

# **NORTHEAST OHIO REGIONAL SEWER DISTRICT**

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## **2014 Big Creek Environmental Monitoring: Biological, Water Quality, and Habitat Survey Results**



**Prepared by  
The Water Quality and Industrial Surveillance Division**

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## Introduction

In 2014, the Northeast Ohio Regional Sewer District (NEORS) conducted stream monitoring activities at River Mile (RM) 0.15 on Big Creek, an urbanized tributary to the Cuyahoga River. RM 0.15 is located downstream of Jennings Road on the Big Creek Main Branch and is downstream of NEORS-owned combined sewer overflows (CSOs). NEORS assessed stream habitat, water chemistry, and fish and benthic macroinvertebrate community health to evaluate the impact of CSOs and other environmental factors on the creek. Macroinvertebrate and water chemistry sampling at RM 0.15 is required by Ohio Environmental Protection Agency (Ohio EPA) National Pollutant Discharge Elimination System (NPDES) Permit No. 3PA0002\*GD.

An additional site that was monitored was upstream of Jennings Road and storm sewer outfall BGMB1680 on Big Creek at RM 1.00. NEORS has documented elevated levels of chlorides discharging from the flow of this outfall pipe and a complete environmental assessment was conducted at this site to evaluate if the point source is having an impact on Big Creek RM 0.15. This was the first time that NEORS has conducted any environmental assessments at this site.

Stream monitoring activities were conducted by NEORS Level 3 Qualified Data Collectors certified by Ohio EPA in Fish Community Biology, Benthic Macroinvertebrate Biology, Chemical Water Quality, and Stream Habitat Assessment as explained in the NEORS's Project Study Plan, *2014 Big Creek Environmental Monitoring*, approved by Ohio EPA on April 14, 2014. The results obtained from these assessments were evaluated using the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI), Index of Biotic Integrity (IBI), Modified Index of Well-Being (MIwb), and Invertebrate Community Index (ICI). Water chemistry data was compared to the Ohio Water Quality Standards (Ohio EPA, 2011) to determine attainment of designated uses. An examination of the individual metrics that comprise the IBI and ICI was used in conjunction with the water quality data, NEORS Macroinvertebrate Field Sheet, and QHEI results to identify impacts to the fish and benthic macroinvertebrate communities. Results were also compared to historic data to show temporal trends.

Figure 1 is a map of the sampling locations on Big Creek, and Table 1 lists the sampling locations with respect to river mile, latitude/longitude, site description, and surveys conducted. A digital photo catalog of the sampling locations is available upon request by contacting the NEORS Water Quality and Industrial Surveillance (WQIS) Division.



Figure 1. Sampling Locations

Table 1.						
Water Body	Latitude	Longitude	River Mile	Location Information	USGS HUC 8 Number - Name	Purpose
Big Creek	41.4460	-81.6865	0.15	Downstream of Jennings Road	04110002 Cuyahoga	Evaluate water chemistry and macroinvertebrates as required by Ohio EPA Permit #3PA00002*FD, and evaluate the fish community and instream habitat as supplemental data
Big Creek	41.4436	-81.6996	1.00	Upstream of outfall BGMB1680, Upstream of Jennings Road	04110002 Cuyahoga	Evaluate water chemistry, macroinvertebrates and evaluate the fish community and instream habitat

## Water Chemistry Sampling

### Methods

Water chemistry and bacteriological sampling was conducted five times at RM 1.00 and six times at RM 0.15 between June 18, 2014, and July 22, 2014. Techniques used for sampling and analyses followed the Ohio EPA *Surface Water Field Sampling Manual* (2013). Chemical water quality samples from each site were collected with two 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and two 473-mL plastic bottles. One of the plastic bottles was field preserved with trace nitric acid and the other was field preserved with trace sulfuric acid. All water quality samples were collected as grab samples. Bacteriological samples were collected in sterilized plastic bottles. At the time of sampling, measurements for dissolved oxygen, pH, temperature, and conductivity were collected using either a YSI EXO1 or 600XL sonde. Duplicate samples and field blanks were collected at randomly selected sites, at a frequency not less than 5% of the total samples collected. Relative percent difference (RPD) was used to determine the degree of discrepancy between the primary and duplicate sample (Formula 1).

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

X= is the concentration of the parameter in the primary sample

Y= is the concentration of the parameter in the duplicate sample

2014 Big Creek Environmental Monitoring Results  
January 25, 2017

The acceptable percent RPD is based on the ratio of the sample concentration and detection limit (Formula 2) (Ohio EPA, 2013).

$$\text{Formula 2: Acceptable \% RPD} = [(0.9465X^{-0.344}) * 100] + 5$$

X = sample/detection limit ratio

Those RPDs that are higher than acceptable may indicate potential problems with sample collection and, as a result, the data was not used for comparison to the water quality standards.

Water chemistry analysis sheets for each site are available upon request from the NEORSD WQIS Division.

