

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2018 Chippewa Creek Environmental Monitoring Biological, Water Quality, and Habitat Survey Results



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

Introduction

The lower Cuyahoga River has been designated as one of 42 Great Lakes Areas of Concern (AOC) by the International Joint Commission. Past monitoring of this area has indicated impairment of aquatic biota and was the basis for the establishment of Total Maximum Daily Loads (TMDLs) for the Lower Cuyahoga River. The causes of impairment to the river were classified as organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration (Ohio EPA, 2003). Recently, monitoring by the Northeast Ohio Regional Sewer District (NEORS) has shown recovery of the biological community in some reaches of the river. Further assessments throughout the watershed, including tributaries of the Cuyahoga River, is necessary to determine what areas may be still impaired.

In 2018, NEORS conducted environmental monitoring assessments including water chemistry sampling, habitat evaluation, and fish and macroinvertebrate community surveys on Chippewa Creek, a tributary to the Cuyahoga River. As part of NEORS's general watershed monitoring program, the study objective was to conduct environmental monitoring on Chippewa Creek, in addition to four other tributaries to the Cuyahoga River, as outlined in *2018 Cuyahoga River Tributaries Environmental Monitoring* study plan, approved by Ohio EPA on April 18, 2018. Portions of the collected tributary data will provide additional valuable information in support of continued monitoring efforts of the lower Cuyahoga AOC, and the potential delisting of some beneficial use impairments.

Sampling was conducted by the NEORS Environmental Assessment group of the Water Quality and Industrial Surveillance (WQIS) Division and occurred between June 15 through September 30, 2018 (through October 15 for fish sampling assessments), as required in the Ohio EPA *Biological Criteria for the Protection of Aquatic Life Volume III* (1987b). Sampling was conducted by NEORS Level 3 Qualified Data Collectors (QDCs) certified by Ohio EPA in Fish Community and Benthic Macroinvertebrate Biology, and Chemical Water Quality and Stream Habitat Assessments as explained in the NEORS study plan.

A study area map, noting the sampling locations evaluated during the 2018 environmental monitoring season, are displayed in Figure 1. Each sampling location with respect to river mile, latitude/longitude, description, and the types of surveys conducted are indicated in Table 1. A digital photo catalog of the sampling locations is available upon request by contacting the NEORS WQIS Division.

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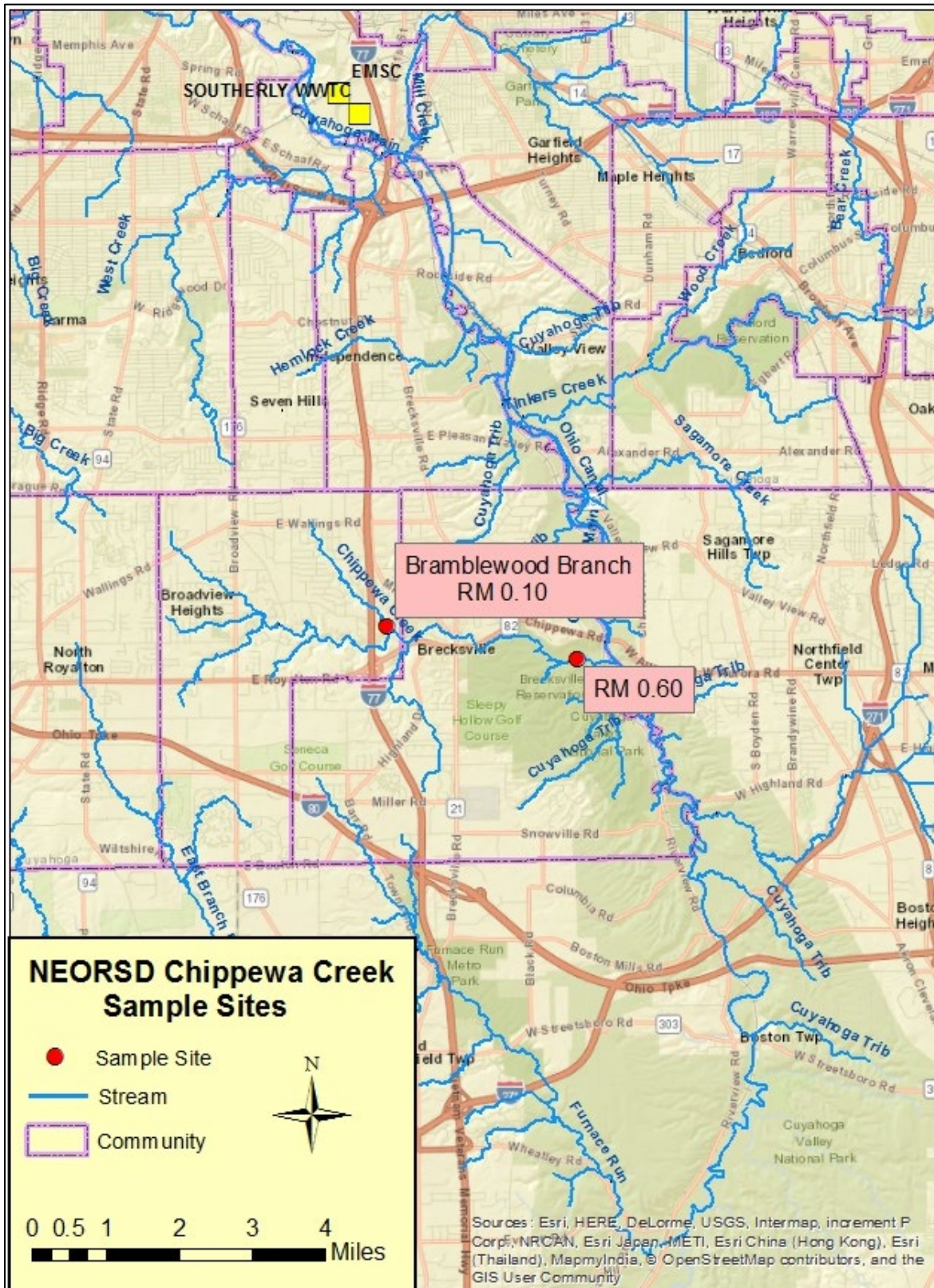


