

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2009 East Branch of Euclid Creek Baseline Biological, Habitat, and Water Chemistry Assessment Study



**Prepared by
Water Quality and Industrial Surveillance's
Environmental Assessment Section**

Introduction

In 2009, the Northeast Ohio Regional Sewer District (NEORS D) completed a baseline assessment study at three sites on the East Branch of Euclid Creek. The baseline study consisted of water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community surveys at river miles (RMs) 0.25 and 0.01; and a habitat assessment at RM 0.13. Sampling was conducted by NEORS D Level 3 Qualified Data Collectors certified by Ohio EPA in Fish Community and Benthic Macroinvertebrate Biology, Chemical Water Quality and Stream Habitat Assessments as explained in the NEORS D study plan *2009 Euclid Creek, East Branch Restoration and Dam Removal* approved by Ohio EPA on May 12, 2009.

The purpose of the sampling was to collect baseline data at the three sites prior to stream restoration that is scheduled to begin in the summer of 2010. The restoration project will consist of removing a dam, located at RM 0.13, and installing cascading step pools immediately upstream of the dam through the removal area. The goal of eliminating the dam is to improve fish passage and water quality in the creek, as it currently serves as a fish migration barrier and a sediment trap. Sampling will again be performed once the restoration project is complete and the results will be compared to the baseline data to determine the effectiveness of the remediation.

Figure 1 is a map of the sampling locations on the East Branch of Euclid Creek, and Table 1 lists the sampling sites with respect to river mile (RM), latitude/longitude, description, and types of surveys conducted. All three sampling sites are considered headwater sites because they each have a tributary drainage area of 12.5 square miles (mi²).