## Results and Discussion

One field blank was collected during the study on July 2, 2014, and the validation results are listed in Table 2.

<b>Table 2. Parameters Requiring Qualification</b>				
Date	Parameter	Qualifier	Blank Result	Sample Result
7/02/14	Cr	J*	J 0.112	1.034
7/02/14	DRP	Level 2	0.01	0.034
7/02/14	Zn	Level 2	1.30	4.388

\*estimated

For the one duplicate sample that was collected during the study, the RPD for the aluminum (Al) and titanium (Ti) results were greater than acceptable and resulted in rejection of the data (Table 3). Potential reasons for this discrepancy include lack of precision and consistency in sample collection and/or analytical procedures, environmental heterogeneity and/or improper handling of samples.

<b>Table 3. Unacceptable Duplicate RPDs</b>					
Date	River Mile	Parameter	Acceptable RPD (%)	Actual RPD (%)	Qualifier
6/25/14	1.00	Al	9.7	18.3	Rejected
		Ti	22.8	133.5	Rejected

The final QA/QC check for the samples was a comparison of paired parameters. This comparison showed that total solids and total dissolved solids results for one sample

2014 Big Creek Environmental Monitoring Results  
January 25, 2017

needed to be listed as estimated. The reason for these parameters not meeting Ohio EPA’s requirements may include differences in sampling and analysis methods.

RM 0.15 and RM 1.00 on Big Creek are designated as warmwater habitat (WWH), agricultural water supply, industrial water supply, and Class B primary contact recreation water. Exceedances of the water quality standards associated with these uses occurred for bacteria, mercury and copper. At RM 0.15 and RM 1.00, copper exceeded the hardness-based limit for the protection of aquatic life outside mixing zone maximum (OMZM) criterion on June 25, 2014. A copper result of 20.17 ug/L exceeded the criterion of 11.74 ug/L at RM 0.15 and a result of 19.15 ug/L exceeded the criterion of 11.54 ug/L at RM 1.00. The bacteriological criteria for *E. coli* consist of two components: a seasonal geometric mean and a value not to be exceeded in more than 10% of the samples collected during a 30-day period (single sample maximum). For those streams designated Class B primary contact recreation, these criteria are 161 colony counts/100mL and 523 colony counts/100mL, respectively. The seasonal geomean criterion was exceeded at RM 0.15 and RM 1.00 in 2014 (Table 4). The single sample maximum criterion was also exceeded for all samples collected in a 30-day period.

<b>Table 4. 2014 Big Creek <i>E. coli</i> Densities (Most Probable Number/100mL)</b>		
Date	RM 0.15	RM 1.00
6/18/2014*	137,340	154,020
6/25/2014*	81,600	56,800
7/2/2014	616	1,810
7/09/2014*	73,080	82,120
7/16/2014*	7,498	13,780
7/22/14	612	-
Seasonal Geomean	11,501.66	28,226.72
*Wet-weather event <span style="background-color: #ccccff; border: 1px solid black; display: inline-block; width: 1em; height: 1em; vertical-align: middle;"></span> Exceeds single sample maximum criterion for 30-day period starting on that date		

Four of the samples were collected as part of wet-weather events<sup>1</sup>. In total, 12 recorded wet-weather overflows to Big Creek or its tributaries occurred from June 18 to July 22, 2014, for those CSOs with monitoring capabilities (Table 5). These overflows contained a mixture of rainwater, urban and stormwater runoff, and raw sewage and were likely sources of elevated *E. coli* densities in the creek.

<sup>1</sup> 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 are considered wet weather samples.

<b>Table 5. Wet-Weather Overflows to Big Creek from June 18 to July 22, 2014</b>				
Outfall Name	Location	Receiving Water	Number of Overflows	Million Gallons (MG)
CSO 051	W. 38th/Muriel	Big Creek	5	Unknown
CSO 055	Bellaire/Kensington Dam	Big Creek	1	Unknown
CSO 056	Bellaire/Kensington Gate	Big Creek	4	0.51
CSO 058	W. 145th/Puritas	Big Creek	2	1.86

Mercury analysis for all of the sampling events was done using EPA Method 245.1. Because the detection limit for this method is above the criteria for the Human Health Nondrinking and Protection of Wildlife Outside Mixing Zone Averages (OMZA), it generally cannot be determined if Big Creek was in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine whether contamination was present above those levels typically found in the creek.

Ohio EPA's Trophic Index Criterion (TIC) is an index that looks at the measures of nutrients, benthic algae, dissolved oxygen, and the biological components and assigns points to ranges of each indicator. Nutrients were assessed in 2014. For Big Creek at RM 0.15 and RM 1.00, the samples collected showed average concentrations of total phosphorus at 0.14mg/L and 0.16mg/L and DIN at 0.69 mg/L and 0.73mg/L, respectively. Based on these concentrations, the nutrient component of the TIC indicates that concentrations are acceptable because they are typical of healthy streams in working landscapes.

