbazole	<500	59J	100J	120J	47J	<440
Benzo(b)fluoranthene	230XJ	520X	1100X	1400X	370XJ	80XJ

Table 3. Continued.

Parameter	Big Walnut Creek Sediment (River Mile) 26.2	25.7	25.57	25.4	25.33	24.8
Semivolatile Organic Compounds (ug/kg)						
Benzo(k)fluoranthene	**270XJ**	**580X**	**1200X**	**1500X**	**410XJ**	89XJ
Benzo(a)pyrene	81J	220J	**480J**	**540**	150J	<440
Indeno(1,2,3-cd)pyrene	<500	120J	**280J**	**320J**	61J	<440
Benzo(g,h,i)perylene	<500	140J	**300J**	**340J**	<460	<440
Dibenzo(a,h)anthracene	<500	<380	<520	**96J**	<460	<440
PCBs (ug/kg)	NONE DETECTED					
Pesticides (ug/kg)						
gamma-BHC	<2.6	2.0P	2.5JP	0.85JP	<2.4	0.11JP
Heptachlor	<2.6	0.39JP	0.54JP	0.28JP	<2.4	0.17JP
Heptachlor epoxide	<2.6	<1.9	0.10J	<2.6	<2.4	<2.3
Dieldrin	<5.0	**3.1J**	**5.9P**	0.72JP	**4.4J**	0.19JP
4,4-DDE	0.089JP	0.10JP	2.0JP	0.78JP	0.57JP	0.28JP
Endrin	<5.0	<3.7	0.11JP	<5.0	<4.6	0.059JP
Endosulfan II	<5.0	<3.7	1.1JP	<5.0	<4.6	<4.4
Endosulfan sulfate	0.36J	<3.7	<5.2	<5.0	<4.6	0.37JP
4,4-DDT	<5.0	0.041JP	3.9J	4.3J	0.29JP	<4.4
Methoxychlor	2.8JP	0.31JP	7.0J	11JP	4.6J	0.26JP
Endrin ketone	0.33JP	<3.7	1.4JP	2.2JP	0.38JP	<4.4
Endrin aldehyde	<5.0	<3.7	0.098JP	<5.0	0.087JP	0.047JP
alpha-Chlordane	0.42J	0.80JP	0.93JP	<2.6	1.4JP	0.16JP
gamma-Chlordane	<2.6	<1.9	<2.7	<2.6	<2.4	0.13JP

J The value reported is less than the Contract Required Quantitation Limit (CRQL) but greater than zero. The results are not quantified and therefore the true concentration has some uncertainty.

P Greater than 25 percent difference for detected concentrations between two GC columns. The lower of the two values is reported.

X Denotes indistinguishable coeluting isomers.

Table 3. Chemical compounds detected in sediment samples collected by Ohio EPA from Big Walnut Creek and the Columbus Airport Tributary, October 28, 1996. Measurements in **bold** exceed the Lowest Effect Level as detailed in Persaud *et al.* 1993. Parameters exceeding the Severe Effect Level are indicated by underlined **bold** numbers. Parameters in *italics* do not have review guidelines established in Persaud *et al.* 1993.

	Sediment		
	Big Walnut Creek		Columbus Airport Trib.
Parameter	**27.35**	**27.11**	**0.10**
Metals - Total (mg/kg)			
Arsenic	**8.25**	**17.9**	**15.3**
Cadmium	**0.605**	**1.05**	**1.2**
Chromium	**41**	**32**	**40**
Copper	**25**	**29**	**31**
Iron	18,400	**28,000**	**31,100**
Lead	<21	<23	<27
Mercury	0.0296	<0.0389	0.0460
Nickel	**27**	**33**	**43**
Selenium	<1.05	1.44	1.85
Zinc	114	**146**	**137**
Volatile Organic Compounds (ug/kg)	NONE DETECTED		
Semivolatile Organic Compounds (ug/kg)			
Benzo(a)anthracene	ND	**800**	ND
Benzo(a)pyrene	ND	**900**	ND
Benzo(b)fluoranne	ND	1300	ND
Benzo(g,h,i)perylene	ND	**800**	ND
Benzo(k)fluoranthene	ND	**1100**	ND
Chrysene	ND	**1400**	ND
Fluoranthene	ND	**2600**	ND
Indeno(1,2,3-cd)pyrene	ND	**800**	ND
Phenanthrene	ND	**1000**	ND
Pyrene	ND	**2000**	ND
PCBs (ug/kg)	NONE DETECTED		
Pesticides (ug/kg)			
Methoxychlor	ND	7.3	ND
Other			
Total Organic Carbon (%)	1.0	2.4	3.9
Particle Size : Sand and larger (%)			
Silt (%)			
Clay (%)			

Surface Water

Surface water chemical analyses were conducted on samples collected from Big Walnut Creek at six locations during 1995 (RMs 26.2 - 24.8) and three locations during 1996 (RMs 27.35 - 24.8). One sample was collected from each location from 1995 (April 26), and 2 - 4 samples were collected between August 15 and October 29 for the 1996 locations. Samples were tested in part or wholly for metal parameters, organochlorinated pesticides, volatile organic compounds, and semivolatile organic compounds. Results of these tests are reported in Tables 4 and 5.

- Water quality results from the 1995 (Table 4) sampling of Big Walnut Creek revealed one parameter from one sample (cadmium: 8.6 ug/l) exceeding the warmwater habitat average Ohio water quality criterion. The sample was collected in Big Walnut Creek at the confluence of the D.E. Edwards North Ditch. All other parameters and samples were either below warmwater habitat water quality criteria (for parameters with criteria), considered low with no difference betweeen upstream and downstream samples, or near or below the parameter laboratory detection limit. Aside from the one cadmium value, all other parameters were reflective of good water quality. Of the over 100 volatile and semivolatile organic chemical compounds tested in surface water, only two parameters (methylene chloride and acetone) were above laboratory detection limits; both compounds were less than the 30-day average WWH water quality criterion.

- Overall water quality results from 1996 (Table 5) were good, with only iron (six samples) exceeding Ohio's WQS criteria. All other chemical parameters with associated water quality criteria were within acceptable levels. All PCB, pesticides, and volatile and semivolatile organic compounds tested were reported by the laboratory as not-detected.

- Water quality sampling in the Columbus Airport Tributary during 1996 revealed iron and fecal coliform bacteria exceedances of Ohio WQS criteria. In addition, three organochlorinated pesticides (4,4'-DDT: 0.046 ug/l, dieldrin: 0.014 ug/l, and methoxychlor: 0.012 ug/l) had values that exceeded Ohio WQS criteria. Elevated nitrates (2.65 - 6.00 mg/l) and biochemical oxygen demand (4.3 and 9.2 mg/l) revealed some nutrient enrichment in the Columbus Airport Tributary.

Table 4. Chemical compounds detected in surface water samples collected by Ohio EPA from Big Walnut Creek, April 26, 1995.

Parameter	Big Walnut Creek Surface Water (River Mile) 26.2	25.7	25.57	25.4	25.33	24.8
Metals - Total (ug/l)						
Aluminum	169b	192b	166b	283	173b	245
Antimony	3.0u	3.0u	3.0u	3.0u	3.3b	3.0u
Arsenic	8.0u	8.0u	8.0u	8.0u	8.0u	8.0u
Barium	65.7b	71.2b	74.6b	71.0b	109b	71.7b
Cadmium	2.0u	2.2b	8.6*	2.0u	2.0u	2.0u
Chromium	5.0u	5.0u	5.0u	5.0u	5.0u	5.0u
Cobalt	2.0u	2.0u	2.0u	2.0u	2.0u	2.0u
Iron	550	504	390	859	426	584
Lead	12.2	4.9	5.2	23.7	19.4	22.1
Magnesium	19,900	20,500	25,900	20,600	30,600	21,200
Manganese	46.6	41.3	52.7	56.8	29.2	42
Nickel	10.0u	10.0u	10.0u	10.0u	10.0u	10.0u
Potassium	3530b	3860b	5160	4210b	5400	3910b
Vanadium	2.0u	2.0u	2.0u	2.0u	2.0u	2.0u
Volatile Organic Compounds (ug/l)						
Methylene chloride	10u	10u	43	4J	10u	10u
Acetone	10u	10u	10u	10u	54	10u
Semivolatile Organic Compounds (ug/l)	None Detected					

J The value reported is less than the Contract Required Quantitation Limit (CRQL) but greater than zero. The results are not quantified and therefore the true concentration has some uncertainty.

b Value is less than the contract required detection limit but greater than or equal to the instrument detection limit.

u Undetected - The compound was not detected or was less than the associated sample detection limit.

* Value exceeded the outside mixing zone 30-day average Ohio Water Quality Standards (WQS) criterion.

Table 5. Results of the chemical/physical surface water sampling conducted by Ohio EPA in the Big Walnut Creek study area during August - September, 1996.

	SURFACE WATER						
	Big Walnut Creek Upstream Airport Tributary RM 27.35			Big Walnut Creek Hamilton Road RM 27.11			
Parameter	8/15/96	8/30/96	9/16/96	8/15/96	8/30/96	9/16/96	10/29/96
Field Conductivity (umhos/cm)	-	400	405	500	300	362	312
Dissolved Oxygen (mg/l)	-	5.2	8.5	8.5	6.8	8.2	8.17
Field pH (SU)	-	7.74	7.72	7.70	7.87	7.78	7.91
Temperature (°C)	-	22.0	17.2	25.0	23.0	17.0	13.05
BOD5 (mg/l)	-	<2	<2	2.0	<2	3.4	<2
COD (mg/l)	-	21	<10	17	27	13	<10
Chloride (mg/l)	-	23	30	26	22	24	21
Nitrate-Nitrite, N (mg/l)	-	0.53	0.28	0.66	0.56	0.92	0.47
Nitrite-N (mg/l)	-	<0.02	<0.02	<0.02	0.02	0.04	<0.02
Ammonia-N (mg/l)	-	<0.05	<0.05	0.05	<0.05	0.11	0.06
TKN (mg/l)	-	0.5	0.4	<0.2	0.3	0.4	0.3
Lab pH (SU)	-	-	8.04	-	-	8.00	-
Phosphorus-T (mg/l)	-	<0.05	<0.05	0.06	<0.05	<0.05	<0.05
Total Residue (mg/l)	-	308	368	-	322	328	262
TSS (mg/l)	-	17	19	26	38	22	10
Sulfate (mg/l)	-	51	63	52	50	49	47
Fecal Coliform (#/100ml)	-	150	523	380	705	1430	130
Fecal Strept. (#/100ml)	-	130	2400	535	200	5850	360
Arsenic-T (ug/l)	-	2	4	2	2	2	3
Cadmium-T (ug/l)	-	<0.2	<0.2	<0.2	<0.2	0.3	<0.2
Calciuim-T (mg/l)	-	51	57	49	53	52	44
Chromium-T (ug/l)	-	<30	<30	<30	<30	<30	<30
Copper-T (ug/l)	-	<10	<10	<10	<10	<10	<10
Iron-T (ug/l)	-	1180*	918	1520*	2770*	1060*	590
Lead-T (ug/l)	-	<2	2	2	3	3	<2
Magnesium-T (mg/l)	-	17	19	17	18	17	15
Nickel-T (ug/l)	-	<40	<40	<40	<40	<40	<40
Zinc-T (ug/l)	-	<10	<10	14	14	48	12
Hardness-T (mg/l)	-	197	221	192	206	200	172

Table 5. Continued.