Figure 1. Chippewa Creek Monitoring Locations

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Table 1. Chippewa Creek Evaluated Sampling Locations						
Site Location	Latitude	Longitude	River Mile	Description	HUC 8	Purpose
Chippewa Creek	41.3173	-81.5952	0.60	Downstream of ford over creek on Chippewa Creek Drive in Metroparks Brecksville Reservation.	04110002 - Cuyahoga	General watershed monitoring and supporting data for Cuyahoga AOC
Chippewa Creek, Bramblewood Branch	41.3244	-81.6448	0.10	Bramblewood Branch, upstream of confluence with the main branch, east of Harris Road and Eagle Valley Court.	04110002 - Cuyahoga	General watershed monitoring

Water Chemistry Sampling

Methods

Five separate water chemistry and bacteriological sampling events were conducted between July 24th and August 21, 2018. Techniques used for sampling and analyses were conducted according to methods found in *Surface Water Field Sampling Manual for water quality parameters and flows* (Ohio EPA, 2018). Chemical water quality samples from each site were collected with a 4-liter disposable polyethylene cubitainer with a disposable polypropylene lid, three 473-mL plastic bottles, and one 125-mL plastic bottle. The first 473-mL plastic bottle was field preserved with trace nitric acid, the second was field preserved with trace sulfuric acid, and the third bottle received no preservative. The sample collected in the 125-mL plastic bottle (dissolved reactive phosphorus) was filtered using a 0.45- μ m PVDF syringe filter. All water quality samples were collected as grab samples. Bacteriological samples were collected in sterilized plastic bottles preserved with sodium thiosulfate. At the time of sampling, measurements for dissolved oxygen, pH, temperature, and conductivity were collected using either a YSI 600XL sonde or YSI EXO1 sonde. Duplicate samples and field blanks were each 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).

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

x = concentration of the parameter in the primary sample

y = concentration of the parameter in the duplicate sample

The acceptable percent RPD is based on the ratio of the sample concentration and detection limit (Formula 2) (Ohio EPA, 2018).

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

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.

Mercury analysis for all the sampling events was completed 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 OMZA, it generally cannot be determined if Chippewa 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 stream.

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

Results and Discussion

For the 2018 study, one duplicate sample and one field blank were collected for quality assurance and quality control (QA/QC) purposes. The duplicate sample was collected at Chippewa Creek RM 0.60 on July 31, 2018. One parameter from the RM 0.60 duplicate sample, zinc (Zn), was rejected based on an RPD value outside of the acceptable RPD range (Table 2). The date in which this sample was collected was not considered wet weather¹. Therefore, the reason for the unacceptable difference between the samples remains unknown, but potentially could be due to lack of precision and consistency in sample collection and/or analytical procedures, environmental heterogeneity, and/or improper handling of samples.