## **Habitat Assessment**

### **Methods**

An instream habitat assessment was conducted once at both sites in 2014 using the Qualitative Habitat Evaluation Index (QHEI). The QHEI was developed by the Ohio EPA to assess aquatic habitat conditions that may influence the presence or absence of fish species by evaluating the physical attributes of a stream. The index is based on six metrics: stream substrate, instream cover, channel morphology, riparian zone and bank condition, pool and riffle quality, and stream gradient. The QHEI has a maximum score of 100, and a score of 60 or more suggests that sufficient habitat exists to support a fish community that meets the warmwater habitat criterion (Ohio EPA, 2003). A more detailed description of the QHEI can be found in Ohio EPA's *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)*

(2006). QHEI field sheets for each site are available upon request from the NEORSD WQIS Division.

**Results and Discussion**

The QHEI score was 68.00 for RM 0.15 in 2014 (Table 6). This site met the target QHEI score of 60, as it has the past seven years. The site has a predominantly gravel and sand substrate and features a large riffle, runs, and deep pools. Instream cover is moderate and consists of undercut banks, overhanging vegetation, slow shallows, boulders, rootwads and logs or woody debris. The creek has a very narrow riparian zone to buffer the surrounding urban and industrial land use, and the bank on river right has severe erosion. The sediments at this site appear to be prone to shifting, presumably during wet-weather events and high flows.

The QHEI score was 65.75 for RM 1.00 in 2014 (Table 6). The site was rated “*Good*”. Cobble and bedrock were the predominant substrate types with normal silt and substrate embeddedness. Instream cover consisted of shallows, deep pools, and boulders with sparse amounts of instream cover. The industrial flood plain had no riparian width and a narrow riparian width on river left and river right, respectively.

Table 6. 2014 Big Creek QHEI Results			
River Mile	Year	QHEI Score	Narrative
0.15	2007	68.75	<i>Good</i>
	2008	64.00	<i>Good</i>
	2009	73.25	<i>Good</i>
	2010	70.50	<i>Good</i>
	2011	69.50	<i>Good</i>
	2012	71.50	<i>Good</i>
	2013	73.50	<i>Good</i>
	2014	68.00	<i>Good</i>
1.00	2014	65.75	<i>Good</i>

**Fish Community Assessment**

**Methods**

One electrofishing pass was conducted by boat at RM 0.15 in 2014. Two quantitative electrofishing passes were conducted at RM 0.15; one each using backpack and longline electrofishing techniques. Sampling consisted of shocking all habitat types within a sampling zone while moving from downstream to upstream. The sampling zones were 0.15 km for backpack electrofishing, 0.20 for longline electrofishing and 0.28

km for the boat electrofishing. The methods that were used followed Ohio EPA protocol methods as detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). Fish collected during the surveys were identified, weighed and examined for the presence of anomalies, including DELTs (deformities, eroded fins, lesions, and tumors). All fish were then released to the waters from which they were collected, except for vouchers and those that could not be easily identified in the field.

The electrofishing results for each pass were compiled and utilized to evaluate fish community health through the application of two Ohio EPA indices, the Index of Biotic Integrity (IBI) and the Modified Index of Well-Being (MIwb). The IBI incorporates 12 community metrics representing structural and functional attributes. The structural attributes are based upon fish community aspects such as fish numbers and diversity. Functional attributes are based upon fish community aspects such as feeding strategies, environmental tolerances, and disease symptoms. These metrics are individually scored by comparing the data collected at the survey site with values expected at reference sites located in a similar geographical region. The maximum possible IBI score is 60 and the minimum possible score is 12. The summation of the 12 individual metrics scores provides a single-value IBI score, which corresponds to a narrative rating of *Exceptional, Good, Marginally Good, Fair, Poor* or *Very Poor*. The 12 metrics utilized for wading sites are listed in Table 7.

<b>Table 7. IBI Metrics</b>	
<b>Wading</b>	<b>Boat</b>
Number of Native Species	Number of Native Species
Number of Darter species	Percent Round-Bodied Suckers
Number of Sunfish Species	Number of Sunfish Species
Number of Sucker Species	Number of Sucker Species
Number of Intolerant Species	Number of Intolerant Species
Percent Tolerant	Percent Tolerant
Percent Omnivores	Percent Omnivores
Percent Insectivores	Percent Insectivores
Percent Top Carnivores	Percent Top Carnivores
Number of Individuals	Number of Individuals
Percent Simple Lithophils	Percent Simple Lithophils
Percent DELT Anomalies	Percent DELT Anomalies

The second fish index utilized by Ohio EPA is the Modified Index of Well-being (MIwb). The MIwb, Formula 1 below incorporates four fish community measures: numbers of individuals, biomass, and the Shannon Diversity Index (H) (Formula 2 below) based on numbers and weight of fish. The MIwb is a result of a mathematical calculation based upon the formula.

