*State of Ohio*
*Environmental Protection Agency*

**Division of Surface Water**

# Biological and Water Quality Study of the Little Miami River – Peters Cartridge Area

**Warren County**

**November 1, 2007**

Ted Strickland, Governor
Chris Korleski, Director

# Biological and Water Quality Study of the Little Miami River

## Peters Cartridge Area

## 2007

Warren County, Ohio
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prepared for
State of Ohio Environmental Protection Agency
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## SUMMARY

A total of 3.5 miles of the Little Miami River were assessed by the Ohio EPA in the vicinity of the Peters Cartridge property during 2007. Based on the performance of the biological communities, the entire 3.5 miles of the Little Miami River were in full attainment of the Exceptional Warmwater Habitat (EWH) aquatic life use (Table 1). This achievement reflects a high level of biological integrity, and meets the biological goals of the Clean Water Act. Surveys of the fish and macroinvertebrate (*e.g.,* aquatic insects and mussels) communities of the Little Miami River study segment revealed healthy populations of numerous pollution sensitive species. Biological communities have improved in the Little Miami River study segment since 1998. Although the 1998 results documented exceptional conditions, further improvement of index scores was observed during 2007. River sediments were tested for heavy metals, and results were within acceptable ecological levels. Biological community results from this study documented that the Peters Cartridge facility currently is not causing impairment to the Little Miami River.

The Little Miami River is listed as Outstanding State Waters (OSW) in the Ohio Water Quality Standards. Sampling during this study validated the Outstanding State Waters designation within the sampling segment. Because the OSW designation is used for exceptional quality streams, it offers added protections from pollutant loadings to the river.

## RECOMMENDATIONS

The aquatic life use designation of Exceptional Warmwater Habitat (EWH) for the Little Miami River has been confirmed in previous Ohio EPA biological and water quality studies. This study verified continued EWH performance for the Little Miami River between river miles 29 and 32.

The Little Miami River is listed as Outstanding State Waters in the Antidegradation Rule (OAC 3745-1-05) of the Ohio Water Quality Standards. This designation is based on the presence of threatened or endangered species and an exceptional level of biological integrity. Included in evaluating exceptional biological value was a determination of declining fish species, high quality habitat to support declining and threatened fish species, and a display of biological integrity equivalent to the Exceptional Warmwater Habitat Index of Biotic Integrity and/or Invertebrate Community Index criteria listed in rule 3745-1-07 of the Ohio Administrative Code. Additionally, Outstanding State Waters are distinguished as being demonstratively among the best waters of the state from an ecological perspective. Sampling during this study validated the Outstanding State Waters designation within the sampling segment.

Observations of extensive Primary Contact Recreation (PCR) during this study verified that the Primary Contact Recreation use is appropriate for the Little Miami River.

## FOREWORD

*What is a Biological and Water Quality Survey?*

A biological and water quality survey, or "biosurvey," is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This effort may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. Each year Ohio EPA conducts biosurveys in 4-5 watersheds study areas with an aggregate total of 250-300 sampling sites.

The Ohio EPA employs biological, chemical, and physical monitoring and assessment techniques in biosurveys in order to meet three major objectives: 1) determine the extent to which use designations assigned in the Ohio Water Quality Standards (WQS) are either attained or not attained; 2) determine if use designations assigned to a given water body are appropriate and attainable; and 3) determine if any changes in key ambient biological, chemical, or physical indicators have taken place over time, particularly before and after the implementation of point source pollution controls or best management practices. The data gathered by a biosurvey is processed, evaluated, and synthesized in a biological and water quality report. Each biological and water quality study contains a summary of major findings and recommendations for revisions to WQS, future monitoring needs, or other actions which may be needed to resolve existing impairment of designated uses. While the principal focus of a biosurvey is on the status of aquatic life uses, the status of other uses such as recreation and water supply, as well as human health concerns, are also addressed.

The findings and conclusions of a biological and water quality study may factor into regulatory actions taken by Ohio EPA (*e.g.,* NPDES permits, Director's Orders, the Ohio Water Quality Standards [OAC 3745-1], Water Quality Permit Support Documents [WQPSDs]), and are eventually incorporated into State Water Quality Management Plans, the Ohio Nonpoint Source Assessment, and the biennial Integrated Water Quality Monitoring and Assessment Report (305[b] and 303[d]).

*Hierarchy of Indicators*

A carefully conceived ambient monitoring approach, using cost-effective indicators consisting of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. Ohio EPA relies on a tiered approach in attempting to link the results of administrative activities with true environmental measures. This integrated approach includes a hierarchical continuum from administrative to true environmental indicators (Figure 1). 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 that are represented here by the biological indices which comprise Ohio's biological criteria. Other response indicators could include target assemblages, *i.e.,* rare, threatened, endangered, special status, and

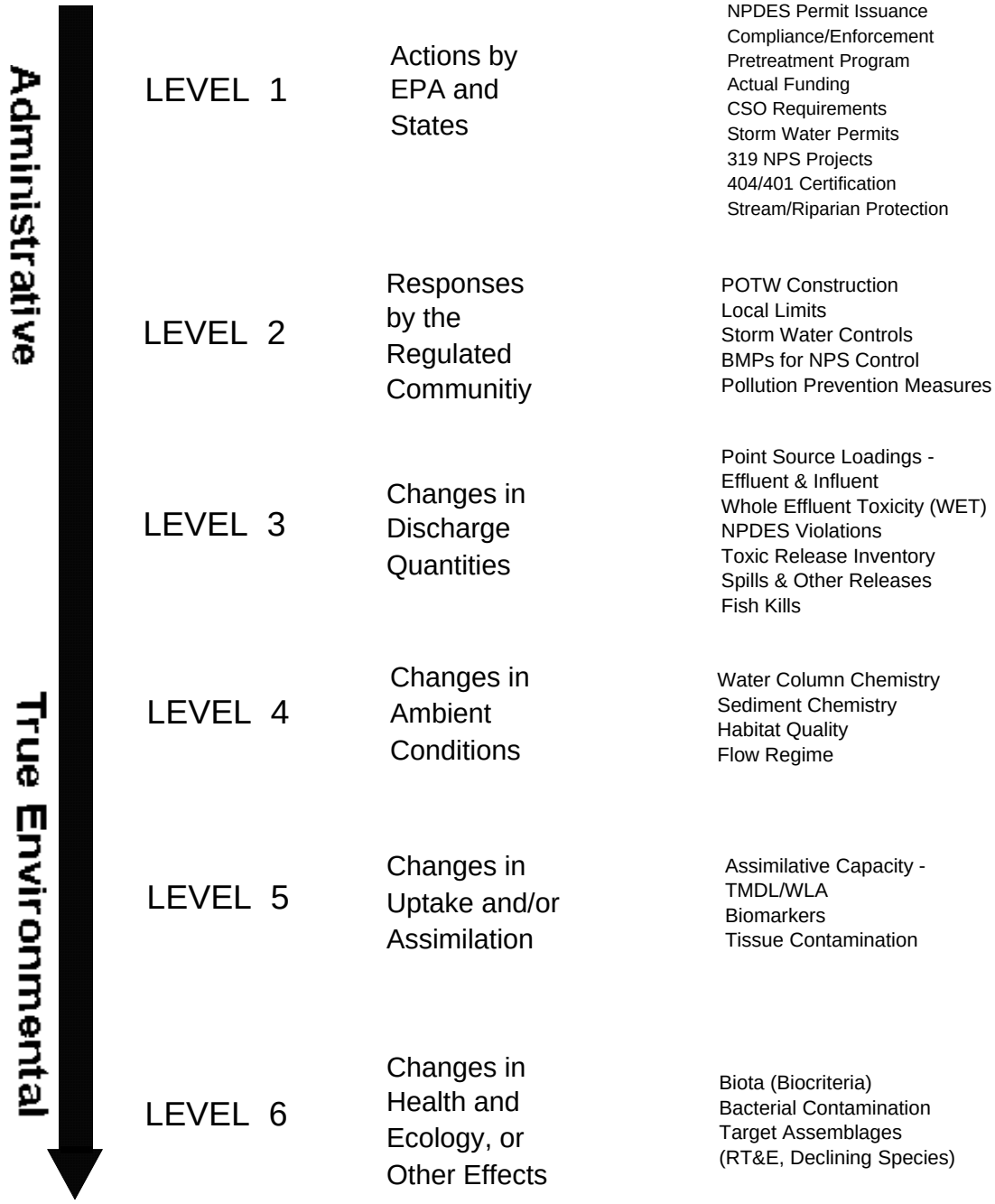


*Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by the U.S. EPA.*

declining species or bacterial levels which serve as surrogates for the recreation uses. These indicators represent the essential technical elements for watershed-based management approaches. The key, however, is to use the different indicators *within* the roles which are most appropriate for each.

Describing the causes and sources associated with observed impairments revealed by the biological criteria and linking this with pollution sources involves an interpretation of multiple lines of evidence including water chemistry data, sediment data, habitat data, effluent data, biomonitoring results, land use data, and biological response signatures within the biological data itself. Thus the assignment of principal causes and sources of impairment represents the association of impairments (defined by response indicators) with stressor and exposure indicators. The principal reporting venue for this process on a watershed or subbasin scale is a biological and water quality report. These reports then provide the foundation for aggregated assessments such as the Integrated Water Quality Monitoring and Assessment Report (305[b] and 303[d]), the Ohio Nonpoint Source Assessment, and other technical bulletins.

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

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

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

3) *Coldwater Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.

4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.

5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 $mi^2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.,* true ephemeral streams), or other irretrievably altered waterways.

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other parameters such as heavy metals,

the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

*Ohio Water Quality Standards: Non-Aquatic Life Uses*

In addition to assessing the appropriateness and status of aquatic life uses, each biological and water quality survey also addresses non-aquatic life uses such as recreation, water supply, and human health concerns as appropriate. The recreation uses most applicable to rivers and streams are the Primary Contact Recreation (PCR) and Secondary Contact Recreation (SCR) uses. The criterion for designating the PCR use can be having a water depth of at least one meter over an area of at least 100 square feet or, lacking this, where frequent human contact is a reasonable expectation. If a water body does not meet either criterion, the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.,* fecal coliform, *E. coli)* and the criteria for each are specified in the Ohio WQS.

