



# **Northeast Ohio Regional Sewer District**

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## **2020 Rocky River East Branch & Baldwin Creek Biological, Water Quality, and Habitat Study**



**Water Quality and Industrial Surveillance  
Environmental Assessment Group**

**May 2021**

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## Introduction

In 2020, the Northeast Ohio Regional Sewer District (NEORS) conducted water chemistry sampling, habitat assessments, and fish and benthic macroinvertebrate community surveys on Rocky River East Branch and Baldwin Creek, one of its tributaries. Rocky River East Branch and Baldwin Creek flow through the communities of North Olmsted, Olmsted Township, Brook Park, Berea, Middleburg Heights, Strongsville and Cleveland before emptying into Lake Erie. Sampling was conducted by NEORS Level 3 Qualified Data Collectors certified by the Ohio Environmental Protection Agency (Ohio EPA) in Fish Community and Benthic Macroinvertebrate Biology, Chemical Water Quality and Stream Habitat Assessments as explained in the NEORS study plan *2020 Rocky River Environmental Monitoring* approved by Ohio EPA on June 15, 2020.

The study's objective was to assess the attainment status of the stream segments at Rocky River East Branch river miles (RM) 0.15, 6.25, 17.50 and Baldwin Creek RM 0.20. Table 1 lists the sampling sites with respect to RM, latitude/longitude, description, and types of surveys conducted. One fish survey and habitat assessment was completed at RREB RM 8.70. A full assessment was not completed at that site due to completion of a dam removal project during the early part of the field season. RM 9.00 had been assessed in 2019 instead of RM 8.70. The site was moved downstream in 2020 in response to changes in habitat following the dam removal. Figure 1 is a map of the sampling locations located on the Rocky River East Branch and Baldwin Creek.

**Table 1.** 2020 Rocky River East Branch and Baldwin Creek Sampling Sites

Water Body	Latitude	Longitude	River Mile	Location Information	USGS HUC 8 Number Name & Station ID	Purpose
Rocky River, East Branch	41.2814	-81.7425	17.50	Upstream of Ridge road	04110001 Black-Rocky, T01W38	Evaluate water chemistry, habitat, fish & macroinvertebrate community for general watershed monitoring
Rocky River, East Branch	41.3300	-81.8360	8.70	Bonnie Park	04110001 Black-Rocky, T01W29	Evaluate water chemistry, habitat, fish & macroinvertebrate community for general watershed monitoring
Rocky River, East Branch	41.3528	-81.8476	6.25	Downstream of Valley Parkway	04110001 Black-Rocky, T01W59	Evaluate water chemistry, habitat, fish & macroinvertebrate community for general watershed monitoring