	SURFACE WATER						
	Big Walnut Creek, East Broad Street RM 24.8				Columbus Airport Tributary Near Mouth RM 0.1		
Parameter	8/15/96	8/30/96	9/16/96	10/29/96	8/30/96	9/16/96	10/29/96
Field Conductivity (umhos/cm)	500	400	360	323	800	440	702
Dissolved Oxygen (mg/l)	8.5	6.2	8.3	9.1	6.0	8.8	5.99
Field pH (SU)	7.70	7.54	7.60	8.01	7.80	7.48	7.70
Temperature (°C)	25.0	22.0	16.9	12.9	22.0	16.2	11.6
BOD5 (mg/l)	2.0	<2	2.1	<2	<2	9.2	4.3
COD (mg/l)	17	21	<10	12	12	19	17
Chloride (mg/l)	26	23	26	22	52	9	48
Nitrate-Nitrite, N (mg/l)	0.66	0.57	0.41	0.51	4.57	2.65	6.00
Nitrite-N (mg/l)	<0.02	0.02	<0.02	<0.02	0.26	0.20	0.32
Ammonia-N (mg/l)	0.05	0.07	0.06	<0.05	0.40	0.54	0.73
TKN (mg/l)	<0.2	0.4	0.3	0.4	0.6	1.0	1.2
Lab pH (SU)	-	-	8.07	-	-	8.00	-
Phosphorus-T (mg/l)	0.06	<0.05	<0.05	0.09	<0.05	<0.05	<0.05
Total Residue (mg/l)	-	300	326	268	718	238	652
TSS (mg/l)	26	26	20	5	39	46	<5
Sulfate (mg/l)	52	50	47	53	117	49	136
Fecal Coliform (#/100ml)	380	190	1120	90	3200**	2570**	170
Fecal Strept. (#/100ml)	535	400	3300	200	230	29,000	190
Arsenic-T (ug/l)	2	<2	3	2	<2	2	2
Cadmium-T (ug/l)	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	0.6
Calciuim-T (mg/l)	49	52	51	46	131	35	121
Chromium-T (ug/l)	<30	<30	<30	<30	<30	<30	<30
Copper-T (ug/l)	<10	<10	<10	<10	<10	14	<10
Iron-T (ug/l)	1520*	1400*	907	454	413	2110*	282
Lead-T (ug/l)	2	<2	2	<2	<2	8	<2
Magnesium-T (mg/l)	17	17	17	15	42	8	35
Nickel-T (ug/l)	<40	<40	<40	<40	<40	<40	<40
Zinc-T (ug/l)	14	10	14	<10	<10	94	16
Hardness-T (mg/l)	192	200	197	177	500	120	446

* - indicates an exceedance of the WWH outside mixing zone 30-day average Ohio Water Quality Standards criterion.
** - indicates an exceedance of the Primary Contact Recreation criterion.

Physical Habitat for Aquatic Life

Physical habitat was evaluated in Big Walnut Creek and the Columbus Airport Tributary at each biological sampling location. Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 6.

- Stream morphology in Big Walnut Creek within the study area is free-flowing and consists of pools interspersed with well developed riffle and run habitats. Bottom substrates are predominated by gravel, cobble, and sand with lesser amounts of bedrock. Qualitative Habitat Evaluation Index (QHEI) scores for Big Walnut Creek within the study area ranged between 74.5 and 86.5 with a mean value of 79.9. These scores are indicative of good to excellent stream and riparian habitat and reflect conditions which are capable of supporting WWH and quite possibly EWH stream fish communities.

- Runway expansion activities at the Columbus Airport contributed to excessive sedimentation and embedding of bottom substrates in Big Walnut Creek. This was particularly apparent at the three biological sampling locations closest to the airport (RMs 27.4, 27.0, and 26.2). An increase in siltation of the stream bottom (from moderate to heavy) occurred at these three sites between the first and second fish sampling passes, with upwards of 12 inches of depositional material occurring in large pool areas. As part of the runway expansion, the riparian corridor along the upper 75 meters of the fish site at RM 27.4 (as well as for approximately one-half mile upstream) was denuded of trees and scrubs, with bare, loose soil exposed along the banks and in the surrounding floodplain. This activity, along with storm runoff from large unvegetated and exposed construction areas, contributed to the sedimentation observed instream.

- The Columbus Airport Tributary was evaluated in the lower 0.2 miles. Stream habitat conditions further upstream were not assessed, however, part of the stream was modified as part of the runway expansion. In the lower 0.2 miles, bottom substrates were predominated by silt and sand with small amounts of cobble and gravel. The stream bottom was extensively embedded with fine-grained material, resulting in reduced cover for aquatic organisms. The stream was represented by a natural channel, however, the riparian zone has been extensively modified, particularly in the floodplain along the stream. The QHEI score was 45.5, with modified warmwater habitat stream attributes predominating. Stream habitat quality was considered fair.

Table 6. Qualitative Habitat Evaluation Index (QHEI) matrix showing modified and warmwater habitat characteristics for Big Walnut Creek and Columbus Airport Tributary, 1996.

			WWH Attributes										MWH Attributes																					
													High Influence										*Moderate Influence*												
Key QHEI Components			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/No Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	Low Sinuosity	Sparse/No Cover	Max. Depth < 40 cm (WD/HW)	**Total H.L MWH Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low/No Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total M.L MWH Attributes**	**MWH HL/WWH Ratio**	**MWH ML/WWH Ratio**
River Mile	QHEI	Gradient (ft/mile)																																
(02-100) Big Walnut Creek																																		
Year: 96																																		
27.4	**83.0**	5.32	■■		■	■	■	■		■	■		8						0	▲										1	0.11	0.22
27.0	**76.0**	5.32	■■		■	■	■	■		■			8						1	▲		▲				▲▲				4	0.22	0.67
26.2	**74.5**	4.44	■■		■		■			■			5						0	▲		▲				▲▲▲				5	0.17	1.00
25.7	**80.5**	4.44	■■		■	■	■	■		■	■		8						0	▲						▲				2	0.11	0.33
25.5	**79.0**	4.44	■■		■	■	■	■		■	■		8						0	▲		▲				▲				3	0.11	0.44
25.2	**86.5**	4.44	■■		■	■	■	■		■	■		8						0	▲						▲				2	0.11	0.33
(02-280) Trib. to Big Walnut Creek (RM 27.29)																																		
Year: 96																																		
0.1	**45.5**	25.00	■			■							2	●		●	●		3	▲		▲				▲▲		▲		5	1.33	3.00

Macroinvertebrate Community

In 1996 macroinvertebrate communities were sampled in Big Walnut Creek at six locations from RMs 27.4 to 25.2 (Table 1). Summarized results from the 1996 macroinvertebrate sampling are compiled in Table 7. ICI metrics and scores and raw data tables by river mile are attached as Appendix Tables 1 and 2. Included in Table 7 are historical Ohio EPA macroinvertebrate data collected in 1991.

Big Walnut Creek

- Analysis of the samples collected from Big Walnut Creek near the Columbus Airport indicated macroinvertebrate communities in the good to very good range (ICI scores of 38, 38, and 42) with all sites meeting the ECBP ecoregion biocriterion. All three sites (RMs 27.4, 27.0, and 26.2, respectively) reflected effects from the heavy sediment load originating from the runway expansion activities at the airport. At the time of the sampling, limited silt controls were in place and construction activities were going to the very edge of the stream. The initial effect on macroinvertebrate communities in streams subjected to an increased silt load is a reduction in the number of taxa present and reduced biomass. An effect of prolonged exposure to heavy silt loads is reduced community diversity, especially a reduction of EPT taxa richness [a widely used measure of stream health based on the presence of members of three pollution sensitive orders: Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies)]. However, biomass may increase with the proliferation of silt tolerant aquatic worms and borrowing midges (Resh and Rosenberg, 1984, and Waters, 1995). These sites had low mayfly taxa diversity and low numbers, as a percentage of the total sample collected, of both mayflies and caddisflies. Total diversity and caddisfly diversity were high as was the percentage of Tanytarsini midges (a family of midges considered relatively pollution intolerant). This indicated that overall water quality was good, aside from the high input of sediment.

- Samples to assess the macroinvertebrate community in the vicinity of the D. E. Edwards landfill at Whitehall Park (RMs 25.6, 25.5, and 25.2) indicated communities in the very good to exceptional range (ICI scores of 44, 48, and 42, respectively). All three sites in this reach exceeded the ECBP ecoregion biocriterion. Total taxa diversity and caddisfly taxa diversity were high. Mayfly taxa diversity ranged from moderate to high and the percentage of Tanytarsini midges was high, ranging from 36% to 59% of the total number of organisms collected. However, pollution tolerant limpets (genus *Ferrissia*) made up 17% of the total organisms in the sample from RM 25.2, resulting in a score of zero in the percent tolerant taxa ICI metric. High numbers of *Ferrissia* are usually associated with elevated nutrients and low dissolved oxygen levels.

Table 7. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in Big Walnut Creek, 1996. Big Walnut Creek has a WWH aquatic life use designation in the Ohio Water Quality Standards.