Table 2. Duplicate Parameter Analysis					
Site	Date	Parameter	Acceptable RPD (%)	Actual RPD (%)	Qualifier
Chippewa Creek RM 0.60	8/16/2017	Zn	46.1	98.7	Rejected

One field blank sample was collected during the 2018 sampling season, at Chippewa Creek Bramblewood Branch RM 0.10. For the field blank, there was one parameter that showed possible contamination. It is unclear how the field blank became contaminated and may be due to inappropriate sample collection, handling, and/or contaminated blank water. Table 3 lists the water quality parameter that was listed as rejected based on Ohio EPA data validation protocol.

Table 3. Parameter Affected by Possible Blank Contamination
TKN

Paired parameters for all samples collected from each of the two sampling locations within Chippewa Creek were evaluated for QA/QC purposes. The comparisons revealed no rejected data for the sampling sites, and one set of parameters with estimated

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 are considered wet weather samples.

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data on several sampling dates (Table 4). Because there were no exceedances associated with these parameters, qualification of these results did not significantly change the overall water chemistry assessment of Chippewa Creek.

Table 4. Paired Data Parameter Analysis						
Site	Date	Parameter	Data Pair	Acceptable RPD (%)	Actual RPD (%)	Qualifier
Chippewa Creek RM 0.60	7/31/2018	Total P	DRP	102.8	18.2	Estimated
Chippewa Creek Bramblewood Branch RM 0.10	7/24/2018	Total P	DRP	102.8	18.2	Estimated
	7/31/2018	Total P	DRP	102.8	18.2	Estimated

Chippewa Creek RM 0.60 is designated as a State Resource Water (SRW), Warmwater Habitat (WWH), Agricultural Water Supply (AWS), Industrial Water Supply (IWS), and Primary Contact Recreation (PCR); and Chippewa Creek Bramblewood Branch is designated WWH, AWS, IWS, and PCR. The water chemistry samples collected at each site were compared to the applicable Ohio Water Quality Standards for the designated uses to determine attainment (Ohio EPA, 2018).

Water chemistry sampling in 2018 for Chippewa Creek RM 0.60 and Bramblewood Branch RM 0.10 revealed mercury concentrations that were below the method detection limit for EPA Method 245.1. It is expected that the use of EPA Method 1631E, a low-level method, instead of EPA Method 245.1, would have resulted in exceedances of the criteria throughout the sampling period. Mercury may be introduced into Chippewa Creek from urban runoff and atmospheric deposition within the watershed.

The Primary Contact Recreation criteria for Chippewa Creek includes an *Escherichia coli* (*E. coli*) criterion not to exceed a Statistical Threshold Value (STV) of 410 colony counts/100mL in more than ten percent of the samples taken during any 90-day period, and a 90-day geometric mean criterion of 126 colony counts/100mL (Ohio EPA, 2015a). In accordance with Ohio EPA procedure and practice to qualify *E. coli* exceedances for the Primary Recreation criteria, the geometric mean and STV are only calculated and compared when a minimum of five bacteriological samples have been collected. Chippewa Creek exceeded the primary contact recreation 90-day geometric mean at both sampling locations. Wet-weather sampling events occurred on July 24, July 31, August 7, and August 21, 2018, and therefore, stormwater runoff may have contributed to these exceedances. *E. coli* exceedances may also have been impacted by possible failing home septic systems in the surrounding residential areas upstream of and adjacent to the sampling locations. The STV criterion was also exceeded for the 90-day period for both

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sampling sites on Chippewa Creek, as RM 0.60 and Bramblewood Branch RM 0.10 averaged above the maximum ten percent allowed (Table 5).

Table 5. 2018 Chippewa Creek <i>E. coli</i> Densities (MPN/100mL)		
Date	RM 0.60	Bramblewood Branch RM 0.10
7/24/2018*	779	1064
7/31/2018*	658.5	54
8/7/2018*	6720	5900
8/14/2018	303	308
8/21/2018*	6900	7100
90 Day Geometric Mean	1484.40	941.90
	Exceeds statistical threshold value (STV)	
	Exceeds geometric mean criterion for 90-day period	
* - Wet Weather Event: 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.		

Apart from the probable mercury exceedances and the exceedances for *E. coli*, Chippewa Creek RM 0.60 had exceedances for nickel (Ni) for Agricultural Outside Mixing Zone Average (OMZA) and Aquatic Life OMZA/Tier 1 OMZA. Of the five water samples collected and assessed for Ni, four samples resulted in concentrations well below the limits for the various OMZA criteria. The fourth sampling event for this location, on August 14, 2018, resulted in a Ni concentration of 851.20 µg/L, therefore causing the exceedances for the above criteria. The August 14th sampling event was not considered a wet-weather event. Upstream of the sampling location is a former landfill area. Periodic heavy rains in the previous three weeks may have contributed to urban runoff from this former landfill or other areas upstream of the sampling location, which may have concentrated during a brief period of lower flow captured during this sampling event.