Formula 1:  $MIwb = 0.5 \ln N + 0.5 \ln B + \bar{H}(No.) + \bar{H}(Wt.)$

$N$  = Relative numbers of all species excluding species designated as highly tolerant, hybrids, or exotics

$B$  = Relative weights of all species excluding species designated as highly tolerant, hybrids, or exotics

$\bar{H}(No.)$  = Shannon Diversity Index based on numbers

$\bar{H}(Wt.)$  = Shannon Diversity Index based on weight

Formula 2: 
$$\bar{H} = - \sum \left[ \left( \frac{n_i}{N} \right) \log_e \left( \frac{n_i}{N} \right) \right]$$

$n_i$  = Relative numbers or weight of species

$N$  = Total number or weight of the sample

Lists of the species, numbers, weights, pollution tolerances and incidence of DELT anomalies for fish collected during the electrofishing pass are available upon request from the NEORSW WQIS Division.

## Results and Discussion

The Warmwater Habitat (WWH) IBI criterion in the Erie-Ontario Lake Plain (EOLP) ecoregion is 38 for wading sites. A site is considered to be in non-significant departure if it is within 4 IBI units of its applicable criterion. The MIwb criterion for wading sites is 7.9; non-significant departure is within 0.5 units. Table 8 lists the average IBI and MIwb scores where applicable. Figure 2 illustrates temporal trends in IBI and MIwb scores from 2007-2014.

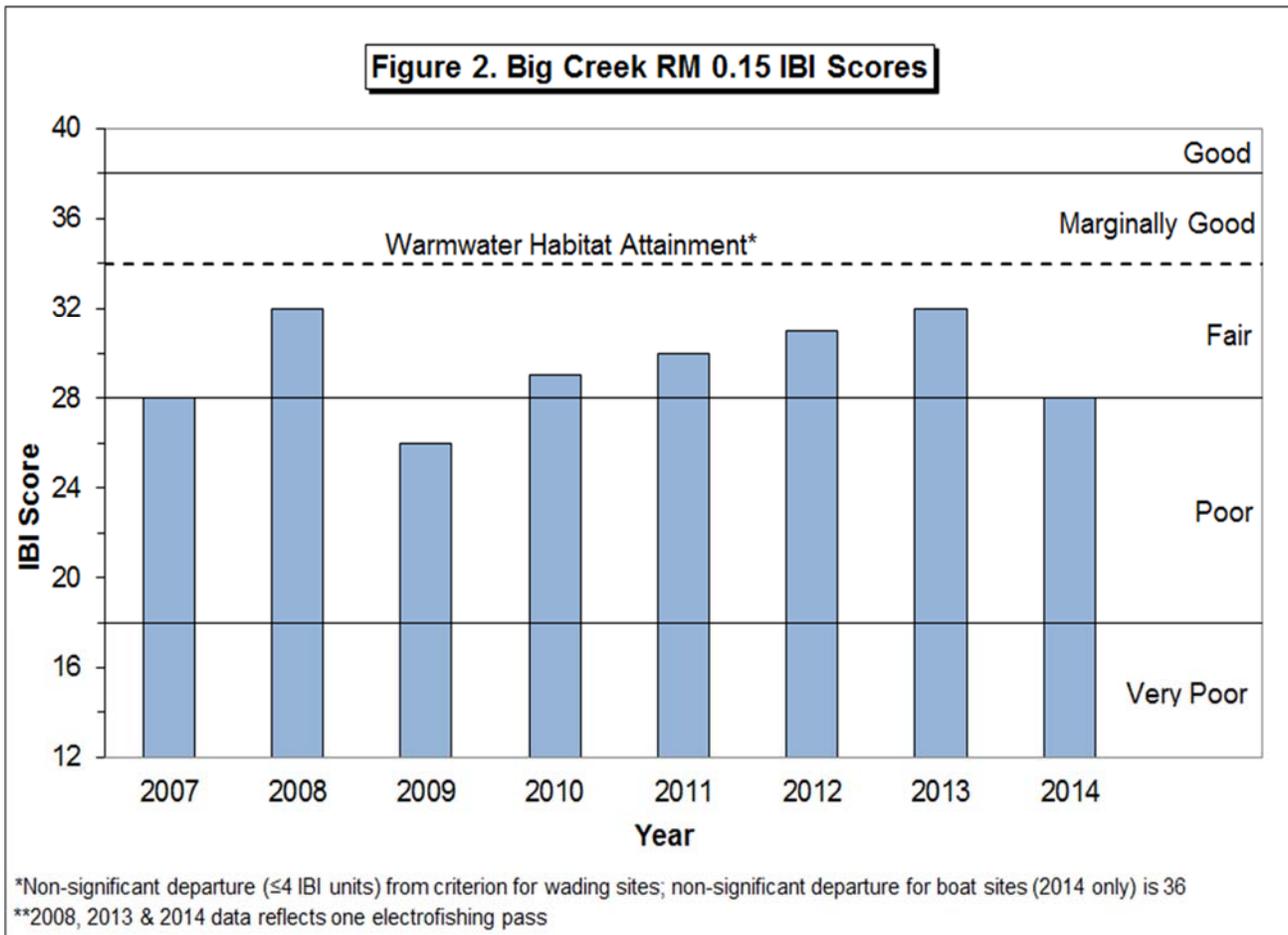
Table 8. Average Big Creek IBI & MIwb Scores					
		IBI		MIwb	
River Mile	Year	Score	Narrative Rating	Score	Narrative Rating
0.15	2007	28 <sup>a</sup>	Fair	5.3 <sup>a</sup>	Poor
	2008	32 <sup>a</sup>	Fair	6.6 <sup>a</sup>	Fair
	2009	26	Poor	5.6	Poor
	2010	29 <sup>a</sup>	Fair	6.1 <sup>a</sup>	Fair
	2011	30 <sup>a</sup>	Fair	6.1 <sup>a</sup>	Fair
	2012	31 <sup>a</sup>	Fair	7.0 <sup>a</sup>	Fair
	2013	32	Fair	5.4	Poor
	*2014	28	Fair	8.6	Marg. Good
1.00	2014	26	Fair	6.1	Fair
		<sup>o</sup> 18	Poor	<sup>o</sup> 3.8	Very Poor