Stream/ River Mile	Relative Density	Total Taxa	Quantitative Taxa	Qualitative Taxa	Qualitative EPT[a]	ICI	Evaluation
Big Walnut Creek (1996)							
27.4	1296	68	53	42	9	38	Good
27.0	1210	55	38	44	14	38	Good
26.2	1155	59	45	36	8	42	Very Good
25.6	3165	64	39	45	10	44	Very Good
25.5	2349	62	44	42	13	48	Exceptional
25.2	820	58	48	34	9	42	Very Good
Big Walnut Creek (1991)							
26.8	575	65	40	53	12	46	Exceptional
25.6	846	66	39	51	12	38	Good

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(Ohio Administrative Code 3745-1-07, Table 7-17)

INDEX	**WWH**	**EWH**	**MWH**[b]
ICI	36	46	22

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

b Modified Warmwater Habitat for channel modified areas.

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

ns Nonsignificant departure from WWH or EWH biocriterion (≤4 IBI units or ≤0.5 MIwb units).

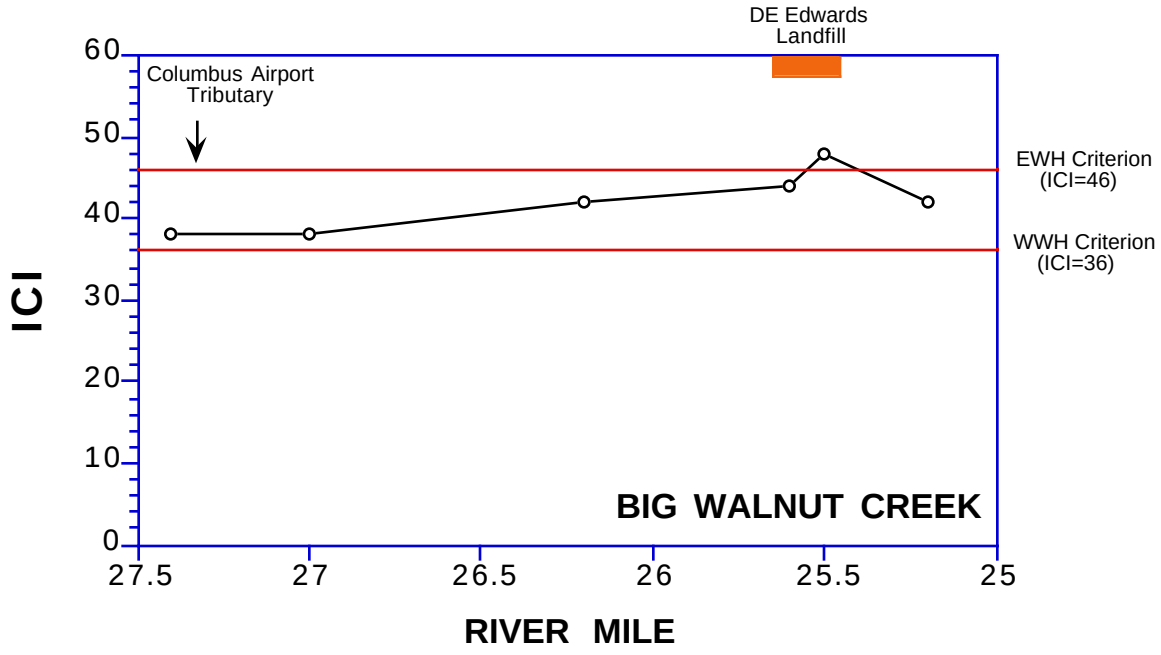


Figure 3. Longitudinal performance of the Invertebrate Community Index (ICI) in Big Walnut Creek, 1996.

Fish Community

A total of 3,863 fish representing 44 species and three hybrids were collected from Big Walnut Creek within the study area between August and October, 1996. The sampling effort included a cumulative distance electrofished of 2.54 km at six locations (Table 8, Figure 4). Relative numbers and species collected per location are presented in Appendix Table 3, and IBI metric results are presented in Appendix Table 4. Sampling locations were evaluated using Warmwater Habitat biocriteria.

Big Walnut Creek

- Central stoneroller (18.2%) and bluntnose minnow (14.1%) predominated the catch numerically, while golden redhorse (20.8%), common carp (18.8%), and northern hog sucker (18.2%) predominated by weight.

- Sampling results in Big Walnut Creek adjacent to and downstream from the D.E. Edwards landfill were reflective of marginally good to very good conditions, with both sites (RMs 25.5 and 25.2) acheiving the Eastern Corn Belt Plains ecoregion biocriteria (Figure 4). The D. E. Edwards landfill did not appear to have a negative influence on the fish communities of Big Walnut Creek.

- Fish community results at RM 26.2 (adjacent to the Columbus Airport golf course) appeared to be influenced by a combination of heavy siltation of the stream bottom in the large pool area, and the lack of a well-developed riffle/run area. The lowest IBI (37) and MIwb (7.6) scores within the study area occurred at RM 26.2, with the fish community indicative of fair to marginally good quality. The influence of the excessive sediment load to Big Walnut Creek is reflected in the change in numbers of intolerant fish and numbers of darters collected between the first and second passes at each site (Figure 5). The second pass occurred after significant runoff event (s) in August contributed to heavy embeddedness of the stream bottom, particularly in large pool areas.

- Aside from RM 26.2, sampling sites upstream from D.E. Edwards landfill had fish community results achieving the ecoregional biocriteria. Results at these upstream sites were reflective of good to exceptional conditions.

Columbus Airport Tributary

- Fish sampling was conducted once near the mouth of the Columbus Airport Tributary. The fish community at RM 0.1 was degraded. The IBI score of 26 was in the poor range, showing substantial departure from the WWH ecoregional biocriterion. The fish community was dominated by species highly tolerant of pollution and habitat modifications.

Table 8. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by the Ohio EPA in Big Walnut Creek during August and October, 1996. The number of samples collected at each location is listed with the sampling method. Relative number and weight are per 0.3 km for wading and headwater sites.

Stream RM	Sampling Method/- # Samples	Mean # Species	Total # Species	Mean Relative Number	Mean Relative Weight(kg)	QHEI	Mean Modified Index of Well Being	Mean Index of Biotic Integrity	Narrative Evaluation[a]
Big Walnut Creek (1996)									
27.4	Wading-2	28.0	34	608	18.54	83.0	8.8	45	Good
27.0	Wading-2	28.5	33	446	10.24	76.0	8.8	44	Good
26.2	Wading-2	18.5	23	309	6.39	74.5	7.6*	37[ns]	Fair/Marginally Good
25.7	Wading-2	25.5	34	380	6.64	80.5	8.4	50	Good/Exceptional
25.5	Wading-2	28.0	33	407	13.44	79.0	8.0[ns]	42	Marg. Good/Good
25.2	Wading-2	28.5	32	588	12.71	86.5	9.0	48	Very Good
Columbus Airport Tributary (1996)									
0.1	Headwater-1	-	9	246	-	45.5	-	26*	Poor

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(Ohio Administrative Code 3745-1-07, Table 7-17)

INDEX	WWH	EWH	MWH[b]
IBI - Wading	40	50	24
IBI - Headwater	40	50	24
MIwb - Wading	8.3	9.4	6.2

* Significant departure from ecoregional biocriteria (>4 IBI units, >0.5 MIwb units); poor and very poor results are underlined.

ns Nonsignificant departure from biocriterion (≤4 IBI units, ≤0.5 MIwb units).

a Narrative evaluation is based on MIwb and IBI scores.

b Modified Warmwater Habitat for channel modified areas.

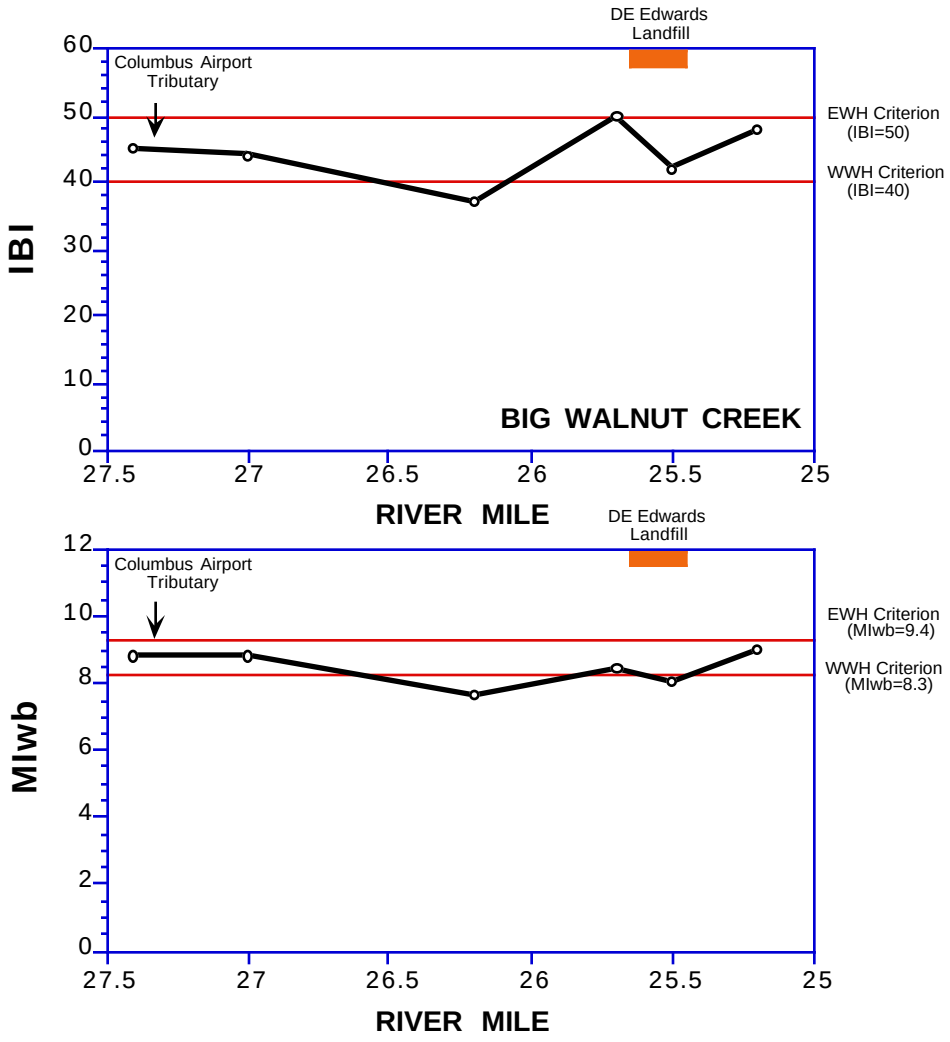


Figure 4. Longitudinal trend of the Index of Biotic Integrity (IBI) and modified Index of Well-being (MIwb) from Big Walnut Creek, 1996.

