NORTHEAST OHIO REGIONAL SEWER DISTRICT

2017 Furnace Run Environmental Monitoring

Prepared by
Water Quality and Industrial Surveillance Division

Introduction

In 2017, the Northeast Ohio Regional Sewer District (NEORSD) conducted water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community surveys on Furnace Run. Sampling was conducted by NEORSD Level 3 Qualified Data Collectors certified by Ohio Environmental Protection Agency (EPA) in Fish Community and Benthic Macroinvertebrate Biology, and Chemical Water Quality and Stream Habitat Assessments as explained in the NEORSD study plan *2017 Cuyahoga River Tributaries Environmental Monitoring* approved by Ohio EPA on May 12, 2017

The lower Cuyahoga River has been designated as one of the 42 Great Lakes Areas of Concern (AOC) by the International Joint Commission. Past monitoring indicated impairment of aquatic biota in the river and was the basis of a Total Maximum Daily Load (TMDL) for the Lower Cuyahoga River (Ohio EPA, 2003). The causes of impairment to the river were classified as organic enrichment, toxicity, low dissolved oxygen, nutrients, and flow alteration. This study was completed to determine current conditions in the stream, as well as provide additional information to support the continued monitoring of the lower Cuyahoga AOC. Fish communities and benthic macroinvertebrate communities were surveyed at two sites in Furnace Run between river mile (RM) 7.25 and RM 1.85. The results from these surveys will help characterize the overall fish and macroinvertebrate community health in the stream.

Figure 1 is a map of the sampling locations evaluated, and Table 1 indicates the sampling locations with respect to river mile, latitude/longitude, description, and surveys conducted. A digital photo catalog of the sampling locations is available upon request by contacting the NEORSD's Water Quality and Industrial Surveillance (WQIS) Division.