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

Water supply uses include Public Water Supply (PWS), Agricultural Water Supply (AWS), and Industrial Water Supply (IWS). Public Water Supplies are simply defined as segments within 500 yards of a potable water supply or food processing industry intake. The AWS and IWS use designations generally apply to all waters unless it can be clearly shown that they are not applicable. An example of this would be an urban area where livestock watering or pasturing does not take place, thus the AWS use would not apply. Chemical criteria are specified in the Ohio WQS for each use and attainment status is based primarily on chemical-specific indicators. Human health concerns are additionally addressed with fish tissue data, but any consumption advisories are issued by the Ohio Department of Health.

## ACKNOWLEDGEMENTS

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## INTRODUCTION

The Peters Cartridge Company site is a partially abandoned manufacturing facility located along the Little Miami River near Kings Mills, Ohio. The site covers about 10 acres in the floodplain and along the south valley wall of the Little Miami River. The Peters Cartridge facility began operations around 1880. The facility produced shotgun shells, and rifle and pistol cartridges. Shotgun pellets were made in the 220 foot tall shot tower. Mercury fulminate, used as a primer in cartridges and shells, was produced in a building at the west end of the site. Production of munitions continued at the facility until 1944. Various businesses unrelated to ammunitions production have occupied the facility since 1944. A site evaluation of the property conducted in 1987 revealed widespread lead contamination in soils and groundwater. In addition, an expanded site inspection in 1999 detected elevated lead and mercury in on-site soil and Little Miami River sediment.

Specific objectives of the evaluation were to:

- Establish biological conditions in the Little Miami River in the vicinity of the Peters Cartridge property by evaluating fish and macroinvertebrate communities,
- Evaluate sediment chemical quality at co-located biological stations in the Little Miami River in the vicinity of the Peters Cartridge property,
- Confirm if previously documented elevated lead levels in sediment were adversely affecting river biology, and
- Determine the aquatic life use attainment status of the Little Miami River with regard to the Exceptional Warmwater Habitat (EWH) aquatic life use designation codified in the Ohio Water Quality Standards.

The study segment of the Little Miami River is located in the Interior Plateau (IP) ecoregion. The Little Miami River is currently assigned the Exceptional Warmwater Habitat (EWH) aquatic life use designation in the Ohio Water Quality Standards.

*Table 1. Aquatic life use attainment status for sampling locations in the Little Miami River, 2007. The Index of Biotic Integrity (IBI), Modified Index of Well-being (MIwb), and Invertebrate Community Index (ICI) scores are based on the performance of the biological community. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biological community. River sites are located in the Interior Plateau (IP) ecoregion. This section of the Little Miami River is designated Exceptional Warmwater Habitat (EWH) in the Ohio Water Quality Standards. If biological impairment has occurred, the cause(s) and source(s) of the impairment are noted.*

| Sample Site River Mile | Attainment Status | IBI | MIwb | ICI | QHEI | Location | Cause | Source |
|---|---|---|---|---|---|---|---|---|
| 31.5 | FULL | 51 | 11.3 | 52 | 89.5 | Upstream Peters Cartridge | None | None |
| 30.9 | FULL | - | - | 52 | - | Upstream Peters Cartridge | None | None |
| 30.5 | FULL | 54 | 11.5 | 50 | 85.5 | Adjacent Peters Cartridge | None | None |
| 30.0 | FULL | - | - | 52 | - | Downstream Peters Cartridge | None | None |
| 29.0 | FULL | 54 | 11.0 | 54 | 85.0 | Downstream Peters Cartridge | None | None |

| Ecoregion Biocriteria: Interior Plateau (IP) (OAC 3745-1-07, Table 7-15) | | |
|---|---|---|
| INDEX - Site Type | WWH | EWH |
| IBI: Boat | 38 | 48 |
| MIwb: Boat | 8.7 | 9.6 |
| ICI | 30 | 46 |

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
ns Nonsignificant departure from biocriterion (≤4 IBI or ICI units; ≤0.5 MIwb units).

*Table 2. Sampling locations in the Little Miami River , Peters Cartridge area, 2007. Type of sampling included fish community (F), macroinvertebrate community (M), and sediment (S).*

| Stream/ River Mile | Type of Sampling | Latitude | Longitude | Landmark |
|---|---|---|---|---|
| 31.5 | F,M,S | 39° 21' 34.9" | 84° 14' 17.5" | Upstream Peters Cartridge, near Middletown Junction |
| 30.9 | M,S | 39° 21' 12.3" | 84° 14' 20.5" | Upstream Peters Cartridge, 0.3 miles upstream Grandin Rd. |
| 30.5 | F,M,S | 39° 21' 2.9" | 84° 14' 46.0" | Adjacent Peters Cartridge, 0.2 miles downstream Grandin Rd. |
| 30.0 | M,S | 39° 20' 47.4" | 84° 15' 17.0" | Downstream Peters Cartridge, near field |
| 29.0 | F,M,S | 39° 19' 54.1" | 84° 15' 11.9" | Downstream Peters Cartridge, far field |

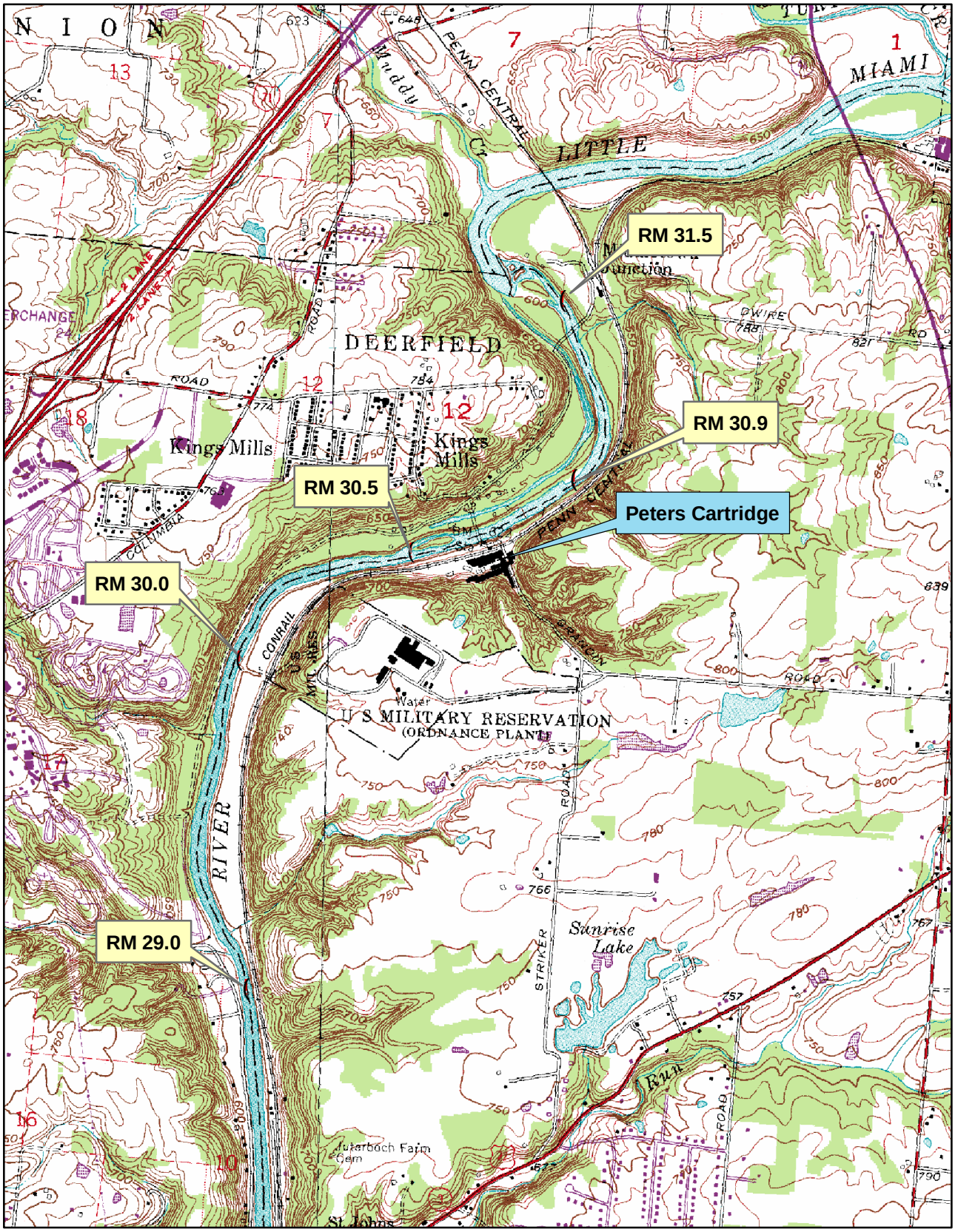


Figure 2. Little Miami River sampling locations, 2007

## METHODS

All chemical, physical, and biological field, EPA laboratory, data processing, and data analysis methods and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 2006d), Biological Criteria for the Protection of Aquatic Life, Volumes II - III (Ohio Environmental Protection Agency 1987b, 1989a, 1989b, 2006a, 2006b), The Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Rankin 1989), Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (Ohio EPA 2006c), and Ohio EPA Sediment Sampling Guide and Methodologies (Ohio EPA 2001).

### Determining Use Attainment

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-15). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Three attainment status results are possible at each sampling location - full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the biocriteria. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria. Non-attainment means that none of the applicable indices meet the biocriteria or one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (Table 1) is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by river mile, the applicable biological indices, the use attainment status (*i.e.,* full, partial, or non), the Qualitative Habitat Evaluation Index (QHEI), and a sampling location description. All biological results were compared to EWH biocriteria.

### Stream Habitat Evaluation

Physical habitat is evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995; Ohio EPA 2006c). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Evaluations of type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient are among the metrics used to evaluate the characteristics of a stream segment, not just the characteristics of a single sampling site. As such, individual sites may have much 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 higher than 60 were generally conducive to the establishment of warmwater faunas while those which scored in excess of 75-80 often typify habitat conditions which have the ability to support exceptional faunas.

