NORTHEAST OHIO REGIONAL SEWER DISTRICT

2017 Rocky River Environmental Monitoring
Biological, Water Quality, and Habitat Survey Results

Prepared by:
Water Quality and Industrial Surveillance Division

Introduction

In 2017, the Northeast Ohio Regional Sewer District (NEORSD) conducted water quality assessments including water chemistry sampling, habitat assessments, and fish and macroinvertebrate community surveys on the Rocky River, a tributary to Lake Erie. The objective of this study was to evaluate the impacts of Combined Sewer Overflows (CSOs) and other environmental factors on the stream, as well as assess the overall water quality at two sites on the lower Rocky River. During the 2017 sampling season, two stream locations were monitored, including river mile (RM) 2.50, which is upstream of Hilliard Boulevard; and RM 8.30, upstream of the Puritas Road bridge (Table 1). Sampling at both sites is required by the Ohio Environmental Protection Agency (Ohio EPA) National Pollution Discharge Elimination System (NPDES) Permit No. 3PA00002*HD (2016).

Sampling was conducted by NEORSD Level 3 Qualified Data Collectors certified by the Ohio EPA in Fish Community Biology, Benthic Macroinvertebrate Biology, Chemical Water Quality, and Stream Habitat Assessment as explained in the *2017 Rocky River Environmental Monitoring* study plan approved by Ohio EPA on May 12, 2017. All sampling and environmental assessments occurred between June 15, 2017 and September 30, 2017 (through October 15 for fish sampling assessments), as required in the Ohio EPA *Biological Criteria for the Protection of Aquatic Life Volume III* (1987b). The results gathered 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 the Invertebrate Community Index (ICI). Water chemistry data was validated per the methods outlined by the Ohio EPA (2015a) and compared to the Ohio Water Quality Standards for their designated use to determine attainment (Ohio EPA 2017). An examination of the individual metrics that comprise the IBI, MIwb, and ICI was used in conjunction with the water chemistry data and QHEI results to assess the health of the stream.

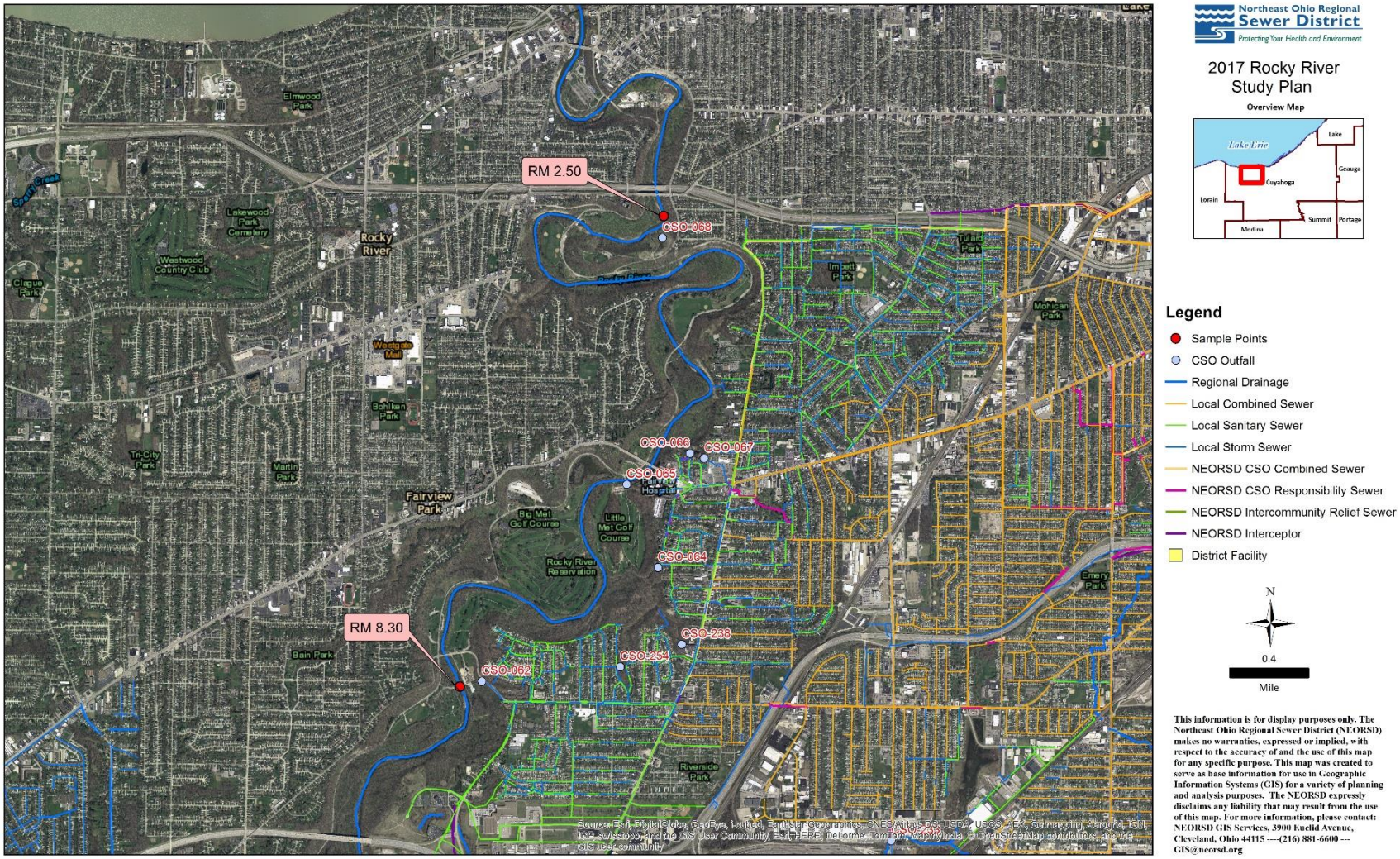
The main branch of the Rocky River, downstream of RM 12.1 to the mouth, has been assigned an aquatic use designation described as warmwater habitat (WWH), and is a primary contact recreation water according to the Ohio EPA Water Quality Standards (2017). Additionally, the Rocky River has been designated as a seasonal salmonid habitat from RM 6.40 downstream to the confluence of Lake Erie.