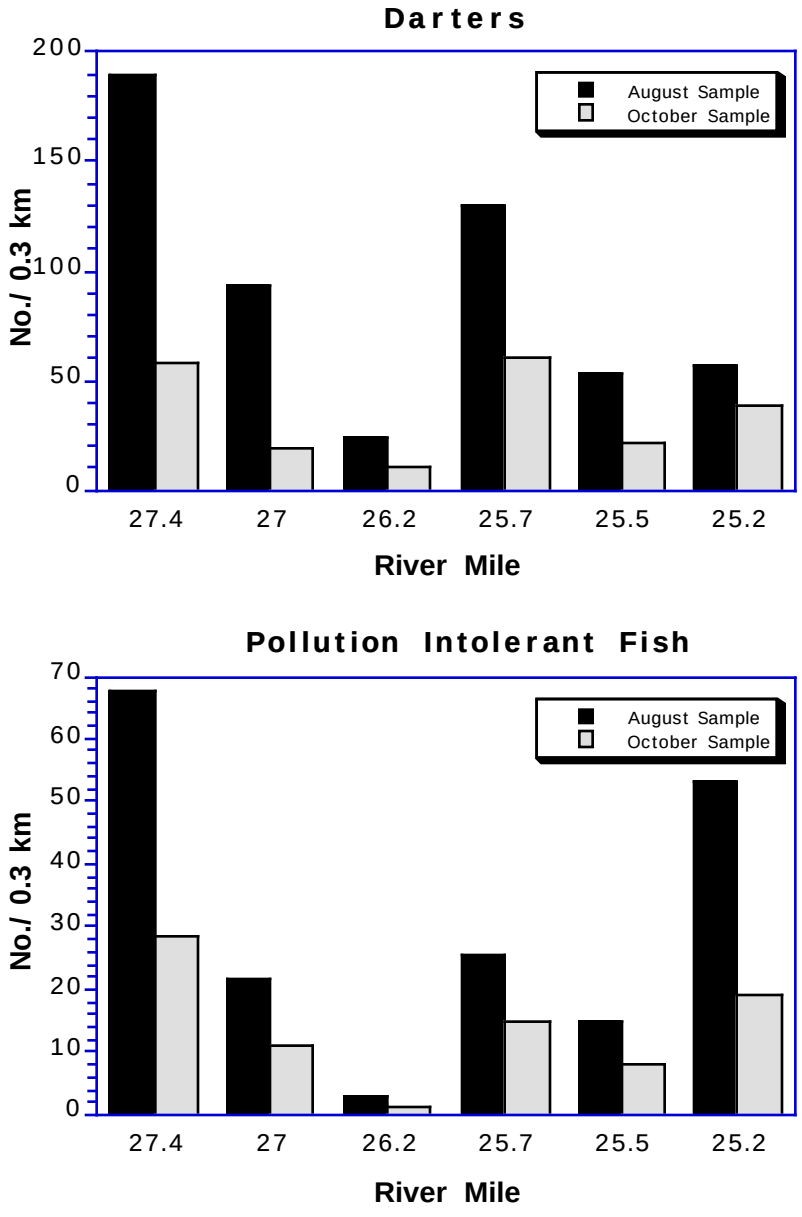


Figure 5. Relative number (number/0.3 km) of intolerant fish and darters collected in Big Walnut Creek during the first (August) and second (October) sampling pass, 1996. A substantial increase in the sediment bed load of Big Walnut Creek was observed between the August and October samples, particularly at the upper three locations.

Trend Assessment

Changes in Macroinvertebrate Community Performance 1991-1996

- Two 1996 sites were sampled in 1991 as part of a larger survey. The upper sites RM 27.0/26.8 showed a decline from the exceptional range in 1991 (ICI = 46) to the good range in 1996 (ICI = 38). This decline resulted primarily from a large decline in the percentage of mayflies and an increase in the percentage of tolerant organisms present. The heavy sediment load related to the runway expansion at the Columbus Airport appeared to be the principal cause of the decline in ICI scoring in this reach. The site at RM 25.6 showed an improvement between 1991 and 1996 (ICI 38 to 44). However, due to low flow conditions encountered during the 1991 sampling period and the effect of reduced current velocity on the colonization of the artificial substrates, macroinvertebrate community conditions in 1991 was not likely much different than in 1996.

Changes in Fish Community Performance 1991-1996

- Two fish sites were sampled in Big Walnut Creek (RMs 27.1 and 24.9) during 1991 as part of a larger stream survey. The 1991 sampling revealed fish populations fully attaining the biological criteria at both locations. Fish sampling during 1996 revealed similar results to the 1991 sampling locations, where full biological attainment prevailed. Area of Degradation Values (ADV) revealed comparable results between 1996 and 1991 (Table 9).

Table 9. Area of Degradation (ADV) statistics for Big Walnut Creek, 1991 and 1996 (calculated using ecoregion biocriteria as the background community performance). ADV values were extrapolated 0.5 miles upstream and downstream from the upper and lower river mile sites, respectively.

	Biological Index Scores				ADV Statistics		Attainment Status (miles)			
Stream Index	Upper RM .	Lower RM .	Mini-mum	Maxi-mum	ADV	**ADV/ Mile**	FULL	PARTIAL	**NON**	Poor/VP
Big Walnut Creek (1991)										
IBI			44	49	0	**0.0**				
MIwb	27.6	24.4	7.9	9.2	0	**0.0**	3.2	0.0	0.0	0.0
ICI			38	46	0	**0.0**				
Big Walnut Creek (1996)										
IBI			37	50	0	**0.0**				
MIwb	27.9	24.7	7.6	9.0	1	**0.5**	3.0	0.2	0.0	0.0
ICI			38	48	0	**0.0**				

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Appendix Table 1. Raw macroinvertebrate data by river mile for the Big Walnut Creek study area, 1996.

Ohio EPA Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/23/96 River Code: 02-100 River: Big Walnut Creek RM: 27.40

Taxa Code	Taxa	Quan/Qual	
01320	*Hydra sp*	172	
01801	*Turbellaria*	4	+
03121	*Paludicella articulata*	10	
03360	*Plumatella sp*	6	+
03600	*Oligochaeta*	128	+
04666	*Helobdella triserialis*	12	
06700	*Crangonyx sp*		+
08250	*Orconectes (Procericambarus) rusticus*		+
08601	*Hydracarina*	76	+
11130	*Baetis intercalaris*		+
12200	*Isonychia sp*		+
13400	*Stenacron sp*	5	
13521	*Stenonema femoratum*	1	
13561	*Stenonema pulchellum*	12	+
16700	*Tricorythodes sp*	119	
17200	*Caenis sp*	40	+
21200	*Calopteryx sp*	1	
21300	*Hetaerina sp*	5	+
22001	*Coenagrionidae*	1	+
22300	*Argia sp*	40	+
22600	*Enallagma sp*		+
43300	*Ranatra sp*		+
47600	*Sialis sp*		+
48410	*Corydalus cornutus*		+
50315	*Chimarra obscura*	3	+
52200	*Cheumatopsyche sp*	197	+
52430	*Ceratopsyche morosa group*	249	+
52530	*Hydropsyche depravata group*	19	+
52540	*Hydropsyche dicantha*	101	+
53800	*Hydroptila sp*	160	
59580	*Oecetis persimilis*	4	
65800	*Berosus sp*	1	+
68075	*Psephenus herricki*	4	+
68601	*Ancyronyx variegata*		+
68708	*Dubiraphia vittata group*		+
68901	*Macronychus glabratus*	5	+
69400	*Stenelmis sp*	13	+
71900	*Tipula sp*	2	
77500	*Conchapelopia sp*	91	+
77750	*Hayesomyia senata or Thienemannimyia norena*	182	
77800	*Helopelopia sp*	273	
80310	*Cardiocladius obscurus*		+
80370	*Corynoneura lobata*	32	
80410	*Cricotopus (C.) sp*	91	
80420	*Cricotopus (C.) bicinctus*	61	
80430	*Cricotopus (C.) tremulus group*	61	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	152	
81240	*Nanocladius (N.) distinctus*	152	
81825	*Rheocricotopus (Psilocricotopus) robacki*	152	+
82070	*Synorthocladius semivirens*	61	
84060	*Parachironomus pectinatellae*	61	
84300	*Phaenopsectra obediens group*	61	+
84450	*Polypedilum (P.) convictum*	515	+
84460	*Polypedilum (P.) fallax group*	61	
84470	*Polypedilum (P.) illinoense*		+
84490	*Polypedilum (P.) ontario*	30	
84520	*Polypedilum (Tripodura) halterale group*		+
84790	*Tribelos fuscicorne*		+
85625	*Rheotanytarsus exiguus group*	1364	+
85800	*Tanytarsus sp*	152	
85814	*Tanytarsus glabrescens group*	1242	
85840	*Tanytarsus guerlus group*	30	
87540	*Hemerodromia sp*	88	+
93900	*Elimia sp*	1	+
95100	*Physella sp*	57	+
96120	*Menetus (Micromenetus) dilatatus*	1	+
96900	*Ferrissia sp*	121	
97601	*Corbicula fluminea*		+

No. Quantitative Taxa: 53 Total Taxa: 68

No. Qualitative Taxa: 42 ICI: **38**

Number of Organisms: 6482 Qual EPT: **9**

Ohio EPA Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/23/96 River Code: 02-100 River: Big Walnut Creek RM: 27.00