Table 6. 2018 Chippewa Creek RM 0.60 Nickel Concentrations	
Date	Concentration of Nickel (µg/L)
7/24/2018*	4.386
7/31/2018*	2.56 ^o
8/7/2018*	3.453 ^o
8/14/2018	851.2
8/21/2018*	12.03
* - Wet Weather Event: 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.	
^o - Data is estimated; result is between practical quantitation limit (PQL) and minimum detection limit (MDL).	
- Exceedance of Aquatic Life, Tier 1, and Agriculture OMZA	
- Exceedance of Agriculture OMZA	

In 2015, the Ohio EPA Nutrients Technical Advisory Group released a proposed Stream Nutrient Assessment Procedure (SNAP) designed to determine the degree of impairment in a stream due to nutrient enrichment. SNAP assigns designations for quality

of surface waters based on factors including dissolved oxygen (DO) swings, benthic chlorophyll *a*, total phosphorous, and dissolved inorganic nitrogen (Ohio EPA, 2015). NEORSD did not assess DO swings or benthic chlorophyll *a* in 2018; however, nutrients were assessed.

Table 7 shows the mean calculated nutrient concentrations for the Chippewa Creek sampling locations assessed in 2018. The results of dissolved inorganic nitrogen and total phosphorous were compared to Table 2 listed in the SNAP document. According to this section of SNAP, both Chippewa Creek RM 0.60 and Chippewa Creek Bramblewood Branch RM 0.10 exhibit “background levels typical of least disturbed conditions” (Ohio EPA, 2015). This indicates that neither phosphorus nor nitrogen are of a significant concern as a primary source of impairment at these sampling sites.

Table 7. 2018 Chippewa Creek Nutrient Concentrations		
Site	Total Phosphorus Geometric Mean (mg/L)	Dissolved Inorganic Nitrogen Geometric Mean (mg/L)
Chippewa Creek RM 0.60	0.030	0.199
Chippewa Creek Bramblewood Branch RM 0.10	0.022	0.389

Habitat Assessment

Methods

Instream habitat assessments were conducted once at the sampling sites on Chippewa Creek and Chippewa Creek Bramblewood Branch in 2018 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 55 or more suggests that sufficient habitat exists to support a fish community that attains the WWH criterion. 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 stream segment at Chippewa Creek RM 0.60 was assessed on July 26, 2018. A QHEI score of 73.75 was calculated with a narrative rating of *Excellent* (Table 8), thereby exceeding the target score of 55 for WWH. The dominant substrates found within the reach were gravel, followed by sand. A small amount of cobble was also found within the riffle area of the stream segment, and hardpan was observed in the pool portion. The reach, while potentially able to support a healthy fish community, was lacking in quality instream cover for fish, with only a low to moderate quantity of undercut banks, overhanging vegetation, slow-water shallows, rootmats, rootwads, and pools with a depth greater than 70 centimeters. Overall, the stream reach was lacking in sinuosity and development, yet minimal bank erosion along with a moderate to wide riparian buffer positively contributed to the stability of the stream channel. The lack of sinuosity may also cause future issues and decline of a balanced riffle-run-pool complex within the reach; future assessment would be required to monitor for a shift. Currently, however, the stable quality riffles present provide a beneficial addition to the QHEI score, as well as the lack of channelization and flood plain characterization (reach is surrounded by forest and a park). Varying current velocities (between slow to moderate), and a high stream gradient also made a positive contribution to the stream segment achieving attainment of the target.

The stream segment at Chippewa Creek Bramblewood Branch RM 0.10 was assessed on July 26, 2018. A QHEI score of 66.00 was calculated with a narrative rating of *Good*, therefore exceeding the WWH attainment target of 55 (Table 8). A significant lack of adequate instream cover for resident or transient fish, marked only by sparse amounts of boulders and logs/woody debris, detracted from the overall score. The stream reach also lacked pools that would provide adequate fish refugia during periods of low flow, with the deepest pools only ranging from 40 to 70 centimeters. A wide riparian zone, along with a forested flood plain, offered a positive contribution to the overall QHEI score. The stream reach also had some challenges with channel morphology, as it was only low to moderately sinuous, which may contribute to stream bank erosion and potential for washouts during high-volume rain events. However, the overall stream channel was stable, and fair to moderately developed, which may mitigate some of these issues.