Table 1 indicates the sampling locations with respect to river mile, latitude and longitude, description, and the types of surveys conducted. Figure 1 is a study area map, noting the location of each sampling location evaluated during the 2017 study. A digital photo catalog of the sampling locations is available upon request by contacting the NEORSD WQIS Division.

Table 1. Rocky River Sampling Locations

Site Location	Latitude	Longitude	River Mile	Description	HUC 8	Purpose
Upstream of Puritas Road Bridge	41.435408	-81.843580	8.30	Rocky River US of NEORSD CSOs	04110001 Black-Rocky	Evaluate water chemistry, fish and macroinvertebrate community biology, and habitat upstream of CSOs
Upstream of Hilliard Boulevard	41.469855	-81.823322	2.50	Rocky River DS of NEORSD CSOs	04110001 Black-Rocky	Evaluate water chemistry, fish and macroinvertebrate community biology, and habitat downstream of CSOs

Figure 1. 2017 Rocky River Monitoring Sites



Water Chemistry & Bacteriological Sampling

Methods

Water chemistry and bacteriological sampling was conducted five times between June 15, 2017 and July 12, 2017. Techniques used for sampling and analyses followed the Ohio EPA's *Surface Water Field Sampling Manual for water chemistry, bacteria, and flows* (2015a). 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-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, 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).

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, 2015a).

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

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.

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

Results and Discussion

Over the course of the sampling, one duplicate sample was collected on June 15, 2017 at RM 2.50 for QA/QC purposes. All chemical parameters were calculated to have relative percent difference values within the acceptable range (Ohio EPA 2015a).

One field blank was collected on July 12, 2017, at RM 2.50. One water quality parameter showed potential field blank contamination. It is unclear how the field blank became contaminated and may be due to inappropriate sample collection, handling, contaminated blank water and/or interference during analysis. The chromium result collected on July 12, 2017, showed a result/field blank result of 4.39 for RM 2.50 and 4.27 for RM 8.30. As defined in the Ohio EPA Surface Water Field Sampling Manual (2015a), samples should be downgraded to "level 2 data" if it falls within the following range: < 3x Result ≤ 5x Blank. The chromium samples collected at both sites were downgraded to level 2, describing the analyte is likely present, but with poor confidence in the numerical result (Ohio EPA 2015a).

Paired parameters were evaluated for QA/QC purposes on all samples where one parameter is a subset of another. No paired parameters exceeded the relative percent difference threshold; therefore, all paired parameters were accepted as valid. However, total dissolved solids, a sub-parameter of total solids, yielded a higher numeric value. Therefore, these parameters were downgraded to estimated values.

The main branch of the Rocky River, downstream of RM 12.10 to the mouth, has been assigned an aquatic use designation described as warmwater habitat (WWH), and is a primary contact recreation water according to the Ohio EPA Water Quality Standards (2017). Additionally, the Rocky River has been designated as a seasonal salmonid habitat from RM 6.40 downstream to the confluence of Lake Erie. The results of the water chemistry and bacteriological samples were compared to the applicable water quality standards to determine attainment status for those designated uses.

The primary contact recreation criteria for the Rocky River consists of two components: an *Escherichia coli (E. coli)* criterion not to exceed a statistical threshold value (STV) of 410 colony counts per 100 milliliters in more than ten percent of the samples taken during any ninety-day period, and a ninety-day geometric mean criterion of 126 colony counts/100mL (Ohio EPA 2018). The STV of 410 colony counts/100mL in more than ten percent of the samples taken was exceeded at both RM 2.50 and RM 8.30 for all 90-day periods. Additionally, both sites exceeded the ninety-day geometric mean criterion of 126 colony counts/100mL for all 90-day periods (Table 2). Three of the five sampling dates were conducted during a wet-weather event*, which may lead to elevated *E. coli* densities due to CSOs, sanitary sewer overflows, and urban runoff. Other likely sources of the elevated *E. coli* densities include failing household sewage treatment systems (HSTSs), illicit discharges, and wildlife.

Table 2. *E. coli* Exceedances

Site	Sample Date	Sample Density (Most Probable Number /100ml)	90-Day Geometric Mean (Colony Counts /100ml)	Statistical Threshold Value (% Days >410 Colony Counts /100ml)
RM 8.30	6/15/2017*	7280	884.3	60.0
	6/21/2017*	596	522.1	50.0
	6/28/2017	194	499.6	33.3
	7/5/2017	378	801.6	50.0
	7/12/2017*	1700	1700.0	100.0
RM 2.50	6/15/2017*	4620	841.9	60.0
	6/21/2017*	196	566.0	50.0
	6/28/2017	184	806.1	66.7
	7/5/2017	940	1687.1	100.0
	7/12/2017*	3028	3028.0	100.0

= Exceedance of the criterion

*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.

One field parameter exceedance was observed on June 15, 2017 at RM 2.50. Field temperature was measured at 76.46 Fahrenheit, therefore exceeding the WWH Aquatic Life criterion for of 75.92 Fahrenheit. An extremely low summer base flow was observed the on June 14, 2017 (<50.0 CFS). This low flow, along with a warm summer rain the morning of June 15, 2017 likely resulted in this temperature exceedance.

Mercury analyses for all sampling events were completed using EPA Method 245.1. The detection limit for this method is above the criteria for the Human Health Nondrinking and Protection of Wildlife Outside Mixing Zone Averages (OMZA), therefore, it generally cannot be determined if sites were in attainment of those criteria. This type of mercury sampling was used as a screening tool to determine whether contamination was present above the detection limit. Water chemistry sampling at both sites in 2017 yielded mercury concentrations below the method detection limit for EPA Method 245.1. It is undetermined whether the use of EPA Method 1631E, a low-level method, instead of EPA Method 245.1, would have resulted in exceedances of the criteria.

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. The 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 2015b). NEORSD did not collect benthic chlorophyll *a* in 2017; however, nutrient concentrations

were assessed for general watershed monitoring purposes. DO swings were measured at a data sonde located at RM 4.20, which is in between the two sampling locations.