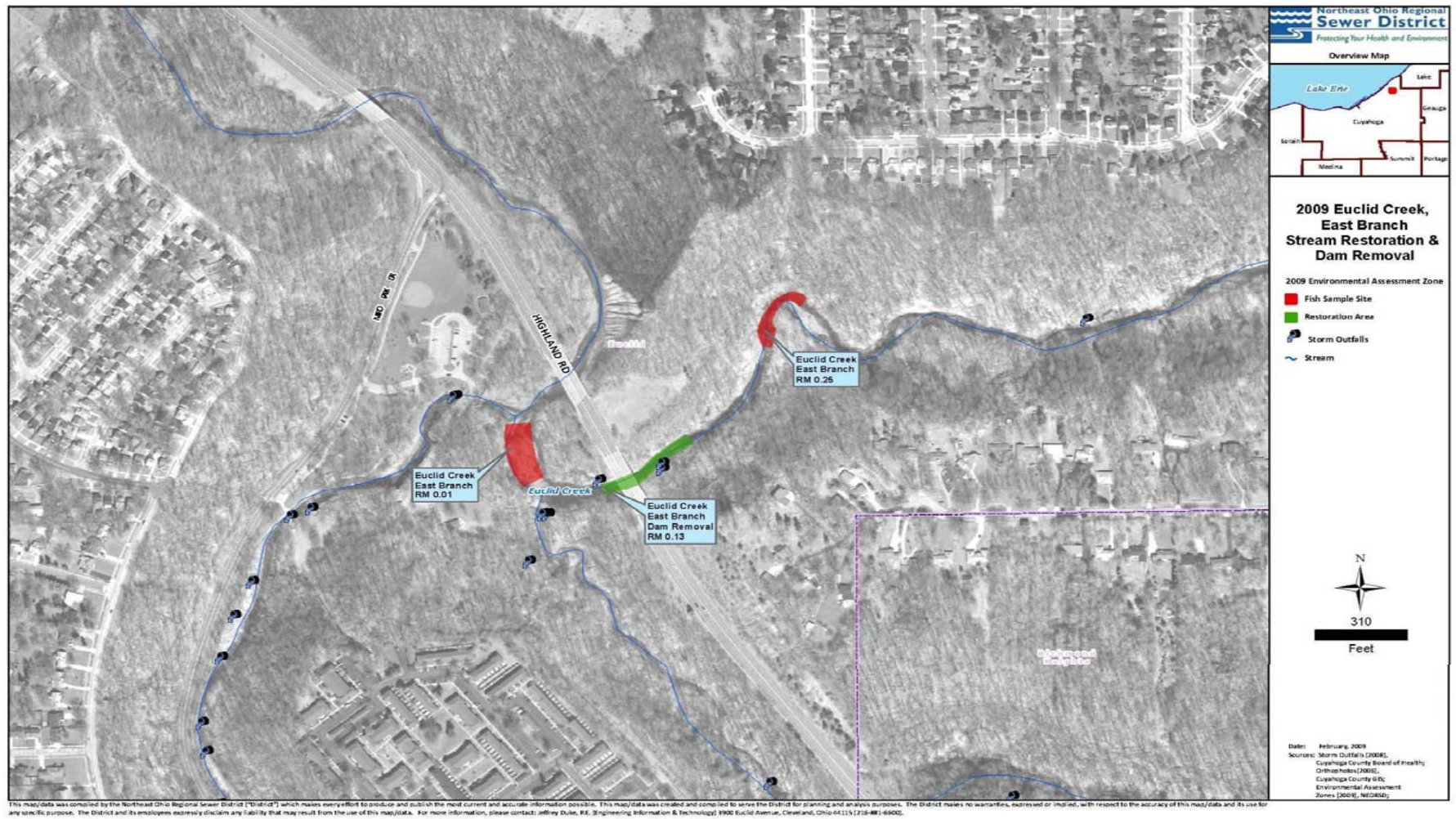


Figure 1. Sampling Locations on the East Branch of Euclid Creek

Table 1. 2009 Sampling Sites

River Mile	Latitude	Longitude	Description	Quadrangle	Purpose
0.25	41.5618°N	81.5277°W	Upstream of the dam removal	East Cleveland	Evaluate water chemistry, habitat, fish, & macroinvertebrates prior to removal of the dam
0.13	41.5604°N	81.5299°W	Location of dam removal	East Cleveland	Evaluate habitat at dam removal site prior to restoration
0.01	41.5610°N	81.5310°W	Downstream of the dam removal	East Cleveland	Evaluate water chemistry, habitat, fish, & macroinvertebrates prior to removal of the dam

Water Chemistry Sampling

Water chemistry samples were collected at RMs 0.25 and 0.01 during the six-week macroinvertebrate colonization period. A total of 10 samples were collected over five sampling events from July 20, 2009, to August 18, 2009. The samples collected on July 20th were associated with a wet weather event¹; all other samples were collected on dry weather days. All techniques used during water sampling and chemical analyses followed the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009) to ensure consistency throughout the study. Field analyses were conducted using either a YSI-556 MPS Multi-Parameter Water Quality Meter or a YSI 600XL sonde meter to measure dissolved oxygen, water temperature, specific conductance and pH at the time of sampling. A Hanna HI 98129 meter was also used when the pH sensor calibration on the YSI-556 MPS or YSI 600XL sonde failed to meet quality assurance and quality control (QA/QC) requirements. On August 14, 2009, it was determined that the pH was being calibrated once a week and not daily. Therefore, some of the samples have field pH measurements that did not follow the Ohio EPA Surveillance Methods. All field notes and field measurements were recorded on a Surface Water Condition Sampling Field Data Form.

¹ Wet weather sampling events: greater than 0.10 inches of rain but less than 0.25 inches, samples collected that day and the following day are considered wet weather samples; greater than 0.25 inches, the samples collected that day and the following two days were considered wet weather samples. Rainfall data taken from the NEORS South Euclid (RSO) Rain Gauge.

