

Biological and Aquatic Life Use Attainment Study of Fields Brook

2000

Ashtabula County, Ohio

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OEPA Site Evaluation Report EAS/2001-6-3

prepared for

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

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INTRODUCTION

The Fields Brook Natural Resource Trustees Council has requested a habitat and biological evaluation of Fields Brook to facilitate the development of natural resource restoration plans. This information was collected by the Ohio EPA, Division of Surface Water, in July, 2000 prior to the anticipated U.S. EPA-directed remediation activities.

Specific objectives of this evaluation were to:

- 1) establish biological conditions in Fields Brook by evaluating fish and macroinvertebrate communities,
- 2) determine the appropriate aquatic life use designation for Fields Brook and evaluate the attainment of that use, and
- 3) establish instream baseline conditions for Fields Brook prior to remediation activities.

SUMMARY/CONCLUSIONS

A total of 2.3 miles of Fields Brook was assessed in 2000 by Ohio EPA. Based on the performance of the biological communities, all 2.3 miles assessed were NOT attaining the recommended Warmwater Habitat (WWH) aquatic life use (Table 2). The biological integrity of Fields Brook was represented by fair to poor conditions. Biological results from 2000 suggested more significant impairment in the lower one mile compared to further upstream. Based on physical habitat features as measured by the Qualitative Habitat Evaluation Index, Fields Brook should have an aquatic life use designation of Warmwater Habitat. An organic chemical odor was evident at the upper sampling site (RM 1.8) and a strong septic odor was noted from a small discharge into Fields Brook at Columbus Street (RM 0.9).

RECOMMENDATIONS

Status of Aquatic Life Uses

Fields Brook was designated as a Limited Warmwater Habitat (LWH) aquatic life use in the 1978 Ohio Water Quality Standards (WQS). The LWH use designation was a temporary classification designed for waters incapable of meeting specific Warmwater Habitat chemical criteria due to low stream flows coupled with heavy industrialized areas that had outdated sewer systems or waste treatment facilities. Stream segments currently designated Limited Warmwater Habitat will be redesignated to another aquatic life use when a use attainability analysis is performed. The techniques used in 1978 did not include standardized approaches to the collection of instream biological data or numerical biological criteria. This study represents a first use of this type of biological data, along with a physical habitat analysis, to evaluate and establish the appropriate

aquatic life use designation for Fields Brook (i.e. Use Attainability Analysis). Ohio EPA is under obligation by a 1981 public notice to review and evaluate all aquatic life use designations outside of the WWH use prior to basing any permitting actions on the existing, unverified use. Beneficial use designations are detailed in Table 1.

The Warmwater Habitat aquatic life use designation is appropriate for Fields Brook. Fields Brook has physical habitat conditions which could support a warmwater biological community (QHEI scores of 69 and 51.5), including pool, run, and riffle areas, pools greater than 80 cm in depth, and a variety of instream cover types. Although the upper reach of Fields Brook appears to have been channel modified in the past, current habitat conditions are adequate for supporting the Warmwater Habitat use.

Status of Non-Aquatic Life Uses

Fields Brook is recommended for Primary Contact Recreation. Water at several locations was of sufficient depth (3 feet deep over a 100 square foot area) to support the Primary Contact Recreation use. In addition, the lower 0.2 miles is influenced by the Ashtabula River lacustuary zone.

Table 1. Waterbody use designations for Fields Brook. Designations based on the 1978 and 1985 Water Quality Standards appear as asterisks (*). Designations based on the results of an integrated ambient biological assessment performed by Ohio EPA are indicated with a plus sign (+). Designations based on justification other than the results of a biological field assessment performed by the Ohio EPA appear as a zero sign (o). A delta (Ä) indicates a new recommendation based on the findings of this report. LWH is designated with an L.

Stream Segment	Use Designations												
	S R W	Aquatic Life Habitat						Water Supply			Recreation		
		WW H	E W H	M W H	S S H	C W H	L R W	P W S	A W S	I W S	B W	P C R	S C R
Fields Brook - S.R. 11 (RM 1.34) to the mouth - all other segments		oL/ Ä								*/+		*/+	
		oL/ Ä								*/+		*/+	

For segment RM 1.34 to the mouth: varied criteria year round - total dissolved solids, 3500 mg/l.

For all other segments: varied criteria year round - total dissolved solids, exempt.