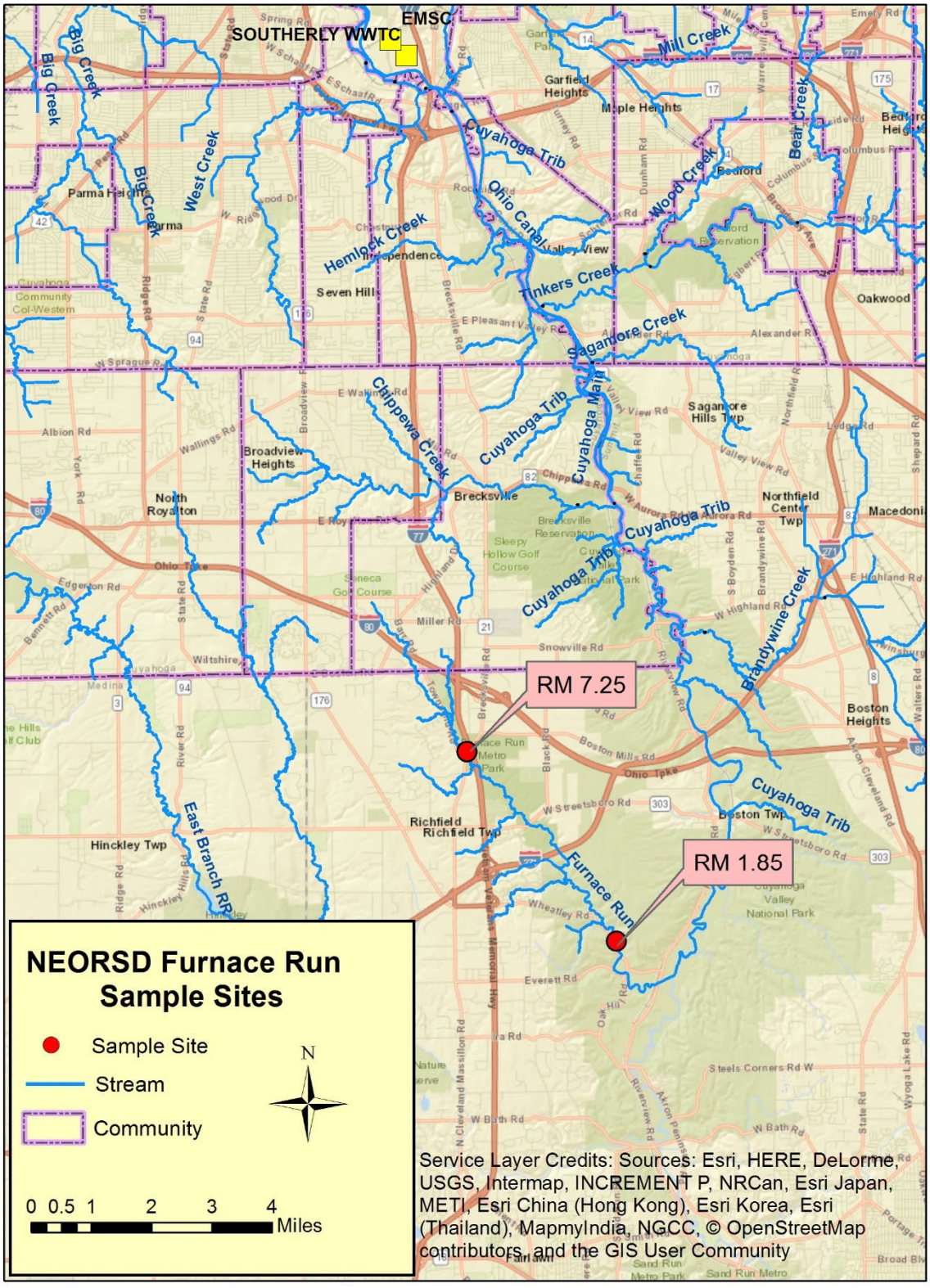

Figure 1. Sampling Locations

Table 1. Sample Locations					
Location	Latitude	Longitude	River Mile	Description	Purpose
Furnace Run	41.2602	-81.63739	7.25	Upstream of Brecksville Road	General watershed monitoring.
Furnace Run	41.21384	-81.58733	1.85	Upstream of Wheatley Road	General watershed monitoring.

Water Chemistry Sampling

Methods

Water chemistry and bacteriological sampling was conducted five times between July 25 and August 23, 2017, on Furnace Run at RMs 7.25 and 1.85. Techniques used for sampling and analyses followed the Ohio EPA *Surface Water Field Sampling Manual for water quality parameters and flows* (2015). 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 a 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-µm 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, dissolved oxygen percent, pH, temperature, specific conductivity, and conductivity were collected using either a YSI 600XL or 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).

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

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

The acceptable percent RPD is based on the ratio of the sample concentration and detection limit (Formula 2) (Ohio EPA, 2015).

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

X = sample/detection limit ratio

Those RPDs that were 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 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 Furnace Run 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

The sites sampled in 2017 are designated warmwater habitat (WWH), agricultural water supply, industrial water supply, and primary contact recreation. For the 2017 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 RM 1.85 on July 25, 2017. There was one parameter, tin, that was rejected based on RPD values (Table 2). The sampling event on July 25, 2017 was not considered wet weather[1]. The reason for the unacceptable difference between the samples 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 samples with RPDs greater than acceptable

Site	Date	Parameter	Acceptable RPD	Actual RPD
1.85	7/25/2017	Sn	39.5	179.8

[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.

The field blank was collected at RM 7.25 on August 16, 2017. For the field blank, there were four parameters 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 water quality parameters that were listed as estimated or rejected based on Ohio EPA data validation protocol.

Table 3. Parameters affected by possible blank contamination
Cr
Cu
DRP
Sn

The final QA/QC check for the samples that were collected was for paired parameters, or those parameters in which one is a subset of the other. In 2017, two instances occurred in which the data for the paired parameters needed to be qualified because the sub-parameter was greater than the parent one (Table 4). The reason for the Total-P/DRP being greater is unknown, but may be because of sample collection methodology. The filtered DRP sample was not collected directly in conjunction with the Total-P sample. These samples are collected in separate containers which prevent a person sampling from collecting them side by side. The time lapse in between samples and the corresponding collection of said samples could potentially result in a greater sub parameter.