Table 8. Chippewa Creek Qualitative Habitat Evaluation Index Scores and Physical Attributes																																
River Mile			WWH Attributes											MWH Attributes																		
														High Influence					Moderate Influence													
														Channelized or no Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/No Cover	Max. Depth <40 cm (WD, HW sites)	Total High Influence Attributes	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	Total Moderate Influence Attribute
No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Development	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max. Depth >40 cm	Low-Normal Riffle Embeddedness	Total WWH Attributes																						
Chippewa Creek RM 0.60	73.75	Excellent	x	x						x		3									x							x	x			5
Chippewa Creek Bramblewood Branch RM 0.10	66.00	Good	x	x	x	x	x	x	x	x	x	10				x						x	x	x	x						4	

Fish Community Assessment

Methods

Two quantitative electrofishing passes were conducted at each sampling site on Chippewa Creek for the 2018 sampling season. Because Ohio EPA was also conducting assessments in Cuyahoga River tributaries, NEORSD investigators collaborated with their field teams to complete electrofishing sampling events at Chippewa Creek RM 0.60². This data may also be used as a part of a benchmarking field study. Both NEORSD and Ohio EPA were responsible for completing one sampling event each, and the resultant data from each organization was averaged to assess the attainment criterion. Both sampling passes for Chippewa Creek Bramblewood Branch RM 0.10 were conducted by NEORSD.

Sampling by the NEORSD Environmental Assessment group was conducted using longline electrofishing techniques and consisted of shocking all habitat types within a sampling zone while moving from downstream to upstream. The sampling zone was 0.15 kilometers for all locations evaluated. The methods 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 the Ohio EPA Index of Biotic Integrity (IBI). 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 headwater sites are listed in Table 9.

² The Ohio EPA field team conducted an electrofishing pass at Chippewa Creek RM 0.36, which was used to compare to the sampling event conducted by NEORSD at RM 0.60.

Table 9. Index of Biotic Integrity (IBI) Metrics
Headwater
Total Number of Native Species
Number of Darters & Sculpins
Number of Headwater Species
Number of Minnow Species
Number of Sensitive Species
Percent Tolerant Species
Percent Pioneering Species
Percent Omnivores
Percent Insectivores
Number of Simple Lithophils
Percent DELT Anomalies
Number of Individuals (less Tolerant Organisms)

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

Results and Discussion

For the 2018 electrofishing events, the Chippewa Creek RM 0.60 (RM 0.36) stream segment averaged an IBI score of 48, narratively *Good*, therefore meeting the IBI WWH criterion (Table 9). The first electrofishing pass (RM 0.60), completed on July 26, 2018, by NEORSW, resulted in an IBI score of 44, narratively *Good* (Table 10 and Figure 2). Of all specimens assessed during the sampling event, no DELTs were reported. Nineteen of the twenty-one taxa collected during the event were native species, which offered a large positive contribution to the overall IBI score. One non-native taxon collected, the goldfish (*Carassius auratus*), only accounted for one specimen in the sample population and had minimal negative impact. Eight of the fish taxa collected belonged to the minnow species category, adding a strong positive contribution to the IBI score. However, only one of the minnow taxa collected, the sand shiner (*Notropis stramineus*), is considered moderately intolerant to stream pollution and environmental stressors. This lack of balance is also somewhat reflected in the percentage of pioneering species, which accounted for 21.4% of individuals in the sample population. The moderate density of these individuals, slightly more than 1/5 of the sample, is an indication that the stream may be slightly impacted by environmental or external stressors. Further, the lack of sensitive species in the sample population, 3 taxa in total, may be an indication of an external stressor impacting the fish population.

The second electrofishing pass, conducted by Ohio EPA at Chippewa Creek RM 0.36, was completed September 5, 2018, and achieved an IBI score of 52, narratively *Exceptional* (Table 10 and Figure 2), which was a significant improvement to the score

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calculated from the first electrofishing event. According to a QHEI assessment performed by the Ohio EPA field team (QHEI score: 75, narratively *Excellent*), this stream segment had slightly improved habitat composition and fish cover - including more sinuosity, better pool and riffle development, and less substrate embeddedness; the range between the two scores is expected. One deformity was reported in a single specimen of a central stoneroller minnow (*Campostoma anomalum*), having a minimal negative impact on the overall IBI score. The total number of individuals collected during this sampling event was nearly four times the number of specimens collected during the July RM 0.60 sampling event. The dominant species within the sample population was also the central stoneroller minnow. This taxon is known for being tolerant to chemical pollution and stream degradation, which may be an indication that there are environmental impacts.