Taxa Code	Taxa	Quan/Qual	
00401	*Spongillidae*		+
01320	*Hydra sp*	209	
01801	*Turbellaria*	16	+
03121	*Paludicella articulata*	1	
03360	*Plumatella sp*	3	+
03600	*Oligochaeta*	44	
08601	*Hydracarina*	205	+
11120	*Baetis flavistriga*		+
11130	*Baetis intercalaris*	30	+
12200	*Isonychia sp*	2	+
13000	*Leucrocuta sp*	9	+
13400	*Stenacron sp*	20	+
13521	*Stenonema femoratum*	1	+
13561	*Stenonema pulchellum*	49	+
16700	*Tricorythodes sp*	40	
17200	*Caenis sp*	4	+
21200	*Calopteryx sp*		+
21300	*Hetaerina sp*	4	+
22001	*Coenagrionidae*		+
22300	*Argia sp*	19	+
45300	*Sigara sp*		+
48410	*Corydalus cornutus*	2	+
49200	*Climacia sp*		+
50315	*Chimarra obscura*	20	+
51300	*Neureclipsis sp*	8	
52200	*Cheumatopsyche sp*	274	+
52430	*Ceratopsyche morosa group*	40	+
52530	*Hydropsyche depravata group*		+
52540	*Hydropsyche dicantha*	19	+
52570	*Hydropsyche simulans*	8	+
65800	*Berosus sp*		+
68708	*Dubiraphia vittata group*		+
69400	*Stenelmis sp*	25	+
77500	*Conchapelopia sp*	52	+
77750	*Hayesomyia senata or Thienemannimyia norena*	181	+
77800	*Helopelopia sp*	77	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	52	
81240	*Nanocladius (N.) distinctus*	155	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	439	
83050	*Dicrotendipes lucifer*		+
84302	*Phaenopsectra punctipes*		+
84450	*Polypedilum (P.) convictum*	181	+
84460	*Polypedilum (P.) fallax group*		+
84470	*Polypedilum (P.) illinoense*		+
84490	*Polypedilum (P.) ontario*		+
85625	*Rheotanytarsus exiguus group*	2761	+
85800	*Tanytarsus sp*	103	
85814	*Tanytarsus glabrescens group*	284	
87540	*Hemerodromia sp*	446	+
93900	*Elimia sp*	2	+
95100	*Physella sp*		+
96120	*Menetus (Micromenetus) dilatatus*	4	
96900	*Ferrissia sp*	263	+
96930	*Laevapex fuscus*		+
97601	*Corbicula fluminea*		+

No. Quantitative Taxa:	38	Total Taxa:	55
No. Qualitative Taxa:	44	ICI:	**38**
Number of Organisms:	6052	Qual EPT:	**14**

Ohio EPA Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/23/96 River Code: 02-100 River: Big Walnut Creek RM: 26.20

Taxa Code	Taxa	Quan/Qual	
00401	*Spongillidae*		+
01320	*Hydra sp*	72	
01801	*Turbellaria*	6	+
03121	*Paludicella articulata*	2	
03360	*Plumatella sp*	1	
08601	*Hydracarina*	58	+
11120	*Baetis flavistriga*		+
11130	*Baetis intercalaris*	9	+
11670	*Procloeon irrubrum*		+
12200	*Isonychia sp*	1	
13400	*Stenacron sp*	16	+
13521	*Stenonema femoratum*	1	
13561	*Stenonema pulchellum*	48	+
16700	*Tricorythodes sp*	10	
17200	*Caenis sp*	63	
21300	*Hetaerina sp*	7	+
22001	*Coenagrionidae*		+
22300	*Argia sp*	26	+
50315	*Chimarra obscura*	7	+
51300	*Neureclipsis sp*	5	
52200	*Cheumatopsyche sp*	395	+
52430	*Ceratopsyche morosa group*	22	+
53800	*Hydroptila sp*	4	
68075	*Psephenus herricki*		+
68601	*Ancyronyx variegata*		+
68708	*Dubiraphia vittata group*	2	+
68901	*Macronychus glabratus*		+
69400	*Stenelmis sp*	18	+
71910	*Tipula abdominalis*		+
77750	*Hayesomyia senata or Thienemannimyia norena*	281	+
77800	*Helopelopia sp*	94	
78450	*Nilotanypus fimbriatus*	31	
80370	*Corynoneura lobata*	16	
80410	*Cricotopus (C.) sp*	62	
80420	*Cricotopus (C.) bicinctus*	62	+
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	62	
81240	*Nanocladius (N.) distinctus*	156	
81825	*Rheocricotopus (Psilocricotopus) robacki*	187	
82730	*Chironomus (C.) decorus group*		+
83040	*Dicrotendipes neomodestus*	94	+
84315	*Phaenopsectra flavipes*		+
84450	*Polypedilum (P.) convictum*	94	+
84460	*Polypedilum (P.) fallax group*	62	+
84470	*Polypedilum (P.) illinoense*		+
84700	*Stenochironomus sp*		+
84800	*Tribelos jucundum*		+
85500	*Paratanytarsus sp*	62	
85615	*Rheotanytarsus distinctissimus group*	31	
85625	*Rheotanytarsus exiguus group*	998	
85720	*Stempellinella n.sp nr. flavidula*	31	
85800	*Tanytarsus sp*	218	
85814	*Tanytarsus glabrescens group*	2309	+
87540	*Hemerodromia sp*	24	
93200	*Hydrobiidae*	20	+
93900	*Elimia sp*	2	+
95100	*Physella sp*	4	
96900	*Ferrissia sp*	88	+
97601	*Corbicula fluminea*	16	+
98001	*Sphaeriidae*		+

No. Quantitative Taxa: 45 Total Taxa: 59

No. Qualitative Taxa: 36 ICI: **42**

Number of Organisms: 5777 Qual EPT: **8**

Ohio EPA Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/18/96 River Code: 02-100 River: Big Walnut Creek RM: 25.60

Taxa Code	Taxa	Quan/Qual	
00401	*Spongillidae*		+
01320	*Hydra sp*	129	
01801	*Turbellaria*	20	+
03040	*Fredericella sp*	1	
03121	*Paludicella articulata*	4	+
03360	*Plumatella sp*	7	+
03600	*Oligochaeta*	20	
08250	*Orconectes (Procericambarus) rusticus*		+
08601	*Hydracarina*	689	
11120	*Baetis flavistriga*	4	
11130	*Baetis intercalaris*	31	+
12200	*Isonychia sp*	15	+
13000	*Leucrocuta sp*	1	+
13400	*Stenacron sp*		+
13550	*Stenonema mexicanum integrum*	25	+
13570	*Stenonema terminatum*	14	
16700	*Tricorythodes sp*	35	
17200	*Caenis sp*	12	
21200	*Calopteryx sp*		+
21300	*Hetaerina sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	4	+
26700	*Macromia sp*		+
47600	*Sialis sp*		+
48410	*Corydalus cornutus*	13	+
49200	*Climacia sp*		+
50315	*Chimarra obscura*	11	+
51300	*Neureclipsis sp*	34	
52200	*Cheumatopsyche sp*	2803	+
52430	*Ceratopsyche morosa group*	444	+
52530	*Hydropsyche depravata group*	297	+
52540	*Hydropsyche dicantha*	380	+
52570	*Hydropsyche simulans*	129	
53800	*Hydroptila sp*	28	
65800	*Berosus sp*		+
68075	*Psephenus herricki*		+
68601	*Ancyronyx variegata*		+
69400	*Stenelmis sp*	17	+
70600	*Antocha sp*	4	
71900	*Tipula sp*		+
77500	*Conchapelopia sp*		+
77750	*Hayesomyia senata or Thienemannimyia norena*	872	
77800	*Helopelopia sp*		+
78650	*Procladius sp*		+
80430	*Cricotopus (C.) tremulus group*	87	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	87	
81240	*Nanocladius (N.) distinctus*	262	+
81270	*Nanocladius (N.) spiniplenus*	174	
81825	*Rheocricotopus (Psilocricotopus) robacki*	87	
83040	*Dicrotendipes neomodestus*		+
84060	*Parachironomus pectinatellae*		+
84300	*Phaenopsectra obediens group*		+
84302	*Phaenopsectra punctipes*		+
84450	*Polypedilum (P.) convictum*	523	+
84460	*Polypedilum (P.) fallax group*		+
84470	*Polypedilum (P.) illinoense*		+
84520	*Polypedilum (Tripodura) halterale group*		+
84790	*Tribelos fuscicorne*		+
85625	*Rheotanytarsus exiguus group*	7412	+
85814	*Tanytarsus glabrescens group*	523	
87540	*Hemerodromia sp*	216	
95100	*Physella sp*	1	+
96900	*Ferrissia sp*	409	+
96930	*Laevapex fuscus*		+

No. Quantitative Taxa:	39	Total Taxa:	64
No. Qualitative Taxa:	45	ICI:	**44**
Number of Organisms:	15824	Qual EPT:	**10**

Ohio EPA Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/18/96 River Code: 02-100 River: Big Walnut Creek RM: 25.50

Taxa Code	Taxa	Quan/Qual	
00401	*Spongillidae*		+
01320	*Hydra sp*	84	
01801	*Turbellaria*	8	+
03121	*Paludicella articulata*	4	
03360	*Plumatella sp*	6	
03600	*Oligochaeta*	20	+
08250	*Orconectes (Procericambarus) rusticus*		+
08601	*Hydracarina*	496	
11120	*Baetis flavistriga*	4	
11130	*Baetis intercalaris*	43	+
11670	*Procloeon irrubrum*		+
12200	*Isonychia sp*		+
13400	*Stenacron sp*	4	+
13550	*Stenonema mexicanum integrum*	8	
13561	*Stenonema pulchellum*	66	+
13570	*Stenonema terminatum*		+
16700	*Tricorythodes sp*	86	
17200	*Caenis sp*	16	+
21200	*Calopteryx sp*	1	+
21300	*Hetaerina sp*	13	+
22001	*Coenagrionidae*		+
22300	*Argia sp*	62	+
24107	*Nasiaeschna pentacantha*		+
47600	*Sialis sp*		+
48410	*Corydalus cornutus*	7	+
49200	*Climacia sp*		+
50315	*Chimarra obscura*	5	+
51300	*Neureclipsis sp*	4	+
52200	*Cheumatopsyche sp*	1786	+
52430	*Ceratopsyche morosa group*	296	+
52530	*Hydropsyche depravata group*	85	
52540	*Hydropsyche dicantha*	86	+
52570	*Hydropsyche simulans*	84	
53800	*Hydroptila sp*	62	
59110	*Ceraclea ancylus*		+
65800	*Berosus sp*	1	
68075	*Psephenus herricki*		+
68601	*Ancyronyx variegata*		+
68901	*Macronychus glabratus*	4	
69400	*Stenelmis sp*	5	+
70600	*Antocha sp*	1	
74100	*Simulium sp*	8	
77500	*Conchapelopia sp*	309	+
77800	*Helopelopia sp*	103	+
80430	*Cricotopus (C.) tremulus group*	206	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	206	
84040	*Parachironomus frequens*	103	
84300	*Phaenopsectra obediens group*		+
84450	*Polypedilum (P.) convictum*	309	+
84470	*Polypedilum (P.) illinoense*		+
84490	*Polypedilum (P.) ontario*		+
84790	*Tribelos fuscicorne*		+
85625	*Rheotanytarsus exiguus group*	6276	+
85800	*Tanytarsus sp*	103	
85814	*Tanytarsus glabrescens group*	514	+
87540	*Hemerodromia sp*	104	
93900	*Elimia sp*	7	+
95100	*Physella sp*	56	+
96120	*Menetus (Micromenetus) dilatatus*	16	
96900	*Ferrissia sp*	76	
96930	*Laevapex fuscus*		+
97601	*Corbicula fluminea*		+