During water chemistry sampling, one sample duplicate and one sample field blank were obtained for QA/QC purposes. The sample duplicate was collected at RM 0.01 during the July 27th sampling event. The sample field blank was collected at RM 0.25 during the August 18th sampling event. The results from the sample duplicate and primary sample from RM 0.01 were compared using relative percent difference (RPD), see Formula 1:

$$\text{Formula 1) } \quad \text{RPD} = \left(\frac{|X-Y|}{((X+Y)/2)} \right) * 100$$

X= is the concentration of an analyte in the primary sample

Y= is the concentration of the same analyte in the duplicate sample

An RPD was calculated for each of the 40 individual chemical parameters reported on the Certificate of Analysis. The acceptable RPD between duplicate and primary samples is less than or equal to 30 percent. Any difference greater than 30 percent was investigated as to the cause of the disparity. After evaluating the RPD values, two potential disparities were found; one for ammonia (37.0% RPD) and one for total dissolved solids (41.9% RPD). The concentrations of both parameters were less than 10 times the practical quantitation limit, so the increased RPD values were most likely due to the low concentrations of ammonia and total dissolved solids measured. The field blank results appeared to be normal and did not show any signs of contamination through handling or transportation.

RMs 0.25, 0.13 and 0.01 on Euclid Creek are designated as warmwater habitat (WWH), agricultural water supply, industrial water supply, and primary contact recreation waters (Ohio EPA, 2009b). The results of the 10 water chemistry samples and duplicate sample were compared to the Ohio water quality standards to see if there were any exceedances associated with these use designations. The comparison yielded no exceedances of the Ohio water quality standards. All Certificates of Analysis and Surface Water Condition Sampling Field Data Forms are available upon request from the NEORS Water Quality and Industrial Surveillance, Environmental Assessment Group.

Habitat Assessment

In 2009, aquatic habitat conditions were assessed at RMs 0.25, 0.13, and 0.01 using the Qualitative Habitat Evaluation Index (QHEI). The QHEI, as described in the Ohio EPA document *Methods for Assessing Habitat in Flowing Waters: Using the*

Qualitative Habitat Evaluation Index (QHEI) (2006), is an index used to assess the physical components of a stream that are important to fish communities. The index is comprised of six metrics: stream substrate, instream cover, channel morphology, riparian zone and bank erosion, pool/glide and riffle-run quality, and map gradient. Each metric is given a score, and the sum of all metric scores is the total QHEI score for that site. The QHEI field sheets for each site are available upon request.

The sites upstream and downstream of the dam at RMs 0.25 and 0.01 met Ohio EPA's QHEI target goal of 60 (Ohio EPA, 2005), indicating that they should be capable of meeting applicable WWH biocriterion. The dam impoundment site at RM 0.13 did not meet the target goal of 60 (Table 2). In 2008, the Ohio EPA conducted baseline habitat and biological evaluations at RMs 0.20 and 0.10 on the East Branch of Euclid Creek as part of the Section 319(h) Clean Water Act Grants program (Ohio EPA, 2009c). In Ohio EPA's study, RM 0.20 was the site of the dam impoundment and RM 0.10 was the site downstream of the dam. The site at RM 0.10 met the QHEI target goal of 60, but the site at RM 0.20 did not (Table 2).

The QHEI scores for Ohio EPA's dam impoundment site at RM 0.20 and NEORSD's site at RM 0.13 were both below the target score of 60. Although these sites are listed as different locations, both contain the dam impoundment and therefore are comparable. The sites shared similar attributes that are indicative of a modified warmwater habitat (MWH) stream. Attributes that are considered characteristic of MWHs are further classified as being of moderate or high influence to fish communities (Rankin, 1995). The presence of one high or four moderate influence characteristics has been found to result in lower IBI scores, with a greater prevalence of these characteristics usually preventing a site from meeting WWH attainment (Ohio EPA, 1999). Both sites exhibited more than one high influence and at least four moderate influence characteristics. These characteristics included: channelization, no sinuosity, sparse instream cover, heavy-to-moderate silt cover, poor development, no fast current, and high-to-moderate overall embeddedness (Table 2).