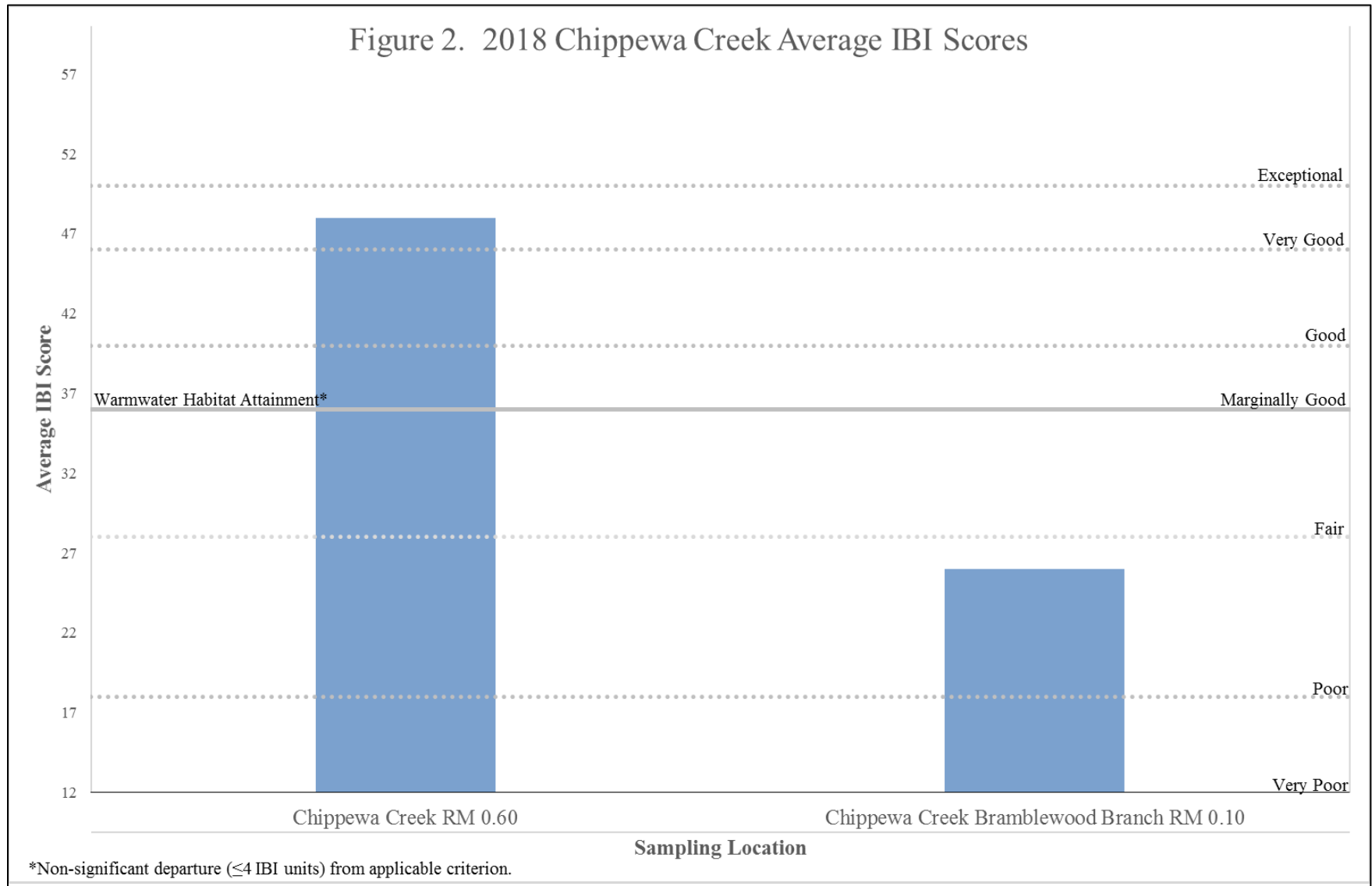
While the QHEI assessments indicate that the stream segments can sustain a healthy fish community, there may be an external influence affecting the composition of the fish population. Chippewa Creek RMs 0.60 and 0.36 flow through the Cleveland Metroparks in an area that is heavily landscaped. Introduction of nutrients and other chemicals through runoff during rain events may have had a negative effect and skewed the composition of the fish community toward a predominantly tolerant population.

For the 2018 electrofishing events, the Chippewa Creek Bramblewood Branch RM 0.10 stream segment averaged an IBI score of 26, narratively *Poor*, therefore not meeting the IBI WWH criterion (Table 10). The first electrofishing pass, completed on July 26, 2018, resulted in an IBI score of 24, narratively *Poor* (Table 10 and Figure 2). Only three taxa were collected during the sampling event, including blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), and central stoneroller minnow. None of the specimens had any DELTs reported, which along with a lack of omnivorous species, provided the only large positive contribution to the IBI score. As this sample population is comprised of taxa that are tolerant of pollution and stream degradation, it is likely that there are external environmental factors impacting the stream.