Table 3 shows the 2017 nutrient concentrations for the two Rocky River sites. The results of dissolved inorganic nitrogen and total phosphorous were compared to Table 2 listed in the SNAP document (Figure 2). According to this section of SNAP, both sites received an ecological risk narrative level described as "levels typical of working landscapes; low risk to beneficial use if allied responses are within normal range," (Ohio EPA 2015). Allied response indicators include 24-hour dissolved oxygen swings and benthic chlorophyll concentrations. While NEORSD did not collect benthic chlorophyll during this study, daily DO swings were collected from the data sonde located at RM 4.20. The Ohio EPA defines wide DO swings which may have a negative effect on aquatic life as swings greater than 6.5 mg/L daily. Daily measurements from June 28 to July 12, 2017, were all calculated to have daily DO swings below 6.05 mg/L, indicating that nutrient concentrations display a low risk of causing impairment of the Rocky River beneficial uses.

Table 3. Nutrient Results for the Rocky River used in 2017 SNAP Analysis

River Mile	Geomean DIN (mg/L)	StdDev DIN	Geomean Total-P (mg/L)	StdDev Total-P	Geomean DRP (mg/L)	StdDev DRP
8.30	1.9537	0.5744	0.0739	0.0493	0.0253	0.0083
2.50	1.7867	0.7418	0.0632	0.0631	0.0160	0.0116

Data used in Table 2 of SNAP (Ohio EPA, 2015b)

		← 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 (DO swing, benthic chlorophyll)

Figure 2: Table 2 of the Stream Nutrient Assessment Procedure (Ohio EPA 2015b).

Land Cover Analysis

A land cover analysis of the Rocky River watershed was performed in 2017. The United States Geologic Survey StreamStats Program was used to obtain a watershed polygon representing the watershed that drains the confluence of the Rocky River and Lake Erie. The corresponding watershed polygon was then imported to ArcMap 10.3 and the intersect tool was used to combine the watershed with the National Land Cover Database, 2011 (Homer et. al 2015). The resulting figure 3 represents the different land cover types within the Rocky River watershed.

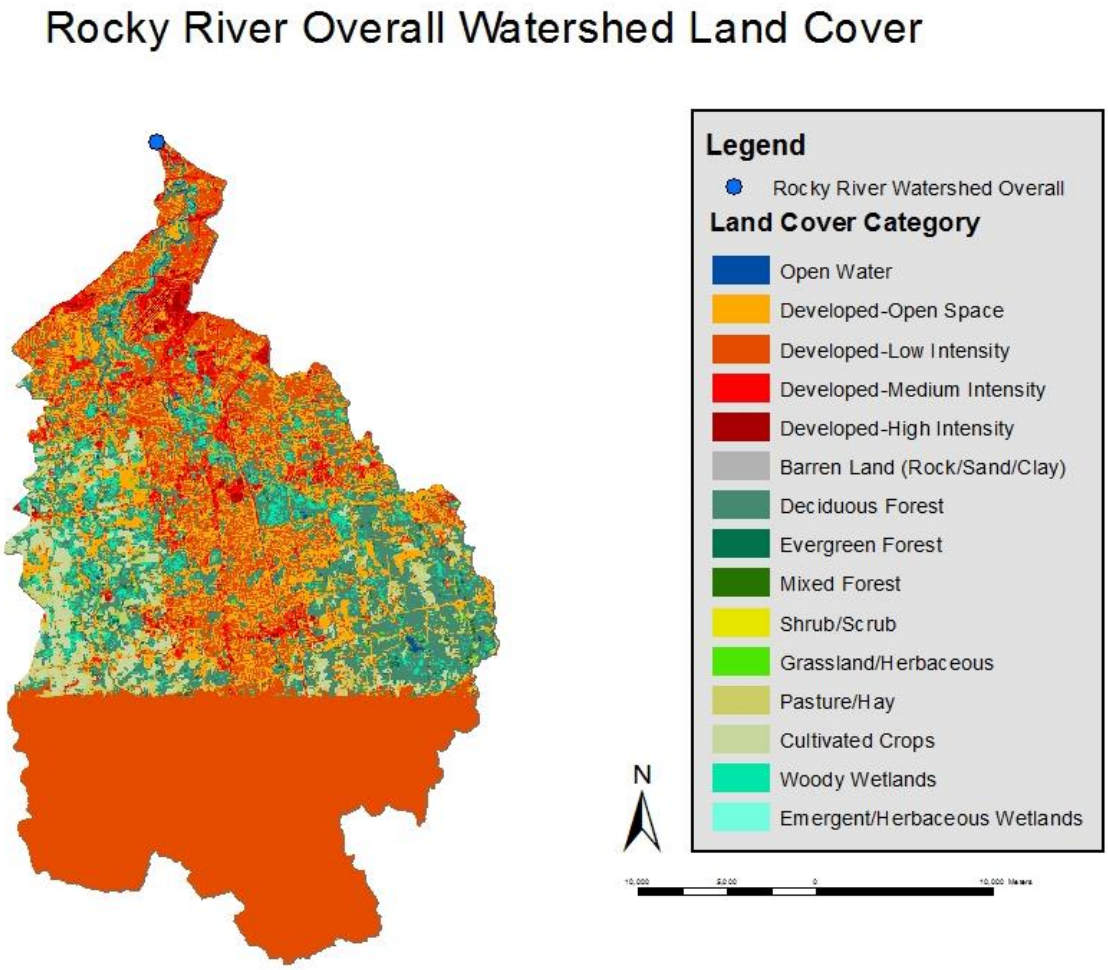


Figure 3. Rocky River Land Cover Map

Highly urban and developed watersheds have been linked to negative water quality and hydrology effects. Pollutants associated with urban runoff include sediments, nutrients, pathogens, oxygen-demanding matter, heavy metals, and salts (Schueler 1987). The northern section of the Rocky River watershed is highly developed, located between the suburban communities of Lakewood and Rocky River, while the southern parts of the watershed consists of a more forested land cover, yet still exhibiting a large proportion of developed land. Highly developed land consists of a vast landscape of impervious surfaces that are designed to remove rainfall as quickly as possible. These highly developed areas lead to increased peak discharges, increased erosion, and increased pollutants transferred to the stream (USEPA 1993). The large amounts of developed and urban landscape that the Rocky River watershed experiences may have a negative effect on the overall water quality.