The QHEI scores at Ohio EPA's downstream site at RM 0.10 and NEORSD's site at RM 0.01 both met the target score of 60. Both sites shared similar attributes as the majority of their characteristics fell into the WWH classification. These characteristics included: no channelization, boulder/cobble/gravel substrates, fast currents/eddies, low-to-normal overall embeddedness, max run depth greater than 40 cm, and low-to-normal riffle embeddedness.

Table 2. Qualitative Habitat Evaluation Index scores and physical attributes																																
River Mile	QHEI Score	Habitat Rating	WWH Attributes										MWH Attributes																			
			No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max. Depth >40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes	High Influence					Moderate Influence													
														Channelized or no Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max. Dept <40 cm (WD, HW sites)	Total High Influence Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total Moderate Influence Attribute
East Branch of Euclid Creek																																
0.25	62.25	Good	x			x		x	x	x	x	x	7		x					1		x			x				x	x		4
0.20*	30.00	Poor											0	x		x	x	x	4		x			x		x		x	x		x	6
0.13	46.50	Fair		x						x			2	x		x	x		3		x			x			x	x	x			5
0.10*	60.00	Good	x	x				x	x	x	x		6			x	x		2				x									1
0.01	74.00	Excellent	x	x		x		x	x	x	x		7		x				1				x									1

*2008 Ohio EPA Sampling Sites

Electrofishing

Methods

Electrofishing surveys were conducted one time at RMs 0.25 and 0.01 in 2009. Sampling was conducted using longline electrofishing techniques and consisted of shocking all habitat types within a sampling zone of 0.15 kilometers in length, while moving from downstream to upstream. The methods that were used followed Ohio EPA's protocols in the document *Biological Criteria for the Protection of Aquatic Life, Volume III: Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities* (Updated September 30, 1989; November 8, 2006; and August 26, 2008). Fish collected during the surveys were identified to species level, counted, and examined for the presence of external anomalies including deformities, erosions, lesions, and tumors (DELTs).

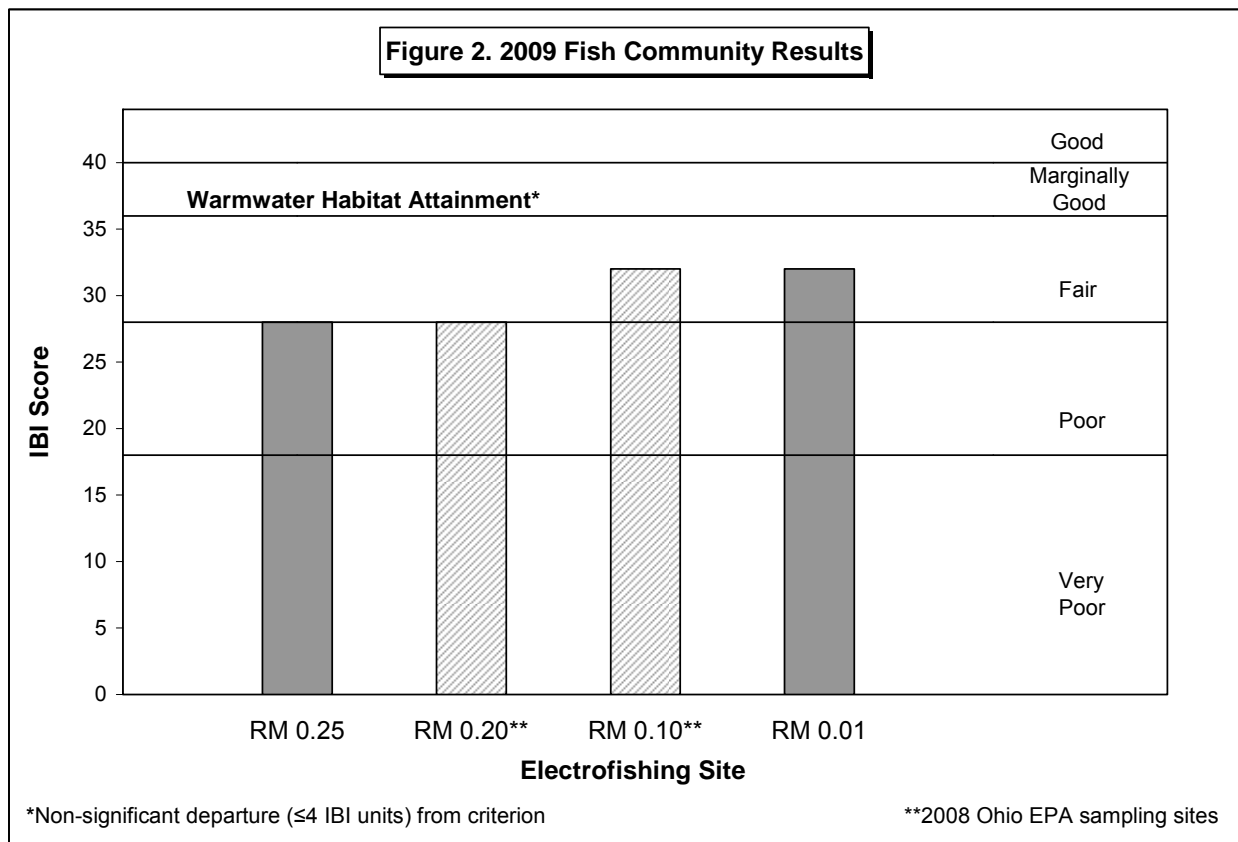
The results from this sampling were used to calculate Index of Biotic Integrity (IBI) scores for each site. The IBI is a measure of the overall fish community health and is comprised of 12 metrics that represent the structural and functional attributes of the community. For headwater sites, the 12 IBI metrics are:

- | | |
|-----------------------------------|------------------------------------------|
| 1. Number of native species | 7. Proportion of omnivores |
| 2. Number of darter species | 8. Proportion of insectivores |
| 3. Number of headwater species | 9. Proportion of pioneering species |
| 4. Number of minnow species | 10. Number of individuals |
| 5. Number of sensitive species | 11. Number of simple lithophilic species |
| 6. Proportion of tolerant species | 12. Proportion with DELT anomalies |

Each metric can receive a score of five (highest possible), three, or one (lowest possible). The sum of all metric scores is the overall IBI score. An IBI score of 40 (*Good*) meets the WWH biocriterion value for headwater sites in the *Erie Ontario Lake Plain* ecoregion of Ohio and is in attainment of the WWH use designation. An IBI score of 36 (*Marginally Good*) is also in attainment, as it is considered nonsignificant departure (≤ 4 IBI units) from the criterion. A list of the species, numbers, pollution tolerances and incidence of DELT anomalies for fish collected during the electrofishing surveys at each site is available upon request.

Results and Discussion

The IBI scores for 2009 did not meet the WWH biocriterion value and therefore did not attain the WWH use designation (Figure 2). The IBI scores from Ohio EPA’s 2008 study also did not attain the WWH use designation. All IBI scores fell into the narrative range of *Fair*.



With an IBI score of 28, the assessment conducted at RM 0.25 consisted of central stoneroller minnows, creek chubs, western blacknose dace, common white suckers, bluntnose minnows, yellow bullhead, and green sunfish. All of these species are highly tolerant to pollution, except for the central stoneroller minnow, which has intermediate tolerance to pollution. The central stoneroller minnow was also the dominant fish, comprising 33.9% of the total fish collected. A direct comparison between NEORSD’s site at RM 0.25 and Ohio EPA site at RM 0.20 cannot be made because Ohio EPA did not sample outside of the dam impoundment area. Despite this fact, Ohio EPA’s site at RM 0.20 also obtained an IBI score of 28 and consisted of a similar fish community to RM 0.25. The dominant fish at RM 0.20 was also the central stoneroller minnow, which comprised 36.4% of the total fish collected.