The second electrofishing pass at Chippewa Creek Bramblewood Branch RM 0.10 was completed on October 1, 2018, that resulted in an IBI score of 28, narratively *Fair*. An additional taxon was collected, the rainbow darter (*Etheostoma caeruleum*), which only accounted for one specimen in the sample population. The sample population continued to be dominated by tolerant species, which confirms the likelihood of a strong presence of external environmental impact to the stream.

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Table 10. 2018 Chippewa Creek IBI Results					
	1st Pass		2nd Pass		Average
River Mile	Date	IBI <i>(Narrative Rating)</i>	Date	IBI <i>(Narrative Rating)</i>	IBI <i>(Narrative Rating)</i>
Chippewa Creek RM 0.60	7/26/2018	44 (Good)	--	--	48 (Good)^
Chippewa Creek RM 0.36	--	--	9/5/2018*	52 (Exceptional)	--
Chippewa Creek Bramblewood Branch RM 0.10	7/26/2018	24 (<i>Poor</i>)	10/1/2018	28 (<i>Fair</i>)	26 (<i>Poor</i>)
Bold = meets WWH criterion [IBI ≥40 (Headwater Site)] * - Sample collected by Ohio EPA ^ - Score averaged from Chippewa Creek RM 0.60 and RM 0.36 sampling passes					



Macroinvertebrate Community Assessment

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) taxa, also referred to as EPT taxa, inhabiting available habitats at the time of HD retrieval. Sampling was conducted at the Chippewa Creek sampling locations listed in Table 1. Methods for sampling followed the Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b). The recommended period for HD deployment is six weeks.

The macroinvertebrate samples were sent to Third Rock Consulting of Lexington, Kentucky for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as defined by the Ohio EPA (1987b). Lists of the species collected during the quantitative and qualitative sampling are available upon request from the NEORSW WQIS Division.

The overall aquatic macroinvertebrate community in the stream was evaluated using Ohio EPA's Invertebrate Community Index (ICI) (Ohio EPA 1987b, DeShon 1995). The ICI consists of ten community metrics (Table 11), 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.

Table 11. ICI Metrics
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

The HD sampler was successfully recovered from Chippewa Bramblewood Branch RM 0.10 in the 2018 season. Combined with qualitative macroinvertebrate sampling on the day of HD retrieval, this allowed for a calculated ICI score to assess this sampling location. Unfortunately, likely due to severe weather events during the 2018 sampling season, the HD sampler deployed at Chippewa Creek RM 0.60 was unable to be recovered. Therefore, a narrative assessment was designated for this sample site based on data from qualitative sampling, and by utilizing the best professional judgment of the leading macroinvertebrate biologists and Qualified Data Collectors (QDCs). Factors considered in the assignment of narrative ratings include, but are not limited to: historical data from the site; total site drainage area; macroinvertebrate population composition in the qualitative sample with respect to the number of total taxa, EPT taxa, pollution sensitive taxa, and pollution tolerant taxa; and organism abundance within individual families or groups noted during sample collection.

The stream segment at Chippewa Creek RM 0.60 was assigned a narrative rating of “*Marginally Good*” (Table 12). While the taxa diversity and number of EPT taxa at this site were within the potential range of a sampling reach in attainment of the warmwater habitat biological criterion, the organism abundance was skewed toward organisms that are considered tolerant of impacted water quality conditions. A total of 25 taxa were collected during qualitative sampling at this location with pollution tolerance categories ranging from moderately intolerant to tolerant according to the Ohio EPA Macroinvertebrate Taxa List. Of these 25 taxa, four are listed in the Ohio EPA Pollution Tolerant Taxa List. Present EPT taxa included three mayfly taxa, *Baetis flavistriga*, *Baetis intercalaris*, and *Caenis sp.*; and five caddisfly taxa, *Chimarra aterrima*, *Chimarra obscura*, *Polycentropus sp.*, *Cheumatopsyche sp.*, and *Ceratopsyche morosa*; with pollution tolerance ratings ranging from facultative to moderately intolerant. A notable absence in this qualitative sample, was the lack of Chironomidae (non-biting midge) species. This family in the order Diptera (true flies) is usually abundant in a range of habitats. Field investigation noted that overall, the presence of Chironomidae were low, and the species found were more tolerant of poor water quality. It is possible, due to the severe rain event that occurred on September 26, 2018, prior to sampling, that the overall macroinvertebrate community composition was affected negatively and was falsely biased toward a lower assessment of the stream reach. Considering existing habitat conditions, including non-developed riffles, embedded and sandy substrate, and minute margin habitat; it is likely that this stream may not be able to sustain a healthy macroinvertebrate community and therefore was assessed a “*Marginally Good*” narrative rating in 2018.