METHODS

All physical and biological field, laboratory, data processing, and data analysis methodologies and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 1989a) and Biological Criteria for the Protection of Aquatic Life, Volumes I-III (Ohio Environmental Protection Agency 1987a, 1987b, 1989b, 1989c), The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application (Rankin 1989, 1995) for aquatic habitat assessment, and the June 23, 2000 Fields Brook Workplan (Ohio EPA 2000). The sampling location proposed at RM 0.4 in the work plan was deleted due to access problems.

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-14). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on 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 2) 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.

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.

Table 2. Attainment status of the recommended WWH aquatic life use for Fields Brook based on biological sampling conducted during July, 2000.

RIVER MILE Fish/Invert.	IBI	MIwb	ICT^a	QHEI	Attainment Status	Site Location
Fields Brook	<i>Erie Ontario Lake Plain (EOLP) - WWH Use Designation (Recommended)</i>					
1.8 / 1.8	32*	NA	F*	51.5	NON	Upst./Dst. State Road
0.9 / 0.9	<u>20</u> *	NA	F*	74.0	NON	Columbus Street

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

a Narrative evaluation used in lieu of ICI when scores not available (F - fair).

NA Not applicable (due to small drainage area).

Table 3. Sampling locations in Fields Brook, 2000. Type of sampling included fish community (F) and macroinvertebrate community (M).

Stream/ River Mile	Type of Sampling	Latitude	Longitude	Landmark
1.8	F,M	41 53 35	80 46 21	State Road
0.9	F,M	41 53 20	80 47 10	Columbus Street

RESULTS

Physical Habitat For Aquatic Life

Physical habitat was evaluated in Fields Brook at each sampling location (Figure 1, Table 3). Qualitative Habitat Evaluation Index (QHEI) scores are detailed in Table 4. Sand and bedrock predominated in the substrates in the lower mile of stream, while further upstream, lakebed clays dominated. Natural channel conditions were clearly evident in the lower 1.3 miles, with a moderate to narrow riparian corridor established. Instream channel development was good to fair, with a mixture of pool, riffle and run habitats. Habitat evaluation at RM 1.8 revealed a stream channel which appeared to have previously been modified, although showing some signs of recovery. Lakebed clays in the form of hardpan were the predominating substrate at RM 1.8. Pools, riffles, and runs were well represented in this area, and wetlands bordered the stream. QHEI scores for Fields Brook were 69.0 (RM 0.9) and 51.5 (RM 1.8). These scores are indicative of good to fair stream and riparian habitat.



Figure 1. Map of the Fields Brook study area with sampling locations noted by river mile.

Table 4. QHEI

Macroinvertebrate Assessment

Macroinvertebrate communities from RM 1.8 were predominated by dense populations of relatively tolerant blackflies, baetid mayflies, pulmonate snails, and midges. A total of 38 taxa were collected but most were moderate to tolerant in their pollution sensitivity. The QCTV score of 32.8 was in the low performance range and reflected the general lack of pollution sensitive taxa in the collections. The number of EPT (*i.e.*, mayfly, stonefly, caddisfly) taxa (7) exceeded ecoregional expectations for small drainage areas in the EOLP ecoregion but, again, nearly all were very common and relatively tolerant varieties. Water quality conditions appeared enriched and moderately degraded. The condition of the benthic community was considered fair (Table 5).

Macroinvertebrate community health appeared to experience further declines downstream at Columbus Road (RM 0.9). Total taxa dropped from 38 at RM 1.8 to 19 at RM 0.9 and EPT taxa richness dropped from 7 to 3 between stations. The condition of the benthic community was considered fair.

Table 5. Summary of macroinvertebrate data collected from the natural substrates (qualitative sampling) in the Fields Brook study area, July 25, 2000.