Both NEORSD and Ohio EPA obtained an IBI score of 32 at the downstream sites during their respective surveys. NEORSD's site at RM 0.01 consisted of central stoneroller minnows, creek chubs, western blacknose daces, common white suckers, northern fathead minnows, bluntnose minnows, pumpkinseed sunfish, and green sunfish. The majority of these species are highly tolerant to pollution, except for the central stoneroller minnow (intermediate tolerance) and the pumpkinseed sunfish (moderately tolerant). The fish community composition was similar at Ohio EPA's site at RM 0.10, and was comprised of common white suckers, western blacknose dace, creek chubs, fathead minnows, bluntnose minnows, central stoneroller minnows, yellow bullhead, black bullhead, largemouth bass, bluegill sunfish, redear sunfish, hybrid sunfish, and logperch darter. At both downstream sites, the dominant fish was the central stoneroller minnow, which comprised 38.2% of the total fish collected at RM 0.01 and 54.4% at RM 0.10.

Macroinvertebrate Sampling

Methods

In 2009, macroinvertebrates were sampled quantitatively over a six-week period at RMs 0.25 and 0.01 using a modified multi-plate Hester-Dendy (HD) sampler. The modified HD consists of five replicates of artificial substrate samplers affixed to a cinder block and deployed at each location. A qualitative assessment was also completed during retrieval of the HD, at which time all available habitats were actively sampled with a dip net. A Marsh-McBirney FloMate Model 2000 Portable Flow Meter, which measures velocity in feet per second (fps), was used during deployment and retrieval of the HD to measure stream velocity. Since stream flow over the HD is second only to water quality in determining the macroinvertebrate community represented during sampling, stream flow should be 0.3 feet per second (fps) or greater to use the data with confidence (DeShon, 1995). Stream flow was greater than 0.3 fps at RMs 0.25 and 0.01 during both deployment and retrieval of the HD samplers.

Quantitative and qualitative macroinvertebrate samples were shipped to EA Engineering, Science and Technology, Incorporated (Deerfield, IL), for identification and enumeration. Specimens were identified to the lowest practical taxonomic level, as defined by Ohio EPA (1987), when life stage and condition allowed. The taxa lists and enumerations are available upon request.

The overall aquatic macroinvertebrate community was evaluated using Ohio EPA's Invertebrate Community Index (ICI). The ICI consists of ten community metrics based on drainage area, each with four different scoring categories. Metrics 1-9 are based on the quantitative sample, while Metric 10 is based on the number of Ephemeroptera

(mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) in the qualitative sample. The total of the 10 individual metric categories determines the ICI score. The higher the ICI score, the less of a deviation from relatively unimpacted reference sites utilized by the Ohio EPA for each eco-region. An ICI score of 34 (*Good*) meets the WWH biocriterion value and is in attainment of the WWH use designation for the Erie/Ontario Lake Plain ecoregion. An ICI score of 30 (*Marginally Good*) is also in attainment, as it is considered nonsignificant departure (≤ 4 ICI units) from the criterion.