Habitat Assessment

Methods

An instream habitat assessment was conducted at RM 2.50 and RM 8.30 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 values greater than 60 on streams greater than 20 square miles suggests that sufficient habitat exists to support a warmwater fish community. Scores greater than 75 frequently demonstrate habitat conditions that can support exceptional warmwater faunas (Ohio EPA 2006). 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 at Rocky River RM 2.50 was calculated at 78.00, which correlates to an *Excellent* narrative rating. The QHEI score at Rocky River RM 8.30 was calculated at 70.75, which correlates to a *Good* narrative rating. Both values exceed the Ohio EPA's target score of 60, which suggests that sufficient habitat exists to support a warmwater fish community.

For the Rocky River at RM 2.50, the most prominent substrate present consisted of boulder and cobble with a normal to moderate silt narrative. Moderate amount of instream cover included overhanging vegetation, shallows, pools greater than 70 cm, rootwads, boulders, and woody debris. Development of the riffle/run/pool complex was rated fair to good, which indicates that riffles were present, but poorly developed, and a distinct transition was observed between the riffles and pools. Pool widths measuring less than riffle widths, a moderate overall embeddedness, and a shale substrate origin are all attributes that may have lowered the overall QHEI score.

For the Rocky River at RM 8.30, the most prominent substrate present consisted of boulder and bedrock with a moderate silt quality. Sparse instream cover included shallows, pools greater than 70 cm, boulders, oxbows, backwaters, and woody debris. The development of the riffle/run/pool complex was rated moderate to good, with a low sinuosity and high to moderate stability. Like RM 2.50, RM 8.30 consisted of a shale origin, a moderate amount of silt, and had pools widths measuring less than riffle widths; all which are attributes which may have negatively affected the overall QHEI score.

Table 4 lists attributes defined by the Ohio EPA which have both positive and negative influences on the fish community. Negative influences have been identified as

attributes that can have the greatest influence on whether the system can support a WWH fish community. Note that the habitat rating is used to determine if the habitat can support a robust fish community and does not necessarily reflect what type of community is found at the site.

The Rocky River at RM 2.50 contained seven WWH attributes, no high influence modified warmwater habitat (MWH) attributes, and five moderate influence MWH attributes as seen in Table 4. The Rocky River at RM 8.30 contains eight WWH attributes, one high influence, and two moderate influences of MWH attributes as seen in Table 4. Both sites display QHEI scores greater than 60 with far less MWH attributes than WWH attributes, suggesting that they can support a WWH fish assemblage.

Table 4: Rocky River 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 Sinousity	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**
8.30	70.75	*Good*	X	X		X	X		X	X	X	X	8				X		1		X				X						2
2.50	78.00	*Excellent*	X	X		X		X	X		X	X	7						0		X			X	X			X	X		5

Fish Community Biology

Methods

Two quantitative electrofishing passes were conducted at each site on the Rocky River in 2017. A list of the dates when the surveys were completed, along with daily average flow measured at the United States Geological Survey gage station near Berea, Ohio (USGS# 04201500) is given in Table 5. Sampling was conducted using the *rollerbeast* electrofishing technique and consisted of shocking all habitat types within the 0.20-kilometer sampling zone while moving from downstream to upstream. 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 to species, counted, 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.

Table 5. Sampling Dates and River Flows		
Date	Sites sampled (RMs)	Daily Mean Flow (CFS)
6/22/2017	2.50, 8.30	56.53
8/3/2017	2.50	30.68
8/10/2017	8.30	31.65

The electrofishing results for each pass were compiled and utilized to evaluate fish community health through the application of the two Ohio EPA indices, the Index of Biotic Integrity (IBI) and the Modified Index of Well-Being (MIwb). The IBI incorporates twelve community metrics representing structural and functional attributes. The structural attributes are based upon fish community aspects such as fish abundance 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 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: $$MIwb = 0.5\ lnN + 0.5\ lnB + \overline{H}(No.) + \overline{H}(Wt.)$$

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

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

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

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

n_i = Relative numbers or weight of species

N = Total number or weight of the sample

The Rocky River is located completely within the Erie-Ontario Lake Plains (EOLP) ecoregion and follows the EOLP IBI metric scoring. The 12 IBI metrics utilized for wading sites are listed in Table 6. The WWH IBI scoring criterion in the EOLP ecoregion is 38 and a site is considered to be within nonsignificant departure if the score falls within 4 IBI units or 0.5 MIwb units of the criterion (Table 7). Lists of the species diversity, abundance, 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.

Table 6. IBI Metrics (Wading sites)
Total Number of Indigenous Fish Species
Number of Darter Species
Number of Sunfish Species
Number of Sucker Species
Number of Intolerant Species
Percent Abundance of Tolerant Species
Percent Omnivores
Percent Insectivores
Proportion of Top Carnivore Species
Number of Individuals in a Sample
Proportion of Individuals as Simple Lithophilic Spawners
Proportion of Individuals with DELTs

Table 7. Fish Community Biology Ranges for Wading sites in the EOLP Ecoregion							
Ohio EPA Narrative*	Very Poor	Poor	Fair	Marginally Good	Good	Very Good	Exceptional
IBI Score	12-17	18-27	28-33	34-37	38-45	46-49	50-60
MIwb Score	0-4.4	4.5-5.8	5.9-7.3	7.4-7.8	7.9-8.8	8.9-9.3	≥9.4
Ohio EPA Status	Non-Attainment			NSD	Attainment		
*Narrative scores for wading sites NSD – Non-Significant Departure of WWH attainment							

Results and Discussion

Both sites on the Rocky River were calculated to be in full attainment for the WWH aquatic life use criterion. The Rocky River site at RM 2.50 averaged an IBI score of 44 and a MIwb score of 9.3 which both received an Ohio EPA narrative as *Very Good*. The

second pass at RM 2.50 received an MIwb score of 9.7, which correlates to the highest Ohio EPA narrative, classified as an *Exceptional WWH*. RM 8.30 scored slightly lower, but still well within the WWH criterion, averaging an IBI score of 41 and an MIwb score of 8.7. The Rocky River fish community biology scores are shown below in Table 8.