<i>Qualitative Evaluation</i>						
<i>Stream</i> River Mile	Relative Density	Qual. Taxa	Qual. EPT ^a	QCTV ^b	ICI ^c	Narrative Evaluation
<i>Fields Brook (2000)</i>						
<i>Eastern Corn Belt Plains WWH Use Designation (Existing)</i>						
1.8	High	38	7	32.8	F*	Fair
0.9	NA	19	3	35.3	F*	Fair
<p>^a EPT= total Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).</p> <p>^b Qualitative Community Tolerance Value (QCTV) is calculated as the median tolerance value of all taxa collected during qualitative (<i>i.e.</i>, natural substrate) sampling.</p> <p>^c A narrative evaluation based on qualitative sampling results and best professional judgement is used when quantitative data is not available for calculation of the Invertebrate Community Index (ICI).</p> <p>* Significant departure from ecoregion biocriteria (>4 ICI units); <i>poor</i> and <i>very poor</i> results are underlined.</p> <p>^{ns} Nonsignificant departure from biocriterion (<4 ICI units).</p>						

Fish Community Assessment

Fish communities were assessed at two Fields Brook sites on July 25, 2000 (Figure 1). The two sites were located at State Road (RM 1.8) and Columbus Street (RM 0.9). The fish communities were sampled at each site once using pulsed DC electrofishing equipment, with each site sampled over a distance of 200 meters. Fish were processed in the field, and included identifying each individual to species and recording any external abnormalities.

The fish communities in Fields Brook (RMs 1.8 and 0.9) were evaluated as fair and poor, with IBI scores of 32 and 20, respectively (Table 6). These scores did not meet the ecoregional biocriteria established for Warmwater Habitat (WWH) headwater streams in Ohio. Highly pollution tolerant fish were very abundant at RM 0.9, comprising 85% of the community. An organic chemical odor was evident at the upper sampling site (RM 1.8) and a strong septic odor was noted from a small discharge into Fields Brook at Columbus Street (RM 0.9).

Table 6. Fish community indices from Fields Brook, 2000 based on pulsed D.C. electrofishing at sites sampled by Ohio EPA.

Stream/ River Mile	Number of Species	Relative Numbers (No./0.3 km)	QHEI	Index of Biotic Integrity (IBI)	Narrative Evaluation ^a
<i>Fields Brook</i>					
1.8	6	340	51.5	32*	Fair
0.9	12	264	69.0	<u>20*</u>	Poor

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)

<u>INDEX</u>	<u>WWH</u>	<u>EWH</u>	<u>MWH</u>
IBI-Headwaters	38	50	24

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

^a Narrative evaluation is based on IBI score.

REFERENCES

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

APPENDICES

Appendix Table 1 Fields Brook IBI

River Mile	Type	Date	Drainage area (sq mi)	Number of						Percent of Individuals					Rel.No. minus tolerants /(0.3km)	IBI
				Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Tolerant fishes	Omni- vores	Pioneering fishes	Insect- ivores	DELT anomalies		
<i>Fields Brook - (07-010)</i>																
Year: 2000																
1.80	E	07/25/2000	4.1	6(3)	1(1)	0(1)	0(1)	0(1)	1(1)	46(3)	11(5)	34(3)	52(5)	0.0(5)	183(3)	32
0.90	E	07/25/2000	5.3	12(3)	4(3)	0(1)	0(1)	0(1)	2(1)	85(1)	64(1)	29(5)	14(1)	1.7(1)	39(1)	20

▲ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Species List

River Code: 07-010 River Mile: 1.80	Stream: Fields Brook Basin: Ashtabula River Time Fished: 2040 sec Drain Area: 4.1 sq mi Dist Fished: 0.20 km No of Passes: 1	Sample Date: 2000 Date Range: 07/25/2000 Sampler Type: E
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Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Mudminnow		I	C	T	5	7.50	2.20			
White Sucker	W	O	S	T	24	36.00	10.57			
Creek Chub	N	G	N	T	12	18.00	5.29			
Largemouth Bass	F	C	C		73	109.50	32.16			
Green Sunfish	S	I	C	T	64	96.00	28.19			
Pumpkinseed Sunfish	S	I	C	P	49	73.50	21.59			
<i>Mile Total</i>					227	340.50				
<i>Number of Species</i>					6					
<i>Number of Hybrids</i>					0					