### Sediment Assessment

Fine grain sediment samples were collected multi-incrementally in the upper four inches of bottom material at each location using decontaminated stainless steel scoops. At each location, between 30 and 35 scoops of fine grained material over a 200 to 300 meter section of river were collected. Sediment incremental samples were homogenized in stainless steel pans, transferred into glass jars with teflon lined lids, placed on ice (to maintain 4$^{o}$C) in a cooler, and shipped to an Ohio EPA contract lab. Sediment data are reported on a dry weight basis. Decontamination of sediment sampling equipment followed the procedures outlined in the Ohio EPA sediment sampling guidance manual (Ohio EPA 2001). Sediment evaluations were conducted using guidelines established in MacDonald *et al.* (2000), along with a comparison of results to Ohio Sediment Reference Values (Ohio EPA 2003).

### Macroinvertebrate Community Assessment

Macroinvertebrates were collected from artificial substrates and from the natural habitats at all five stream sites. The artificial substrate collection provided quantitative data and consisted of a composite sample of five modified Hester-Dendy multiple-plate samplers colonized for six weeks. At the time of the artificial

substrate collection, a qualitative multihabitat composite sample was also collected. This sampling effort consisted of an inventory of all observed macroinvertebrate taxa from the natural habitats at each site with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major macrohabitat types (*e.g.,* riffle, run, pool, margin). Detailed discussion of macroinvertebrate field and laboratory procedures is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989a, 2006b).

**Fish Community Assessment**

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

**Field Instrument Calibration**

Field instruments are calibrated using manufacturer recommended procedures along with procedures noted in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (2006d) and Biological Criteria for the Protection of Aquatic Life, Volume III (1989b). Laser rangefinders, used to measure sampling distance, were calibrated once at the Groveport Field Facility prior to summer field sampling activities. Fish weighing scales were checked against certified weights once per month during the field season.

**Causal Associations**

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

## RESULTS

### Sediment Quality

Sediment samples were collected at five locations in the Little Miami by the Ohio EPA on August 2, 2007. Sampling locations were co-located at biological sampling sites. All stream sampling locations are indicated by river mile in Figure 2. Samples were analyzed for total analyte list inorganics (23 metals), total organic carbon, and particle size. Specific chemical parameters tested and results are listed in Appendix Table 1. Sediment data were evaluated using guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et.al*. 2000), and *Ohio Specific Sediment Reference Values (SRVs)* for metals (Ohio EPA 2003). The consensus-based sediment guidelines define two levels of ecotoxic effects. A *Threshold Effect Concentration* (TEC) is a level of sediment chemical quality below which harmful effects are unlikely to be observed. A *Probable Effect Concentration* (PEC) indicates a level above which harmful effects are likely to be observed.

Sediment samples were conservatively sampled by focusing on depositional areas of fine grain material. These areas typically are represented by higher contaminant levels, compared to sands and gravels. All Little Miami River sediment sampling sites were in nearshore areas along the river bank, which were represented by sparse deposits of fine grained material. These nearshore areas comprised only a small fraction of the bottom substrates of the Little Miami River. River substrates were predominated by cobble and gravel material.

Metal parameters measured above ecological screening guidelines are presented in Table 3. Of the metal parameters tested in this study, only lead was detected above the TEC guideline. This elevated lead value, located adjacent to the Peters Cartridge site, was below the Ohio Sediment Reference value of 47 mg/kg. Overall, lead measurements in the Little Miami River were within levels protective of river biology. Two metal parameters (mercury and cadmium) were slightly above Ohio SRV guidelines, but below TEC values. Silver was measured slightly above the Ohio SRV guideline (no TEC value) at two sampling locations. Mercury, cadmium, and silver were within acceptable levels for protection of ecological integrity. Aside from lead, all other parameters which were measured above ecological screening levels had qualified results (J).

Ohio EPA sediment sampling in the Little Miami River during 1999 reported elevated lead concentrations at two locations directly adjacent to the Peters Cartridge property, with results of 192 and 332 mg/kg (Ohio EPA 1999).

*Table 3. Chemical parameters measured above screening levels in sediment samples collected by Ohio EPA from the Little Miami River, August, 2007. Contamination levels were determined for parameters using consensus-based sediment quality guidelines (MacDonald et.al. 2000). Sediment reference values are listed in the Ohio EPA Ecological Risk Assessment Guidance (2003). Shaded numbers indicate values above the following: Threshold Effect Concentration -TEC (yellow), and Sediment Reference Value (orange). Sampling locations are indicated by river mile (RM).*

| | Little Miami River | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **RM 31.5** | **RM 30.9** | **RM 30.5** | **RM 30.0** | **RM 29.0** | **RM 29.0 Duplicate** |
| Mercury | <0.0138 | 0.0234J | 0.144J | 0.0341J | 0.0271J | 0.0359J |
| Silver | <0.281 | 0.456J | 0.297J | 0.500J | 0.401J | <0.332 |
| Cadmium | 0.245J | 0.330J | 0.314J | 0.353J | 0.341J | 0.340J |
| Lead | 9.41 | 12.5 | 43.7 | 13.6 | 13.4 | 13.3 |

J - The analyte was positively identified, but the quantitation was below the reporting limit (RL).
< - Not detected at or above the method detection limit (MDL value reported with the less than symbol).

**River Physical Habitat**

Physical habitat was evaluated in the Little Miami River at each fish sampling location. Physical habitat was assessed using the Qualitative Habitat Evaluation Index (QHEI); scores are detailed in Table 4.

QHEI scores for the Little Miami River sites ranged between 85.0 and 89.5. These scores are indicative of excellent river habitat, and are adequate for supporting Exceptional Warmwater Habitat biological communities.

The Little Miami River was predominated by bottom substrates of cobble and gravel, with lesser amounts of boulders, boulder slabs, and sand. These conditions were consistent across all three sampling locations. Bottom embeddedness, the degree to which cobble, gravel and boulder substrates are surrounded or covered by fine materials, was normal at each site. Instream cover was moderate, reflective of adequate levels for supporting exceptional warmwater fish communities. The Little Miami River at these three sites consisted of a stable, natural channel, with a variety of flow conditions. In addition, pool, riffle, and run areas were well represented.

Table 4. Qualitative Habitat Evaluation Index (QHEI) scores and physical attributes for fish sampling sites on the Little Miami River, 2007.

| | | | **MWH Attributes** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **WWH 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-Normal Riffle Embeddedness | **Total WWH Attributes** | Channelized or No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/ No Cover | Max. Depth <40 cm (WD,HW sites) | **Total High Influence Attributes** | Recovering Channel | Heavy/Moderate Silt Cover | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1-2 Cover Types | Intermittent & Poor Pools | No Fast Current | High/Mod. Overall Embeddedness | High/Mod. Riffle Embeddedness | No Riffle | **Total Moderate Influence Attributes** | **(MWH H.I.+1)/ (WWH+1) Ratio** | **(MWH M.I.+1)/ (WWH+1) Ratio** |
| River Mile | QHEI | Gradient (ft/mile) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (11-001) Little Miami River Year: 2007 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31.5 | **89.5** | 2.79 | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 9 | | | | | | 0 | | ● | | | | | | | | | | | | | | 1 | 0.10 | 0.20 |
| 30.5 | **85.5** | 3.56 | ■ | ■ | | ■ | | ■ | ■ | ■ | ■ | ■ | 8 | | | | | | 0 | | ● | | | | ● | | | | | | | | | | 2 | 0.11 | 0.33 |
| 29.0 | **85.0** | 3.56 | ■ | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | 9 | | | | | | 0 | | ● | | | | ● | | | | | | | | | | 2 | 0.10 | 0.30 |

**Fish Community**

A total of 2,526 fish representing 47 species were collected from the Little Miami River between June and August, 2007. Relative numbers and species collected per location are presented in Appendix Table 2 and IBI metrics are presented in Appendix Table 3. Sampling locations were evaluated using Exceptional Warmwater Habitat biocriteria. Sampling locations were selected to assess potential contributions of contaminants from the Peters Cartridge property.

Little Miami River fish communities at all three sampling locations achieved the EWH biocriterion. IBI scores for these three sites ranged from 51 to 54, and MIwb scores ranged from 11.0 to 11.5, all within the exceptional range (Table 5).

Ohio endangered (E), threatened (T), or special concern (S) fish species collected during this survey included mountain madtom (E), and river redhorse (S). Fish species collected which are intolerant of water pollution included mooneye, river redhorse, black redhorse, mimic shiner, stonecat madtom, mountain madtom, slenderhead darter, banded darter, and variegate darter.

The 2007 fish results revealed an improvement in the fish community compared with 1998. Two comparable sites sampled in the Little Miami River during 1998 (RMs 32.0 and 28.3) reported fish community results within the exceptional range, with IBI scores of 48 and MIwb values of 10.1 and 10.2. Higher exceptional conditions were noted during 2007.

*Table 5. Fish community summaries based on pulsed D.C. boat electrofishing sampling conducted by Ohio EPA in the Little Miami from June – August, 2007. Relative numbers and weight are per 1.0 km for boat sites. The applicable aquatic life use designation is EWH.*

| *Stream* River Mile | Sampling Method | Species (Mean) | Species (Total) | Relative Number | Relative Weight (kg) | QHEI | Modified Index of Well-Being | Index of Biotic Integrity | Narrative Evaluation |
|---|---|---|---|---|---|---|---|---|---|
| *Little Miami River* | | | | | | | | | |
| 31.5 | Boat | 32.5 | 40 | 925 | 245.5 | 89.5 | 11.3 | 51 | Exceptional |
| 30.5 | Boat | 35.5 | 42 | 849 | 290.0 | 85.5 | 11.5 | 54 | Exceptional |
| 29.0 | Boat | 36.5 | 41 | 681 | 234.2 | 85.0 | 11.0 | 54 | Exceptional |

Ecoregion Biocriteria: Interior Plateau (IP)
(Ohio Administrative Code 3745-1-07, Table 7-15)

| INDEX - Site Type | WWH | EWH |
|---|---|---|
| IBI: Boat | 38 | 48 |
| MIwb: Boat | 8.7 | 9.6 |

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
ns Nonsignificant departure from biocriterion (≤4 IBI units; ≤0.5 MIwb units).