Table 4. Unacceptable Paired Parameter RPDs					
River Mile	Date	Paired Parameters	Acceptable RPD (%)	Actual RPD (%)	Qualifier
1.85	8/16/2017	Total-P/DRP	79.6	76.9	J
J=Result is estimated.					

Exceedances of the recreational bacteriological criteria occurred at both of the sites during 2017. The criteria for *Escherichia coli (E. coli)* consist of two components: a 90-day geometric mean and a value not to be exceeded in more than 10% of the samples collected during a 90-day period (statistical threshold value). For those streams designated primary contact recreation, these criteria are 126 colony counts/100mL or most-probable number (MPN)/100mL and 410 colony counts/100mL or MPN/100mL, respectively. Both criteria were exceeded at RM 1.85 for the 90-day periods beginning on July 25, 2017 (Table 5). The 90-day geometric mean was exceeded at RM 7.25.

Potential sources of bacteria to the stream could include stormwater runoff and improperly functioning home sewage treatment systems.

Table 5. 2017 Furnace Run *E. coli* Densities (most-probable number/100mL)		
Date	RM 7.25	RM 1.85
7/25/2017	58	50
8/2/2017	70	13
8/9/2017	255	38
8/16/2017	170	70
8/23/2017	166	674

* Wet-weather event

Exceeds statistical threshold value starting on that date
Exceeds geometric mean criterion for 90-day period starting on that date
Exceeds both statistical threshold value and geometric mean criterion for 90-day period

Water chemistry sampling at Furnace Run RMs 1.85 and 7.25, in 2017 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 Furnace Run from urban runoff within the watershed.

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, 2015a).

While all the parameters necessary for SNAP were not assessed in 2017, nutrients were assessed for general watershed monitoring at the sites in 2017. Table 6 shows the results of the geometric mean concentration and standard deviations of all five sampling events in 2017 of dissolved inorganic nitrogen, total phosphorus, and dissolved reactive phosphorus. Table 2 of SNAP (See Figure 2) assesses a general ecological risk of nutrient enrichment based upon the dissolved inorganic nitrogen and total phosphorus concentrations.

Table 6. 2017 Furnace Run Nutrient Concentrations			
River Mile	Total Phosphorus Geometric Mean (mg/L)	Dissolved Inorganic Nitrogen Geometric Mean (mg/L)	Dissolved Reactive Phosphorus Geometric Mean (mg/L)
7.25	0.017	0.087	0.009
1.85	0.006	0.025	0.003

The results of using Table 2 of SNAP reveal a narrative of "background levels typical of least disturbed conditions for Furnace Run RMs 7.25 and 1.85. This indicates that neither phosphorus or nitrogen are of a significant concern as a primary source of impairment at this site.

TABLE 2 – Concentrations of total phosphorus (TP) and dissolved inorganic nitrogen (DIN) arrayed by narrative levels of ecological risk.

Table 2 presents narrative descriptions of various levels of ecological condition and potential risk, arrayed with ranges of nutrient concentrations commonly observed at the respective ecological condition levels. This information may be useful reference for nutrient assessment using Charts A or C. **Chart A**: Attenuation from a defined source may be inferred by nutrient concentrations measured at successive stations within an evaluated segment decreasing from a higher risk level to a lower risk level. **Chart C**: Table 2 may be used as a general reference in assessing impairment risk. Actual risks and the potential benefits of abatement are site-specific determinations.

