*State of Ohio*
*Environmental Protection Agency*

**Division of Surface Water**

# Biological and Water Quality Study of the Dry Fork Whitewater River

**Butler County**

**February 22, 2006**

Bob Taft, Governor
Joseph P. Koncelik, Director

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Sportsman 25 Gun Club Property

2005

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# TABLE OF CONTENTS

INTRODUCTION . . . . . 1
SUMMARY . . . . . 1
RECOMMENDATIONS . . . . . 2
METHODS . . . . . 5
RESULTS . . . . . 8
Surface Water . . . . . 8
Sediment Chemistry . . . . . 8
Physical Habitat for Aquatic Life . . . . . 9
Fish Community . . . . . 9
Macroinvertebrate Community . . . . . 10
REFERENCES . . . . . 15
APPENDICES . . . . . 17

# NOTICE TO USERS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

# FOREWORD

*What is a Biological and Water Quality Survey?*

A biological and water quality survey, or "biosurvey", is an interdisciplinary monitoring effort coordinated on a waterbody specific or watershed scale. This effort may involve a relatively simple setting focusing on one or two small streams, one or two principal stressors, and a handful of sampling sites or a much more complex effort including entire drainage basins, multiple and overlapping stressors, and tens of sites. Each year Ohio EPA conducts biosurveys in 6-10 different study areas with an aggregate total of 350-400 sampling sites.

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

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

*Hierarchy of Indicators*

A carefully conceived ambient monitoring approach, using cost-effective indicators comprised of ecological, chemical, and toxicological measures, can ensure that all relevant pollution sources are judged objectively on the basis of environmental results. Ohio EPA relies on a tiered approach in attempting to link the results of administrative activities with true environmental measures. This integrated approach is outlined in Figure 1 and includes a hierarchical continuum from administrative to true environmental indicators. The six "levels" of indicators include: 1) actions taken by regulatory agencies (permitting, enforcement, grants); 2) responses by the regulated community (treatment works, pollution prevention); 3) changes in discharged quantities (pollutant loadings); 4) changes in ambient conditions (water quality, habitat); 5) changes in uptake and/or assimilation (tissue contamination, biomarkers, wasteload allocation); and, 6) changes in health,

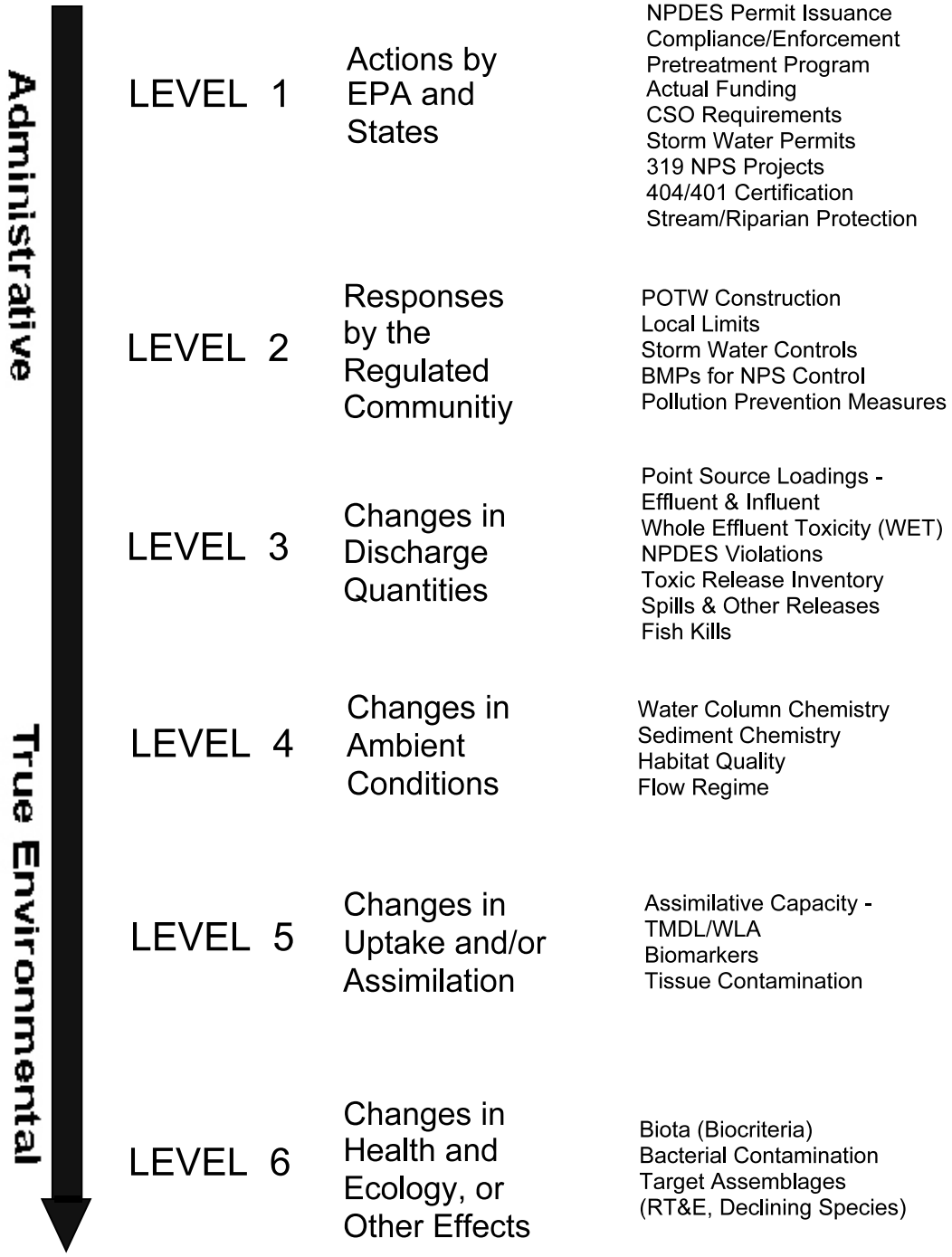


*Figure 1. Hierarchy of administrative and environmental indicators which can be used for water quality management activities such as monitoring and assessment, reporting, and the evaluation of overall program effectiveness. This is patterned after a model developed by U.S. EPA (1995).*

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

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

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

*Ohio Water Quality Standards: Designated Aquatic Life Uses*

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

The five different aquatic life uses currently defined in the Ohio WQS are described as follows:

1) *Warmwater Habitat (WWH)* - this use designation defines the "typical" warmwater assemblage of aquatic organisms for Ohio rivers and streams; *this use represents the principal restoration target for the majority of water resource management efforts in Ohio.*
2) *Exceptional Warmwater Habitat (EWH)* - this use designation is reserved for waters which support "unusual and exceptional" assemblages of aquatic organisms which are characterized by a high diversity of species, particularly those which are highly intolerant and/or rare, threatened, endangered, or special status (*i.e.*, declining species); *this designation represents a protection goal for water resource management efforts dealing with Ohio's best water resources.*
3) *Coldwater Habitat (CWH)* - this use is intended for waters which support assemblages of cold water organisms and/or those which are stocked with salmonids with the intent of providing a put-and-take fishery on a year round basis which is further sanctioned by the Ohio DNR, Division of Wildlife; this use should not be confused with the Seasonal Salmonid Habitat (SSH) use which applies to the Lake Erie tributaries which support periodic "runs" of salmonids during the spring, summer, and/or fall.
4) *Modified Warmwater Habitat (MWH)* - this use applies to streams and rivers which have been subjected to extensive, maintained, and essentially permanent hydromodifications such that the biocriteria for the WWH use are not attainable *and where the activities have been sanctioned and permitted by state or federal law;* the representative aquatic assemblages are generally composed of species which are tolerant to low dissolved oxygen, silt, nutrient enrichment, and poor quality habitat.
5) *Limited Resource Water (LRW)* - this use applies to small streams (usually <3 mi.$^2$ drainage area) and other water courses which have been irretrievably altered to the extent that no appreciable assemblage of aquatic life can be supported; such waterways generally include small streams in extensively urbanized areas, those which lie in watersheds with extensive drainage modifications, those which completely lack water on a recurring annual basis (*i.e.*, true ephemeral streams), or other irretrievably altered waterways.

Chemical, physical, and/or biological criteria are generally assigned to each use designation in accordance with the broad goals defined by each. As such the system of use designations employed in the Ohio WQS constitutes a "tiered" approach in that varying and graduated levels of protection are provided by each. This hierarchy is especially apparent for parameters such as dissolved oxygen, ammonia-nitrogen, temperature, and the biological criteria. For other parameters such as heavy metals, the technology to construct an equally graduated set of criteria has been lacking, thus the same water quality criteria may apply to two or three different use designations.

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

In addition to assessing the appropriateness and status of aquatic life uses, each biological and water quality survey also addresses non-aquatic life uses such as recreation, water supply, and human health concerns as appropriate. The recreation uses most applicable to rivers and streams are the Primary Contact Recreation (PCR) and Secondary Contact Recreation (SCR) uses. The criterion for designating the PCR use is simply having a water depth of at least one meter over an area of at least 100 square feet or where canoeing is a feasible activity. If a water body is too small and shallow to meet either criterion the SCR use applies. The attainment status of PCR and SCR is determined using bacterial indicators (*e.g.*, fecal coliforms, *E. coli)* and the criteria for each are specified in the Ohio WQS.