**Macroinvertebrate Community**

The macroinvertebrate communities at five Little Miami River sites were sampled in 2007 using qualitative (multi-habitat composite) and quantitative (artificial substrate) sampling protocols. Results are summarized in Table 6. The ICI metrics with the associated scores for the Interior Plateau ecoregion and the raw data are attached as Appendix Tables 4 and 5.

The macroinvertebrate communities from all five of the Little Miami River sampling locations were evaluated as exceptional, indicative of attainment of the Exceptional Warmwater Habitat use designation. The macroinvertebrate community ICI scores ranged from 50 to 54, with no apparent impacts from the Peters Cartridge property.

*Table 6. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Little Miami River, 2007.*

| Stream/ River Mile | Density Number/ft$^2$ | Total Taxa | Quantitative Taxa | Qualitative Taxa | Qualitative EPT[a] | ICI | Evaluation |
|---|---|---|---|---|---|---|---|
| ***Little Miami River*** | | | | | | | |
| 31.5 | 992 | 75 | 36 | 60 | 20 | 52 | Exceptional |
| 30.9 | 968 | 68 | 40 | 49 | 17 | 52 | Exceptional |
| 30.5 | 735 | 63 | 42 | 38 | 13 | 50 | Exceptional |
| 30.0 | 952 | 65 | 32 | 54 | 18 | 52 | Exceptional |
| 29.0 | 596 | 58 | 34 | 43 | 16 | 54 | Exceptional |

| Ecoregion Biocriteria: Interior Plateau (IP) (Ohio Administrative Code 3745-1-07, Table 7-15) | | |
|---|---|---|
| INDEX | WWH | EWH |
| ICI | 30 | 46 |

[a] EPT=total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness, a measure of pollution sensitive organisms.
* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
[ns] Nonsignificant departure from biocriterion (≤4 ICI units).

## NOTICE TO USERS

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

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

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

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

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

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

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

Ohio Environmental Protection Agency. 2006a. 2006 updates to Biological Criteria for the Protection of Aquatic Life: Volume II and Volume II Addendum. Users manual for biological field assessment of Ohio surface waters. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 2006b. 2006 updates to Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 2006c. Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Tech. Bull. EAS/2006-06-1. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

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

In addition to the preceding guidance documents, the following publications by the Ohio EPA should also be consulted as they present supplemental information and analyses used by the Ohio EPA to implement the biological criteria.

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

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

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

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

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

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

Yoder, C.O. and M.A. Smith. 1999. Using fish assemblages in a State biological assessment and criteria program: essential concepts and considerations, pp. 17-63. in T. Simon (ed.). Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Boca Raton, FL.

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

Ohio EPA, Division of Surface Water
Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125
(614) 836-8786

or

www.epa.state.oh.us/dsw/formspubs.html

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Ohio Environmental Protection Agency. 2006a. 2006 updates to Biological Criteria for the Protection of Aquatic Life: Volume II and Volume II Addendum. Users manual for biological field assessment of Ohio surface waters. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 2006b. 2006 updates to Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 2006c. Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Tech. Bull. EAS/2006-06-1. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.

Ohio Environmental Protection Agency. 2006d. Ohio EPA manual of surveillance methods and quality assurance practices, updated edition. Division of Environmental Services, Columbus, Ohio.

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

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

Ohio Environmental Protection Agency. 1999. Expanded site inspection report, Peters Cartridge Factory site. Division of Emergency and Remedial Response, Columbus, Ohio. Prepared for U.S. Environmental Protection Agency.

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

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

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

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

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Appendix Table 1. Results of Ohio EPA sediment sampling conducted in the Little Miami River, August 2, 2007. NA - not applicable. Shaded values exceed applicable TEC (yellow) or SRV (orange) screening levels.

| Stream | Little Miami River | Little Miami River | Little Miami River | Little Miami River | Little Miami River | Little Miami River | Screening Benchmarks | |
|---|---|---|---|---|---|---|---|---|
| River Mile | 31.5 | 30.9 | 30.5 | 30.0 | 29.0 | 29.0 | Sediment | MacDonald |
| Date Sampled | 8/2/2007 | 8/2/2007 | 8/2/2007 | 8/2/2007 | 8/2/2007 | 8/2/2007 | Reference | 2000 |
| Time Sampled | 10:20 AM | 11:55 AM | 1:15 PM | 2:30 PM | 4:10 PM | 4:10 PM | Values (SRV) | TEC |
| **TAL Metals (mg/kg)** | | | | | | Duplicate | | |
| Mercury | <0.0138 | 0.0234J | 0.144J | 0.0341J | 0.0271J | 0.0359J | 0.12 | 0.18 |
| Aluminum | 5,260 | 7,300 | 6,060 | 7,540 | 7,890 | 8,160 | 28,000 | NA |
| Silver | <0.281 | 0.456J | 0.297J | 0.500J | 0.401J | <0.332 | 0.43 | NA |
| Arsenic | 3.11 | 3.24 | 3.69 | 3.82 | 4.18 | 4.41 | 11 | 9.79 |
| Barium | 46.3 | 55.5 | 124 | 60.3 | 63.1 | 64.2 | 170 | NA |
| Beryllium | 0.239J | 0.319J | 0.275J | 0.411J | 0.362J | 0.366J | NA (0.80)[a] | NA |
| Calcium | 44,100 | 48,500 | 41,800 | 39,400 | 46,400 | 51,100 | 94,000 | NA |
| Cadmium | 0.245J | 0.330J | 0.314J | 0.353J | 0.341J | 0.340J | 0.3 | 0.99 |
| Cobalt | 3.93 | 4.92 | 4.15 | 5.07 | 5.43 | 5.65 | NA (12)[a] | NA |
| Chromium | 7.21 | 9.46 | 7.88 | 11.3 | 10.1 | 10.4 | 30 | 43.4 |
| Copper | 9.2 | 12.1 | 16.3 | 13.5 | 14.8 | 15.7 | 25 | 31.6 |
| Iron | 9,880 | 14,300 | 10,400 | 14,900 | 13,200 | 13,800 | 31,000 | NA |
| Potassium | 756 | 1,010 | 839 | 1,030 | 1,080 | 1,150 | 5,900 | NA |
| Magnesium | 8,530 | 10,800 | 9,510 | 8,670 | 11,800 | 11,600 | 20,000 | NA |
| Manganese | 368 | 521 | 425 | 430 | 453 | 459 | 1,400 | NA |
| Sodium | 131 | 144 | 130 | 145 | 146 | 155 | NA | NA |
| Nickel | 7.78 | 9.86 | 8.4 | 12.7 | 11.2 | 11.7 | 33 | 22.7 |
| Lead | 9.41 | 12.5 | 43.7 | 13.6 | 13.4 | 13.3 | 47 | 35.8 |
| Vanadium | 11 | 15.3 | 12.6 | 16.4 | 15.3 | 15.6 | NA (40)[a] | NA |
| Zinc | 36.5 | 47.3 | 43.8 | 46.9 | 57.3 | 59.8 | 100 | 121 |
| Antimony | <0.0739 | <0.0749 | <0.0769 | <0.0851 | <0.0854 | 0.0872J | NA | NA |
| Selenium | 1.04J | 1.01J | 1.01J | 0.627J | 0.815J | <0.663 | 1.6 | NA |
| Thallium | 0.117 | 0.0848 | 0.14 | 0.132 | 0.161 | 0.271 | NA (4.7)[a] | NA |
| **Other** | | | | | | | | |
| Total Organic Carbon (mg/kg) | 28,400 | 28,300 | 29,600 | 26,600 | 61,400 | 34,600 | NA | NA |
| Percent Solids | 66.9 | 62.2 | 64.4 | 58.7 | 56.7 | 55.8 | NA | NA |
| **Particle Size (%)** | | | | | | | | |
| Gravel | 14.4 | 0.9 | 2.3 | 0.0 | 0.7 | 3.7 | NA | NA |
| Sand | 64.4 | 57.1 | 57.4 | 54.3 | 31.4 | 31.4 | NA | NA |
| Silt | 13.8 | 27.5 | 27.7 | 27.9 | 47.4 | 45.4 | NA | NA |
| Clay | 7.4 | 14.5 | 12.6 | 17.8 | 20.5 | 19.5 | NA | NA |

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

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

a - The SRV has not been developed for the Interior Plateau ecoregion. The value noted is a statewide SRV guideline.

Appendix Table 2. Ohio EPA fish species results from the Little Miami River, Peters Cartridge area, 2007.