		← *DECREASING RISK*				
	TP Conc. (mg/l)	**DIN Concentration (mg/l)**				
		<0.44	0.44 < 1.10	1.10 < 3.60	3.60 < 6.70	≥6.70
DECREASING RISK →	<0.040	background levels typical of least disturbed conditions	levels typical of developed lands; little or no risk to beneficial uses	levels typical of modestly enriched condition in phosphorus limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition in phosphorus limited systems; moderate risk to beneficial use if allied responses are elevated	characteristic of tile-drained lands; otherwise atypical condition with moderate risk to beneficial use if allied responses are elevated (1.1% of observations)
	0.040-<0.080	levels typical of developed lands; little or no risk to beneficial uses	levels typical of developed lands; little or no risk to beneficial uses	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition in phosphorus limited systems; moderate risk to beneficial use if allied responses are elevated	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated (1.1% of observations)
	0.080-<0.131	levels typical of modestly enriched condition in nitrogen limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	levels typical of working landscapes; low risk to beneficial use if allied responses are within normal ranges	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated; increased risk with poor habitat	characteristic of tile-drained lands; moderate risk to beneficial use if allied responses are elevated (1.0% of observations)
	0.131-<0.400	levels typical of modestly enriched condition in nitrogen limited systems; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition; low risk to beneficial use if allied responses are within normal ranges	levels typical of enriched condition; low risk to beneficial use if allied responses are within normal ranges; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors
	≥0.400	atypical condition (1.3% of observations)	atypical condition (1% of observations);	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors ; increased risk with poor habitat	enriched condition; generally high risk to beneficial uses; often co-occurring with multiple stressors

"allied responses" = allied response indicators (24-hour DO swing, benthic chlorophyll)

SNAP Appendix – November 2015 **Table 2**

TABLE 2 (continued)

Ohio EPA's monitoring data for the years 1981 through 2011 (n = 16,870), from index period samples (June-October) and all stream sizes, was used to derive the information presented in Table 2. Following is the frequency of occurrence in the database for each nutrient concentration range, expressed as percent of total data values.

Frequency of Occurrence in Database, as Percent of Total (n=16,870)

Total Phosphorus (TP) [mg/l]	**Dissolved Inorganic Nitrogen (DIN) [mg/l]**				
	<0.44	0.44 < 1.10	1.10 < 3.60	3.60 < 6.70	≥6.70
<0.040	18.14%	5.00%	4.26%	1.13%	0.66%
0.040 < 0.080	6.50%	5.66%	4.87%	1.11%	0.29%
0.080 < 0.131	3.30%	3.77%	5.20%	1.01%	0.31%
0.131 < 0.400	3.62%	4.31%	11.39%	3.01%	1.45%
≥0.400	1.33%	0.99%	4.84%	4.07%	3.78%

Figure 2. Table 2 of SNAP

Habitat Assessment

Methods

Instream habitat assessments were conducted once at RM 7.25 and RM 1.85 in 2017 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 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

Both sites had QHEI scores that met Ohio EPA's target of 55 and, therefore, should be capable of supporting WWH fish communities. Both sites received scores in the *Excellent* narrative range with scores above 75. River mile 7.25 had the highest score of 87.0.

A stream habitat assessment was conducted on July 24, 2017, on Furnace Run at RM 1.85. The QHEI score was calculated at 77.5 with a narrative rating of *Excellent*. This site was characterized by a dominant cobble and sand substrate. Moderate amounts of instream cover were found throughout the stream reach. Logs, woody debris, and shallows in slow water were the most common cover types present. The reach was heavily impacted by erosion on both sides of the stream, which is likely due to the dominance of gravel and sand in the area. Lack of channelization, good development, and moderate sinuosity all benefit the total score. Due to the unstable substrate, shifts in the stream location and pool/riffle/run sequence are possible. Future monitoring will make note of this.

A stream habitat assessment was conducted on July 24, 2017, on Furnace Run at RM 7.25. The QHEI score was calculated at 87.0 with a narrative rating of *Excellent*. The site was dominated by a cobble and gravel substrate throughout the stream reach. Moderate to extensive amounts of instream cover were present throughout the sampling area. Overhanging vegetation, rootmats, pools greater than 70 cm, rootwads, logs, and woody debris were all common throughout the reach. Good development, no stream

channelization, and a sinuous stream all contributed to the high QHEI score of this stream segment. Although there is some erosion occurring on river right, the physical conditions of this stream segment can support a healthy fish community.

Individual components of the QHEI can also be used to evaluate whether a site is capable of meeting the WWH designated use. This is done by categorizing specific attributes as indicative of either a WWH or modified warmwater habitat (MWH) (Rankin, 1995). Attributes that are considered characteristic of MWH are further classified as being of moderate or high influence on fish communities. 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 had the WWH characteristics of fast currents, maximum depths greater than 40 cm, and either had never been channelized or had recovered from it (Table 7). The total number of moderate influence MWH attributes at each site were zero. Based on lack of the MWH attributes at these sites, it would be expected that these sites would be able to support WWH fish communities without issue.