Table 8. 2017 Rocky River IBI and MIwb Results

		1st Pass		2nd Pass		Average	
Location	River Mile	IBI	MIwb	IBI	MIwb	IBI	MIwb
Upstream of Puritas Road Bridge	8.30	40	8.2	42	9.1	41	8.7
Upstream of Hilliard Boulevard Bridge	2.50	40	8.8	48	9.7	44	9.3

= meets WWH criterion
= meets exceptional WWH criterion

The individual metrics in the IBI were also examined to determine any trends in specific components of the fish community. For all metrics at the two Rocky River sites, at least one electrofishing pass resulted in a score of either a "3" or "5", indicating a healthy or exceptionally healthy fish population. Fluctuations within these scores from one pass to another could be due to variability in the fish community or the surveys themselves and may not necessarily be a result of water quality issues.

Metrics that are consistently poor (score of "1") may be a sign that water quality or habitat limitations are negatively impacting the fish population at a location. During NEORSD's 2011 fish community assessment, there were several instances in which a metric scored a "1" for both electrofishing passes. Both the number of darter species metric at RMs 8.30 and 2.50 and the number of sucker species metric at RM 8.30 were assigned a score of "1". Numerous species classified in the darter or sucker family are categorized as pollution-sensitive fish, and their absence may indicate water quality impacts if the habitat does not appear to be limiting. In 2017, although one electrofishing pass yielded a metric score of "1", none of the twelve IBI metrics scored "1" for both electrofishing passes, indicating that water quality of the Rocky River may have improved since 2011 at these locations.

Three fish species listed by Ohio EPA as pollution intolerant were collected on the Rocky River in 2017: rosyface shiners (*Notropis rubellus)*, mimic shiners (*Notropis volucellus*), and stonecat madtoms (*Noturus flavus*). The presence of fish listed as pollution intolerant is generally a sign of good water quality within the river. The efforts by NEORSD and local municipalities to eliminate dry and wet weather sanitary sewage discharges to the river may have helped improve the fish community. A continued effort may help these sites meet the criteria of an exceptional warmwater habitat in the future.

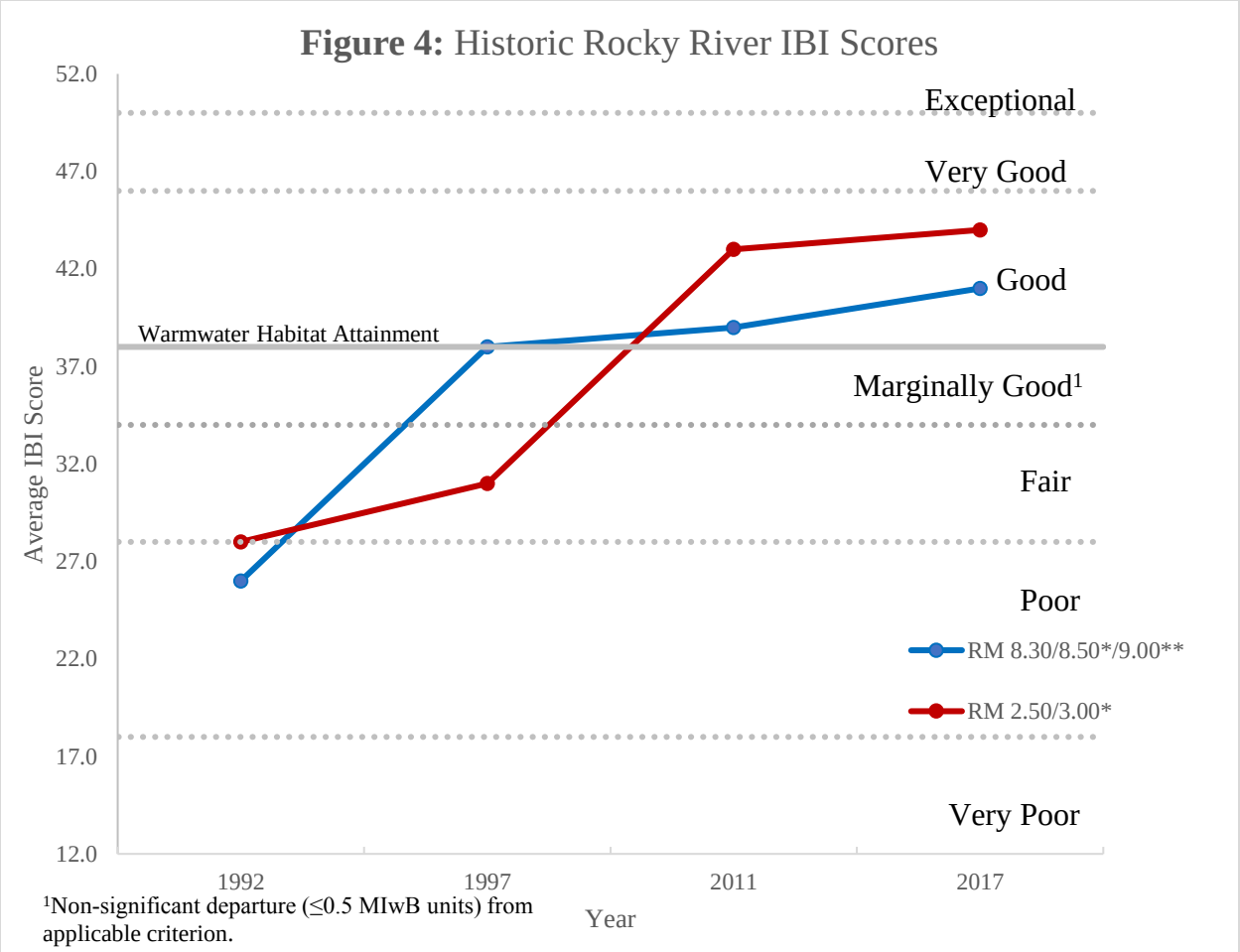
Historical data from Ohio EPA's 1992 and 1999 bioassessments was used to

compare temporal trends in the fish community biology of the Rocky River (Table 9). The 1992 and 1997 fish community biology scores from Ohio EPA show RMs 3.0 and 8.5/9.0 to be in non-attainment for all fish community scores. The QHEI scores greater than 60 show that these sites had the potential to attain WWH use (Ohio EPA 1989), indicating there may have been water quality issues contributing to the poor fish community scores. Sampling by NEORSD in 2011 and 2017, however, indicates that the fish community has recovered from past water pollution as evidence of the improved IBI and MIwb scores (Figures 4 and 5). Both the IBI and MIwb scores from RM 2.50 and 8.30 now meet the attainment criterion for their designated WWH aquatic life use.