| | | |
|---|---|---|
| River Code: **11-001** | Stream: **Little Miami River** | Sample Date: **2007** |
| River Mile: **31.50** | Location: upst. Grandin Rd. | Date Range: 06/21/2007 |
| Time Fished: 3855 sec | Drainage: 1052.0 sq mi | Thru: 08/03/2007 |
| Dist Fished: 1.00 km | Basin: Little Miami River No of Passes: 2 | Sampler Type: A |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Longnose Gar | | P | M | | 16 | 16.00 | 1.73 | 7.51 | 3.06 | 469.19 |
| Mooneye | | I | M | R | 1 | 1.00 | 0.11 | 0.28 | 0.11 | 275.00 |
| Skipjack Herring | | P | M | | 1 | 1.00 | 0.11 | 0.02 | 0.01 | 15.00 |
| Gizzard Shad | | O | M | | 65 | 65.00 | 7.03 | 9.62 | 3.92 | 147.95 |
| Smallmouth Buffalo | C | I | M | | 29 | 29.00 | 3.14 | 69.53 | 28.32 | 2,397.59 |
| River Carpsucker | C | O | M | | 9 | 9.00 | 0.97 | 7.95 | 3.24 | 883.33 |
| Highfin Carpsucker | C | O | M | | 1 | 1.00 | 0.11 | 0.65 | 0.26 | 648.00 |
| Silver Redhorse | R | I | S | M | 7 | 7.00 | 0.76 | 10.30 | 4.20 | 1,471.43 |
| Black Redhorse | R | I | S | I | 14 | 14.00 | 1.51 | 6.84 | 2.79 | 488.79 |
| Golden Redhorse | R | I | S | M | 39 | 39.00 | 4.22 | 21.65 | 8.82 | 555.07 |
| River Redhorse [S] | R | I | S | I | 2 | 2.00 | 0.22 | 4.30 | 1.75 | 2,150.00 |
| Northern Hog Sucker | R | I | S | M | 73 | 73.00 | 7.89 | 16.56 | 6.74 | 226.79 |
| Smallmouth Redhorse | R | I | S | M | 83 | 83.00 | 8.97 | 39.94 | 16.27 | 481.24 |
| Common Carp | G | O | M | T | 5 | 5.00 | 0.54 | 12.43 | 5.06 | 2,485.00 |
| Gravel Chub | N | I | S | M | 1 | 1.00 | 0.11 | 0.00 | 0.00 | 2.00 |
| Emerald Shiner | N | I | M | | 100 | 100.00 | 10.81 | 0.18 | 0.07 | 1.81 |
| Steelcolor Shiner | N | I | M | P | 18 | 18.00 | 1.95 | 0.14 | 0.06 | 7.94 |
| Spotfin Shiner | N | I | M | | 82 | 82.00 | 8.86 | 0.47 | 0.19 | 5.71 |
| Mimic Shiner | N | I | M | I | 28 | 28.00 | 3.03 | 0.07 | 0.03 | 2.54 |
| Bluntnose Minnow | N | O | C | T | 33 | 33.00 | 3.57 | 0.09 | 0.04 | 2.73 |
| Central Stoneroller | N | H | N | | 42 | 42.00 | 4.54 | 0.26 | 0.10 | 6.07 |
| Channel Catfish | F | | C | | 12 | 12.00 | 1.30 | 17.55 | 7.15 | 1,462.50 |
| Flathead Catfish | F | P | C | | 1 | 1.00 | 0.11 | 0.29 | 0.12 | 290.00 |
| Stonecat Madtom | | I | C | I | 5 | 5.00 | 0.54 | 0.06 | 0.03 | 12.60 |
| Mountain Madtom [E] | | I | C | R | 1 | 1.00 | 0.11 | 0.00 | 0.00 | 4.00 |
| Brook Silverside | | I | M | M | 1 | 1.00 | 0.11 | 0.00 | 0.00 | 2.00 |
| White Bass | F | P | M | | 1 | 1.00 | 0.11 | 0.30 | 0.12 | 300.00 |
| Rock Bass | S | C | C | | 3 | 3.00 | 0.32 | 0.19 | 0.08 | 61.67 |
| Smallmouth Bass | F | C | C | M | 20 | 20.00 | 2.16 | 4.95 | 2.01 | 247.30 |
| Spotted Bass | F | C | C | | 2 | 2.00 | 0.22 | 0.04 | 0.01 | 17.50 |
| Green Sunfish | S | I | C | T | 1 | 1.00 | 0.11 | 0.08 | 0.03 | 75.00 |
| Longear Sunfish | S | I | C | M | 10 | 10.00 | 1.08 | 0.31 | 0.13 | 31.20 |
| Sauger | F | P | S | | 6 | 6.00 | 0.65 | 1.64 | 0.67 | 273.67 |
| Slenderhead Darter | D | I | S | R | 21 | 21.00 | 2.27 | 0.14 | 0.06 | 6.71 |
| Logperch | D | I | S | M | 77 | 77.00 | 8.32 | 0.97 | 0.39 | 12.55 |
| Greenside Darter | D | I | S | M | 42 | 42.00 | 4.54 | 0.11 | 0.05 | 2.64 |
| Banded Darter | D | I | S | I | 33 | 33.00 | 3.57 | 0.07 | 0.03 | 2.18 |
| Variegate Darter | D | I | S | I | 5 | 5.00 | 0.54 | 0.02 | 0.01 | 3.80 |
| Rainbow Darter | D | I | S | M | 19 | 19.00 | 2.05 | 0.06 | 0.02 | 2.89 |
| Freshwater Drum | | | M | P | 16 | 16.00 | 1.73 | 9.97 | 4.06 | 623.25 |
| | *Mile Total* | | | | 925 | 925.00 | | 245.51 | | |
| | *Number of Species* | | | | 40 | | | | | |
| | *Number of Hybrids* | | | | 0 | | | | | |

| | | |
|---|---|---|
| River Code: **11-001** | Stream: **Little Miami River** | Sample Date: **2007** |
| River Mile: **30.50** | Location: adj. Peters Cartridge | Date Range: 06/21/2007 |
| Time Fished: 3652 sec | Drainage: 1054.0 sq mi | Thru: 08/03/2007 |
| Dist Fished: 1.00 km | Basin: Little Miami River No of Passes: 2 | Sampler Type: A |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Longnose Gar | | P | M | | 3 | 3.00 | 0.35 | 1.63 | 0.56 | 543.33 |
| Mooneye | | I | M | R | 1 | 1.00 | 0.12 | 0.25 | 0.09 | 250.00 |
| Gizzard Shad | | O | M | | 23 | 23.00 | 2.71 | 4.12 | 1.42 | 179.13 |
| Smallmouth Buffalo | C | I | M | | 12 | 12.00 | 1.41 | 28.68 | 9.89 | 2,389.58 |
| Quillback | C | O | M | | 7 | 7.00 | 0.82 | 4.90 | 1.69 | 700.00 |
| River Carpsucker | C | O | M | | 20 | 20.00 | 2.36 | 19.41 | 6.69 | 970.65 |
| Highfin Carpsucker | C | O | M | | 1 | 1.00 | 0.12 | 0.65 | 0.22 | 650.00 |
| Silver Redhorse | R | I | S | M | 5 | 5.00 | 0.59 | 7.55 | 2.60 | 1,510.00 |
| Black Redhorse | R | I | S | I | 15 | 15.00 | 1.77 | 6.11 | 2.10 | 407.00 |
| Golden Redhorse | R | I | S | M | 122 | 122.00 | 14.37 | 63.16 | 21.78 | 517.72 |
| Northern Hog Sucker | R | I | S | M | 98 | 98.00 | 11.54 | 20.78 | 7.17 | 212.08 |
| Smallmouth Redhorse | R | I | S | M | 87 | 87.00 | 10.25 | 36.33 | 12.53 | 417.63 |
| Common Carp | G | O | M | T | 7 | 7.00 | 0.82 | 16.33 | 5.63 | 2,332.14 |
| Gravel Chub | N | I | S | M | 5 | 5.00 | 0.59 | 0.03 | 0.01 | 6.20 |
| Emerald Shiner | N | I | M | | 55 | 55.00 | 6.48 | 0.10 | 0.03 | 1.82 |
| Steelcolor Shiner | N | I | M | P | 28 | 28.00 | 3.30 | 0.13 | 0.05 | 4.68 |
| Spotfin Shiner | N | I | M | | 48 | 48.00 | 5.65 | 0.22 | 0.08 | 4.54 |
| Sand Shiner | N | I | M | M | 3 | 3.00 | 0.35 | 0.01 | 0.00 | 1.67 |
| Mimic Shiner | N | I | M | I | 31 | 31.00 | 3.65 | 0.15 | 0.05 | 4.81 |
| Bullhead Minnow | N | O | C | | 1 | 1.00 | 0.12 | 0.00 | 0.00 | 3.00 |
| Bluntnose Minnow | N | O | C | T | 7 | 7.00 | 0.82 | 0.01 | 0.00 | 1.29 |
| Central Stoneroller | N | H | N | | 16 | 16.00 | 1.88 | 0.08 | 0.03 | 5.06 |
| Channel Catfish | F | | C | | 20 | 20.00 | 2.36 | 37.34 | 12.87 | 1,867.00 |
| Flathead Catfish | F | P | C | | 3 | 3.00 | 0.35 | 1.17 | 0.40 | 390.00 |
| Stonecat Madtom | | I | C | I | 4 | 4.00 | 0.47 | 0.06 | 0.02 | 13.75 |
| Mountain Madtom [E] | | I | C | R | 4 | 4.00 | 0.47 | 0.01 | 0.00 | 1.75 |
| White Bass | F | P | M | | 1 | 1.00 | 0.12 | 0.20 | 0.07 | 200.00 |
| Rock Bass | S | C | C | | 2 | 2.00 | 0.24 | 0.09 | 0.03 | 45.00 |
| Smallmouth Bass | F | C | C | M | 25 | 25.00 | 2.94 | 4.76 | 1.64 | 190.53 |
| Spotted Bass | F | C | C | | 1 | 1.00 | 0.12 | 0.18 | 0.06 | 175.00 |
| Largemouth Bass | F | C | C | | 1 | 1.00 | 0.12 | 0.25 | 0.09 | 250.00 |
| Green Sunfish | S | I | C | T | 1 | 1.00 | 0.12 | 0.06 | 0.02 | 60.00 |
| Longear Sunfish | S | I | C | M | 25 | 25.00 | 2.94 | 0.91 | 0.31 | 36.20 |
| Sauger | F | P | S | | 4 | 4.00 | 0.47 | 1.10 | 0.38 | 274.00 |
| Blackside Darter | D | I | S | | 1 | 1.00 | 0.12 | 0.00 | 0.00 | 3.00 |
| Slenderhead Darter | D | I | S | R | 8 | 8.00 | 0.94 | 0.03 | 0.01 | 3.13 |
| Logperch | D | I | S | M | 57 | 57.00 | 6.71 | 0.99 | 0.34 | 17.35 |
| Greenside Darter | D | I | S | M | 22 | 22.00 | 2.59 | 0.06 | 0.02 | 2.50 |
| Banded Darter | D | I | S | I | 19 | 19.00 | 2.24 | 0.01 | 0.00 | 0.74 |
| Variegate Darter | D | I | S | I | 5 | 5.00 | 0.59 | 0.04 | 0.01 | 8.00 |
| Rainbow Darter | D | I | S | M | 11 | 11.00 | 1.30 | 0.01 | 0.00 | 1.27 |
| Freshwater Drum | | | M | P | 40 | 40.00 | 4.71 | 32.15 | 11.09 | 803.81 |
| | *Mile Total* | | | | 849 | 849.00 | | 290.03 | | |
| | *Number of Species* | | | | 42 | | | | | |
| | *Number of Hybrids* | | | | 0 | | | | | |