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

# ACKNOWLEDGMENTS

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## INTRODUCTION

The Sportsman 25 Gun Club operates a skeet shooting facility in Morgan Township, Butler County, Ohio one mile west of the town of Okeana. The skeet range is located adjacent to the Dry Fork Whitewater River. Shot used at the skeet range has been found in the stream sediments, and a fisherman has reported shot raining down on him as he fished in the Dry Fork adjacent to the range. Lead shot is typically used at skeet ranges. In addition, clay pigeons used at skeet ranges can have elevated levels of polycyclic aromatic hydrocarbon (PAHs) compounds.

Specific objectives of this evaluation were to:

1) Establish biological conditions in the Dry Fork Whitewater River in the vicinity of the Sportsman 25 Gun Club property by evaluating fish and macroinvertebrate communities,

2) Evaluate surface water and sediment chemical quality in the Dry Fork Whitewater River, and

3) Determine the aquatic life use attainment status of the Dry Fork Whitewater River with regard to the Exceptional Warmwater Habitat (EWH) aquatic life use designation codified in the Ohio Water Quality Standards.

## SUMMARY

A total of 2.0 miles of the Dry Fork Whitewater River were assessed by the Ohio EPA in 2005. Based on the performance of the biological communities, the lower 0.7 miles of the Dry Fork were in full attainment of the Exceptional Warmwater Habitat aquatic life use and the upper 1.3 miles were in partial attainment (Table 1). The partial attainment was caused by a macroinvertebrate community reflective of good quality, but not exceptional conditions. Fish community results within the entire two miles of stream exhibited exceptional quality. Natural environmental conditions, including elevated water temperature and low stream flows, caused the lower macroinvertebrate quality at the sites adjacent to and upstream from the Sportsman 25 Gun Club property. Lead shot was documented in the sediments of the Dry Fork Whitewater River in the pool area adjacent to the Sportsman 25 Gun Club. Chemical results of a grab sample of the sediment in this area noted elevated lead and arsenic, largely associated with visible shot in the sample material. A Toxicity Characteristic Leaching Procedure (TCLP) analysis of the grab sediment sample revealed lead exceeding the Resource Conservation and Recovery Act (RCRA) limit of 5 mg/l. Chemical compounds in incremental sediment samples (composite of at least 15 subsamples) and surface water collected from each location in the Dry Fork Whitewater River were not at levels considered harmful to the stream biology. Biological community results from this study documented that the Sportsman 25 Gun Club did not cause impairment to the Dry Fork Whitewater River.

# RECOMMENDATIONS

**Status of Aquatic Life Uses**

The aquatic life use designation of Exceptional Warmwater Habitat (EWH) for the upper Dry Fork Whitewater River has been confirmed in a previous Ohio EPA biological and water quality study. This study verified the EWH use designation for the upper Dry Fork Whitewater River.

**Status of Non-Aquatic Life Uses**

This study verified that the Primary Contact Recreation use is appropriate for the Dry Fork Whitewater River.

Table 1. Aquatic life use attainment status for the Dry Fork Whitewater River based on biological sampling conducted during July and September, 2005. Attainment status is based on biocriteria for the Eastern Corn Belt Plains ecoregion of Ohio (OAC Chapter 3745-1-07, Table 7-15).

| **RIVER MILE Fish/Invert.** | **IBI** | **MIwb** | **ICI** | **QHEI** | **Attainment Status** | **Comment** |
|---|---|---|---|---|---|---|
| **Dry Fork Whitewater River -2005** | | *Eastern Corn Belt Plains Ecoregion - EWH Use Designation* | | | | |
| 16.6/ 16.6 | 53 | 10.1 | 40* | 74.0 | PARTIAL | Upstream Sportsman 25 gun club |
| 15.9/ 15.9 | 53 | 9.6 | 36* | 75.0 | PARTIAL | Adjacent Sportsman 25 gun club |
| 15.6/ 15.6 | 51 | 10.1 | 54 | 77.0 | FULL | Downstream Sportsman 25 gun club |

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

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

* - Significant departure from ecoregion biocriterion ( >4 IBI or ICI units; >0.5 MIwb units).
[ns] - Nonsignificant departure from ecoregion biocriterion ( ≤4 IBI or ICI units; ≤0.5 MIwb units).
[a] - Modified Warmwater Habitat for channel modified areas.

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

| Stream/ River Mile | Type of Sampling | Latitude | Longitude | Landmark |
|---|---|---|---|---|
| ***Dry Fork Whitewater River*** | | | | |
| 16.6 | F,M,S,W | 39º 21' 41.2" | 84º 46' 12.1" | Upstream Sportsman 25, @ Buck Run and SR 126 |
| 15.95 | S | 39º 21' 15.6" | 84º 46' 28.6" | Adjacent Sportsman 25 gun club property |
| 15.9 | F,M,S,W | 39º 21' 13.9" | 84º 46' 29.0" | Adjacent Sportsman 25 gun club property |
| 15.6 | F,M,S,W | 39º 20' 58.6" | 84º 46' 30.7" | Downstream Sportsman 25 @ Okeana - Drewersburg Road |

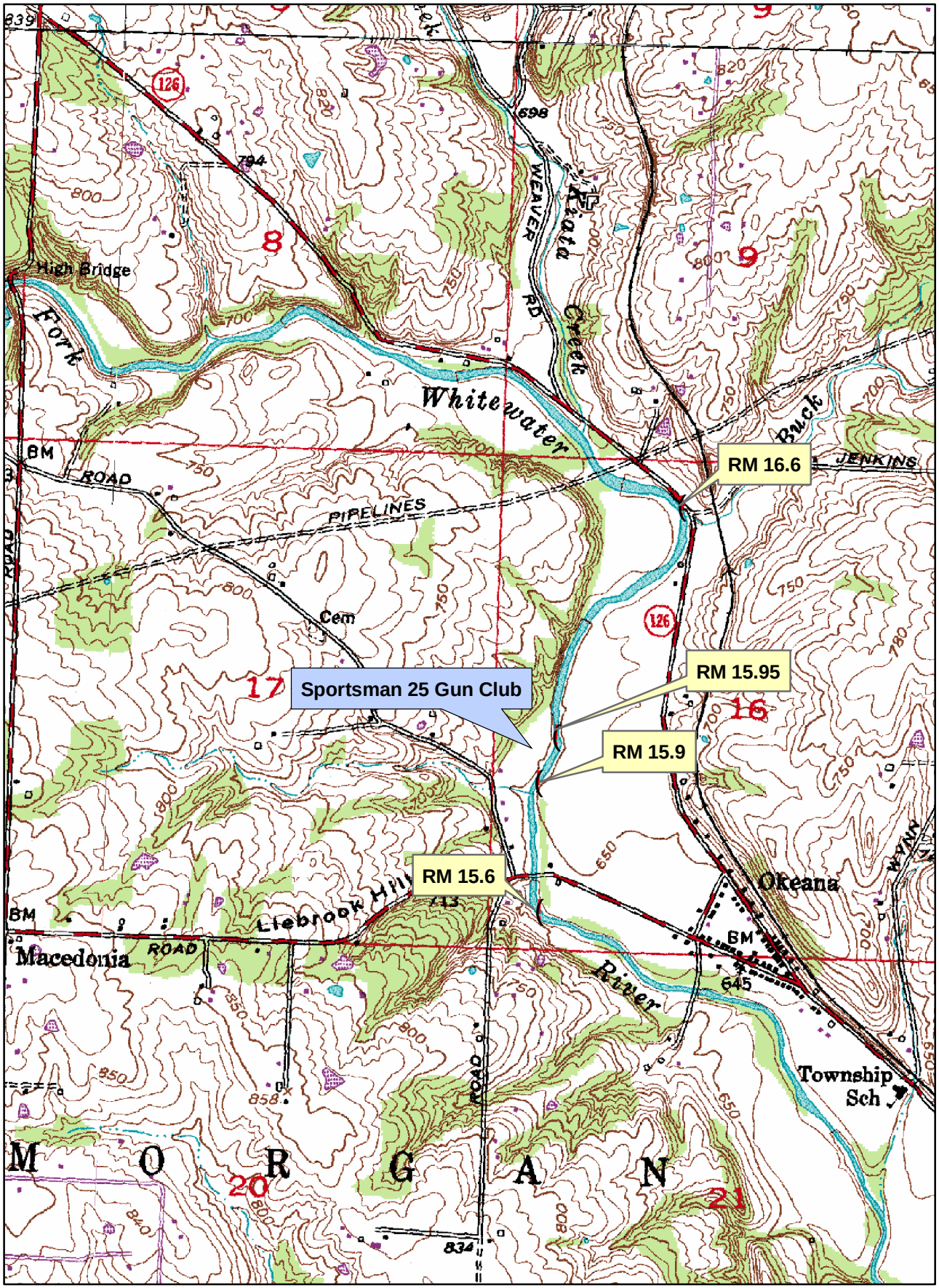


**Figure 2. Sampling locations by river mile in the Dry Fork Whitewater River, 2005.**

# METHODS

All physical, chemical, and biological field, laboratory, data processing, and data analysis methodologies and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 2003a) and Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a, 1987b, 1989a, 1989b), The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989, 1995) for aquatic habitat assessment, and the Ohio EPA Sediment Sampling Guide and Methodologies (Ohio EPA 2001). Toxicity Characteristic Leaching Procedure (TCLP) analytical processes adhered to method 1311. Sampling locations are listed in Table 2.

## Determining Use Attainment Status

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

## Habitat Assessment

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

consistent with the WWH biological criteria. Scores greater than 75 frequently typify habitat conditions which have the ability to support exceptional warmwater faunas.