<sup>a</sup>Average score \* Boat electroshock method <sup>o</sup> backpack electroshocking; not considered to be a representative assessment

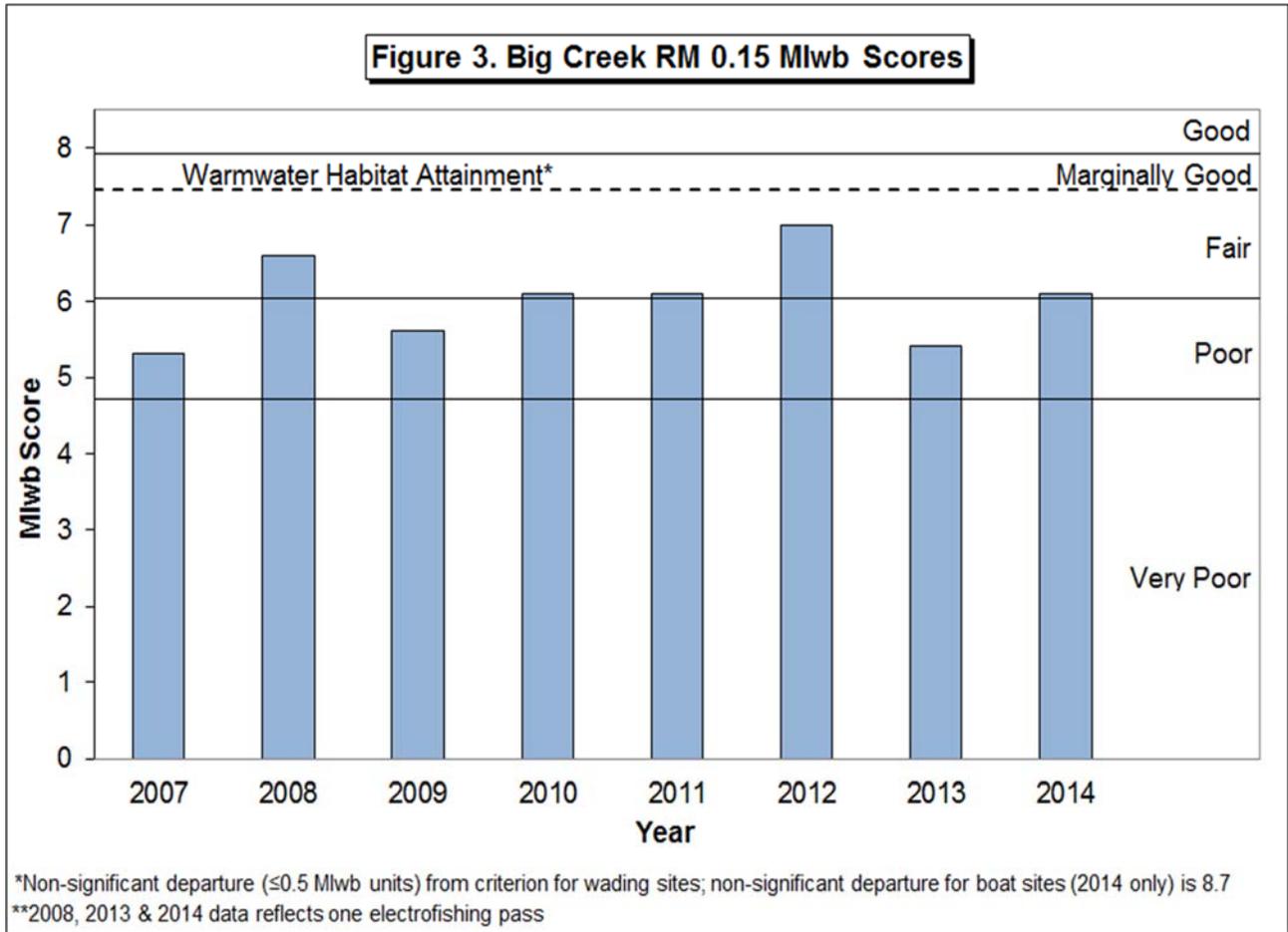
The fish community at RM 0.15 was electrofished on July 13, 2014. Previously, this site had been assessed using longline methods. Due to changes in the site that resulted in an increase in depth in the upper portions of the sampling zone, a boat had to be used instead in 2014. This assessment resulted in an IBI score of 28 (*Fair*) and a MIwb score of 8.6 (*Marginally Good*), failing to meet the IBI WWH biocriterion, but meeting the one for the MIwb biocriterion. The 2014 IBI score remains consistent with previous six years IBI scores (Table 8) for this site even though a different method was used. Eighty fish, which consisted of sixteen different species, were collected in the one electrofishing pass, and about 55% of the total catch consisted of pollution-tolerant individuals such as common white sucker (*Catostomus commersonii*), yellow bullhead (*Ictalurus natalis*), green sunfish (*Lepomis cyanellus*) and goldfish (*Carassius auratus*). Twelve smallmouth bass (*Micropterus dolomieu*) were also collected and these fish are moderately intolerant to pollution.