| | | |
|---|---|---|
| River Code: **11-001** | Stream: **Little Miami River** | Sample Date: **2007** |
| River Mile: **29.00** | Location: dst. Peters Cartridge | Date Range: 06/21/2007 |
| Time Fished: 3792 sec | Drainage: 1059.0 sq mi | Thru: 08/03/2007 |
| Dist Fished: 1.12 km | Basin: Little Miami River No of Passes: 2 | Sampler Type: A |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Gizzard Shad | | O | M | | 9 | 8.03 | 1.18 | 0.90 | 0.38 | 107.22 |
| Smallmouth Buffalo | C | I | M | | 24 | 22.06 | 3.24 | 38.41 | 16.40 | 1,782.13 |
| Quillback | C | O | M | | 4 | 3.42 | 0.50 | 3.40 | 1.45 | 993.75 |
| River Carpsucker | C | O | M | | 12 | 10.06 | 1.48 | 9.50 | 4.06 | 937.50 |
| Highfin Carpsucker | C | O | M | | 5 | 4.23 | 0.62 | 2.76 | 1.18 | 650.00 |
| Silver Redhorse | R | I | S | M | 15 | 14.23 | 2.09 | 25.89 | 11.06 | 1,833.33 |
| Black Redhorse | R | I | S | I | 28 | 24.13 | 3.54 | 17.16 | 7.33 | 711.79 |
| Golden Redhorse | R | I | S | M | 145 | 128.16 | 18.83 | 69.17 | 29.54 | 538.14 |
| River Redhorse [S] | R | I | S | I | 1 | 0.81 | 0.12 | 1.57 | 0.67 | 1,950.00 |
| Northern Hog Sucker | R | I | S | M | 16 | 14.84 | 2.18 | 2.28 | 0.97 | 157.38 |
| Smallmouth Redhorse | R | I | S | M | 63 | 58.74 | 8.63 | 17.20 | 7.34 | 292.94 |
| Common Carp | G | O | M | T | 4 | 3.42 | 0.50 | 6.54 | 2.79 | 1,937.50 |
| Emerald Shiner | N | I | M | | 57 | 47.90 | 7.04 | 0.12 | 0.05 | 2.49 |
| Striped Shiner | N | I | S | | 2 | 1.81 | 0.27 | 0.01 | 0.00 | 6.00 |
| Steelcolor Shiner | N | I | M | P | 10 | 9.23 | 1.36 | 0.08 | 0.03 | 8.40 |
| Spotfin Shiner | N | I | M | | 58 | 49.68 | 7.30 | 0.21 | 0.09 | 4.24 |
| Sand Shiner | N | I | M | M | 1 | 1.00 | 0.15 | 0.00 | 0.00 | 2.00 |
| Mimic Shiner | N | I | M | I | 99 | 97.84 | 14.37 | 0.15 | 0.07 | 1.58 |
| Bullhead Minnow | N | O | C | | 6 | 5.61 | 0.82 | 0.02 | 0.01 | 3.00 |
| Bluntnose Minnow | N | O | C | T | 21 | 18.68 | 2.74 | 0.05 | 0.02 | 2.71 |
| Central Stoneroller | N | H | N | | 12 | 11.23 | 1.65 | 0.06 | 0.03 | 5.42 |
| Channel Catfish | F | | C | | 9 | 8.23 | 1.21 | 9.94 | 4.24 | 1,234.00 |
| Flathead Catfish | F | P | C | | 5 | 4.23 | 0.62 | 6.39 | 2.73 | 1,548.00 |
| Stonecat Madtom | | I | C | I | 2 | 1.61 | 0.24 | 0.05 | 0.02 | 30.00 |
| Mountain Madtom [E] | | I | C | R | 1 | 0.81 | 0.12 | 0.00 | 0.00 | 2.00 |
| White Bass | F | P | M | | 1 | 0.81 | 0.12 | 0.15 | 0.07 | 190.00 |
| Rock Bass | S | C | C | | 4 | 3.42 | 0.50 | 0.33 | 0.14 | 98.50 |
| Smallmouth Bass | F | C | C | M | 27 | 24.10 | 3.54 | 8.11 | 3.46 | 334.07 |
| Spotted Bass | F | C | C | | 2 | 1.61 | 0.24 | 0.23 | 0.10 | 140.00 |
| Largemouth Bass | F | C | C | | 1 | 0.81 | 0.12 | 0.07 | 0.03 | 90.00 |
| Green Sunfish | S | I | C | T | 5 | 4.23 | 0.62 | 0.10 | 0.04 | 23.00 |
| Bluegill Sunfish | S | I | C | P | 3 | 2.42 | 0.36 | 0.05 | 0.02 | 21.00 |
| Longear Sunfish | S | I | C | M | 23 | 20.48 | 3.01 | 1.12 | 0.48 | 55.70 |
| Sauger | F | P | S | | 7 | 6.23 | 0.91 | 1.97 | 0.84 | 313.14 |
| Slenderhead Darter | D | I | S | R | 6 | 5.81 | 0.85 | 0.04 | 0.02 | 7.33 |
| Logperch | D | I | S | M | 31 | 30.03 | 4.41 | 0.52 | 0.22 | 17.34 |
| Greenside Darter | D | I | S | M | 10 | 9.23 | 1.36 | 0.04 | 0.02 | 4.40 |
| Banded Darter | D | I | S | I | 2 | 1.81 | 0.27 | 0.00 | 0.00 | 2.50 |
| Variegate Darter | D | I | S | I | 3 | 2.81 | 0.41 | 0.01 | 0.00 | 4.00 |
| Rainbow Darter | D | I | S | M | 2 | 1.61 | 0.24 | 0.01 | 0.00 | 3.00 |
| Sauger X Walleye | E | P | | | 1 | 1.00 | 0.15 | 1.13 | 0.48 | 1,125.00 |
| Freshwater Drum | | | M | P | 15 | 14.42 | 2.12 | 8.43 | 3.60 | 595.80 |
| | *Mile Total* | | | | 752 | 680.77 | | 234.18 | | |
| | *Number of Species* | | | | 41 | | | | | |
| | *Number of Hybrids* | | | | 1 | | | | | |

Appendix Table 3. Index of Biotic Integrity (IB) scores and metrics for the Little Miami River, 2007.

| River Mile | Type | Date | Drainage area (sq mi) | Number of: Total species | Number of: Sunfish species | Number of: Sucker species | Number of: Intolerant species | Percent of Individuals: Rnd-bodied suckers | Percent of Individuals: Simple Lithophils | Percent of Individuals: Tolerant fishes | Percent of Individuals: Omni-vores | Percent of Individuals: Top carnivores | Percent of Individuals: Insect-ivores | DELT anomalies | Rel.No. minus tolerants /(1.0 km) | IBI | Modified Iwb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Little Miami River - (11-001) | | | | | | | | | | | | | | | | | |
| Year: 2007 | | | | | | | | | | | | | | | | | |
| 31.50 | A | 06/21/2007 | 1052 | 28(5) | 2(3) | 7(5) | 7(5) | 31(3) | 53(5) | 1(5) | 12(5) | 6(3) | 77(5) | 0.3(5) | 726(5) | 54 | 11.1 |
| 31.50 | A | 08/03/2007 | 1052 | 35(5) | 3(3) | 7(5) | 7(5) | 19(1) | 41(3) | 6(5) | 12(5) | 5(3) | 73(5) | 0.6(3) | 1046(5) | 48 | 11.5 |
| 30.50 | A | 06/21/2007 | 1054 | 29(5) | 2(3) | 8(5) | 6(5) | 44(5) | 62(5) | 2(5) | 6(5) | 2(1) | 81(5) | 0.3(5) | 740(5) | 54 | 11.2 |
| 30.50 | A | 08/03/2007 | 1054 | 40(5) | 2(3) | 9(5) | 8(5) | 34(3) | 48(5) | 2(5) | 9(5) | 7(3) | 77(5) | 0.2(5) | 928(5) | 54 | 11.7 |
| 29.00 | A | 06/21/2007 | 1059 | 32(5) | 3(3) | 9(5) | 5(5) | 33(3) | 45(5) | 3(5) | 6(5) | 5(1) | 83(5) | 0.3(5) | 746(5) | 52 | 10.9 |
| 29.00 | A | 08/03/2007 | 1059 | 39(5) | 4(5) | 10(5) | 8(5) | 38(5) | 43(3) | 5(5) | 11(5) | 8(3) | 78(5) | 0.3(5) | 563(5) | 56 | 11.1 |

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

Appendix Table 4. Ohio EPA macroinvertebrate results from the Little Miami River, Peters Cartridge area, 2007.

**Ohio EPA/DSW Ecological Assessment Section**
**Macroinvertebrate Collection**

Site: Little Miami River upst. Grandin Rd.