**Sediment and Surface Water Assessment**

Fine grain sediment samples were collected multi-incrementally in the upper four inches of bottom material at three of four Dry Fork Whitewater River locations (one location was sampled as a grab) using decontaminated stainless steel scoops. Decontamination of sediment sampling equipment followed the procedures outlined in the Ohio EPA sediment sampling guidance manual (Ohio EPA 2001). Sediment incremental and grab 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 is reported on a dry weight basis. Surface water samples were collected directly into appropriate containers, preserved and delivered to an Ohio EPA contract lab. Surface water samples were evaluated using comparisons to Ohio Water Quality Standards criteria, reference conditions, or published literature. Sediment evaluations were conducted using guidelines established in MacDonald *et al.* (2000) and USEPA Region 5 Ecological Screening Levels - ESLs (2003), along with a comparison of metals results to Ohio Sediment Reference Values (Ohio EPA 2003b).

The grab sediment sample from the Dry Fork was collected adjacent to the skeet shooting range where shot was observed in a section of stream. In addition to testing for bulk analysis of lead and arsenic, this sample was tested using the Toxicity Characteristic Leaching Procedure (TCLP). When toxic wastes (e.g., containing mercury or lead) are land disposed, contaminated liquid may leach from the waste and pollute ground water. The TCLP is a test used to determine whether a waste exhibits the hazardous waste characteristic for toxicity. The test was designed to model a theoretical scenario in which a waste is mismanaged by placing it in an unlined landfill containing municipal solid waste. An acetic acid solution is used in the test to simulate the result of rainwater infiltrating the landfill, reacting with the municipal solid waste, and then leaching through the waste being tested. The numerical limits for the RCRA toxicity characteristic (40 CFR 261.24) were derived using the same scenario and were set at levels that would prevent the ground water under the landfill from posing a threat to human health and the environment. The RCRA regulatory limit for lead and arsenic is 5 mg/L.

**Macroinvertebrate Community Assessment**

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

**Fish Community Assessment**

Fish were sampled twice at each site using pulsed DC electrofishing methods, with sampling distances of 150 - 160 meters at each site in the Dry Fork Whitewater River. Fish were processed in the field, and included identifying each individual to species, counting, weighing, and recording any external abnormalities. Discussion of the fish community assessment methodology used in this report is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989a).

**Causal Associations**

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

# RESULTS

## Surface Water Quality

Chemical analyses were conducted on surface water samples collected on July 20 and September 23, 2005 from three locations in the Dry Fork Whitewater River (Table 3, Appendix Tables 1 and 2). Surface water samples were analyzed for total analyte list inorganics, and polycyclic aromatic hydrocarbons (PAHs).

Aside from one elevated water temperature measurement taken during the first fish sampling pass (31.8ºC - exceeded daily maximum criterion), there were no exceedences of Ohio WQS criteria at any of the three locations sampled during this survey (Table 3). Slightly elevated levels of lead and antimony, two elements associated with skeet shot, were noted in the water adjacent to the Sportsman 25 gun club; however, these levels were far below water quality criteria. Concentrations of all PAH parameters tested were reported as not detected. Metals concentrations were very low, with half of the tested parameters less than lab detection limits. The elevated water temperature occurred at the upstream location (RM 16.6) and was measured at the bottom end of a long shallow riffle and run area. The riffle and run section (at least 200 meters long) was characterized by low water flow and an open canopy at the wetted area of stream.

## Sediment Chemistry

Incremental sediment samples were collected at three locations in the Dry Fork Whitewater River by the Ohio EPA on September 23, 2005. In addition, one grab sediment sample was collected in a pool area adjacent to the skeet shooting range, and contained visible shot. All stream sampling locations are indicated by river mile in Table 2 and Figure 2. Incremental samples were analyzed for total analyte list inorganics, PAHs, and percent solids. The one grab sediment sample was analyzed for lead, arsenic, and TCLP. Specific chemical parameters tested and results are listed in Appendix Table 3.

Sediment data were evaluated using guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et.al*. 2000), and USEPA Region 5, RCRA Appendix IX compounds - Ecological Screening Levels (ESLs) (USEPA 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. Ecological screening levels (ESLs) are initial screening levels used by USEPA to evaluate RCRA site constituents. In addition, sediment reference values (SRVs) for metals (Ohio EPA 2003b) are presented in Table 4 for comparison to Dry Fork Whitewater River results.

Sediment collected from all three incremental sampling locations in the Dry Fork Whitewater River (upstream, adjacent, and downstream from the Sportsman 25 gun club property) were not at levels considered harmful to sediment-dwelling organisms (MacDonald *et.al*. 2000). PAH compounds were detected in low concentrations at the upstream and adjacent sites; no detectable levels of PAHs were noted at the downstream location (RM 15.6). The PAH compounds which did have detectable levels were all below ecological screening levels (TECs and ESLs). One metal

parameter, silver, was reported slightly above the TEC at the downstream location in the Dry Fork Whitewater River. All other heavy/toxic metal parameters were below ecological screening levels and Ohio sediment reference values. Lead was slightly elevated in the incremental sediment sample collected adjacent to the Sportsman 25 gun club, when compared to the upstream site. However, the reported concentration (28 mg/kg) was below ecological screening levels and the Ohio sediment reference value (47 mg/kg).

The grab sediment sample collected in the large pool adjacent to the skeet shooting range had extremely elevated levels of arsenic (1640 mg/kg) and lead (47,700 mg/kg). These elevated levels were associated with lead shot present in the sediment sample. The grab sediment sample had a TCLP result of 13.1 mg/l for lead and 2.92 mg/l for arsenic . The TCLP value for lead exceeded the RCRA limit of 5 mg/l. If sediment or soil is disturbed or removed during a clean-up action and it fails TCLP, the soil or sediment would have to be managed as a hazardous waste.

**Physical Habitat For Aquatic Life**

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

QHEI scores for the Dry Fork Whitewater River sites ranged between 74.0 and 77.0. These scores reflect good to excellent stream habitat and indicate the potential to support WWH and EWH biological communities. All three sampling locations were similar in the following habitat qualities: bottom substrates predominated by cobbles, boulders and gravel, normal to moderate siltation, moderate amounts of instream cover, and a natural stream channel. Water flow was moderate in the riffle areas during the first fish sampling pass. Reduced flow conditions occurred during the second fish pass, with riffle areas experiencing shallow depths and minimal flow velocity. A large pool area was located in the fish sampling zone adjacent to the Sportsman 25 gun club (RM 15.9). This pool had an extensive layer of silt covering a large portion of the bottom, with some areas at least 6 inches deep in fine silt. These silt conditions were not observed at the other two sampling locations

**Fish Community Assessment**

Fish communities were assessed at three locations in the Dry Fork Whitewater River (Table 2, Figure 2, Table 6, Appendix Tables 6 and 7). Sampling locations were selected to assess contributions of potential contaminants from the Sportsman 25 gun club property.

Fish communities were exceptional at all three sites in the Dry Fork Whitewater River. IBI scores ranged between 51 and 53, and these values achieved the ecoregional biocriterion established for Exceptional Warmwater Habitat (EWH) streams and rivers in Ohio (Table 1). Modified Index of Well-Being scores were in the exceptional range, with values between 9.6 and 10.1. These MIwb scores achieved the ecoregional biocriterion established for Exceptional Warmwater Habitat (EWH) streams and rivers in Ohio. Pollution sensitive species were common, and included black redhorse, smallmouth bass, and numerous darter species. White sucker, a pollution tolerant fish, was most numerous at RM 15.9. A large number of white suckers were collected within the deep pool area at RM 15.9, an area with an extensive layer of silt.

**Macroinvertebrate Community Assessment**

The macroinvertebrate communities at three Dry Fork Whitewater River sites were sampled in 2005 using qualitative (multi-habitat composite) and quantitative (artificial substrate) sampling protocols (Table 2, Figure 2). Results are summarized in Table 7. The ICI metrics with the associated scores for the Eastern Corn Belt Plains ecoregion and the raw data are attached as Appendix Tables 4 and 5.

The ICI scores for the three Dry Fork Whitewater River sites (RMs 16.6, 15.9, and 15.6) were 40, 36, and 54, respectively. The macroinvertebrate community at the downstream sampling location, with an ICI of 54, met the EWH biocriterion for Ohio streams and rivers. The upstream and the adjacent sampling locations did not meet the EWH biocriterion. The upstream sampling location was at the downstream end of a long shallow riffle just before it entered a large pool. The stream channel was wide and, although trees lined the river, the stream bed was exposed to direct sunlight with no shading from the trees. A temperature of 31.8$^{o}$ C was recorded in the stream at the bottom of the riffle where the HD was set. The observed temperature exceeded the daily maximum Water Quality Standards criterion. High temperatures are probably the cause of the impairment of the macroinvertebrate community. The lower macroinvertebrate community ICI score for the artificial substrate sample from the upstream site was primarily due to the presence of large numbers of the snail genus Physella, which are tolerant of high temperatures. The qualitative sampling notes listed Physella snails as the predominant taxon from this site. Physella snails were the second most abundant macroinvertebrate taxon collected from artificial substrates at the adjacent site. The artificial substrate sample from the downstream sampling location had a low number of the snails. Inflow of cool groundwater was observed at several locations within the sampled area.

Table 3. Exceedences of Ohio Water Quality Standards criteria (OAC 3745-1) for chemical/physical parameters measured in the Dry Fork Whitewater River, 2005.

| River Mile | Parameter (value) |
|---|---|
| ***Dry Fork Whitewater River*** | |
| 16.6 | Temperature (31.8$^{o}$C)* |
| 15.9 | None |
| 15.6 | None |

* Exceedence of daily maximum water quality criterion (July 1- 31).