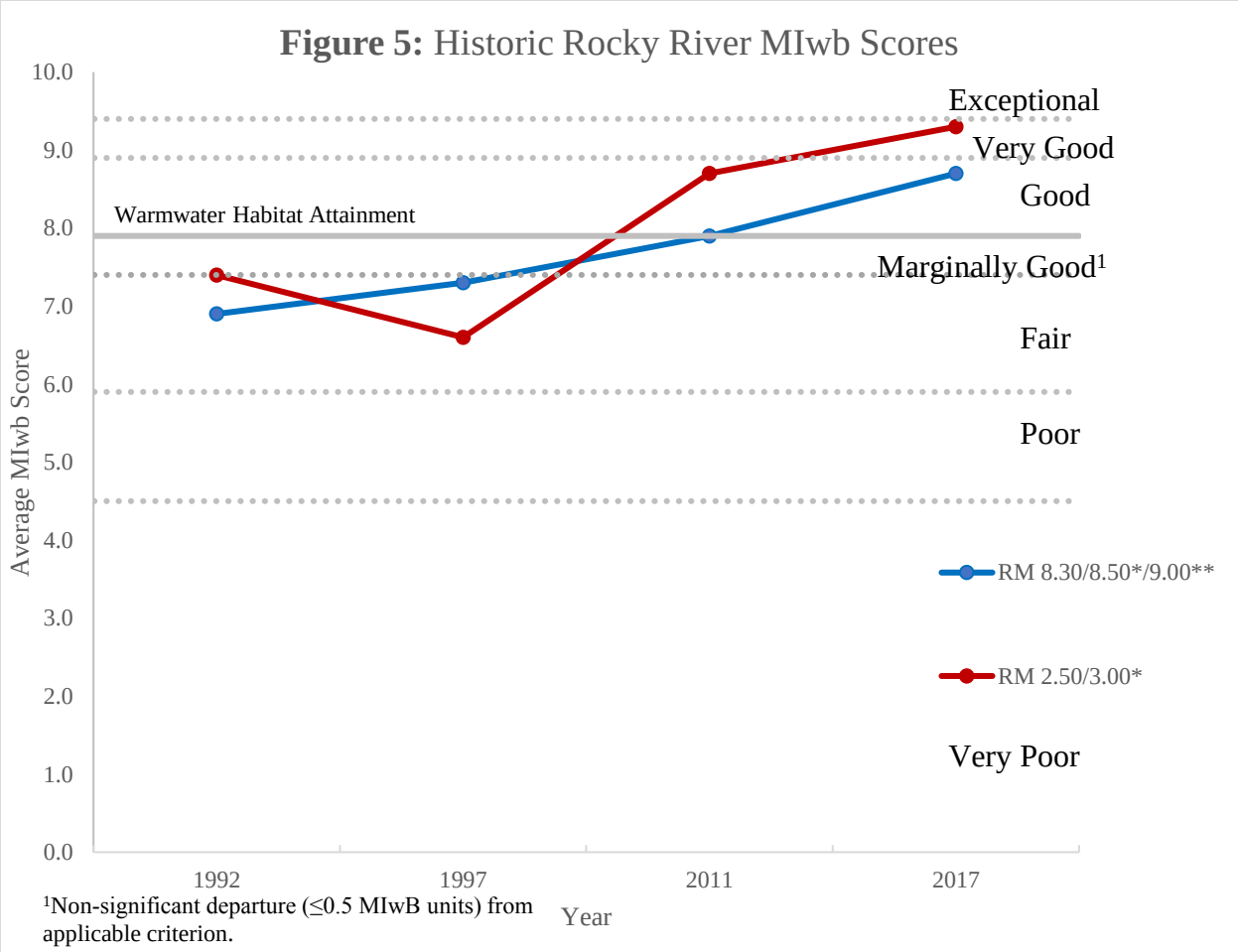
Table 9. Historical Fish Community Biology Scores

	1992 Ohio EPA			1997 Ohio EPA			2011 NEORSD			2017 NEORSD		
	QHEI	IBI	MIwb	QHEI	IBI	MIwb	QHEI	IBI	MIwb	QHEI	IBI	MIwb
RM 8.30/8.50* /9.00**	70.50	26	6.9	66.00	38	7.3	70.50	39	7.9	70.75	41	8.7
RM 2.50/3.00*	80.50	28	7.4	73.00	31	6.6	76.25	43	8.7	78.00	44	9.3

*Ohio EPA Sampling River Mile
**Ohio EPA Sampling River Mile, 1997
= Non-attainment, WWH Aquatic Life Use
= Non-significant departure, WWH Aquatic Life Use
= Attainment, WWH Aquatic Life Use



[1]Non-significant departure (≤0.5 MIwB units) from applicable criterion.



Improvements in water quality from 1992 to present include the elimination of nine WWTP effluent discharges, which contributed approximately 10 MGD of treated wastewater to the Rocky River basin (Ohio EPA, 1999). The wastewater from these WWTPs are now tied in to the NEORSD Southwest Interceptor and discharged to the Cuyahoga River at RM 10.57 after proper treatment. The Cleveland Hopkins International Airport discontinued use of urea as a deicing agent in 1998. Urea forms ammonia during decay, which is toxic to aquatic organisms at low concentrations and is a nutrient that promotes biological overgrowth (US EPA, 2012). NEORSD and local community efforts have helped eliminate sanitary sewage contaminated flows through the Illicit Discharge Detection and Elimination program. These improvements have allowed the Rocky River to meet the fish community biology WWH criteria since 1998.

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 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 HDs to be installed is six weeks.

The collected macroinvertebrate specimens 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 NEORSD WQIS department.

The macroinvertebrate sampling methods used followed Ohio EPA protocol methods as detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). The overall aquatic macroinvertebrate community in the stream was evaluated using Ohio EPA's Invertebrate Community Index (ICI). 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 collected. The sum of the individual metric scores result in the overall ICI score. This scoring evaluates the macroinvertebrate community against Ohio EPA's reference sites for each specific eco-region. The WWH ICI criterion in the EOLP ecoregion is 34 (Table 11) and a site is within non-significant departure if the score falls within 4 ICI units of the criterion.