The fish community at RM 0.15 in 2013 had an IBI score of 32 (*Fair*) and a MIwb score of 5.4 (*Poor*), failing to meet the WWH biocriteria. The 2013 score was consistent with previous years IBI scores (Table 8) for this site. Ten species of fish were collected in the one electrofishing pass, and about 60% of the total catch consisted of pollution-tolerant individuals such as common white sucker, yellow bullhead, and green sunfish. Previous years IBI and MIwb scores are depicted in Figure 2 and Figure 3.

The fish community at RM 1.00 in 2014 had an IBI score of 26 (*Poor*) and a MIwb score of 6.1 (*Fair*), failing to meet the IBI and MIwb WWH biocriteria. Nine species of fish were collected out of a total of 909 fish collected in one longline electrofishing pass that was conducted on September 3, 2014. About 40% of the total catch consisted of pollution-tolerant individuals such as common white sucker, western blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), bluntnose minnow (*Pimephales notatus*), yellow bullhead and green sunfish. This site was also backpack electrofished on July 3, 2014, and a total of 51 fish were collected by this method. An IBI and MIwb score of 18 (*Poor*) and 3.8 (*Very Poor*) were obtained at this site, respectively. The low numbers and diversity of fish may be attributed to insufficient power dispersed in the stream, due to a deeper faster water current velocity at this location, and is not considered to be a representative assessment.



A total of 12 CSO overflow events, from June 18, 2014 to July 22, 2014, contributed more than 2.4 million gallons of combined sewage to Big Creek; these overflows may detract from a movement of more desirable pollution-sensitive species from inhabiting the site. There are also a number of illicit discharges located upstream of the sampling area. The fish community would likely improve with the reduction/removal of overflow events and illicit discharges, as the habitat should be capable of supporting a more diverse population of fish.



## Macroinvertebrate Sampling

### Methods

Macroinvertebrates were sampled quantitatively using modified Hester-Dendy (HD) samplers in conjunction with a qualitative assessment of Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly), also referred to as EPT taxa, inhabiting available habitats at the time of HD retrieval. Methods for sampling followed the Ohio EPA’s Biological Criteria for the Protection of Aquatic Life, Volume III (1987b). The recommended period for HDs to be installed is six weeks.

The macroinvertebrate qualitative samples were sent to Third Rock Consultants, LLC for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as recommended in Ohio EPA’s *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989; November 8,

2006; and August 26, 2008). The taxa lists and enumerations are available upon request from NEORSD's WQIS Division.

The overall aquatic macroinvertebrate community in the stream was evaluated using Ohio EPA's Invertebrate Community Index (ICI) (OEPA 1987a, Ohio EPA undated). The ICI consists of ten community metrics (Table 9), each with four scoring categories. Metrics 1-9 are based on the quantitative sample, while Metric 10 is based on the qualitative EPT taxa. The total of the individual metric scores result in the overall score. This scoring evaluates the community against Ohio EPA's reference sites for each specific eco-region.