Table 4. Chemical parameters measured above screening levels in sediment samples collected by Ohio EPA from the Dry Fork Whitewater River, September, 2005. Contamination levels were determined for parameters using either consensus-based sediment quality guidelines (MacDonald et.al. 2000), ecological screening levels for RCRA appendix IX constituents (USEPA 2003), or sediment reference values (SRVs) for metals listed in the Ohio EPA Ecological Risk Assessment Guidance (2003b). NA = not analyzed.

| ***Parameter*** | Dry Fork Whitewater R. RM 16.6 | Dry Fork Whitewater R. RM 15.95 | Dry Fork Whitewater RM 15.9 | Dry Fork Whitewater R. RM 15.6 | Reference Levels SRVs |
|---|---|---|---|---|---|
| Silver (mg/kg) | 0.429J | NA | 0.456J | 0.628J [E] | 0.43 |
| Calcium (mg/kg) | 113,000 | NA | 74,000 | 158,000 | 121,000 |
| Lead (mg/kg) | 5.86 | 47,700 [P] | 28 | 4.67 | 47 |
| Arsenic (mg/kg) | 5.51 | 1,640 [P] | 3.25 | 3.82 | 18 |

J - The analyte was positively identified, but the quantitation was below the reporting limit (RL).
T - Above Threshold Effect Concentration (below which harmful effects are unlikely to occur; MacDonald *et.al.* 2000).
P - Above Probable Effect Concentration (above which harmful effects are likely to occur; MacDonald *et.al*. 2000).
E - Above Ecological Screening Level for RCRA appendix IX constituents (USEPA 2003).

Table 5. QHEI table for Dry Fork Whitewater River, sampled in 2005.

| | | | 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-Normal Riffle Embeddedness | **Total WWH Attributes** | Channelized or No Recovery | Silt/Muck Substrates | No Sinuosity | Sparse/No Cover | Max Depth < 40 cm (WD, HW) | **Total HL MWH Attributes** | Recovering Channel | Heavy/Moderate Silt Cover | Sand Substrates (Boat) | Hardpan Substrate Origin | Fair/Poor Development | Low Sinuosity | Only 1-2 Cover Types | Intermittent and Poor Pools | No Fast Current | High/Mod. Overall Embeddedness | High/Mod. Riffle Embeddedness | No Riffle | **Total ML MWH Attributes** | **(MWH HL+1)/(WWH+1) Ratio** | **(MWH ML+1)/(WWH+1) Ratio** |
| River Mile | QHEI | Gradient (ft/mile) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| (14-302) Dry Fork | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Year: 2005 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 16.4 | **74.0** | 21.28 | ■ | ■ | | ■ | | ■ | | ■ | ■ | ■ | 7 | | | | | | 0 | | • | | | | • | | | • | | | | 3 | 0.13 | 0.50 |
| 16.0 | **75.0** | 18.52 | ■ | ■ | | ■ | | ■ | | ■ | ■ | ■ | 7 | | | | | | 0 | | • | | | | • | | | • | | • | | 4 | 0.13 | 0.63 |
| 15.7 | **77.0** | 18.52 | ■ | ■ | | ■ | | ■ | | ■ | ■ | ■ | 7 | | | | | | 0 | | • | | | | • | | | • | | | | 3 | 0.13 | 0.50 |

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

| Stream/ River Mile | Mean Number of Species | Total Number Species | Mean Relative Number | Mean Relative Weight (kg) | QHEI | Mean Modified Index of Well-Being | Mean Index of Biotic Integrity | Narrative Evaluation |
|---|---|---|---|---|---|---|---|---|
| ***Dry Fork Whitewater River (2005)*** | | | | | | | | |
| 16.6 | 24.0 | 26 | 1651 | 71.91 | 74.0 | 10.1 | 53 | Exceptional |
| 15.9 | 25.5 | 28 | 1816 | 41.78 | 75.0 | 9.6 | 53 | Exceptional |
| 15.6 | 23.0 | 26 | 3168 | 46.60 | 77.0 | 10.1 | 51 | Exceptional |

Ecoregion Biocriteria: Eastern Corn Belt Plains (ECBP)
(Ohio Administrative Code 3745-1-07, Table 7-15)

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

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

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

| River Mile | Density Number/ft$^2$ | Total Taxa | Quantitative Taxa | Qualitative Taxa | Qualitative EPT[a] | ICI | Evaluation |
|---|---|---|---|---|---|---|---|
| | | | | *EWH Use Designation* | | | |
| ***Dry Fork Whitewater River*** | | | | | | | |
| 16.6 | 292 | 64 | 44 | 49 | 15 | 40* | Good |
| 15.9 | 208 | 69 | 45 | 54 | 12 | 36* | Good |
| 15.6 | 141 | 73 | 49 | 53 | 15 | 54 | Exceptional |

**Ecoregion Biocriteria**: Eastern Corn Belt Plains (ECBP)
(Ohio Administrative Code 3745-1-07, Table 7-15)

| INDEX | WWH | EWH | MWH[b] |
|---|---|---|---|
| ICI | 36 | 46 | 22 |

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

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# APPENDICES

Appendix Table 1. Results of chemical surface water sampling conducted by Ohio EPA in the Dry Fork Whitewater River on July 20, 2005.

| **Stream** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** |
|---|---|---|---|
| River Mile | **16.6** | **15.9** | **15.6** |
| Date Sampled | 7/20/2005 | 7/20/2005 | 7/20/2005 |
| Time Sampled | 5:35 PM | 5:15 PM | 10:00 AM |
| **TAL Metals (ug/l)** | | | |
| Mercury | <0.1 | <0.1 | <0.1 |
| Aluminum | 56.3 | 1,370 | 446 |
| Silver | <5 | <5 | <5 |
| Arsenic | 1.66 | 2.28 | 1.95 |
| Barium | 45 | 60.5 | 59.6 |
| Beryllium | <0.25 | <0.25 | <0.25 |
| Calcium | 50,400 | 56,800 | 57,400 |
| Cadmium | <2.5 | <2.5 | <2.5 |
| Cobalt | <2.5 | <2.5 | <2.5 |
| Chromium | <2.5 | <2.5 | <2.5 |
| Copper | <5 | <5 | <5 |
| Iron | 212 | 1,760 | 646 |
| Potassium | 3,310 | 3,930 | 3,610 |
| Magnesium | 20,400 | 21,900 | 21,600 |
| Manganese | 32.5 | 140 | 113 |
| Sodium | 11,900 | 11,500 | 12,400 |
| Nickel | <5 | <5 | <5 |
| Lead | <2.5 | 3.33J | <2.5 |
| Vanadium | 6.66J | 9.97J | 8.17J |
| Zinc | <5 | <5 | <5 |
| Antimony | <0.5 | 0.837J | 0.752J |
| Selenium | <1.5 | <1.5 | <1.5 |
| Thallium | <0.1 | <0.1 | <0.1 |

Appendix Table 1. Continued.

| **Stream** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** |
|---|---|---|---|
| River Mile | **16.6** | **15.9** | **15.6** |
| Date Sampled | 7/20/2005 | 7/20/2005 | 7/20/2005 |
| Time Sampled | 5:35 PM | 5:15 PM | 10:00 AM |
| **Polycyclic Aromatic Hydrocarbons (ug/l)** | | | |
| Naphthalene | <0.05 | <0.05 | <0.05 |
| Acenaphthylene | <0.05 | <0.05 | <0.05 |
| Acenaphthene | <0.05 | <0.05 | <0.05 |
| Fluorene | <0.05 | <0.05 | <0.05 |
| Phenanthrene | <0.05 | <0.05 | <0.05 |
| Anthracene | <0.05 | <0.05 | <0.05 |
| Fluoranthene | <0.05 | <0.05 | <0.05 |
| Pyrene | <0.05 | <0.05 | <0.05 |
| Benzo(a)anthracene | <0.05 | <0.05 | <0.05 |
| Chrysene | <0.05 | <0.05 | <0.05 |
| Benzo(b)fluoranthene | <0.05 | <0.05 | <0.05 |
| Benzo(k)fluoranthene | <0.05 | <0.05 | <0.05 |
| Benzo(a)pyrene | <0.05 | <0.05 | <0.05 |
| Indeno(1,2,3-cd)pyrene | <0.05 | <0.05 | <0.05 |
| Dibenzo(a,h)anthracene | <0.05 | <0.05 | <0.05 |
| Benzo(g,h,i)perylene | <0.05 | <0.05 | <0.05 |
| 1-Methylnaphthalene | <0.05 | <0.05 | <0.05 |
| 2-Methylnaphthalene | <0.05 | <0.05 | <0.05 |

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

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

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

Appendix Table 2. Results of chemical surface water sampling conducted by Ohio EPA in the Dry Fork Whitewater River on September 23, 2005.