Table 7. Furnace Run Qualitative Habitat Evaluation Index Score and Physical Attributes

			WWH Attributes											**MWH Attributes**																	
														High Influence						Moderate Influence											
River Mile	QHEI Score	Habitat Rating	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**	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**
7.25	87.0	Excellent	x	x		x	x	x	x	x	x	x	9						0												0
1.85	77.5	Excellent	x	x		x	x	x	x	x	x	x	9						0												0

Fish Community Assessment

Methods

Two quantitative electrofishing passes were conducted at each site in 2017. Sampling 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 each site. 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 Ohio EPA's Index of Biotic Integrity (IBI). The IBI incorporates twelve 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 twelve metrics utilized for longline headwater sites are listed in Table 8.

Table 8. Index of Biotic Integrity Metrics
Longline Headwater
Number of native species
Number of darter species
Number of headwater species
Number of minnow species
Number of sensitive species
Percent tolerant
Percent omnivores
Percent insectivores
Percent pioneering species
Number of individuals

Table 8. Index of Biotic Integrity Metrics
Longline Headwater
Percent simple lithophils
Percent DELTs

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

Results and Discussion

Both sites on Furnace Run had IBI scores that met the WWH criterion (Table 9). 2017 surveys were the first that WQIS staff have conducted on Furnace Run. This data will be used for comparison with future surveys that are conducted on the stream. Surveys will be conducted again in 2018.

Table 9. 2017 Furnace Run IBI Results				
		1st Pass	2nd Pass	Average
Location	River Mile	IBI	IBI	IBI
Upstream of Wheatley Road	7.25	**42**	**40**	**41**
Upstream of Brecksville Road	1.85	**44**	**44**	**44**
Bold = meets WWH criterion [IBI ≥40; MIwb ≥8.7] *Italics = non-significant departure from WWH criterion [IBI ≥36; MIwb ≥8.2]*				

For the 2017 electrofishing events, the fish community within Furnace Run RM 1.85 sampling reach averaged an IBI score of 44, narratively *Good*, therefore attaining the IBI WWH criterion. When comparing the metric scores of each electrofishing pass, they were almost identical on each survey. IBI metrics, "Number of Minnow Species" and "Proportion of Insectivores", were the only two metrics whose scores differed. Even then, they offset and still resulted in the same total IBI score on each pass. Of all the fish collected during both surveys, there were no DELT anomalies reported and species composition was almost identical between the two surveys as well. Thirteen native species including the silverjaw minnow, barred fantail and johnny darters as well as the non-native, rainbow trout, were collected on each electrofishing pass.

At Furnace Run RM 7.25, the sampling reach averaged an IBI score of 41, narratively *Good*, and again, attaining the IBI WWH criterion. Again, when comparing scores from each pass, they were almost identical on each survey. The only difference in

IBI metrics between both electrofishing passes was "Number of Individuals". There were 183 fewer fish collected during the second survey on August 22, 2017. It is unknown as to why there was a reduction in the number of fish collected. Most of the species collected saw a reduced number of individuals obtained. There was not one particular species that saw any sort of large reduction in numbers. Due to fewer fish collected, this resulted in a metric score that reduced the total IBI score on this pass. Collectively, between the two passes at RM 7.25, over 28% of the species collected (northern hogsucker and rainbow darter) were moderately intolerant to pollution.

An examination of the individual IBI metrics also showed that generally, the number of sensitive species scored poorly (metric score of 1) at each sampling event on Furnace Run. This can most likely be attributed to water quality issues, such as failing septic systems, upstream of the sample site. The stress to fish associated with upstream water quality issues could therefore be a hindrance to the establishment of those sensitive species. Future monitoring will help confirm any water quality issues that may be present.

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. Sampling was conducted at all of the locations listed in Table 1. Methods for sampling followed the Ohio EPA's Biological Criteria for the Protection of Aquatic Life, Volume III (1987b). HDs within the navigation channel were floated at a depth of approximately two feet below the surface. The recommended period for HDs to be installed 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 at each site are available upon request from WQIS.