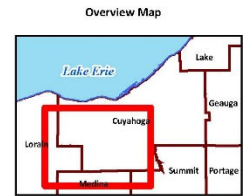
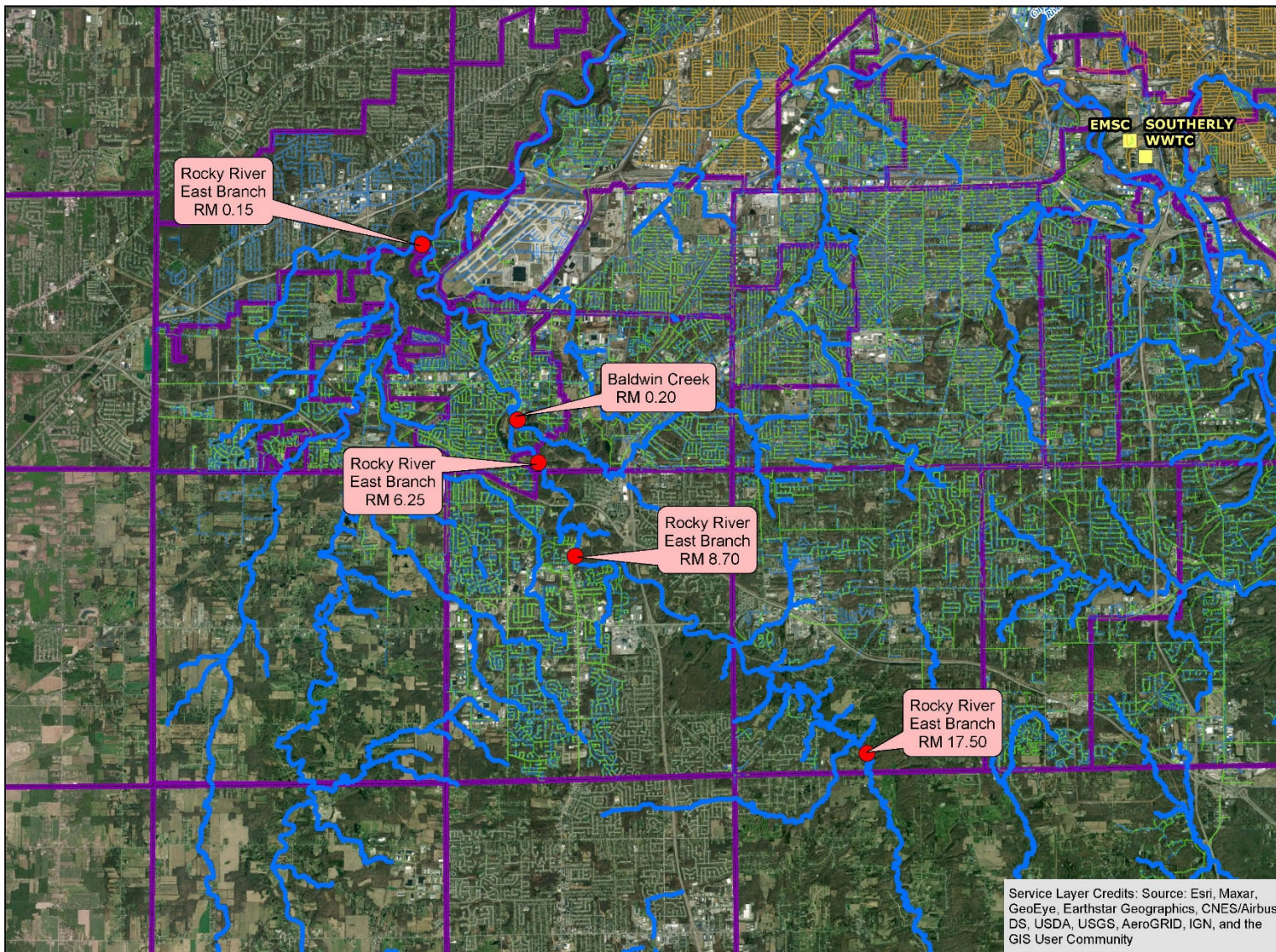
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 May 6, 2021

**Table 1.** 2020 Rocky River East Branch and Baldwin Creek Sampling Sites

Water Body	Latitude	Longitude	River Mile	Location Information	USGS HUC 8 Number Name & Station ID	Purpose
Rocky River, East Branch	41.4060	-81.8846	0.15	Upstream of Metro Park Valley Parkway	04110001 Black-Rocky, T01P31	Evaluate water chemistry, habitat, fish & macroinvertebrate community for general watershed monitoring



**2020 Rocky River  
 East Branch Watershed  
 Environmental Monitoring**



**Legend**

- Sample Locations
- Regional Drainage
- Local Combined Sewer
- Local Sanitary Sewer
- Local Storm Sewer
- Cuyahoga\_Co\_Communities
- District Facility



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**Figure 1.** 2020 Rocky River East Branch and Baldwin Creek Sampling Locations

## Water Chemistry and Bacteriological Sampling

### Methods

Water chemistry and bacteriological sampling was conducted five times between June 17, 2020 and July 15, 2020. Techniques used for sampling and analyses followed the Ohio EPA *Surface Water Field Sampling Manual for water quality parameters and flows* (2019). 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- $\mu$ 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 an 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:

$$\text{RPD} = \frac{|X-Y|}{((X+Y)/2)} * 100$$

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, 2018b).