| **Stream** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** |
|---|---|---|---|
| River Mile | **16.6** | **15.9** | **15.6** |
| Date Sampled | 9/23/2005 | 9/23/2005 | 9/23/2005 |
| Time Sampled | 11:00 AM | 3:15 PM | 2:30 PM |
| **TAL Metals (ug/l)** | | | |
| Mercury | <0.1 | <0.1 | <0.1 |
| Aluminum | 113 | 214 | 325 |
| Silver | <5 | <5 | <5 |
| Arsenic | 5.38J | 4.4J | 8.47J |
| Barium | 51.8 | 50.3 | 50.3 |
| Beryllium | <0.25 | <0.25 | <0.25 |
| Calcium | 65,000 | 60,600 | 60,300 |
| Cadmium | <2.5 | <2.5 | <2.5 |
| Cobalt | <2.5 | <2.5 | <2.5 |
| Chromium | <2.5 | <2.5 | <2.5 |
| Copper | <5 | <5 | <5 |
| Iron | 247 | 298 | 385 |
| Potassium | 4,510 | 4,830 | 4,610 |
| Magnesium | 19,200 | 19,200 | 18,600 |
| Manganese | 25.6 | 58.6 | 51.4 |
| Sodium | 14,100 | 14,400 | 14,200 |
| Nickel | <5 | <5 | <5 |
| Lead | <2.5 | 3.75J | <2.5 |
| Vanadium | 7.1J | 9.63J | 8.18J |
| Zinc | <5 | <5 | <5 |
| Antimony | <0.5 | 1.62 | <0.5 |
| Selenium | ND (5.35) | ND (5.24) | ND (5.29) |
| Thallium | 0.189J | 0.213 | 0.204 |

Appendix Table 2. Continued.

| **Stream** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** |
|---|---|---|---|
| River Mile | **16.6** | **15.9** | **15.6** |
| Date Sampled | 9/23/2005 | 9/23/2005 | 9/23/2005 |
| Time Sampled | 11:00 AM | 3:15 PM | 2:30 PM |
| **Polycyclic Aromatic Hydrocarbons (ug/l)** | | | |
| Naphthalene | <0.0565 | <0.0625 | <0.0571 |
| Acenaphthylene | <0.0565 | <0.0625 | <0.0571 |
| Acenaphthene | <0.0565 | <0.0625 | <0.0571 |
| Fluorene | <0.0565 | <0.0625 | <0.0571 |
| Phenanthrene | <0.0565 | <0.0625 | <0.0571 |
| Anthracene | <0.0565 | <0.0625 | <0.0571 |
| Fluoranthene | <0.0565 | <0.0625 | <0.0571 |
| Pyrene | <0.0565 | <0.0625 | <0.0571 |
| Benzo(a)anthracene | <0.0565 | <0.0625 | <0.0571 |
| Chrysene | <0.0565 | <0.0625 | <0.0571 |
| Benzo(b)fluoranthene | <0.0565 | <0.0625 | <0.0571 |
| Benzo(k)fluoranthene | <0.0565 | <0.0625 | <0.0571 |
| Benzo(a)pyrene | <0.0565 | <0.0625 | <0.0571 |
| Indeno(1,2,3-cd)pyrene | <0.0565 | <0.0625 | <0.0571 |
| Dibenzo(a,h)anthracene | <0.0565 | <0.0625 | <0.0571 |
| Benzo(g,h,i)perylene | <0.0565 | <0.0625 | <0.0571 |
| 1-Methylnaphthalene | <0.0565 | <0.0625 | <0.0571 |
| 2-Methylnaphthalene | <0.0565 | <0.0625 | <0.0571 |

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

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

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

ND - Not detected at or above the reporting limit (reporting limit in parentheses).

Appendix Table 3. Results of Ohio EPA sediment sampling conducted in the Dry Fork Whitewater River, September 23, 2005. Shaded values exceed applicable SRVs,TEC or ESL screening levels.

| **Stream** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | | | |
|---|---|---|---|---|---|---|---|
| River Mile | **16.6** | **15.95** | **15.9** | **15.6** | Sediment | MacDonald | USEPA |
| Date Sampled | 9/23/2005 | 9/23/2005 | 9/23/2005 | 9/23/2005 | Reference | 2000 | 2003 |
| Time Sampled | 11:30 PM | 4:30 PM | 3:15 PM | 2:30 PM | Values (SRVs) | TEC | ESLs |
| **TAL Metals (mg/kg)** | | | | | | | |
| Mercury | <0.012 | NA | 0.0125J | <0.0113 | 0.12 | 0.18 | 0.174 |
| Aluminum | 2,270 | NA | 4,860 | 2,760 | 29,000 | NA | NA |
| Silver | 0.429J | NA | 0.456J | 0.628J | 0.43 | NA | 0.5 |
| Arsenic | 5.51 | 1,640 | 3.25 | 3.82 | 18 | 9.79 | 9.79 |
| Barium | 16 | NA | 35.1 | 26.5 | 240 | NA | NA |
| Beryllium | 0.134J | NA | 0.222J | 0.176J | 0.8 | NA | NA |
| Calcium | 113,000 | NA | 74,000 | 158,000 | 121,000 | NA | NA |
| Cadmium | 0.31J | NA | 0.288J | 0.285J | 0.9 | 0.99 | 0.99 |
| Cobalt | 3.22 | NA | 3.83 | 4.04 | 12 | NA | 50 |
| Chromium | 5.06 | NA | 6.55 | 4.8 | 40 | 43.4 | 43.4 |
| Copper | 5.78 | NA | 7.17 | 6.13 | 34 | 31.6 | 31.6 |
| Iron | 8,690 | NA | 9,150 | 11,200 | 33,000 | NA | NA |
| Potassium | 386 | NA | 842 | 540 | 11,000 | NA | NA |
| Magnesium | 20,100 | NA | 12,800 | 29,300 | 35,000 | NA | NA |
| Manganese | 325 | NA | 309 | 486 | 1,500 | NA | NA |
| Sodium | 108 | NA | 97.9 | 168 | NA | NA | NA |
| Nickel | 5.59 | NA | 7.4 | 6.3 | 42 | 22.7 | 22.7 |
| Lead | 5.86 | 47,700 | 28 | 4.67 | 47 | 35.8 | 35.8 |
| Vanadium | 9.38 | NA | 11.8 | 14.8 | 40 | NA | NA |
| Zinc | 12.2 | NA | 23.1 | 20.4 | 160 | 121 | 121 |
| Antimony | <0.12 | NA | <0.121 | <0.12 | 0.92 | NA | NA |
| Selenium | 1.65 | NA | 0.81 | 0.826 | 2.3 | NA | NA |
| Thallium | <0.0598 | NA | 0.0816 | 0.0704J | 4.7 | NA | NA |

Appendix Table 3. Continued.

| **Stream** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | **Dry Fork Whitewater R.** | | | |
|---|---|---|---|---|---|---|---|
| River Mile | **16.6** | **15.95** | **15.9** | **15.6** | Sediment | MacDonald | USEPA |
| Date Sampled | 9/23/2005 | 9/23/2005 | 9/23/2005 | 9/23/2005 | Reference | 2000 | 2003 |
| Time Sampled | 11:30 PM | 4:30 PM | 3:15 PM | 2:30 PM | Values (SRVs) | TEC | ESLs |
| **Polycyclic Aromatic Hydrocarbons** | | | | | | | |
| Naphthalene | <14.6 | NA | <30.0 | <28.9 | NA | 176 | 176 |
| Acenaphthylene | <14.6 | NA | <30.0 | <28.9 | NA | NA | 5.87 |
| Acenaphthene | <14.6 | NA | <30.0 | <28.9 | NA | NA | 6.71 |
| Fluorene | <14.6 | NA | <30.0 | <28.9 | NA | 77.4 | 77.4 |
| Phenanthrene | 20.9J | NA | 35.1J | <28.9 | NA | 204 | 204 |
| Anthracene | <14.6 | NA | <30.0 | <28.9 | NA | 57.2 | 57.2 |
| Fluoranthene | 41.6 | NA | 92.9 | <28.9 | NA | 423 | 423 |
| Pyrene | 35.3 | NA | 80.8 | <28.9 | NA | 195 | 195 |
| Benzo(a)anthracene | 18.6J | NA | 54.0J | <28.9 | NA | 108 | 108 |
| Chrysene | 17.7J | NA | 45.3J | <28.9 | NA | 166 | 166 |
| Benzo(b)fluoranthene | 20.4J | NA | 72.7 | <28.9 | NA | NA | 10,400 |
| Benzo(k)fluoranthene | <14.6 | NA | <30.0 | <28.9 | NA | NA | 240 |
| Benzo(a)pyrene | 18.3J | NA | 55.9J | <28.9 | NA | 150 | 150 |
| Indeno(1,2,3-cd)pyrene | <14.6 | NA | 37.4J | <28.9 | NA | NA | 200 |
| Dibenzo(a,h)anthracene | <14.6 | NA | <30.0 | <28.9 | NA | 33 | 33 |
| Benzo(g,h,i)perylene | 16.9J | NA | 46.1J | <28.9 | NA | NA | 170 |
| 1-Methylnaphthalene | <14.6 | NA | <30.0 | <28.9 | NA | NA | NA |
| 2-Methylnaphthalene | <14.6 | NA | <30.0 | <28.9 | NA | NA | 20.2 |
| **Other** | | | | | | | |
| Percent Solids | 83.7 | 87.3 | 82.4 | 83 | NA | NA | NA |

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

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

NA - Not Available.

**Appendix Table 4. Invertebrate Community Index scores (ICI) and metrics, Dry Fork Whitewater River, 2005.**

| River Mile | Drainage Area (sq mi) | Number of Total Taxa | Number of Mayfly Taxa | Number of Caddisfly Taxa | Number of Dipteran Taxa | Percent: Mayflies | Percent: Caddis-flies | Percent: Tany-tarsini | Percent: Other Dipt/NI | Percent: Tolerant Organisms | Qual. EPT | Eco-region | ICI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Dry Fork (14-302)** | | | | | | | | | | | | | |
| **Year: 2005** | | | | | | | | | | | | | |
| 16.60 | 41.0 | 44(6) | 9(6) | 4(6) | 17(4) | 26.9(4) | 9.0(4) | 2.3(2) | 59.2(2) | 31.9(0) | 15(6) | 5 | 40 |
| 15.90 | 41.0 | 45(6) | 8(6) | 6(6) | 19(4) | 22.2(4) | 4.9(2) | 9.3(2) | 62.1(2) | 26.7(0) | 12(4) | 5 | 36 |
| 15.60 | 42.0 | 49(6) | 9(6) | 7(6) | 17(4) | 35.6(6) | 9.1(4) | 19.7(4) | 28.9(6) | 3.5(6) | 15(6) | 5 | 54 |

Appendix Table 5. Ohio EPA macroinvertebrate results from the Dry Fork Whitewater River, 2005.