The overall aquatic macroinvertebrate community in the stream was evaluated using the Ohio EPA's Invertebrate Community Index (ICI) (Ohio EPA 1987a, Ohio EPA undated). The ICI consists of ten community metrics (Table 10), 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 10. Metrics
ICI
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 samplers were successfully recovered from both sampling sites on Furnace Run during the 2017 season. Combined with qualitative macroinvertebrate sampling on the day of HD retrieval, this allowed for a calculated ICI score to assess each of the sampling sites.

The macroinvertebrate community at Furnace Run, RM 1.85 received an ICI score of 44 with a narrative rating of *Good* for 2017 (Table 11), therefore exceeding the WWH criterion. Of the 53 total taxa collected in both the HD and qualitative sampling, nine representative species from the EPT (Ephemeroptera, Plecoptera, and Trichoptera) were present, including: *Baetis flavistriga*, *Baetis intercalaris*, *Stenonema femoratum, Caenis sp., Chimarra obscura, Cheumatopsyche sp.*, *Ceratopsyche morosa*, *Ceratopsyche sparna*, and *Hydropsyche depravata group*. The highest scoring metrics (score of six) were "Number of Caddisfly Taxa," "Percent Caddisflies," "Percent Tanytarsini Midges," and "Percent Tolerant Organisms". These four metrics contributed to more than 54% of the total ICI score for RM 1.85

Table 11. 2017 Furnace Run Macroinvertebrate Results						
Location	River Mile	ICI Score	Total Number of Taxa	Number of Qualitative EPT Taxa	% Tolerant (as defined)	Narrative Rating
Upstream of Brecksville Road	7.25	**38**	44	7	0.06	*Good*
Upstream of Wheatley Road	1.85	**44**	53	9	2.96	*Good*
Bold indicates attainment of WWH criterion						
Italics indicates non-significant departure (≤4 ICI units) from criterion						

The macroinvertebrate community at Furnace Run, RM 7.25 received an ICI score of 38 with a narrative rating of *Good* for 2017, therefore exceeding the WWH criterion. Of the 44 total taxa collected in both the HD and qualitative sampling, seven representative species from the EPT (Ephemeroptera, Plecoptera, and Trichoptera) were present, including: *Baetis flavistriga*, *Baetis intercalaris*, *Stenonema femoratum, Chimarra aterrima, Cheumatopsyche sp.*, *Ceratopsyche morosa*, and *Hydropsyche depravata group*. There were only two ICI metrics that scored a "6"at RM 7.25 when compared to the downstream RM 1.85 site. "Percent Tanytarsini Midges," and "Percent Tolerant Organisms" were the only two metrics to contribute six points each to the overall ICI score. Even with the reduction of in ICI score, RM 7.85 is still in attainment of WWH criterion.

Conclusions

In 2017, the sampling that was conducted indicated that RMs 1.85 and 7.25 were in full attainment of the biological criteria (Table 12). Minimum WWH biocriteria were exceeded at both sites on Furnace Run.

Table 12. 2017 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
Furnace Run RM 7.25	FULL	*41 (Good)*	*38 (Good)*	*87 (Excellent)*	*E. coli*
Furnace Run RM 1.85	FULL	*44 (Good)*	*44 (Good)*	*77.50 (Excellent)*	*E. coli*
WWH biocriterion attainment: IBI score of 40; MIwb score of 8.2; ICI score of 34					
Non-significant departure: ≤4 IBI units; ≤0.5 MIwb units; ≤4 ICI units					

Environmental assessments in 2017 showed that for both of the sites, some water quality impairments may be preventing establishment of healthier biological communities. Exceedances of the water quality standards occurred for *E. coli*, indicating the presence of some sanitary sewage in the river. Potential sources of pollution include illicit discharges, failing septic systems, stormwater runoff, wildlife fecal material, and flow from upstream tributaries. Addressing these potential sources could potentially improve the overall quality of the in-stream biological community. Future monitoring will allow for the collection and comparison of more data regarding Furnace Run. Sampling is scheduled for Summer 2018.