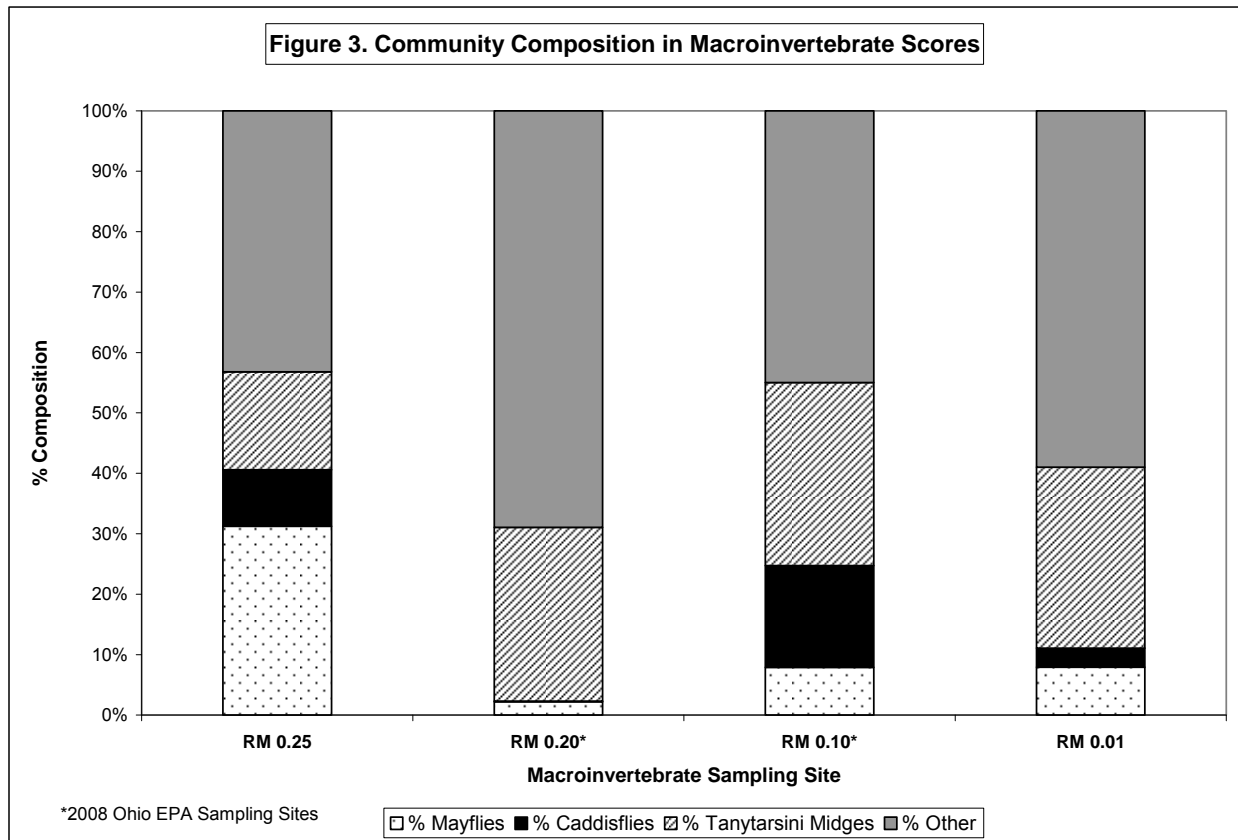
Results and Discussion

The ICI scores for 2009 met the WWH biocriterion value and were in attainment of the WWH use designation (Table 3). The ICI scores from Ohio EPA’s 2008 study showed attainment at the site at RM 0.10, but not at RM 0.20.

River Mile	Retrieval Date	ICI Score	Narrative Rating
0.25	8/25/2009	34*	<i>Good</i>
0.20**	9/23/2008	24	<i>Fair</i>
0.10**	9/23/2008	38*	<i>Good</i>
0.01	8/25/2009	42*	<i>Very Good</i>
*WWH attainment			
**2008 Ohio EPA sampling sites			

The percent composition of mayflies, caddisflies, and tribe Tanytarsini midges are important to the community composition as these organisms are good indicators of environmental conditions, since they disappear rapidly under environmental stress (Deshon, 1995). The upstream site at RM 0.25 had a high percent of caddisflies and tribe Tanytarsini midges as well as a low percent of tolerant organisms (Figure 3). On the other hand, Ohio EPA’s site at RM 0.20 had a low percent of mayflies and caddisflies and a high percent of tolerant organisms. The difference in ICI scores may be attributed to NEORSD deploying the HD sampler farther upstream, outside of the dam impoundment area where functional riffles existed. According to Ohio EPA’s QHEI results, there were no riffles present at RM 0.20 (Table 2).

The downstream site at RM 0.01 had a high percent of mayflies, caddisflies and tribe Tanytarsini midges, high number of caddisfly taxa, and a low percentage of tolerant organisms (Figure 3). Ohio EPA’s downstream site at RM 0.10 yielded similar results, as they had a high percentage of mayflies, caddisflies and tribe Tanytarsini midges as well as a high number of caddisfly taxa. The similar ICI scores may be attributed to the two sites being located in the same stretch of the creek, where fast currents and excellent riffles existed.