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

Collection Date: 09/02/2005 River Code: 14-302 RM: 16.60 Site: Dry Fork upst. Sportsman 25 Gun Club

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01320 | *Hydra sp* | 152 | |
| 01801 | *Turbellaria* | 34 | + |
| 03360 | *Plumatella sp* | 3 | + |
| 03600 | *Oligochaeta* | 134 | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | | + |
| 08601 | *Hydrachnidia* | 4 | + |
| 11020 | *Acerpenna pygmaea* | 30 | + |
| 11130 | *Baetis intercalaris* | 20 | + |
| 11200 | *Callibaetis sp* | | + |
| 11651 | *Procloeon sp (w/o hindwing pads)* | 7 | |
| 11670 | *Procloeon viridoculare* | | + |
| 12200 | *Isonychia sp* | 9 | + |
| 13000 | *Leucrocuta sp* | 1 | |
| 13400 | *Stenacron sp* | 19 | + |
| 13510 | *Stenonema exiguum* | | + |
| 13521 | *Stenonema femoratum* | 77 | + |
| 13540 | *Stenonema mediopunctatum* | | + |
| 13561 | *Stenonema pulchellum* | | + |
| 16700 | *Tricorythodes sp* | 206 | + |
| 17200 | *Caenis sp* | 24 | + |
| 22001 | *Coenagrionidae* | 1 | + |
| 22300 | *Argia sp* | 6 | + |
| 42700 | *Belostoma sp* | | + |
| 43300 | *Ranatra sp* | | + |
| 44501 | *Corixidae* | | + |
| 48410 | *Corydalus cornutus* | | + |
| 48620 | *Nigronia serricornis* | | + |
| 50315 | *Chimarra obscura* | 35 | + |
| 52200 | *Cheumatopsyche sp* | 79 | + |
| 53800 | *Hydroptila sp* | 16 | |
| 58505 | *Helicopsyche borealis* | | + |
| 59500 | *Oecetis sp* | 1 | |
| 60900 | *Peltodytes sp* | | + |
| 65800 | *Berosus sp* | 22 | + |
| 66500 | *Enochrus sp* | 1 | + |
| 67800 | *Tropisternus sp* | | + |
| 68075 | *Psephenus herricki* | | + |
| 68901 | *Macronychus glabratus* | 1 | + |
| 69400 | *Stenelmis sp* | 8 | + |
| 70501 | *Tipulidae* | 2 | |
| 71300 | *Limonia sp* | 1 | + |
| 74650 | *Atrichopogon sp* | 50 | |
| 77500 | *Conchapelopia sp* | 37 | + |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 4 | + |
| 77800 | *Helopelopia sp* | 2 | + |
| 78450 | *Nilotanypus fimbriatus* | 15 | |
| 78599 | *Pentaneura sp* | 2 | |
| 80370 | *Corynoneura lobata* | 6 | |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 8 | |
| 82141 | *Thienemanniella xena* | 2 | |
| 82820 | *Cryptochironomus sp* | | + |
| 83040 | *Dicrotendipes neomodestus* | 4 | + |
| 83158 | *Endochironomus nigricans* | | + |
| 83310 | *Glyptotendipes (Trichotendipes) amplus* | | + |
| 83840 | *Microtendipes pedellus group* | 2 | |
| 84201 | *Paratendipes sp 1* | | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 60 | + |
| 84470 | *Polypedilum (P.) illinoense* | 2 | + |
| 85260 | *Cladotanytarsus vanderwulpi group* | | + |
| 85625 | *Rheotanytarsus sp* | 12 | + |
| 85821 | *Tanytarsus glabrescens group sp 7* | 21 | + |
| 93900 | *Elimia sp* | 4 | |
| 94400 | *Fossaria sp* | 8 | |
| 95100 | *Physella sp* | 330 | + |

No. Quantitative Taxa: 44 Total Taxa: 64
No. Qualitative Taxa: 49 ICI: **40**
Number of Organisms: 1462 Qual EPT: 15

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

Collection Date: 09/02/2005 River Code: 14-302 RM: 15.90 Site: Dry Fork adj. Sportsman 25 Gun Club

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01320 | *Hydra sp* | 5 | |
| 01801 | *Turbellaria* | 2 | + |
| 03360 | *Plumatella sp* | 2 | + |
| 03600 | *Oligochaeta* | 49 | + |
| 04687 | *Placobdella parasitica* | | + |
| 06201 | *Hyalella azteca* | | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | | + |
| 08601 | *Hydrachnidia* | | + |
| 11020 | *Acerpenna pygmaea* | 5 | |
| 11200 | *Callibaetis sp* | | + |
| 11651 | *Procloeon sp (w/o hindwing pads)* | 2 | |
| 12200 | *Isonychia sp* | 1 | + |
| 13400 | *Stenacron sp* | 18 | + |
| 13510 | *Stenonema exiguum* | | + |
| 13521 | *Stenonema femoratum* | 10 | + |
| 13540 | *Stenonema mediopunctatum* | 1 | |
| 13561 | *Stenonema pulchellum* | | + |
| 16700 | *Tricorythodes sp* | 19 | + |
| 17200 | *Caenis sp* | 175 | + |
| 22001 | *Coenagrionidae* | | + |
| 22300 | *Argia sp* | 11 | + |
| 23909 | *Boyeria vinosa* | | + |
| 26700 | *Macromia sp* | | + |
| 28208 | *Erythemis simplicicollis* | | + |
| 28908 | *Perithemis tenera* | | + |
| 47600 | *Sialis sp* | | + |
| 50315 | *Chimarra obscura* | 3 | + |
| 52200 | *Cheumatopsyche sp* | 13 | + |
| 52430 | *Ceratopsyche morosa group* | 1 | + |
| 53800 | *Hydroptila sp* | 8 | |
| 58505 | *Helicopsyche borealis* | 25 | + |
| 59500 | *Oecetis sp* | 1 | |
| 60900 | *Peltodytes sp* | | + |
| 65800 | *Berosus sp* | 1 | + |
| 66500 | *Enochrus sp* | | + |
| 68075 | *Psephenus herricki* | 1 | + |
| 68130 | *Helichus sp* | | + |
| 68201 | *Scirtidae* | | + |
| 69400 | *Stenelmis sp* | 2 | + |
| 71900 | *Tipula sp* | | + |
| 72700 | *Anopheles sp* | | + |
| 74501 | *Ceratopogonidae* | 17 | + |
| 77500 | *Conchapelopia sp* | 28 | + |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 14 | + |
| 77800 | *Helopelopia sp* | 5 | |
| 78450 | *Nilotanypus fimbriatus* | 9 | |
| 80370 | *Corynoneura lobata* | 40 | |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 5 | + |
| 82730 | *Chironomus (C.) decorus group* | 70 | + |
| 83040 | *Dicrotendipes neomodestus* | 107 | + |
| 83310 | *Glyptotendipes (Trichotendipes) amplus* | 9 | |
| 84000 | *Parachironomus sp* | | + |
| 84210 | *Paratendipes albimanus or P. duplicatus* | 37 | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 60 | + |
| 84460 | *Polypedilum (P.) fallax group* | 5 | + |
| 84470 | *Polypedilum (P.) illinoense* | | + |
| 84520 | *Polypedilum (Tripodura) halterale group* | 5 | |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | 14 | |
| 84750 | *Stictochironomus sp* | | + |
| 85625 | *Rheotanytarsus sp* | 18 | + |
| 85800 | *Tanytarsus sp* | 5 | |
| 85816 | *Tanytarsus glabrescens group sp 2* | | + |
| 85821 | *Tanytarsus glabrescens group sp 7* | 74 | + |
| 87540 | *Hemerodromia sp* | 2 | |
| 93900 | *Elimia sp* | | + |
| 94400 | *Fossaria sp* | 6 | + |
| 95100 | *Physella sp* | 152 | + |
| 96900 | *Ferrissia sp* | 2 | + |
| 98200 | *Pisidium sp* | 1 | |

No. Quantitative Taxa: 45 Total Taxa: 69
No. Qualitative Taxa: 54 ICI: **36**
Number of Organisms: 1040 Qual EPT: 12

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

Collection Date: 09/02/2005 River Code: 14-302 RM: 15.60 Site: Dry Fork adj. Sportsman 25 Gun Club