The stream segment at Chippewa Creek Bramblewood Branch RM 0.10 received an ICI score of 36 with a narrative rating of *Good* (Table 12), therefore exceeding the WWH criterion of 34. Between the HD sampler and qualitative dipnet sampling, 40

different taxa were collected. While a moderate amount of Ephemeroptera and Trichoptera were collected during the qualitative sampling event, only three taxa – *Baetis flavistriga*, *Ceratopsyche morosa*, and *Ceratopsyche sparna*, were collected on the HD. The lack of mayfly taxa had a negative impact on the overall ICI score, while incidentally, the quantity of caddisfly taxa had a positive effect on the overall ICI score. Another factor that negatively impacted the ICI score was the abundance of non-Tanytarsini Chironomidae and other Diptera, reported as 48.18% of the sample population. While these taxa are generally found in healthy stream conditions, their significant abundance is likely indicative of adverse conditions in the stream. Aside from the potential of external pollutants, the substrate within the stream reach, which is mainly bedrock with some boulders and cobble, which is not conducive habitat for a healthy macroinvertebrate population.

Table 12. Invertebrate Community Index (ICI) Scores	
River Mile	ICI Score (<i>Narrative Rating</i>)
Chippewa Creek RM 0.60	* (<i>Marginally Good</i>)
Chippewa Creek Bramblewood Branch RM 0.10	36 (Good)
Bold – Attainment of WWH criterion * - HD not collected during 2018 sampling season, Narrative Assessment only	

Conclusions

The results of the water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community surveys conducted by NEORSD in 2018 indicate that the Chippewa Creek watershed may have been impacted by a variety of environmental or human stressors. Chippewa Creek RM 0.60 resulted in full Aquatic Life Use Attainment status, and Chippewa Creek Bramblewood Branch RM 0.10 was in non-attainment (Table 13).

Bacteriological sampling within the Chippewa Creek sampling locations showed elevated densities of *E. coli*, which is regarded as an indicator of poor water quality conditions. These water quality exceedances may be attributed to stormwater runoff including outfalls, failing home septic systems in the nearby area, or the former landfill upstream of RM 0.60, which also may have caused an additional exceedance for nickel.

Additionally, the water quality conditions present at the time of evaluation, may have caused a disturbance in the fish and/or macroinvertebrate communities at each sampling location, through overall loss of taxa presence or population shifts toward more pollution-tolerant species.

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In 2018, an improper sanitary connection was identified originating from a storm outfall (CCMB0310) tributary to Chippewa Creek. CCMB0310 is located upstream of the sampling locations assessed in 2018 and may have contributed to the water quality exceedances. The improper connection to CCMB0310 was remediated on December 5, 2018. Post-remediation evaluation of the outfall determined significant decreases in *E. coli*, which in turn is likely to provide a positive influence on the downstream water quality conditions.

Habitat conditions within some of the sampling locations may have presented a minor challenge to the biological community and may have prohibited the support of higher-quality or sensitive/intolerant fish and macroinvertebrate communities. Sparseness of in-stream cover for fish and unstable or inaccessible substrate may have impacted the stream biota composition.

Bacteriological issues may be able to be improved to achieve attainment of water quality status, therefore improving the overall quality of the in-stream biological community. The quality of habitat, however, and the associated impacts to the fish and macroinvertebrate communities, may not be easily remediated. Issues with erosion and lack of instream cover may be impacted by human influence, and also by natural environmental occurrence. Ultimately, water quality and the elimination of external environmental stressors will be required to improve water quality and create permanent positive changes in the biological communities.

Table 13. 2018 Furnace Run Survey Results

River Mile	Aquatic Life Use Attainment Status	Average IBI Score (Narrative Rating)	ICI Score (Narrative Rating)	QHEI Score (Narrative Rating)	Water Quality Exceedances
0.60	FULL	48 (Very Good)	* (Marginally Good)	73.75	<i>E. coli</i> , Ni
Bramblewood Branch RM 0.10	NON	26 (Poor)	36 (Good)	66.00	<i>E. coli</i>

* - HD not collected. Narrative rating based on qualitative sample and best professional judgement.
 WWH biocriterion attainment: IBI score of 40, ICI score of 34, QHEI score target of 55
 Non-significant departure: ≤4 IBI units; ≤4 ICI units

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