Table 10. 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

Table 11. Invertebrate Community Index (ICI) Range for EOLP Ecoregion								
Ohio EPA Narrative	Very Poor	Poor	Low Fair	Fair	Marginally Good	Good	Very Good	Exceptional
ICI Score	0-6	8-12	14-20	22-28	30-32	34-40	42-44	46-60
Ohio EPA Status	Non-Attainment				NSD	Attainment		
NSD – Non-Significant Departure of WWH attainment								

Results and Discussion

For the 2017 sampling season, both RM 2.50 and 8.30 met the WWH aquatic life use criterion for invertebrate community biology by receiving an ICI scores of 36. Historical data from Ohio EPA's 1992 and 1999 bioassessments was used to compare temporal trends in the macroinvertebrate community biology of the Rocky River (Table 12). Ohio EPA's 1992 macroinvertebrate community biology scores show RMs 3.00 and 8.30/9.00 to be in non-attainment of the ICI WWH criterion. There was a slight decrease from the NEORSD 2011 ICI score at RM 8.30, as well as a decrease from the Ohio EPA 1997 ICI score at RM 2.50/2.90 as seen in Table 12. Although these scores reflect a lower numerical value in 2017, both sites met the macroinvertebrate community biology WWH criterion.

Table 12. Historical Rocky River ICI Scores

	1992 Ohio EPA	1997 Ohio EPA	2011 NEORSD	2017 NEORSD
RM 8.30/9.00*	30	30	44	36
RM 2.50/2.90* /3.00**	MG	46	N/A	36

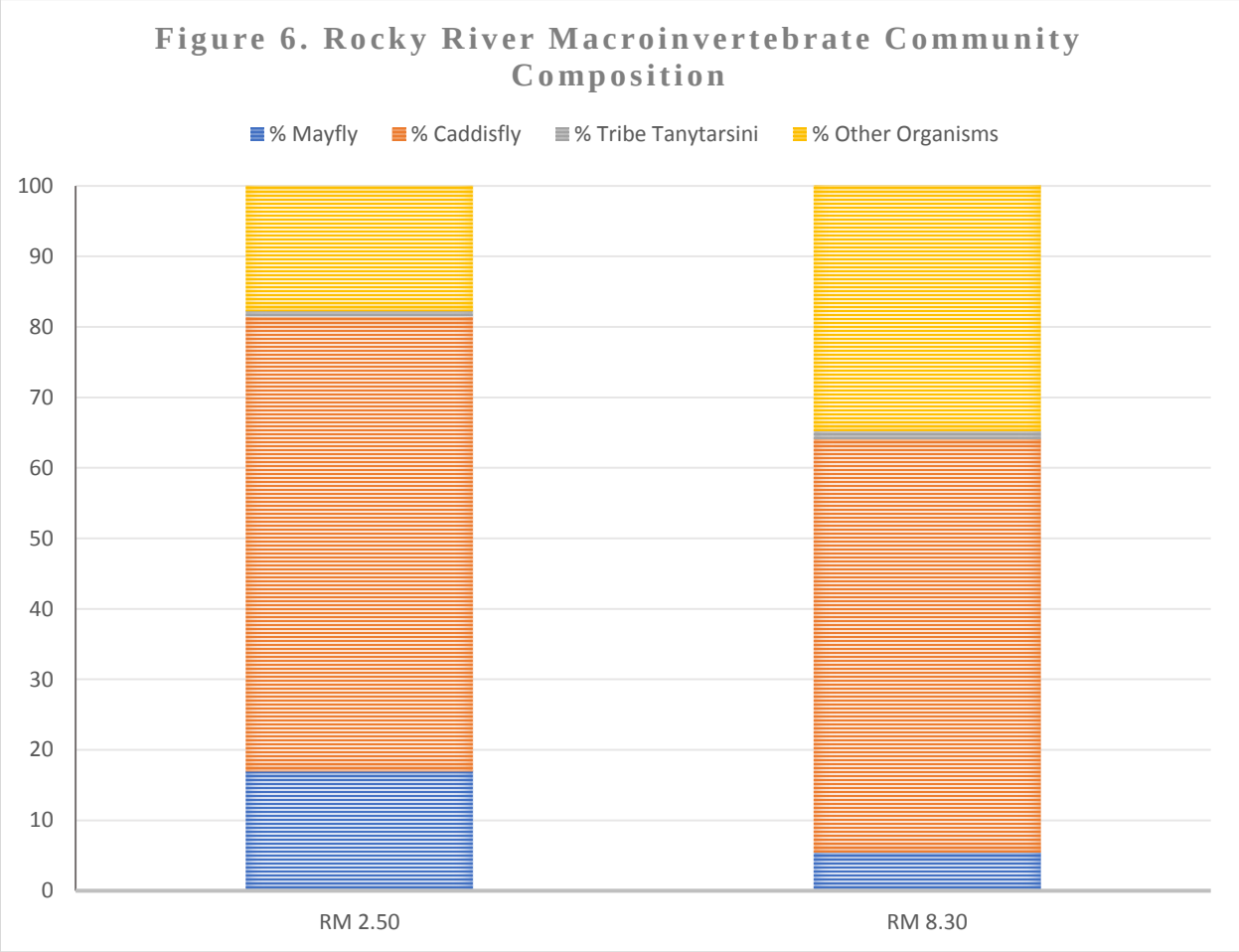
*Ohio EPA Sampling River Mile
**Ohio EPA Sampling River Mile, 1997
= Attainment, WWH Aquatic Life Use
MG = Ohio EPA Narrative of *Marginally Good*

Table 13 below displays a more detailed description of the two Rocky River sample sites. Both sites displayed a diverse and abundant EPT taxa composition. The assemblage of macroinvertebrates collected shows that these sites contain a well-established population of organisms that are considered intolerant to water pollution, with RM 2.50 consisting of greater than 60% intolerant organisms. The abundance of intolerant species, especially at RM 2.50, indicates that NEORSD CSOs may not be having a negative impact on the aquatic macroinvertebrate assemblage.