Species List

River Code: 07-010 River Mile: 0.90	Stream: Fields Brook Basin: Ashtabula River Time Fished: 2220 sec Drain Area: 5.3 sq mi Dist Fished: 0.20 km No of Passes: 1	Sample Date: 2000 Date Range: 07/25/2000 Sampler Type: E
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Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Central Mudminnow		I	C	T	2	3.00	1.14			
White Sucker	W	O	S	T	95	142.50	53.98			
Creek Chub	N	G	N	T	30	45.00	17.05			
Common Shiner	N	I	S		1	1.50	0.57			
Fathead Minnow	N	O	C	T	17	25.50	9.66			
Bluntnose Minnow	N	O	C	T	1	1.50	0.57			
Yellow Bullhead		I	C	T	2	3.00	1.14			
Black Bullhead		I	C	P	1	1.50	0.57			
Largemouth Bass	F	C	C		9	13.50	5.11			
Green Sunfish	S	I	C	T	3	4.50	1.70			
Bluegill Sunfish	S	I	C	P	6	9.00	3.41			
Pumpkinseed Sunfish	S	I	C	P	9	13.50	5.11			
<i>Mile Total</i>					176	264.00				
<i>Number of Species</i>					12					
<i>Number of Hybrids</i>					0					

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

Collection Date: 07/25/2000 River Code: 07-010 River: Fields Brook

RM: 1.80

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	<i>Turbellaria</i>	+			
03600	<i>Oligochaeta</i>	+			
06201	<i>Hyalella azteca</i>	+			
06810	<i>Gammarus fasciatus</i>	+			
11120	<i>Baetis flavistriga</i>	+			
11130	<i>Baetis intercalaris</i>	+			
11200	<i>Callibaetis sp</i>	+			
17200	<i>Caenis sp</i>	+			
22001	<i>Coenagrionidae</i>	+			
23600	<i>Aeshna sp</i>	+			
23700	<i>Anax sp</i>	+			
45000	<i>Hesperocorixa sp</i>	+			
45400	<i>Trichocorixa sp</i>	+			
52200	<i>Cheumatopsyche sp</i>	+			
52530	<i>Hydropsyche depravata group</i>	+			
53800	<i>Hydroptila sp</i>	+			
65800	<i>Berosus sp</i>	+			
69400	<i>Stenelmis sp</i>	+			
71300	<i>Limonia sp</i>	+			
72700	<i>Anopheles sp</i>	+			
74100	<i>Simulium sp</i>	+			
77500	<i>Conchapelopia sp</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
80410	<i>Cricotopus (C.) sp</i>	+			
80420	<i>Cricotopus (C.) bicinctus</i>	+			
80430	<i>Cricotopus (C.) tremulus group</i>	+			
82141	<i>Thienemanniella xena</i>	+			
82730	<i>Chironomus (C.) decorus group</i>	+			
82820	<i>Cryptochironomus sp</i>	+			
83040	<i>Dicrotendipes neomodestus</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	+			
85625	<i>Rheotanytarsus exiguus group</i>	+			
85840	<i>Tanytarsus guerlus group</i>	+			
94400	<i>Fossaria sp</i>	+			
95100	<i>Physella sp</i>	+			
96002	<i>Helisoma anceps anceps</i>	+			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	+			

No. Quantitative Taxa: 0 Total Taxa: 38
 No. Qualitative Taxa: 38 ICI:
 Number of Organisms: 0 Qual EPT: 7

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

Collection Date: 07/25/2000 River Code: 07-010 River: Fields Brook

RM: 0.90

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	<i>Turbellaria</i>	+			
04960	<i>Mooreobdella sp</i>	+			
06700	<i>Crangonyx sp</i>	+			
08260	<i>Orconectes (Crockerinus) sanbornii sanbornii</i>	+			
11120	<i>Baetis flavistriga</i>	+			
22300	<i>Argia sp</i>	+			
52200	<i>Cheumatopsyche sp</i>	+			
52530	<i>Hydropsyche depravata group</i>	+			
74100	<i>Simulium sp</i>	+			
77500	<i>Conchapelopia sp</i>	+			
78655	<i>Procladius (Holotanypus) sp</i>	+			
82141	<i>Thienemanniella xena</i>	+			
84210	<i>Paratendipes albimanus or P. duplicatus</i>	+			
84450	<i>Polypedilum (P.) flavum</i>	+			
84700	<i>Stenochironomus sp</i>	+			
85625	<i>Rheotanytarsus exiguus group</i>	+			
87540	<i>Hemerodromia sp</i>	+			
96280	<i>Planorbella (Pierosoma) trivolvis</i>	+			
98200	<i>Pisidium sp</i>	+			

No. Quantitative Taxa: 0 Total Taxa: 19
 No. Qualitative Taxa: 19 ICI:
 Number of Organisms: 0 Qual EPT: 3