<b>Table 9. ICI Metrics</b>
Total number of taxa
Number of mayfly taxa
Number of caddisfly taxa
Number of dipteran taxa
Percent mayflies
Percent caddisflies
Percent Tanytarsini midges
Percent other diptera and non-insects
Percent tolerant organisms (as defined)
Number of qualitative EPT taxa

## Results and Discussion

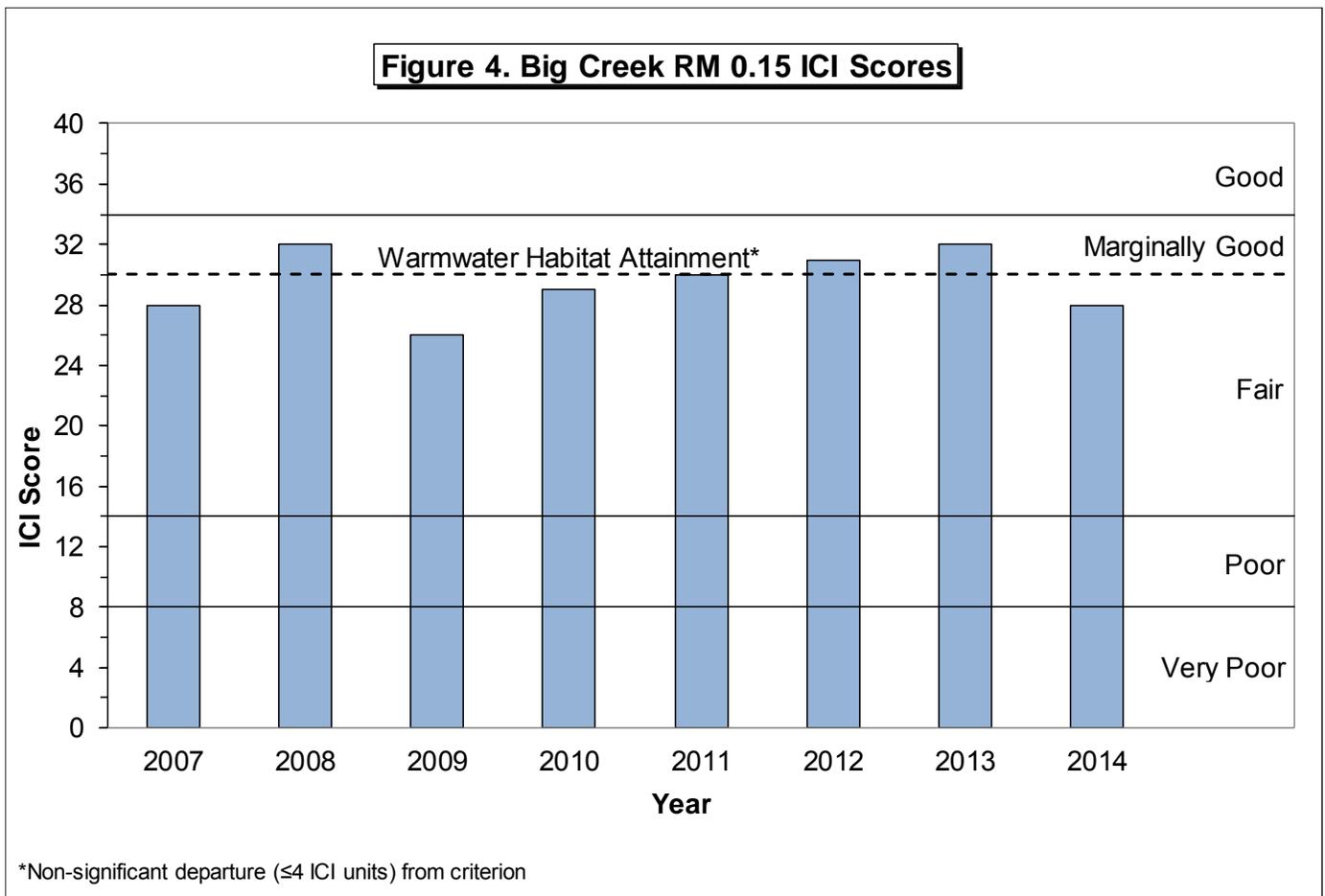
As in 2013, HD samplers had to be reinstalled on Big Creek at RM 0.15 due to missing samplers or the samplers being buried. Initial installation was on June 18, 2014, and an additional installation took place on June 30, 2014. The HD sampler was retrieved on August 15, 2014. The ICI score was calculated at 30 with a narrative rating of *Marginally Good*, and was in non-significant departure of the WWH ICI criterion of 34 for the EOLP ecoregion. Twenty-three percent of the taxa were comprised of *Thienemannimyia* group. One moderately-intolerant taxa was collected on the HD, *Ceratopsyche morose*, and two moderately tolerant taxa were collected *Berosus* sp and *Cricotopus* (*C.*) *tremulus* group. The qualitative sample showed 25 taxa collected with a low density and diversity of organisms collected in the riffle, runs and pools.

In 2013, the ICI score was calculated at 24, lower than the score of 30 obtained in 2014. Twenty-four percent of the taxa were comprised of *Oligochaeta*. Table 10 and Figure 4 summarizes the sampling results from 2007-2014.