Table 13. 2017 Macroinvertebrate Results

Location	River Mile	ICI Score	Density (Organisms per square foot)	Total Number of Taxa	Number of EPT Taxa	% Tolerant Organisms	% Intolerant Organisms	Narrative Rating
Upstream of Puritas Road Bridge	8.30	36	1998	43	10	0.48%	41.91%	*Good*
Upstream of Hilliard Boulevard Bridge	2.50	36	1755	48	13	0.00%	60.21%	*Good*

Figure 6 displays the macroinvertebrate community composition for each sample site. Both sites displayed a high number of total taxa which consisted mostly of caddisfly taxa. Mayfly, as well as other diptera and non-insects were present in moderate amounts, with tribe tanytarsini midges present, but rare. Caddisfly and mayfly taxa are generally considered to be pollution-sensitive species, which is an indicator of good water quality.



Conclusions

For the 2017 sampling season, both Rocky River sites met full attainment of the WWH aquatic life criterion (Table 14). The fish community received *Good* to *Very Good* narratives based on the IBI and MIwb indices and the macroinvertebrate community received a *Good* narrative based on the ICI score. Both bioassessments displayed fish and macroinvertebrate species that are considered intolerant to water pollution, which is generally a sign of good water quality within the river. The QHEI scores display that habitat is not a limiting factor preventing the aquatic biota from reaching WWH criterion.

Table 14: 2017 Rocky River Biomonitoring Results						
River Mile	**Aquatic Life Use Attainment Status**	**IBI** *(Narrative Rating)*	**MIwb** *(Narrative Rating)*	**ICI** *(Narrative Rating)*	**QHEI** *(Narrative Rating)*	**Water Quality Exceedances**
8.30	Full	41* *Good*	8.7* *Good*	36 *Good*	70.75 *Good*	*E. coli*
2.50	Full	44* *Good*	9.3* *Very Good*	36 *Good*	78 *Excellent*	*E. coli*, Temperature
	Warmwater Habitat Criterion	38	7.4	30		
	Target for WWH communities				60	
	*Average of the two fish sampling events					

Historical sampling completed by Ohio EPA in 1992 and 1997, along with sampling done by NEORSD in 2011 and 2017 show improvements to water quality over time. Tables 9 and 12 shows that the 1992 and 1997 Ohio EPA bioassessments fail to meet full WWH aquatic life criterion. Recent sampling from NEORSD in 2011 and 2017 illustrate that these same sections of Rocky River are now in full attainment of the WWH aquatic life criterion, which may be correlated to improvements in water quality. Improvements from 1992 to present include the elimination of nine WWTPs contributing approximately 10 MGD of treated wastewater effluent from the Rocky River basin, the discontinued use of urea as a deicing agent at Cleveland Hopkins International Airport, and the elimination of sanitary sewage illicit discharges.

Sampling was also conducted to determine if NEORSD CSOs or other potential sources of pollution were negatively impacting the water quality and biological communities in the river. Eight NEORSD CSOs are located on the Rocky River between RM 2.50 and 8.30. Overall, the biological indices (IBI, MIwb, and ICI) scores all increased or remained the same from RM 8.30 to RM 2.50. RM 2.50 also met the exceptional WWH criterion for the second pass MIwb score, which is the highest-ranking water quality criterion for fish community biology. The increased biological indices downstream of these CSOs indicate that they may not be significantly impacting the aquatic life in the Rocky River. The continued efforts by NEORSD and local municipalities to eliminate dry and wet weather sanitary sewage inputs to the river may help to improve the water quality and allow the lower Rocky River to become an exceptional warmwater habitat.

Exceedances of the recreational water quality standards occurred for *E. coli*, which may be due to sanitary sewage contamination. Potential sources of sanitary sewage include CSOs, sanitary sewer overflows, failing HSTSs, illicit discharges, wildlife, and urban runoff. One other exceedance of the aquatic life water quality standards was exceeded at RM 2.50 on June 15, 2017. Field temperature was measured at 76.46 Fahrenheit, which is

0.54 degrees above the Ohio water quality standard of 75.92 Fahrenheit. Nutrient levels show that the Rocky River displays nutrient levels typical of working landscapes, and current levels display a low risk of causing impairment of the Rocky River beneficial uses.

Overall, the Rocky River at these locations are in full WWH attainment. Although chemical water quality exceedances were observed for both sites, they does not seem to be having a negative impact on the fish and macroinvertebrate communities. The biological communities at these locations have the potential to achieve exceptional WWH criteria as water quality issues continue to be addressed.

Acknowledgments

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

Kelsey Amidon
Hannah Boesinger
Nya Dreyfuss
Donna Friedman
Seth Hothem
Mark Matteson
Mario Meany
Denise Phillips
John Rhoades
Eric Soehnlen
Justin Telep, Author
Cathy Zamborsky

WQIS Paraprofessional Interns: Sarah Foley, James Ferritto

NEORSD Analytical Services Division – Completed analysis for all water chemistry sampling

References:

Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K. (2015). *Completion of the 2011 National Land Cover Database for the conterminous United States-Representing a decade of land cover change information.* Photogrammetric Engineering and Remote Sensing, v. 81, no. 5, p. 345-354

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. (1989). The Qualitative Habitat Evaluation Index [QHEI]: Rationale, Methods, and Application. Columbus, Ohio: Ecological Assessment Section Division of Water Quality Planning & Assessment

Ohio Environmental Protection Agency. (1993). *Biological and Water Quality Study of the Rocky River and Selected Tributaries*. Columbus, OH: Division of Surface Water.

Ohio Environmental Protection Agency. (1999). *Biological and Water Quality Study of the Rocky River and Selected Tributaries*. Columbus, OH: Division of Surface Water.

Ohio Environmental Protection Agency. (2006). 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, Ecological Assessment Section.

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

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

Ohio Environmental Protection Agency. (2018). *State of Ohio Water Quality Standards Ohio Administrative Code Chapter 3745-1* (Revision: Adopted October 2, 2015; Effective February 6, 2017).

Schueler, T. (1987). *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban Best Management Practices.* Metropolitan Washington Council of Governments, Washington, DC.

United States Environmental Protection Agency. (1993). *Urban Runoff Pollution Prevention Control Planning.* Cincinnati, OH: Office of Research and Development, Center for Environmental Research Information.

United States Environmental Protection Agency. (2012). *Environmental Impact and Benefit Assessment for the Final Effluent Limitation Guidelines and Standards for the Airport Deicing Category*. Office of Water, Engineering and Analysis Division.