Collection Date: 08/02/2007 River Code: 11-001 RM: 31.50

| Taxa Code | Taxa | Quant/Qual |
|---|---|---|
| 01801 | *Turbellaria* | 148 + |
| 03360 | *Plumatella sp* | 3 + |
| 03600 | *Oligochaeta* | 2 |
| 05900 | *Lirceus sp* | + |
| 06201 | *Hyalella azteca* | + |
| 06700 | *Crangonyx sp* | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | + |
| 11119 | *Plauditus dubius or P. virilis* | 6 + |
| 11120 | *Baetis flavistriga* | 8 |
| 11130 | *Baetis intercalaris* | 181 + |
| 11620 | *Paracloeodes sp 2* | + |
| 12200 | *Isonychia sp* | 23 + |
| 13000 | *Leucrocuta sp* | + |
| 13400 | *Stenacron sp* | 1 + |
| 13510 | *Maccaffertium exiguum* | 43 |
| 13521 | *Stenonema femoratum* | + |
| 13561 | *Maccaffertium pulchellum* | 382 + |
| 13570 | *Maccaffertium terminatum* | 89 + |
| 16700 | *Tricorythodes sp* | 95 + |
| 17200 | *Caenis sp* | + |
| 18100 | *Anthopotamus sp* | + |
| 21300 | *Hetaerina sp* | + |
| 22001 | *Coenagrionidae* | + |
| 22300 | *Argia sp* | + |
| 23804 | *Basiaeschna janata* | + |
| 23909 | *Boyeria vinosa* | + |
| 44501 | *Corixidae* | + |
| 47600 | *Sialis sp* | + |
| 50315 | *Chimarra obscura* | 3 + |
| 51206 | *Cyrnellus fraternus* | + |
| 51300 | *Neureclipsis sp* | 1 + |
| 51600 | *Polycentropus sp* | + |
| 52200 | *Cheumatopsyche sp* | 2026 + |
| 52430 | *Ceratopsyche morosa group* | 1076 + |
| 52510 | *Hydropsyche aerata* | 14 |
| 53400 | *Protoptila sp* | + |
| 53800 | *Hydroptila sp* | 5 |
| 59140 | *Ceraclea maculata* | 4 |
| 59407 | *Nectopsyche candida* | + |
| 59970 | *Petrophila sp* | 2 |
| 65800 | *Berosus sp* | + |
| 67500 | *Laccobius sp* | + |
| 68075 | *Psephenus herricki* | + |
| 68201 | *Scirtidae* | + |
| 68601 | *Ancyronyx variegata* | 2 + |
| 68702 | *Dubiraphia bivittata* | + |
| 68708 | *Dubiraphia vittata group* | + |
| 68901 | *Macronychus glabratus* | 57 + |
| 69400 | *Stenelmis sp* | 10 + |
| 72700 | *Anopheles sp* | + |
| 74100 | *Simulium sp* | 5 |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 47 |
| 78750 | *Rheopelopia paramaculipennis* | 13 |
| 80410 | *Cricotopus (C.) sp* | + |
| 82101 | *Thienemanniella taurocapita* | 2 |
| 82220 | *Tvetenia discoloripes group* | 128 |
| 82730 | *Chironomus (C.) decorus group* | + |
| 83040 | *Dicrotendipes neomodestus* | + |
| 83300 | *Glyptotendipes (G.) sp* | + |
| 84020 | *Parachironomus carinatus* | + |
| 84300 | *Phaenopsectra obediens group* | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 329 + |
| 84470 | *Polypedilum (P.) illinoense* | + |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | 7 |
| 84700 | *Stenochironomus sp* | + |
| 84750 | *Stictochironomus sp* | + |
| 85261 | *Cladotanytarsus vanderwulpi group Type 1* | + |
| 85625 | *Rheotanytarsus sp* | 228 + |
| 85800 | *Tanytarsus sp* | 13 + |
| 87540 | *Hemerodromia sp* | 4 |
| 93900 | *Elimia sp* | 2 + |
| 96900 | *Ferrissia sp* | 1 + |
| 97601 | *Corbicula fluminea* | 1 |
| 97710 | *Dreissena polymorpha* | + |
| 99280 | *Lasmigona costata* | + |

No. Quantitative Taxa: 36 Total Taxa: 75

No. Qualitative Taxa: 60 ICI: **52**

Number of Organisms: 4961 Qual EPT: 20

**Ohio EPA/DSW Ecological Assessment Section**
**Macroinvertebrate Collection**

Site: Little Miami River

Collection Date: 08/02/2007 River Code: 11-001 RM: 30.90

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01200 | *Cordylophora lacustris* | | + |
| 01801 | *Turbellaria* | 10 | + |
| 03360 | *Plumatella sp* | 2 | + |
| 03600 | *Oligochaeta* | 8 | |
| 06700 | *Crangonyx sp* | | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | | + |
| 11119 | *Plauditus dubius or P. virilis* | 71 | + |
| 11120 | *Baetis flavistriga* | 49 | + |
| 11130 | *Baetis intercalaris* | 855 | + |
| 11620 | *Paracloeodes sp 2* | | + |
| 12200 | *Isonychia sp* | 15 | + |
| 13000 | *Leucrocuta sp* | | + |
| 13400 | *Stenacron sp* | 75 | + |
| 13510 | *Maccaffertium exiguum* | 85 | + |
| 13521 | *Stenonema femoratum* | 1 | |
| 13561 | *Maccaffertium pulchellum* | 192 | + |
| 13570 | *Maccaffertium terminatum* | 116 | + |
| 16700 | *Tricorythodes sp* | 456 | + |
| 17200 | *Caenis sp* | | + |
| 22001 | *Coenagrionidae* | | + |
| 22300 | *Argia sp* | | + |
| 23804 | *Basiaeschna janata* | | + |
| 47600 | *Sialis sp* | | + |
| 50315 | *Chimarra obscura* | | + |
| 51206 | *Cyrnellus fraternus* | 2 | |
| 51300 | *Neureclipsis sp* | 1 | |
| 52200 | *Cheumatopsyche sp* | 463 | + |
| 52430 | *Ceratopsyche morosa group* | 979 | + |
| 52510 | *Hydropsyche aerata* | 16 | + |
| 52570 | *Hydropsyche simulans* | 1 | |
| 53800 | *Hydroptila sp* | 74 | + |
| 59160 | *Ceraclea spongillovorax* | 4 | |
| 59970 | *Petrophila sp* | 18 | |
| 60900 | *Peltodytes sp* | | + |
| 65800 | *Berosus sp* | | + |
| 68702 | *Dubiraphia bivittata* | | + |
| 68708 | *Dubiraphia vittata group* | | + |
| 68901 | *Macronychus glabratus* | 14 | + |
| 69400 | *Stenelmis sp* | 1 | + |
| 74100 | *Simulium sp* | | + |
| 74501 | *Ceratopogonidae* | | + |
| 77120 | *Ablabesmyia mallochi* | 13 | |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 76 | |
| 78655 | *Procladius (Holotanypus) sp* | | + |
| 78750 | *Rheopelopia paramaculipennis* | 63 | |
| 80410 | *Cricotopus (C.) sp* | 13 | + |
| 80430 | *Cricotopus (C.) tremulus group* | 63 | |
| 81825 | *Rheocricotopus (Psilocricotopus) robacki* | 13 | |
| 82101 | *Thienemanniella taurocapita* | 72 | |
| 82121 | *Thienemanniella lobapodema* | 8 | |
| 82220 | *Tvetenia discoloripes group* | 50 | + |
| 83040 | *Dicrotendipes neomodestus* | 13 | |
| 83051 | *Dicrotendipes simpsoni* | | + |
| 83300 | *Glyptotendipes (G.) sp* | | + |
| 83820 | *Microtendipes "caelum" (sensu Simpson & Bode, 1980)* | 13 | |
| 84060 | *Parachironomus pectinatellae* | 25 | |
| 84315 | *Phaenopsectra flavipes* | | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 403 | + |
| 84460 | *Polypedilum (P.) fallax group* | | + |
| 84470 | *Polypedilum (P.) illinoense* | | + |
| 84790 | *Tribelos fuscicorne* | | + |
| 84888 | *Xenochironomus xenolabis* | | + |
| 85625 | *Rheotanytarsus sp* | 492 | + |
| 85821 | *Tanytarsus glabrescens group sp 7* | 13 | |
| 87540 | *Hemerodromia sp* | 4 | |
| 93900 | *Elimia sp* | | + |
| 97710 | *Dreissena polymorpha* | | + |
| 98600 | *Sphaerium sp* | | + |

No. Quantitative Taxa: 40 Total Taxa: 68

No. Qualitative Taxa: 49 ICI: **52**

Number of Organisms: 4842 Qual EPT: 17

**Ohio EPA/DSW Ecological Assessment Section**
**Macroinvertebrate Collection**

Site: Little Miami River adj. Peters Cartridge

Collection Date: 08/02/2007 River Code: 11-001 RM: 30.50

| Taxa Code | Taxa | Quant/Qual |
|---|---|---|
| 01801 | *Turbellaria* | 395 + |
| 03360 | *Plumatella sp* | 1 + |
| 03451 | *Urnatella gracilis* | + |
| 04683 | *Placobdella multilineata* | 1 |
| 04750 | *Myzobdella lugubris* | 1 |
| 05800 | *Caecidotea sp* | + |
| 06700 | *Crangonyx sp* | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | + |
| 11119 | *Plauditus dubius or P. virilis* | 4 + |
| 11120 | *Baetis flavistriga* | 3 |
| 11130 | *Baetis intercalaris* | 118 + |
| 12200 | *Isonychia sp* | 3 + |
| 13400 | *Stenacron sp* | 65 + |
| 13510 | *Maccaffertium exiguum* | 50 + |
| 13561 | *Maccaffertium pulchellum* | 216 + |
| 13570 | *Maccaffertium terminatum* | 110 + |
| 16700 | *Tricorythodes sp* | 399 + |
| 17200 | *Caenis sp* | + |
| 21300 | *Hetaerina sp* | 1 |
| 22001 | *Coenagrionidae* | + |
| 22300 | *Argia sp* | + |
| 23804 | *Basiaeschna janata* | + |
| 47600 | *Sialis sp* | + |
| 50315 | *Chimarra obscura* | + |
| 51206 | *Cyrnellus fraternus* | + |
| 51300 | *Neureclipsis sp* | 12 |
| 51600 | *Polycentropus sp* | 2 |
| 52200 | *Cheumatopsyche sp* | 687 + |
| 52430 | *Ceratopsyche morosa group* | 487 + |
| 52510 | *Hydropsyche aerata* | 30 |
| 52570 | *Hydropsyche simulans* | 1 |
| 53800 | *Hydroptila sp* | 15 |
| 59100 | *Ceraclea sp* | 4 |
| 59970 | *Petrophila sp* | 28 |
| 68075 | *Psephenus herricki* | + |
| 68601 | *Ancyronyx variegata* | 1 |
| 68901 | *Macronychus glabratus* | 9 + |
| 69400 | *Stenelmis sp* | + |
| 74100 | *Simulium sp* | + |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 63 + |
| 78655 | *Procladius (Holotanypus) sp* | + |
| 78750 | *Rheopelopia paramaculipennis* | 48 |
| 80360 | *Corynoneura "celeripes" (sensu Simpson & Bode, 1980)* | 8 |
| 80370 | *Corynoneura lobata* | 8 |
| 80410 | *Cricotopus (C.) sp* | 8 |
| 80427 | *Cricotopus (C.) politus* | 8 |
| 80430 | *Cricotopus (C.) tremulus group* | 32 |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 8 |
| 82101 | *Thienemanniella taurocapita* | 2 |
| 82220 | *Tvetenia discoloripes group* | 48 + |
| 82820 | *Cryptochironomus sp* | + |
| 83040 | *Dicrotendipes neomodestus* | 40 |
| 83820 | *Microtendipes "caelum" (sensu Simpson & Bode, 1980)* | + |
| 84040 | *Parachironomus frequens* | + |
| 84300 | *Phaenopsectra obediens group* | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 318 + |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | 8 |
| 85500 | *Paratanytarsus sp* | 8 |
| 85625 | *Rheotanytarsus sp* | 206 |
| 85821 | *Tanytarsus glabrescens group sp 7* | 8 |
| 93900 | *Elimia sp* | 211 + |
| 95501 | *Planorbidae* | + |
| 97710 | *Dreissena polymorpha* | + |

| | | | |
|---|---|---|---|
| No. Quantitative Taxa: | 42 | Total Taxa: | 63 |
| No. Qualitative Taxa: | 38 | ICI: | **50** |
| Number of Organisms: | 3675 | Qual EPT: | 13 |