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 01320 | *Hydra sp* | 12 | |
| 01801 | *Turbellaria* | 26 | + |
| 03360 | *Plumatella sp* | 2 | |
| 03600 | *Oligochaeta* | 8 | + |
| 05900 | *Lirceus sp* | 2 | + |
| 06201 | *Hyalella azteca* | | + |
| 08250 | *Orconectes (Procericambarus) rusticus* | | + |
| 08601 | *Hydrachnidia* | 13 | + |
| 11020 | *Acerpenna pygmaea* | 1 | + |
| 11120 | *Baetis flavistriga* | 1 | |
| 11130 | *Baetis intercalaris* | 1 | |
| 11200 | *Callibaetis sp* | | + |
| 11651 | *Procloeon sp (w/o hindwing pads)* | 4 | + |
| 12200 | *Isonychia sp* | 3 | + |
| 13400 | *Stenacron sp* | 17 | + |
| 13521 | *Stenonema femoratum* | 17 | + |
| 13561 | *Stenonema pulchellum* | | + |
| 16700 | *Tricorythodes sp* | 26 | + |
| 17200 | *Caenis sp* | 181 | + |
| 21200 | *Calopteryx sp* | | + |
| 22001 | *Coenagrionidae* | | + |
| 22300 | *Argia sp* | 7 | + |
| 23909 | *Boyeria vinosa* | | + |
| 26700 | *Macromia sp* | | + |
| 28500 | *Libellula sp* | | + |
| 48410 | *Corydalus cornutus* | 1 | + |
| 48620 | *Nigronia serricornis* | | + |
| 50315 | *Chimarra obscura* | 7 | + |
| 52200 | *Cheumatopsyche sp* | 21 | + |
| 52430 | *Ceratopsyche morosa group* | 4 | + |
| 52530 | *Hydropsyche depravata group* | 1 | + |
| 53800 | *Hydroptila sp* | 2 | |
| 58505 | *Helicopsyche borealis* | 21 | + |
| 59500 | *Oecetis sp* | 8 | + |
| 60900 | *Peltodytes sp* | | + |
| 65800 | *Berosus sp* | | + |
| 66500 | *Enochrus sp* | 4 | + |
| 67800 | *Tropisternus sp* | | + |
| 68075 | *Psephenus herricki* | 2 | + |
| 68130 | *Helichus sp* | 1 | + |
| 68708 | *Dubiraphia vittata group* | | + |
| 68901 | *Macronychus glabratus* | 2 | + |
| 69400 | *Stenelmis sp* | 31 | + |
| 71300 | *Limonia sp* | | + |

| Taxa Code | Taxa | Quant/Qual | |
|---|---|---|---|
| 77500 | *Conchapelopia sp* | 16 | |
| 77750 | *Hayesomyia senata or Thienemannimyia norena* | 9 | |
| 77800 | *Helopelopia sp* | | + |
| 78350 | *Meropelopia sp* | | + |
| 79085 | *Telopelopia okoboji* | | + |
| 80370 | *Corynoneura lobata* | 4 | |
| 80430 | *Cricotopus (C.) tremulus group* | 2 | |
| 81201 | *Nanocladius (N.) sp* | 16 | |
| 81231 | *Nanocladius (N.) crassicornus or N. (N.) "rectinervis"* | 5 | |
| 82820 | *Cryptochironomus sp* | | + |
| 83040 | *Dicrotendipes neomodestus* | 16 | |
| 83840 | *Microtendipes pedellus group* | 2 | |
| 84210 | *Paratendipes albimanus or P. duplicatus* | | + |
| 84450 | *Polypedilum (Uresipedilum) flavum* | 25 | + |
| 84460 | *Polypedilum (P.) fallax group* | 11 | |
| 84470 | *Polypedilum (P.) illinoense* | 2 | |
| 84480 | *Polypedilum (P.) laetum group* | 2 | |
| 84520 | *Polypedilum (Tripodura) halterale group* | | + |
| 84540 | *Polypedilum (Tripodura) scalaenum group* | 2 | |
| 84700 | *Stenochironomus sp* | | + |
| 84750 | *Stictochironomus sp* | | + |
| 85500 | *Paratanytarsus sp* | 2 | |
| 85625 | *Rheotanytarsus sp* | 91 | + |
| 85800 | *Tanytarsus sp* | | + |
| 85821 | *Tanytarsus glabrescens group sp 7* | 46 | |
| 87540 | *Hemerodromia sp* | 16 | |
| 94400 | *Fossaria sp* | 9 | + |
| 95100 | *Physella sp* | 3 | + |
| 96900 | *Ferrissia sp* | 1 | + |

| | | | |
|---|---|---|---|
| No. Quantitative Taxa: | 49 | Total Taxa: | 73 |
| No. Qualitative Taxa: | 53 | ICI: | **54** |
| Number of Organisms: | 706 | Qual EPT: | 15 |

Appendix Table 6. Fish IBI and MIwb results for the Dry Fork Whitewater River, 2005.

| | | | | Number of | | | | | Percent of Individuals | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| River Mile | Type | Date | Drainage area (sq mi) | Total species | Sunfish species | Sucker species | Intolerant species | Darter species | Simple Lithophils | Tolerant fishes | Omni-vores | Top carnivores | Insect-ivores | DELT anomalies | Rel.No. minus tolerants /(0.3km) | IBI | Modified Iwb |
| Dry Fork Whitewater - (14302) | | | | | | | | | | | | | | | | | |
| Year: 2005 | | | | | | | | | | | | | | | | | |
| 16.60 | E | 07/29/2005 | 37 | 24(5) | 4(5) | 4(5) | 1(1) | 5(5) | 35(3) | 7(5) | 6(5) | 8.0(5) | 53(3) | 0.0(5) | 2046(5) | 52 | 10.3 |
| 16.60 | E | 09/23/2005 | 37 | 22(5) | 4(5) | 5(5) | 1(1) | 4(3) | 49(5) | 2(5) | 3(5) | 12.0(5) | 57(5) | 0.0(5) | 1076(5) | 54 | 9.9 |
| 15.90 | E | 07/20/2005 | 41 | 26(5) | 4(5) | 4(5) | 2(1) | 5(5) | 49(5) | 20(5) | 17(5) | 2.1(3) | 62(5) | 0.0(5) | 1776(5) | 54 | 9.7 |
| 15.90 | E | 09/23/2005 | 41 | 24(5) | 4(5) | 5(5) | 2(1) | 3(3) | 61(5) | 24(5) | 21(3) | 7.9(5) | 58(5) | 0.0(5) | 1063(5) | 52 | 9.6 |
| 15.60 | E | 07/20/2005 | 42 | 24(5) | 3(3) | 4(5) | 1(1) | 5(5) | 41(5) | 12(5) | 9(5) | 1.8(3) | 57(5) | 0.0(5) | 3096(5) | 52 | 10.4 |
| 15.60 | E | 09/23/2005 | 42 | 22(5) | 3(3) | 5(5) | 1(1) | 3(3) | 41(5) | 5(5) | 3(5) | 5.1(5) | 48(3) | 0.0(5) | 2704(5) | 50 | 9.8 |

na - Qualitative data, Modified Iwb not applicable.

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 7.  Ohio EPA fish results from the Dry Fork Whitewater River, 2005.

# Species List



| | | |
|---|---|---|
| River Code: **14-302** | Stream: **Dry Fork** | Sample Date: **2005** |
| River Mile: **16.60** | Location: adj. S.R. 126, at confl. Buck Run | Date Range: 07/29/2005 |
| Time Fished: 5100 sec | Drainage: 37.0 sq mi | Thru: 09/23/2005 |
| Dist Fished: 0.30 km | Basin: Great Miami River No of Passes: 2 | Sampler Type: E |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Quillback Carpsucker | C | O | M | | 6 | 6.00 | 0.36 | 0.30 | 0.42 | 50.00 |
| Black Redhorse | R | I | S | I | 79 | 79.00 | 4.78 | 13.12 | 18.24 | 166.03 |
| Golden Redhorse | R | I | S | M | 29 | 29.00 | 1.76 | 4.81 | 6.69 | 165.82 |
| Northern Hog Sucker | R | I | S | M | 73 | 73.00 | 4.42 | 3.27 | 4.54 | 44.77 |
| White Sucker | W | O | S | T | 17 | 17.00 | 1.03 | 2.17 | 3.02 | 127.70 |
| Common Carp | G | O | M | T | 2 | 2.00 | 0.12 | 2.95 | 4.10 | 1,475.00 |
| Creek Chub | N | G | N | T | 2 | 2.00 | 0.12 | 0.01 | 0.01 | 3.00 |
| Rosefin Shiner | N | I | S | M | 33 | 33.00 | 2.00 | 0.08 | 0.10 | 2.29 |
| Striped Shiner | N | I | S | | 283 | 283.00 | 17.14 | 3.83 | 5.32 | 13.53 |
| Spotfin Shiner | N | I | M | | 57 | 57.00 | 3.45 | 0.54 | 0.74 | 9.39 |
| Sand Shiner | N | I | M | M | 93 | 93.00 | 5.63 | 0.29 | 0.40 | 3.07 |
| Silverjaw Minnow | N | I | M | | 6 | 6.00 | 0.36 | 0.03 | 0.04 | 4.67 |
| Bluntnose Minnow | N | O | C | T | 60 | 60.00 | 3.63 | 0.25 | 0.34 | 4.08 |
| Central Stoneroller | N | H | N | | 511 | 511.00 | 30.95 | 5.88 | 8.18 | 11.51 |
| Yellow Bullhead | | I | C | T | 4 | 4.00 | 0.24 | 0.57 | 0.79 | 141.50 |
| Rock Bass | S | C | C | | 27 | 27.00 | 1.64 | 2.98 | 4.14 | 110.38 |
| Smallmouth Bass | F | C | C | M | 107 | 107.00 | 6.48 | 28.56 | 39.71 | 266.88 |
| Largemouth Bass | F | C | C | | 20 | 20.00 | 1.21 | 0.95 | 1.32 | 47.44 |
| Green Sunfish | S | I | C | T | 5 | 5.00 | 0.30 | 0.13 | 0.18 | 26.00 |
| Bluegill Sunfish | S | I | C | P | 14 | 14.00 | 0.85 | 0.13 | 0.18 | 9.28 |
| Longear Sunfish | S | I | C | M | 22 | 22.00 | 1.33 | 0.60 | 0.83 | 27.21 |
| Johnny Darter | D | I | C | | 2 | 2.00 | 0.12 | 0.00 | 0.01 | 2.00 |
| Greenside Darter | D | I | S | M | 51 | 51.00 | 3.09 | 0.18 | 0.26 | 3.61 |
| Rainbow Darter | D | I | S | M | 81 | 81.00 | 4.91 | 0.16 | 0.23 | 2.02 |
| Orangethroat Darter | D | I | S | | 11 | 11.00 | 0.67 | 0.04 | 0.05 | 3.18 |
| Fantail Darter | D | I | C | | 56 | 56.00 | 3.39 | 0.11 | 0.15 | 1.97 |
| | *Mile Total* | | | | 1,651 | 1,651.00 | | 71.91 | | |
| | *Number of Species* | | | | 26 | | | | | |
| | *Number of Hybrids* | | | | 0 | | | | | |