2014 Big Creek Environmental Monitoring Results  
January 25, 2017

Table 10. Big Creek Invertebrate Community Index (ICI) Results							
RM	Date	ICI Score	Narrative Rating	Quantitative Taxa	Qualitative Taxa	Qualitative EPT Taxa	% Tolerant (as defined)
0.15	2007	22	<i>Fair</i>	29	16	5	43.9
0.15	2008	22	<i>Fair</i>	24	15	6	57.4
0.15	2009	28	<i>Fair</i>	26	24	6	19.0
0.15	2010	20	<i>Fair</i>	31	27	3	58.5
0.15	2011	--	--	--	25	7	--
0.15	2012	<b>32*</b>	<i>Marginally Good</i>	31	25	6	18.2
0.15	2013	24	<i>Fair</i>	36	27	3	45.8
0.15	2014	<b>30*</b>	<i>Marginally Good</i>	28	25	4	16.22
1.00	2014	28	<i>Fair</i>	24	20	8	20.97

\* **Bold indicates attainment (non-significant departure) of WWH criterion**



In 2014, HD samplers had to be reinstalled one time on Big Creek at RM 1.00 due to missing samplers or the samplers being buried. Initial installation was on June 18, 2014, and an additional installation took place on July 3, 2014. The HD sampler was retrieved on August 15, 2014. The ICI score was calculated at 28 with a narrative rating

of *Fair*. Fifty-two percent of the taxa were comprised of the *Thienemannimyia* group and *Baetis flavistriga*. One moderately-intolerant taxa was collected at this site, *Ceratopsyche morosa*. Three moderately-tolerant taxa were collected, *Crangonyx* sp, *Cricotopus* (*C.*) *tremulus* group and *Nanocladius* (*N.*) *distinctus*. The qualitative sample showed 20 taxa collected with a low/moderate density and diversity of organisms collected in the riffles and runs and low diversity of organisms collected in all habitat types.

## Conclusions

Sampling on Big Creek in 2014 was conducted to determine point source and non-point source impairments. From the water chemistry portion of this sampling, it was found that exceedances of the applicable water quality standards occurred for bacteria and copper (Table 11). Combined sewer overflows due to wet-weather events, along with illicit discharges, were most likely responsible for the elevated copper and *E. coli* densities that were found.

The storm sewer outfall pipe identified as BGMB1680 is upstream of RM 0.15, and downstream of sampling site RM 1.00. The dry weather flow (DWF) from the storm sewer outfall was found to have an estimated 830 pounds of chlorides per day entering the stream (sampled on 11/20/13). The impact from this dry weather discharge appears not to have any more of an effect on the fish and macroinvertebrate communities than if the dry weather discharge from the storm sewer outfall pipe was absent. The fish and macroinvertebrate scores were relatively the same upstream and downstream of the outfall pipe. However, the biological community at RM 1.00 appears to be impacted from other sources. This site was in non-attainment for both fish and macroinvertebrates. Known illicit discharges, particularly from improper sanitary sewer connections upstream of this site are mostly likely negatively affecting the communities there.

The fish community at RM 0.15 in 2014 had an IBI score of 28 and a MIwb score of 8.6, failing to meet the IBI WWH biocriterion, however, meeting the MIwb biocriterion. An ICI score of 30 was in non-significant departure and met the WWH criterion. An additional impairment may be the torrential current velocity during wet-weather events and heavy erosion along the stream banks. Year after year, it is prevalent that a HD samplers may be lost or buried due to high stream current velocities within the stream. The majority of the population of fish consisted of highly pollution-tolerant fish, such as white suckers, yellow bullheads and green sunfish. A good proportion of the macroinvertebrate community was comprised of *Oligochaeta*, a classification of organisms listed in the ICI metrics as extremely pollution tolerant. The water quality, fish and macroinvertebrate communities are expected to improve in Big Creek over time, if CSO overflows are reduced and or eliminated and illicit outfall discharge are remediated.

<b>Table 11. 2014 Big Creek Survey Results</b>						
River Mile	Aquatic Life Use Attainment Status	IBI Score (Narrative Rating)	MIwb Score (Narrative Rating)	ICI Score (Narrative Rating)	QHEI Score (Narrative Rating)	Water Quality Exceedences
0.15	Partial Attainment	28 ( <i>Fair</i> )	8.6 ( <i>Marginally Good</i> )	30 ( <i>Marginally Good</i> )	73.50 ( <i>Good</i> )	<i>E. coli</i> , copper
1.00	Non-Attainment	26 ( <i>Fair</i> )	6.1 ( <i>Fair</i> )	28 ( <i>Fair</i> )	65.75 ( <i>Good</i> )	<i>E. coli</i> , copper
WWH Biocriteria attainment IBI score of 38 ; ICI Score of 34 Non-significant departure: $\leq 4$ IBI units; $\leq 0.5$ MIwb units						

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Analytical Services Division – Completed analysis for all water chemistry sampling

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2014 Big Creek Environmental Monitoring Results  
January 25, 2017

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