No. Quantitative Taxa:	44	Total Taxa:	62
No. Qualitative Taxa:	42	ICI:	**48**
Number of Organisms:	11743	Qual EPT:	**13**

Ohio EPA Monitoring and Assessment Section
Macroinvertebrate Collection

Collection Date: 09/18/96 River Code: 02-100 River: Big Walnut Creek RM: 25.20

Taxa Code	Taxa	Quan/Qual	
01320	*Hydra sp*	104	
01801	*Turbellaria*	4	+
03121	*Paludicella articulata*	9	
03360	*Plumatella sp*	5	+
03451	*Urnatella gracilis*	4	
08601	*Hydracarina*	128	+
11130	*Baetis intercalaris*	47	
12200	*Isonychia sp*	7	+
13000	*Leucrocuta sp*	28	
13400	*Stenacron sp*	81	
13510	*Stenonema exiguum*	1	
13521	*Stenonema femoratum*	17	
13561	*Stenonema pulchellum*	11	+
13570	*Stenonema terminatum*	30	
16700	*Tricorythodes sp*	8	+
17200	*Caenis sp*	187	
21200	*Calopteryx sp*		+
21300	*Hetaerina sp*		+
22001	*Coenagrionidae*		+
22300	*Argia sp*	39	+
48410	*Corydalus cornutus*	1	+
50315	*Chimarra obscura*	11	+
51300	*Neureclipsis sp*	12	
52200	*Cheumatopsyche sp*	501	+
52430	*Ceratopsyche morosa group*	36	+
52530	*Hydropsyche depravata group*	6	+
52540	*Hydropsyche dicantha*	10	+
52570	*Hydropsyche simulans*		+
53800	*Hydroptila sp*	4	
65800	*Berosus sp*		+
68075	*Psephenus herricki*		+
68901	*Macronychus glabratus*	8	+
69400	*Stenelmis sp*	16	+
71900	*Tipula sp*		+
77500	*Conchapelopia sp*	102	+
77750	*Hayesomyia senata or Thienemannimyia norena*	51	+
77800	*Helopelopia sp*	102	
78450	*Nilotanypus fimbriatus*	26	
80360	*Corynoneura "celeripes" (sensu Simpson & Bode, 1980)*	16	
80370	*Corynoneura lobata*	42	
81231	*Nanocladius (N.) crassicornus or N. (N.) rectinervus*	26	
81240	*Nanocladius (N.) distinctus*	26	+
81825	*Rheocricotopus (Psilocricotopus) robacki*	77	+
82121	*Thienemanniella n.sp 3*	26	
83300	*Glyptotendipes (G.) sp*	26	
84450	*Polypedilum (P.) convictum*	26	+
84460	*Polypedilum (P.) fallax group*	51	+
84470	*Polypedilum (P.) illinoense*		+
85625	*Rheotanytarsus exiguus group*	973	+
85720	*Stempellinella n.sp nr. flavidula*	26	
85802	*Tanytarsus curticornis group*	77	
85814	*Tanytarsus glabrescens group*	384	
87540	*Hemerodromia sp*	33	
93900	*Elimia sp*	7	+
95100	*Physella sp*	7	+
96900	*Ferrissia sp*	681	
96930	*Laevapex fuscus*		+
98600	*Sphaerium sp*		+

No. Quantitative Taxa:	48	Total Taxa:	58
No. Qualitative Taxa:	34	ICI:	**42**
Number of Organisms:	4100	Qual EPT:	**9**

Appendix Table 2. Invertebrate Community Index (ICI) metrics and scores for the Big Walnut Creek study area, 1996.

River Mile	Drainage Area (sq mi)	Number of: Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Percent: Mayflies	Caddis-flies	Tany-tarsini	Other Dipt/NI	Tolerant Taxa	Qual. EPT	Eco-region	ICI
BIG WALNUT CREEK — 02-100													
Year: 96													
27.40	234.0	53(6)	5(2)	7(6)	22(6)	2.7(2)	11.3(4)	43.0(6)	41.9(2)	8.9(2)	9(2)	5	**38**
27.00	236.0	38(6)	8(4)	6(6)	11(2)	2.6(2)	6.1(2)	52.0(6)	38.5(4)	7.6(2)	14(4)	5	**38**
26.20	240.0	45(6)	7(4)	5(6)	19(6)	2.6(2)	7.5(2)	63.2(6)	25.9(4)	6.4(4)	8(2)	5	**42**
25.60	241.0	39(6)	8(4)	8(6)	11(2)	0.9(2)	26.1(6)	50.1(6)	22.7(6)	4.4(4)	10(2)	5	**44**
25.50	241.0	44(6)	7(4)	8(6)	12(4)	1.9(2)	20.5(4)	58.7(6)	18.1(6)	1.3(6)	13(4)	5	**48**
25.20	242.0	48(6)	10(6)	7(6)	18(6)	10.2(2)	14.1(4)	35.6(6)	38.5(4)	18.7(0)	9(2)	5	**42**

Appendix Table 3. Summary of relative numbers and weight of fish and species collected at each location by river mile sampled in the Big Walnut Creek study area, 1996. Relative numbers are per 0.3 km.

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **27.40**	Basin: Scioto River	Date Range: 08/08/96
	Time Fished: 5197 sec Drain Area: 234.0 sq mi	Thru: 10/15/96
	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
SILVER REDHORSE	R	I	S	M	1	0.75	0.12	0.77	4.13	1,020.00
BLACK REDHORSE	R	I	S	I	11	8.25	1.36	1.26	6.77	152.18
GOLDEN REDHORSE	R	I	S	M	24	18.00	2.96	2.66	14.33	147.63
NORTHERN HOG SUCKER	R	I	S	M	39	29.25	4.81	3.56	19.19	121.63
COMMON CARP	G	O	M	T	3	2.25	0.37	3.29	17.76	1,463.33
HORNYHEAD CHUB	N	I	N	I	1	0.75	0.12	0.01	0.04	9.00
SUCKERMOUTH MINNOW	N	I	S		3	2.25	0.37	0.01	0.06	4.67
SILVER SHINER	N	I	S	I	8	6.00	0.99	0.05	0.28	8.75
ROSYFACE SHINER	N	I	S	I	4	3.00	0.49	0.01	0.04	2.25
ROSEFIN SHINER	N	I	S	M	1	0.75	0.12	0.00	0.01	1.00
STRIPED SHINER	N	I	S		35	26.25	4.32	0.23	1.24	8.74
SPOTFIN SHINER	N	I	M		13	9.75	1.60	0.05	0.26	4.92
SAND SHINER	N	I	M	M	35	26.25	4.32	0.05	0.29	2.03
MIMIC SHINER	N	I	M	I	4	3.00	0.49	0.00	0.01	0.50
BLUNTNOSE MINNOW	N	O	C	T	206	154.50	25.40	0.23	1.26	1.52
CENTRAL STONEROLLER	N	H	N		118	88.50	14.55	0.75	4.04	8.46
CHANNEL CATFISH	F		C		1	0.75	0.12	0.61	3.28	812.00
YELLOW BULLHEAD		I	C	T	2	1.50	0.25	0.12	0.66	81.00
STONECAT MADTOM		I	C	I	1	0.75	0.12	0.01	0.05	12.00
BRINDLED MADTOM		I	C	I	1	0.75	0.12	0.00	0.01	2.00
BROOK SILVERSIDE		I	M	M	1	0.75	0.12	0.00	0.01	1.00
ROCK BASS	S	C	C		36	27.00	4.44	1.40	7.55	51.81
SMALLMOUTH BASS	F	C	C	M	16	12.00	1.97	1.95	10.52	162.56
LARGEMOUTH BASS	F	C	C		1	0.75	0.12	0.00	0.02	6.00
GREEN SUNFISH	S	I	C	T	32	24.00	3.95	0.38	2.03	15.63
BLUEGILL SUNFISH	S	I	C	P	7	5.25	0.86	0.04	0.23	8.29
LONGEAR SUNFISH	S	I	C	M	35	26.25	4.32	0.44	2.38	16.83
HYBRID X SUNFISH					1	0.75	0.12	0.01	0.05	11.00
LOGPERCH	D	I	S	M	1	0.75	0.12	0.00	0.02	4.00
JOHNNY DARTER	D	I	C		5	3.75	0.62	0.01	0.03	1.60
GREENSIDE DARTER	D	I	S	M	90	67.50	11.10	0.30	1.60	4.39
BANDED DARTER	D	I	S	I	34	25.50	4.19	0.05	0.25	1.82
RAINBOW DARTER	D	I	S	M	28	21.00	3.45	0.05	0.26	2.27
FANTAIL DARTER	D	I	C		8	6.00	0.99	0.02	0.09	2.88
SAUGER X WALLEYE	E	P			1	0.75	0.12	0.21	1.16	286.00
MOTTLED SCULPIN		I	C		4	3.00	0.49	0.02	0.12	7.50
Mile Total					811	608.25		18.54		
Number of Species					34					
Number of Hybrids					2					