# Species List

| | | |
|---|---|---|
| River Code: **14-302** | Stream: **Dry Fork** | Sample Date: **2005** |
| River Mile: **15.90** | Location: adj. Sportsman 25 Gun Club | Date Range: 07/20/2005 |
| Time Fished: 5100 sec | Drainage: 41.0 sq mi | Thru: 09/23/2005 |
| Dist Fished: 0.32 km | Basin: Great Miami River No of Passes: 2 | Sampler Type: E |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Quillback Carpsucker | C | O | M | | 3 | 2.81 | 0.15 | 0.16 | 0.38 | 56.67 |
| Black Redhorse | R | I | S | I | 46 | 43.13 | 2.37 | 5.41 | 12.95 | 125.47 |
| Golden Redhorse | R | I | S | M | 12 | 11.25 | 0.62 | 2.61 | 6.24 | 231.58 |
| Northern Hog Sucker | R | I | S | M | 44 | 41.25 | 2.27 | 1.32 | 3.15 | 31.89 |
| White Sucker | W | O | S | T | 270 | 253.13 | 13.94 | 18.44 | 44.14 | 72.86 |
| Common Carp | G | O | M | T | 2 | 1.88 | 0.10 | 0.20 | 0.47 | 105.00 |
| Creek Chub | N | G | N | T | 39 | 36.56 | 2.01 | 0.68 | 1.62 | 18.53 |
| Rosefin Shiner | N | I | S | M | 93 | 87.19 | 4.80 | 0.21 | 0.49 | 2.35 |
| Striped Shiner | N | I | S | | 431 | 404.06 | 22.25 | 4.45 | 10.66 | 11.02 |
| Spotfin Shiner | N | I | M | | 34 | 31.88 | 1.76 | 0.15 | 0.36 | 4.67 |
| Sand Shiner | N | I | M | M | 227 | 212.81 | 11.72 | 0.49 | 1.17 | 2.30 |
| Silverjaw Minnow | N | I | M | | 35 | 32.81 | 1.81 | 0.12 | 0.30 | 3.79 |
| Bluntnose Minnow | N | O | C | T | 92 | 86.25 | 4.75 | 0.32 | 0.75 | 3.66 |
| Central Stoneroller | N | H | N | | 276 | 258.75 | 14.25 | 1.60 | 3.84 | 6.20 |
| Yellow Bullhead | | I | C | T | 11 | 10.31 | 0.57 | 0.46 | 1.10 | 44.73 |
| Brown Bullhead | | I | C | T | 1 | 0.94 | 0.05 | 0.16 | 0.39 | 175.00 |
| Stonecat Madtom | | I | C | I | 5 | 4.69 | 0.26 | 0.08 | 0.18 | 16.13 |
| Rock Bass | S | C | C | | 3 | 2.81 | 0.15 | 0.42 | 1.00 | 149.00 |
| Smallmouth Bass | F | C | C | M | 36 | 33.75 | 1.86 | 1.24 | 2.97 | 36.73 |
| Largemouth Bass | F | C | C | | 45 | 42.19 | 2.32 | 1.79 | 4.27 | 42.30 |
| Green Sunfish | S | I | C | T | 8 | 7.50 | 0.41 | 0.33 | 0.79 | 43.88 |
| Bluegill Sunfish | S | I | C | P | 22 | 20.63 | 1.14 | 0.28 | 0.66 | 13.40 |
| Longear Sunfish | S | I | C | M | 23 | 21.56 | 1.19 | 0.46 | 1.11 | 21.46 |
| Johnny Darter | D | I | C | | 3 | 2.81 | 0.15 | 0.00 | 0.01 | 1.33 |
| Greenside Darter | D | I | S | M | 80 | 75.00 | 4.13 | 0.26 | 0.63 | 3.48 |
| Rainbow Darter | D | I | S | M | 64 | 60.00 | 3.30 | 0.10 | 0.24 | 1.66 |
| Orangethroat Darter | D | I | S | | 1 | 0.94 | 0.05 | 0.00 | 0.00 | 2.00 |
| Fantail Darter | D | I | C | | 31 | 29.06 | 1.60 | 0.05 | 0.12 | 1.75 |
| | *Mile Total* | | | | 1,937 | 1,815.94 | | 41.78 | | |
| | *Number of Species* | | | | 28 | | | | | |
| | *Number of Hybrids* | | | | 0 | | | | | |

# Species List

| | | |
|---|---|---|
| River Code: **14-302** | Stream: **Dry Fork** | Sample Date: **2005** |
| River Mile: **15.60** | Location: Okeana-Drewersburg Rd. | Date Range: 07/20/2005 |
| Time Fished: 5100 sec | Drainage: 42.0 sq mi | Thru: 09/23/2005 |
| Dist Fished: 0.30 km | Basin: Great Miami River No of Passes: 2 | Sampler Type: E |

| Species Name / ODNR status | IBI Grp | Feed Guild | Breed Guild | Tol | # of Fish | Relative Number | % by Number | Relative Weight | % by Weight | Ave(gm) Weight |
|---|---|---|---|---|---|---|---|---|---|---|
| Quillback Carpsucker | C | O | M | | 5 | 5.00 | 0.16 | 0.23 | 0.49 | 46.00 |
| Black Redhorse | R | I | S | I | 68 | 68.00 | 2.15 | 6.72 | 14.42 | 98.79 |
| Golden Redhorse | R | I | S | M | 8 | 8.00 | 0.25 | 1.04 | 2.24 | 130.30 |
| Northern Hog Sucker | R | I | S | M | 60 | 60.00 | 1.89 | 2.55 | 5.48 | 42.54 |
| White Sucker | W | O | S | T | 93 | 93.00 | 2.94 | 7.80 | 16.74 | 83.87 |
| Blacknose Dace | N | G | S | T | 1 | 1.00 | 0.03 | 0.00 | 0.00 | 2.00 |
| Creek Chub | N | G | N | T | 58 | 58.00 | 1.83 | 1.27 | 2.72 | 21.88 |
| Rosefin Shiner | N | I | S | M | 86 | 86.00 | 2.71 | 0.23 | 0.49 | 2.66 |
| Striped Shiner | N | I | S | | 687 | 687.00 | 21.69 | 8.40 | 18.03 | 12.23 |
| Spotfin Shiner | N | I | M | | 29 | 29.00 | 0.92 | 0.10 | 0.21 | 3.33 |
| Sand Shiner | N | I | M | M | 260 | 260.00 | 8.21 | 0.54 | 1.17 | 2.09 |
| Silverjaw Minnow | N | I | M | | 64 | 64.00 | 2.02 | 0.25 | 0.54 | 3.94 |
| Bluntnose Minnow | N | O | C | T | 111 | 111.00 | 3.50 | 0.35 | 0.75 | 3.15 |
| Central Stoneroller | N | H | N | | 1,117 | 1,117.00 | 35.26 | 8.89 | 19.07 | 7.95 |
| Yellow Bullhead | | I | C | T | 4 | 4.00 | 0.13 | 0.15 | 0.32 | 36.75 |
| Rock Bass | S | C | C | | 10 | 10.00 | 0.32 | 1.02 | 2.19 | 102.00 |
| Smallmouth Bass | F | C | C | M | 48 | 48.00 | 1.52 | 4.36 | 9.35 | 90.81 |
| Largemouth Bass | F | C | C | | 46 | 46.00 | 1.45 | 1.04 | 2.24 | 22.69 |
| Green Sunfish | S | I | C | T | 1 | 1.00 | 0.03 | 0.02 | 0.04 | 20.00 |
| Bluegill Sunfish | S | I | C | P | 1 | 1.00 | 0.03 | 0.01 | 0.02 | 10.00 |
| Longear Sunfish | S | I | C | M | 30 | 30.00 | 0.95 | 0.90 | 1.93 | 30.02 |
| Johnny Darter | D | I | C | | 5 | 5.00 | 0.16 | 0.01 | 0.01 | 1.00 |
| Greenside Darter | D | I | S | M | 180 | 180.00 | 5.68 | 0.47 | 1.00 | 2.60 |
| Rainbow Darter | D | I | S | M | 112 | 112.00 | 3.54 | 0.15 | 0.32 | 1.33 |
| Orangethroat Darter | D | I | S | | 1 | 1.00 | 0.03 | 0.00 | 0.00 | 1.00 |
| Fantail Darter | D | I | C | | 83 | 83.00 | 2.62 | 0.10 | 0.22 | 1.26 |
| | *Mile Total* | | | | 3,168 | 3,168.00 | | 46.60 | | |
| | *Number of Species* | | | | 26 | | | | | |
| | *Number of Hybrids* | | | | 0 | | | | | |