Acknowledgments

Field activities and report review completed by the following, except where otherwise noted:

Kelsey Amidon
Nya Aron
Donna Friedman
Seth Hothem
Ron Maichle
Mark Matteson, Author
Mario Meany
Denise Phillips
John Rhoades
Eric Soehnlen
Justin Telep
Nicole Velez

WQIS Paraprofessional Interns: Hannah Boesinger, James Ferritto, and Sarah Foley.

Analytical Services Division – Completed analysis for all water chemistry sampling

References

Holomuzki, J.R., & and Biggs, B.J.F. (2000). Taxon-specific responses to high-flow disturbance in streams: implications for population persistence. *Journal of the North American Benthological Society*, 19, 670-679.

Ohio Environmental Protection Agency. (1987a). *Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters* (Updated January 1988; September 1989; November 2006; August 2008). Columbus, OH: Division of Water Quality Monitoring and Assessment.

Ohio Environmental Protection Agency. (1987b). *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 1989; March 2001; November 2006; and August 2008). Columbus, OH: Division of Water Quality Monitoring and Assessment.

Ohio Environmental Protection Agency. (1999). *Association Between Nutrients, Habitat, and the Aquatic Biota in Ohio Rivers and Streams* (MAS/1999-1-1). Columbus, OH: Division of Surface Water.

Ohio Environmental Protection Agency. (2003). Total Maximum Daily Loads for the Lower Cuyahoga River. Ohio EPA, Division of Surface Water. Water Standards and Technical Support Section.

Ohio Environmental Protection Agency. (2006a). *Methods for assessing habitat in flowing waters: using the Qualitative Habitat Evaluation Index (QHEI)*. (Ohio EPA Technical Bulletin EAS/2006-06-1). Columbus, OH: Division of Surface Water; Division of Ecological Assessment Section.

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

Ohio Environmental Protection Agency. (2010). *Draft State of Ohio Water Quality Standards Ohio Administrative Code Chapter 3745-1-44 Criteria for the control of nutrient enrichment in streams.* Columbus, OH: Division of Surface Water, Standards and Technical Support Section.

Ohio Environmental Protection Agency. (2010). *Methods of Assessing Habitat in Lake Erie Shoreline Waters Using the Qualitative Habitat Evaluation Index (QHEI) Approach (Version 2.1).* Twinsburg, OH: Division of Surface Water, Northeast

District Office.

Ohio Environmental Protection Agency. (2012). *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practice.* Columbus, OH: Division of Surface Water; Division of Environmental Services.

Ohio Environmental Protection Agency. (2015). *Surface Water Field Sampling Manual for water quality parameters and flows*. Columbus, Ohio: Division of Surface Water.

Ohio Environmental Protection Agency. (2014). *Proposed Stream Nutrient Assessment Procedure*. Columbus, OH: Ohio EPA Nutrients Technical Advisory Group – Assessment Procedure Subgroup.

Ohio Environmental Protection Agency. (2015a). *Proposed Stream Nutrient Assessment Procedure*. Columbus, OH: Division of Surface Water, Ohio EPA Nutrients Technical Advisory Group.

Ohio Environmental Protection Agency. (Undated). *Biological criteria for the protection of aquatic life: Volume IV: Fish and macroinvertebrate indices for Ohio's Lake Erie nearshore waters, harbors, and lacustuaries.* Columbus, OH: Northeast District Office and Ecological Assessment Unit.

Rankin, E.T. (1995). Habitat indices in water resource quality assessments. In W.S. Davis and T. Simon (eds.). *Biological Assessment and Criteria: Tools for Risk-based Planning and Decision Making* (pp. 181-208). Boca Raton, FL: Lewis Publishers.

Trautman, M. B. (1981). *The Fishes of Ohio*. Columbus, Ohio: The Ohio State University Press.

Yoder, C.O., & E.T. Rankin. (1995). Biological response signatures and the area of degradation value: new tools for interpreting multimetric data, pp. 263-286 (Chapter 17). *in* W.S. Davis and T. Simon (eds.). *Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making.* Lewis Publishers, Boca Raton, FL.