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **27.00**	Basin: Scioto River	Date Range: 08/12/96
	Time Fished: 4161 sec Drain Area: 236.0 sq mi	Thru: 10/15/96
	Dist Fished: 0.44 km No of Passes: 2	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
LONGNOSE GAR		P	M		1	0.68	0.15	0.00	0.02	4.00
GIZZARD SHAD		O	M		1	0.68	0.15	0.06	0.57	86.00
GRASS PICKEREL		P	M	P	2	1.36	0.31	0.02	0.20	14.50
GOLDEN REDHORSE	R	I	S	M	38	25.91	5.81	2.95	28.77	113.74
NORTHERN HOG SUCKER	R	I	S	M	50	34.09	7.65	2.47	24.10	72.42
HORNYHEAD CHUB	N	I	N	I	1	0.68	0.15	0.01	0.13	19.00
CREEK CHUB	N	G	N	T	1	0.68	0.15	0.00	0.02	3.00
SUCKERMOUTH MINNOW	N	I	S		7	4.77	1.07	0.02	0.18	3.86
SILVER SHINER	N	I	S	I	9	6.14	1.38	0.02	0.24	4.00
ROSYFACE SHINER	N	I	S	I	1	0.68	0.15	0.00	0.01	2.00
STRIPED SHINER	N	I	S		46	31.36	7.03	0.11	1.10	3.61
SPOTFIN SHINER	N	I	M		47	32.05	7.19	0.12	1.15	3.68
SAND SHINER	N	I	M	M	10	6.82	1.53	0.03	0.25	3.80
FATHEAD MINNOW	N	O	C	T	2	1.36	0.31	0.00	0.02	2.00
BLUNTNOSE MINNOW	N	O	C	T	62	42.27	9.48	0.13	1.26	3.06
CENTRAL STONEROLLER	N	H	N		100	68.18	15.29	0.67	6.56	9.86
CHANNEL CATFISH	F		C		1	0.68	0.15	1.36	13.31	2,000.00
YELLOW BULLHEAD		I	C	T	2	1.36	0.31	0.01	0.05	4.00
STONECAT MADTOM		I	C	I	1	0.68	0.15	0.01	0.10	15.00
BRINDLED MADTOM		I	C	I	2	1.36	0.31	0.00	0.04	3.50
BROOK SILVERSIDE		I	M	M	6	4.09	0.92	0.00	0.02	0.50
ROCK BASS	S	C	C		16	10.91	2.45	0.31	3.01	28.25
SMALLMOUTH BASS	F	C	C	M	15	10.23	2.29	0.56	5.49	55.00
LARGEMOUTH BASS	F	C	C		3	2.05	0.46	0.02	0.19	9.33
GREEN SUNFISH	S	I	C	T	36	24.55	5.50	0.28	2.78	11.60
BLUEGILL SUNFISH	S	I	C	P	21	14.32	3.21	0.16	1.57	11.18
LONGEAR SUNFISH	S	I	C	M	73	49.77	11.16	0.73	7.16	14.74
JOHNNY DARTER	D	I	C		7	4.77	1.07	0.01	0.06	1.29
GREENSIDE DARTER	D	I	S	M	48	32.73	7.34	0.12	1.14	3.57
BANDED DARTER	D	I	S	I	10	6.82	1.53	0.01	0.08	1.18
RAINBOW DARTER	D	I	S	M	17	11.59	2.60	0.03	0.25	2.24
FANTAIL DARTER	D	I	C		5	3.41	0.76	0.01	0.05	1.40
MOTTLED SCULPIN		I	C		13	8.86	1.99	0.01	0.10	1.18
Mile Total					654	445.91		10.24		
Number of Species					33					
Number of Hybrids					0					

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **26.20**	Basin: Scioto River	Date Range: 08/08/96
	Time Fished: 3409 sec Drain Area: 240.0 sq mi	Thru: 10/15/96
	Dist Fished: 0.42 km No of Passes: 2	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
LONGNOSE GAR		P	M		1	0.71	0.23	0.00	0.07	6.00
GOLDEN REDHORSE	R	I	S	M	24	17.14	5.54	2.24	35.10	130.89
NORTHERN HOG SUCKER	R	I	S	M	50	35.71	11.55	1.10	17.14	30.67
COMMON CARP	G	O	M	T	1	0.71	0.23	1.04	16.20	1,450.00
SUCKERMOUTH MINNOW	N	I	S		6	4.29	1.39	0.01	0.10	1.50
SILVER SHINER	N	I	S	I	2	1.43	0.46	0.00	0.05	2.50
STRIPED SHINER	N	I	S		22	15.71	5.08	0.02	0.24	1.00
STEELCOLOR SHINER	N	I	M	P	2	1.43	0.46	0.02	0.34	15.00
SPOTFIN SHINER	N	I	M		6	4.29	1.39	0.02	0.23	3.46
SAND SHINER	N	I	M	M	68	48.57	15.70	0.10	1.62	2.13
BLUNTNOSE MINNOW	N	O	C	T	62	44.29	14.32	0.10	1.56	2.25
CENTRAL STONEROLLER	N	H	N		73	52.14	16.86	0.11	1.71	2.09
ROCK BASS	S	C	C		10	7.14	2.31	0.36	5.63	50.40
SMALLMOUTH BASS	F	C	C	M	9	6.43	2.08	0.51	7.90	78.56
LARGEMOUTH BASS	F	C	C		3	2.14	0.69	0.01	0.18	5.33
GREEN SUNFISH	S	I	C	T	15	10.71	3.46	0.12	1.82	10.87
BLUEGILL SUNFISH	S	I	C	P	6	4.29	1.39	0.03	0.54	8.00
LONGEAR SUNFISH	S	I	C	M	47	33.57	10.85	0.53	8.21	15.64
GREEN SF X BLUEGILL					1	0.71	0.23	0.04	0.56	50.00
LOGPERCH	D	I	S	M	1	0.71	0.23	0.00	0.03	3.00
JOHNNY DARTER	D	I	C		3	2.14	0.69	0.00	0.05	1.67
GREENSIDE DARTER	D	I	S	M	18	12.86	4.16	0.04	0.63	3.13
BANDED DARTER	D	I	S	I	1	0.71	0.23	0.00	0.02	2.00
RAINBOW DARTER	D	I	S	M	2	1.43	0.46	0.00	0.05	2.00
Mile Total					433	309.29		6.39		
Number of Species					23					
Number of Hybrids					1					

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **25.70**	Basin: Scioto River	Date Range: 08/07/96
	Time Fished: 4762 sec Drain Area: 241.0 sq mi	Thru: 10/16/96
	Dist Fished: 0.40 km No of Passes: 2	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
GIZZARD SHAD		O	M		1	0.75	0.20	0.09	1.35	119.00
SILVER REDHORSE	R	I	S	M	1	0.75	0.20	0.79	11.87	1,050.00
BLACK REDHORSE	R	I	S	I	2	1.50	0.40	0.50	7.59	335.50
GOLDEN REDHORSE	R	I	S	M	22	16.50	4.35	2.16	32.49	130.68
NORTHERN HOG SUCKER	R	I	S	M	33	24.75	6.52	1.14	17.19	46.09
BLACKNOSE DACE	N	G	S	T	1	0.75	0.20	0.00	0.02	2.00
CREEK CHUB	N	G	N	T	1	0.75	0.20	0.00	0.02	1.00
SUCKERMOUTH MINNOW	N	I	S		16	12.00	3.16	0.05	0.81	4.50
SILVER SHINER	N	I	S	I	5	3.75	0.99	0.01	0.17	3.00
ROSEFIN SHINER	N	I	S	M	4	3.00	0.79	0.01	0.08	1.75
STRIPED SHINER	N	I	S		18	13.50	3.56	0.06	0.87	4.28
STEELCOLOR SHINER	N	I	M	P	1	0.75	0.20	0.00	0.07	6.00
SPOTFIN SHINER	N	I	M		20	15.00	3.95	0.06	0.94	4.18
SAND SHINER	N	I	M	M	29	21.75	5.73	0.05	0.75	2.28
MIMIC SHINER	N	I	M	I	3	2.25	0.59	0.00	0.07	2.00
FATHEAD MINNOW	N	O	C	T	2	1.50	0.40	0.00	0.02	1.00
BLUNTNOSE MINNOW	N	O	C	T	55	41.25	10.87	0.11	1.63	2.62
CENTRAL STONEROLLER	N	H	N		115	86.25	22.73	0.48	7.22	5.56
STONECAT MADTOM		I	C	I	1	0.75	0.20	0.01	0.20	18.00
BRINDLED MADTOM		I	C	I	1	0.75	0.20	0.00	0.02	2.00
BROOK SILVERSIDE		I	M	M	1	0.75	0.20	0.00	0.02	2.00
ROCK BASS	S	C	C		17	12.75	3.36	0.47	7.12	37.06
SMALLMOUTH BASS	F	C	C	M	6	4.50	1.19	0.12	1.85	27.17
SPOTTED BASS	F	C	C		1	0.75	0.20	0.01	0.13	11.00
LARGEMOUTH BASS	F	C	C		1	0.75	0.20	0.00	0.06	5.00
GREEN SUNFISH	S	I	C	T	2	1.50	0.40	0.03	0.47	21.00
BLUEGILL SUNFISH	S	I	C	P	2	1.50	0.40	0.02	0.23	10.00
LONGEAR SUNFISH	S	I	C	M	16	12.00	3.16	0.17	2.49	13.75
JOHNNY DARTER	D	I	C		9	6.75	1.78	0.01	0.11	1.00
GREENSIDE DARTER	D	I	S	M	82	61.50	16.21	0.22	3.31	3.57
BANDED DARTER	D	I	S	I	15	11.25	2.96	0.01	0.16	0.93
RAINBOW DARTER	D	I	S	M	16	12.00	3.16	0.04	0.56	3.06
FANTAIL DARTER	D	I	C		6	4.50	1.19	0.01	0.11	1.50
MOTTLED SCULPIN		I	C		1	0.75	0.20	0.00	0.06	5.00
Mile Total					506	379.50		6.64		
Number of Species					34					
Number of Hybrids					0					