Conclusions

Overall, the 2009 baseline results were consistent with Ohio EPA’s findings in 2008 (Table 4). The QHEI scores and biological scores were comparable between the two studies. Any difference in scoring may be attributed to temporal or sampling variability from year to year.

Year	River Mile	Relative Location	Attainment Status	IBI	ICI	QHEI	Biological Assessment
2009	0.25	Upstream of dam	PARTIAL	28	34	62.25 (Good)	<i>Fair to Good</i>
2008*	0.20	Dam impoundment	NON	28	24	30.00 (Poor)	<i>Fair</i>
2009	0.13	Dam impoundment	-	-	-	46.50 (Fair)**	-
2008*	0.10	Downstream of dam	PARTIAL	32	38	60.00 (Good)	<i>Fair to Good</i>
2009	0.01	Downstream of dam	PARTIAL	32	42	74.00 (Excellent)	<i>Fair to Very Good</i>
WWH biocriterion value - IBI score of 40, ICI score of 34							
Nonsignificant Departure from criterion ≤4 IBI units, ≤4 ICI units							
*Ohio EPA Sampling							
**NEORSD conducted QHEI assessment only							

In both studies, the overall macroinvertebrate community appears to be healthy, except for at Ohio EPA's site RM 0.20. The community limitations at RM 0.20 are most likely due to the undesirable habitat conditions caused by the dam impoundment, which is evident in Ohio EPA's QHEI score, and from lack of adequate flow.

The fish communities in both studies fell into the fair range, as the majority of the species collected were highly tolerant to pollution. At three of the sites, the QHEI scores met the target goal of 60 and the ICI scores were in attainment, but IBI scores were not. The dam impoundment is most likely the limiting factor on the fish communities at the upstream electrofishing site. It acts as a migration barrier and a habitat impairment, which may deter high-quality fish species from inhabiting the upstream and downstream sites.

The main goal of the restoration project is to remove the dam and establish a more natural habitat in its place. This project may have a positive effect on the fish communities seen at the upstream and downstream sites, and may improve the undesirable habitat and poor flow conditions that appear to be limiting the macroinvertebrate communities. Further sampling, once restoration is complete, will determine the project effectiveness and any changes in the fish and macroinvertebrate communities.

Reference List

- DeShon, J.E. 1995. Development and application of the invertebrate community index (ICI). Pages 217-243 in W.S. Davis and T.P. Simon (editors). *Biological assessment and criteria: Tools for water resource planning and decision making*. Lewis Publishers, Boca Raton, Florida.
- Ohio EPA. 1987. *Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities*. Division of Water Quality Monitoring and Assessment. Columbus, Ohio. Last updated: August 2008.
- Ohio EPA. 1999. *Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams*. Ohio EPA Technical Bulletin MAS/1999-1-1.
- Ohio EPA. 2005. *Total Maximum Daily Loads for the Euclid Creek Watershed*. Ohio Environmental Protection Agency, Division of Surface Water. Columbus, Ohio.

Ohio EPA. 2006. *Manual for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)*. Ohio Environmental Protection Agency, Division of Surface Water. Columbus, Ohio.

Ohio EPA. 2009. *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices*. Ohio Environmental Protection Agency, Division of Surface Water, Division of Environmental Services. Columbus, Ohio.

Ohio EPA. 2009b. State of Ohio Water Quality Standards *Ohio Administrative Code* Chapter 3745-1. Revision: Adopted July 9, 2009; Effective October 9, 2009. Ohio Environmental Protection Agency, Division of Surface Water, Standards and Technical Support Section. Columbus, Ohio.

Ohio EPA. 2009c. *Biological and Habitat Studies: 11 River and Stream Projects*. Year 2008 Section 319(h) Clean Water Act Grants. Ohio Environmental Protection Agency, Division of Surface Water. Columbus, Ohio.