**Ohio EPA/DSW Ecological Assessment Section**
**Macroinvertebrate Collection**

Site: Little Miami River

Collection Date: 08/02/2007 River Code: 11-001 RM: 30.00

| Taxa Code | Taxa | Quant/Qual |
|---|---|---|
| 01801 | *Turbellaria* | 2 + |
| 03360 | *Plumatella sp* | 4 + |
| 03600 | *Oligochaeta* | + |
| 06201 | *Hyalella azteca* | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | + |
| 11119 | *Plauditus dubius or P. virilis* | 56 + |
| 11120 | *Baetis flavistriga* | 26 + |
| 11130 | *Baetis intercalaris* | 168 + |
| 11620 | *Paracloeodes sp 2* | + |
| 11670 | *Procloeon viridoculare* | + |
| 12200 | *Isonychia sp* | + |
| 13100 | *Nixe sp* | + |
| 13400 | *Stenacron sp* | 2 + |
| 13510 | *Maccaffertium exiguum* | 12 + |
| 13561 | *Maccaffertium pulchellum* | 142 + |
| 13570 | *Maccaffertium terminatum* | 33 + |
| 16700 | *Tricorythodes sp* | 625 + |
| 17200 | *Caenis sp* | + |
| 18700 | *Hexagenia sp* | + |
| 22001 | *Coenagrionidae* | + |
| 22300 | *Argia sp* | 1 + |
| 23804 | *Basiaeschna janata* | + |
| 24501 | *Gomphidae* | + |
| 43300 | *Ranatra sp* | + |
| 47600 | *Sialis sp* | + |
| 51206 | *Cyrnellus fraternus* | 1 + |
| 51300 | *Neureclipsis sp* | 8 |
| 52200 | *Cheumatopsyche sp* | 566 + |
| 52430 | *Ceratopsyche morosa group* | 631 + |
| 52510 | *Hydropsyche aerata* | 28 + |
| 53800 | *Hydroptila sp* | 27 |
| 59160 | *Ceraclea spongillovorax* | 1 |
| 59970 | *Petrophila sp* | 27 + |
| 60900 | *Peltodytes sp* | + |
| 65800 | *Berosus sp* | + |
| 67800 | *Tropisternus sp* | + |
| 68075 | *Psephenus herricki* | + |
| 68708 | *Dubiraphia vittata group* | + |
| 68901 | *Macronychus glabratus* | 3 + |
| 69400 | *Stenelmis sp* | 1 + |
| 70600 | *Antocha sp* | 16 |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | + |
| 78655 | *Procladius (Holotanypus) sp* | + |
| 78750 | *Rheopelopia paramaculipennis* | 120 |
| 80310 | *Cardiocladius obscurus* | 24 |
| 81690 | *Paratrichocladius sp* | 24 |
| 82101 | *Thienemanniella taurocapita* | 32 |
| 82730 | *Chironomus (C.) decorus group* | + |
| 83040 | *Dicrotendipes neomodestus* | 24 |
| 83400 | *Harnischia sp* | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 528 + |
| 84520 | *Polypedilum (Tripodura) halterale group* | + |
| 84750 | *Stictochironomus sp* | + |
| 84800 | *Tribelos jucundum* | + |
| 84960 | *Pseudochironomus sp* | + |
| 85625 | *Rheotanytarsus sp* | 1536 + |
| 85720 | *Stempellinella fimbriata* | + |
| 85821 | *Tanytarsus glabrescens group sp 7* | 72 |
| 87540 | *Hemerodromia sp* | 16 |
| 93900 | *Elimia sp* | 2 + |
| 97601 | *Corbicula fluminea* | + |
| 97710 | *Dreissena polymorpha* | + |
| 98600 | *Sphaerium sp* | + |
| 99400 | *Quadrula quadrula* | + |
| 99700 | *Potamilus alatus* | + |

No. Quantitative Taxa: 32 Total Taxa: 65

No. Qualitative Taxa: 54 ICI: **52**

Number of Organisms: 4758 Qual EPT: 18

**Ohio EPA/DSW Ecological Assessment Section**
**Macroinvertebrate Collection**

Site: Little Miami River dst. Peters Cartridge

Collection Date: 08/02/2007 River Code: 11-001 RM: 29.00

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 00401 | *Spongillidae* | | + |
| 01801 | *Turbellaria* | 19 | + |
| 03360 | *Plumatella sp* | 2 | + |
| 03600 | *Oligochaeta* | | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | | + |
| 11119 | *Plauditus dubius or P. virilis* | 24 | + |
| 11120 | *Baetis flavistriga* | 1 | + |
| 11130 | *Baetis intercalaris* | 137 | + |
| 11200 | *Callibaetis sp* | | + |
| 11670 | *Procloeon viridoculare* | | + |
| 12200 | *Isonychia sp* | 7 | + |
| 13000 | *Leucrocuta sp* | 2 | |
| 13400 | *Stenacron sp* | 9 | + |
| 13510 | *Maccaffertium exiguum* | 9 | + |
| 13521 | *Stenonema femoratum* | | + |
| 13561 | *Maccaffertium pulchellum* | 116 | + |
| 13570 | *Maccaffertium terminatum* | 11 | + |
| 16700 | *Tricorythodes sp* | 132 | + |
| 17200 | *Caenis sp* | | + |
| 22001 | *Coenagrionidae* | | + |
| 22300 | *Argia sp* | 1 | + |
| 23804 | *Basiaeschna janata* | | + |
| 49400 | *Sisyra sp* | | + |
| 51206 | *Cyrnellus fraternus* | 1 | |
| 51300 | *Neureclipsis sp* | 6 | |
| 52200 | *Cheumatopsyche sp* | 497 | + |
| 52430 | *Ceratopsyche morosa group* | 587 | + |
| 52510 | *Hydropsyche aerata* | 21 | |
| 52530 | *Hydropsyche depravata group* | 3 | |
| 53800 | *Hydroptila sp* | 43 | + |
| 59140 | *Ceraclea maculata* | 5 | |
| 59970 | *Petrophila sp* | 1 | |
| 65800 | *Berosus sp* | | + |
| 68075 | *Psephenus herricki* | 1 | + |
| 68901 | *Macronychus glabratus* | 6 | |
| 69400 | *Stenelmis sp* | | + |
| 71900 | *Tipula sp* | | + |
| 74100 | *Simulium sp* | 8 | |
| 77120 | *Ablabesmyia mallochi* | | + |
| 78655 | *Procladius (Holotanypus) sp* | | + |
| 78750 | *Rheopelopia paramaculipennis* | 12 | |
| 80430 | *Cricotopus (C.) tremulus group* | 12 | |
| 82100 | *Thienemanniella sp* | 12 | |
| 82220 | *Tvetenia discoloripes group* | 49 | |
| 83300 | *Glyptotendipes (G.) sp* | | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 341 | + |
| 84470 | *Polypedilum (P.) illinoense* | | + |
| 84520 | *Polypedilum (Tripodura) halterale group* | | + |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | | + |
| 84790 | *Tribelos fuscicorne* | | + |
| 85625 | *Rheotanytarsus sp* | 865 | + |
| 85800 | *Tanytarsus sp* | | + |
| 85821 | *Tanytarsus glabrescens group sp 7* | 24 | |
| 87540 | *Hemerodromia sp* | 16 | |
| 93900 | *Elimia sp* | 1 | + |
| 95100 | *Physella sp* | | + |
| 96900 | *Ferrissia sp* | | + |
| 97601 | *Corbicula fluminea* | | + |

No. Quantitative Taxa: 34 Total Taxa: 58

No. Qualitative Taxa: 43 ICI: **54**

Number of Organisms: 2981 Qual EPT: 16

**Appendix Table 5. Invertebrate Community Index (ICI) scores and metrics for the Little Miami River, 2007.**



| River Mile | Drainage Area (sq mi) | Number of | | | | Percent: | | | | | Qual. EPT | Eco-region | ICI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Total Taxa | Mayfly Taxa | Caddisfly Taxa | Dipteran Taxa | Mayflies | Caddis-flies | Tany-tarsini | Other Dipt/NI | Tolerant Organisms | | | |
| **Little Miami River (11-001)** | | | | | | | | | | | | | |
| **Year: 2007** | | | | | | | | | | | | | |
| 31.50 | 1052 | 36(6) | 9(6) | 7(6) | 10(4) | 16.7(4) | 63.1(6) | 4.9(2) | 13.9(6) | 0.1(6) | 20(6) | 2 | 52 |
| 30.90 | 1054 | 40(6) | 10(6) | 8(6) | 16(6) | 39.6(6) | 31.8(4) | 10.4(2) | 17.5(4) | 0.2(6) | 17(6) | 2 | 52 |
| 30.50 | 1054 | 42(6) | 9(6) | 8(6) | 16(6) | 26.3(6) | 33.7(6) | 6.0(2) | 32.9(2) | 0.0(6) | 13(4) | 2 | 50 |
| 30.00 | 1055 | 32(4) | 8(6) | 7(6) | 10(4) | 22.4(4) | 26.5(4) | 33.8(6) | 16.6(6) | 0.0(6) | 18(6) | 2 | 52 |
| 29.00 | 1059 | 34(6) | 10(6) | 8(6) | 9(4) | 15.0(4) | 39.0(6) | 29.8(6) | 15.8(6) | 0.0(6) | 16(4) | 2 | 54 |