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **25.50**	Basin: Scioto River	Date Range: 08/07/96
	Time Fished: 4869 sec Drain Area: 241.0 sq mi	Thru: 10/16/96
	Dist Fished: 0.44 km No of Passes: 2	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
BLACK REDHORSE	R	I	S	I	1	0.68	0.17	0.12	0.88	174.00
GOLDEN REDHORSE	R	I	S	M	32	21.82	5.36	2.38	17.74	109.29
NORTHERN HOG SUCKER	R	I	S	M	21	14.32	3.52	0.87	6.44	60.40
WHITE SUCKER	W	O	S	T	1	0.68	0.17	0.00	0.01	3.00
SPOTTED SUCKER	R	I	S		1	0.68	0.17	0.01	0.05	10.00
COMMON CARP	G	O	M	T	5	3.41	0.84	6.99	51.99	2,050.00
HORNYHEAD CHUB	N	I	N	I	1	0.68	0.17	0.00	0.01	2.00
CREEK CHUB	N	G	N	T	5	3.41	0.84	0.01	0.05	2.00
SUCKERMOUTH MINNOW	N	I	S		4	2.73	0.67	0.02	0.12	6.00
SILVER SHINER	N	I	S	I	3	2.05	0.50	0.01	0.10	7.00
ROSEFIN SHINER	N	I	S	M	3	2.05	0.50	0.00	0.02	1.33
STRIPED SHINER	N	I	S		22	15.00	3.69	0.08	0.61	5.46
SPOTFIN SHINER	N	I	M		25	17.05	4.19	0.06	0.46	3.61
SAND SHINER	N	I	M	M	50	34.09	8.38	0.07	0.54	2.14
MIMIC SHINER	N	I	M	I	4	2.73	0.67	0.01	0.04	2.25
BLUNTNOSE MINNOW	N	O	C	T	112	76.36	18.76	0.13	0.93	1.64
CENTRAL STONEROLLER	N	H	N		83	56.59	13.90	0.48	3.59	8.52
STONECAT MADTOM		I	C	I	2	1.36	0.33	0.00	0.01	1.00
BRINDLED MADTOM		I	C	I	2	1.36	0.33	0.01	0.06	5.50
BROOK SILVERSIDE		I	M	M	3	2.05	0.50	0.00	0.01	1.00
ROCK BASS	S	C	C		17	11.59	2.85	0.51	3.76	43.59
SMALLMOUTH BASS	F	C	C	M	6	4.09	1.01	0.32	2.41	79.17
SPOTTED BASS	F	C	C		1	0.68	0.17	0.18	1.32	260.00
LARGEMOUTH BASS	F	C	C		1	0.68	0.17	0.01	0.06	11.00
GREEN SUNFISH	S	I	C	T	24	16.36	4.02	0.23	1.73	14.21
BLUEGILL SUNFISH	S	I	C	P	19	12.95	3.18	0.10	0.77	7.95
LONGEAR SUNFISH	S	I	C	M	90	61.36	15.08	0.71	5.29	11.58
JOHNNY DARTER	D	I	C		13	8.86	2.18	0.02	0.12	1.85
GREENSIDE DARTER	D	I	S	M	35	23.86	5.86	0.10	0.73	4.08
BANDED DARTER	D	I	S	I	4	2.73	0.67	0.00	0.02	1.00
RAINBOW DARTER	D	I	S	M	2	1.36	0.33	0.00	0.03	2.50
FANTAIL DARTER	D	I	C		3	2.05	0.50	0.01	0.04	3.00
MOTTLED SCULPIN		I	C		2	1.36	0.34	0.01	0.06	6.00
Mile Total					597	407.05		13.44		
Number of Species					33					
Number of Hybrids					0					

River Code: **02-100**	Stream: **Big Walnut Creek**	Sample Date: **1996**
River Mile: **25.20**	Basin: Scioto River	Date Range: 08/07/96
	Time Fished: 5206 sec Drain Area: 242.0 sq mi	Thru: 10/16/96
	Dist Fished: 0.44 km No of Passes: 2	Sampler Type: D

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
LONGNOSE GAR		P	M		1	0.68	0.12	0.00	0.02	3.00
GOLDEN REDHORSE	R	I	S	M	21	14.32	2.44	1.77	13.93	123.67
NORTHERN HOG SUCKER	R	I	S	M	80	54.55	9.28	3.24	25.49	59.40
WHITE SUCKER	W	O	S	T	2	1.36	0.23	0.22	1.75	163.00
SPOTTED SUCKER	R	I	S		1	0.68	0.12	0.00	0.02	4.00
COMMON CARP	G	O	M	T	1	0.68	0.12	1.47	11.53	2,150.00
CREEK CHUB	N	G	N	T	1	0.68	0.12	0.00	0.01	2.00
SUCKERMOUTH MINNOW	N	I	S		26	17.73	3.02	0.10	0.81	5.77
SILVER SHINER	N	I	S	I	28	19.09	3.25	0.06	0.50	3.36
ROSYFACE SHINER	N	I	S	I	8	5.45	0.93	0.01	0.08	1.88
ROSEFIN SHINER	N	I	S	M	1	0.68	0.12	0.00	0.02	3.00
STRIPED SHINER	N	I	S		47	32.05	5.45	0.26	2.06	8.18
SPOTFIN SHINER	N	I	M		46	31.36	5.34	0.10	0.75	3.02
SAND SHINER	N	I	M	M	143	97.50	16.59	0.21	1.63	2.12
MIMIC SHINER	N	I	M	I	3	2.05	0.35	0.01	0.05	3.00
BLUNTNOSE MINNOW	N	O	C	T	41	27.95	4.76	0.08	0.66	3.02
CENTRAL STONEROLLER	N	H	N		214	145.91	24.83	1.13	8.89	7.75
YELLOW BULLHEAD		I	C	T	6	4.09	0.70	0.12	0.94	29.33
STONECAT MADTOM		I	C	I	5	3.41	0.58	0.06	0.46	17.20
BROOK SILVERSIDE		I	M	M	1	0.68	0.12	0.00	0.00	1.00
ROCK BASS	S	C	C		26	17.73	3.02	1.01	7.91	56.73
SMALLMOUTH BASS	F	C	C	M	9	6.14	1.04	1.71	13.47	279.00
SPOTTED BASS	F	C	C		1	0.68	0.12	0.00	0.02	4.00
LARGEMOUTH BASS	F	C	C		3	2.05	0.35	0.03	0.22	13.67
GREEN SUNFISH	S	I	C	T	8	5.45	0.93	0.09	0.70	16.38
BLUEGILL SUNFISH	S	I	C	P	8	5.45	0.93	0.08	0.62	14.50
LONGEAR SUNFISH	S	I	C	M	60	40.91	6.96	0.69	5.41	16.80
JOHNNY DARTER	D	I	C		5	3.41	0.58	0.00	0.03	1.20
GREENSIDE DARTER	D	I	S	M	36	24.55	4.18	0.08	0.62	3.23
BANDED DARTER	D	I	S	I	9	6.14	1.04	0.00	0.03	0.56
RAINBOW DARTER	D	I	S	M	18	12.27	2.09	0.03	0.22	2.28
FANTAIL DARTER	D	I	C		2	1.36	0.23	0.00	0.02	1.50
SAUGER X WALLEYE	E	P			1	0.68	0.12	0.14	1.12	210.00
Mile Total					862	587.73		12.71		
Number of Species					32					
Number of Hybrids					1					

River Code: **02-280**	Stream: **Trib. to Big Walnut Creek (RM**	Sample Date: **1996**
River Mile: **0.10**	Basin: Scioto River	Date Range: 10/25/96
	Time Fished: 1479 sec Drain Area: 2.9 sq mi	
	Dist Fished: 0.15 km No of Passes: 1	Sampler Type: E

Species Name / ODNR Status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
WHITE SUCKER	W	O	S	T	4	8.00	3.25			
BLACKNOSE DACE	N	G	S	T	3	6.00	2.44			
CREEK CHUB	N	G	N	T	105	210.00	85.37			
BLUNTNOSE MINNOW	N	O	C	T	1	2.00	0.81			
CENTRAL STONEROLLER	N	H	N		2	4.00	1.63			
SMALLMOUTH BASS	F	C	C	M	2	4.00	1.63			
GREEN SUNFISH	S	I	C	T	1	2.00	0.81			
BLUEGILL SUNFISH	S	I	C	P	2	4.00	1.63			
JOHNNY DARTER	D	I	C		3	6.00	2.44			
Mile Total					123	246.00				
Number of Species					9					
Number of Hybrids					0					

Appendix Table 4. Index of Biotic Integrity (IBI) metrics and scores and Modified Index of Well-being (MIwb) scores by river mile for locations sampled in the Big Walnut Creek study area, 1996.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Percent of Individuals: Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)		IBI	Modified Iwb
Big Walnut Creek - (02100)																		
Year: 96																		
27.40	D	08/08/96	234	27(5)	4(5)	4(3)	6(5)	5(3)	45(5)	9(5)	5(5)	8.2(5)	65(5)	0.6(3)	632(3)		52	9.7
27.40	D	10/15/96	234	27(5)	3(3)	3(3)	5(3)	6(5)	21(3)	58(1)	53(1)	4.6(3)	36(3)	0.0(5)	221(3)		38	7.8
27.00	D	08/12/96	236	31(5)	4(5)	2(1)	5(3)	5(3)	34(3)	16(5)	10(5)	6.4(5)	66(5)	2.4(1)	521(3)		44	9.3
27.00	D	10/15/96	236	26(5)	4(5)	2(1)	4(3)	5(3)	35(3)	16(5)	10(5)	4.0(3)	74(5)	0.5(3)	231(3)		44	8.2
26.20	D	08/08/96	240	19(3)	4(5)	2(1)	1(1)	2(1)	26(3)	19(3)	15(5)	4.8(3)	60(5)	0.3(3)	407(3)		36	8.2
26.20	D	10/15/96	240	17(3)	3(3)	2(1)	1(1)	5(3)	41(5)	15(5)	12(5)	7.3(5)	76(5)	2.4(1)	100(1)	*	38	6.9
25.70	D	08/07/96	241	27(5)	4(5)	3(3)	5(3)	5(3)	43(5)	11(5)	10(5)	5.7(5)	58(5)	0.0(5)	449(3)		52	8.8
25.70	D	10/16/96	241	24(5)	2(3)	3(3)	3(3)	5(3)	42(5)	14(5)	14(5)	3.5(3)	65(5)	0.0(5)	219(3)		48	8.0
25.50	D	08/07/96	241	30(5)	4(5)	4(3)	6(5)	5(3)	24(3)	17(5)	13(5)	3.4(3)	65(5)	0.5(3)	438(3)		48	8.6
25.50	D	10/16/96	241	24(5)	4(5)	3(3)	4(3)	4(3)	17(1)	38(1)	32(3)	5.7(5)	55(3)	1.0(3)	176(1)		36	7.3
25.20	D	08/07/96	242	28(5)	4(5)	3(3)	5(3)	4(3)	31(3)	5(5)	4(5)	4.4(3)	70(5)	0.5(3)	738(3)		46	9.3
25.20	D	10/16/96	242	27(5)	4(5)	4(3)	5(3)	5(3)	33(3)	10(5)	8(5)	5.5(5)	56(5)	0.0(5)	357(3)		50	8.6

na - Qualitative data, Modified Iwb not applicable.
▲ - IBI is low-end adjusted.
● - One or more species excluded from IBI calculation.

River Mile	Type	Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants /(0.3km)	IBI
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies		
Trib to Big Walnut - (02-280)																
Year: 96																
0.10	E	10/25/96	2.9	9(3)	4(3)	1(1)	1(1)	1(1)	2(3)	93(1)	4(5)	89(1)	5(1)	0.0(5)	18(1)	26