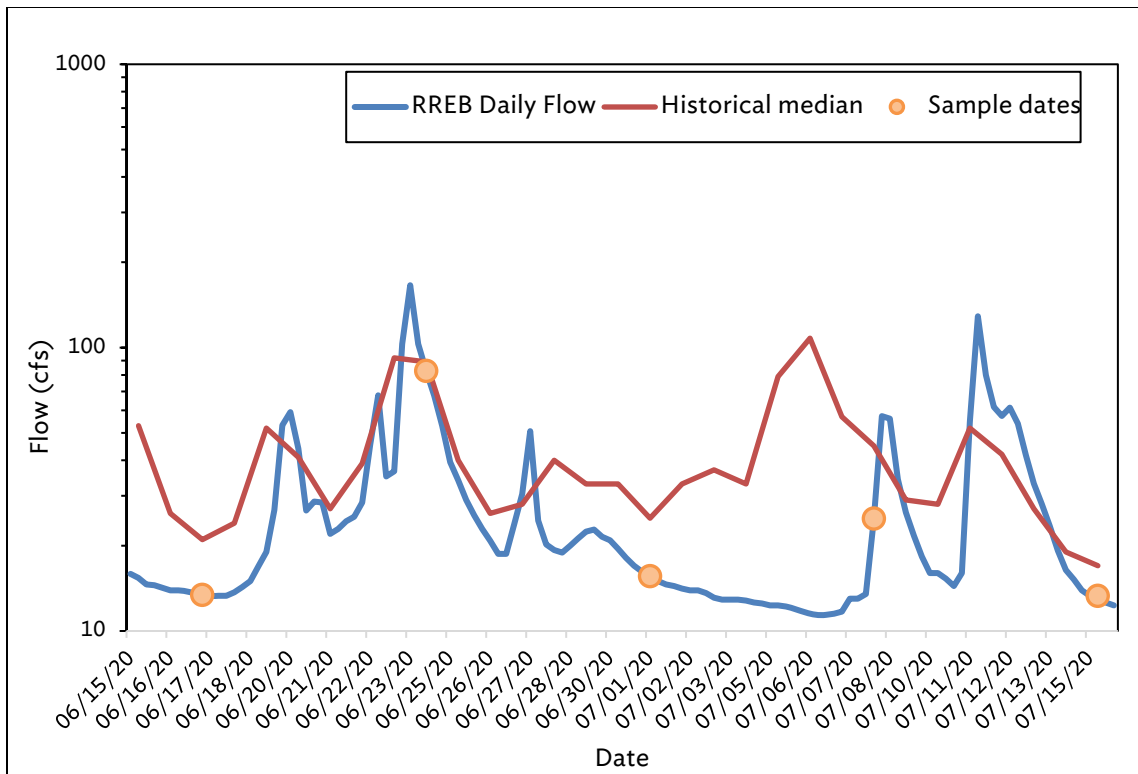
Formula 2:           Acceptable % RPD =  $[(0.9465X^{-0.344}) * 100] + 5$

X = sample/detection limit ratio

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

Water chemistry analysis sheets for each site are available upon request from the NEORS D WQIS Division. Dates of water chemistry sampling compared to Rocky River East Branch (USGS 04201484) and Baldwin Creek (USGS 04201495) flow data are shown below in Figure 2.





**Figure 2.** 2020 Rocky River East Branch & Baldwin Creek Flow Data

**Results and Discussion**

Within the study area, Rocky River East Branch and Baldwin Creek are designated as Warmwater Habitat (WWH), Agricultural Water Supply (AWS), Industrial Water Supply (IWS), and Primary Contact Recreation (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, 2021).

Over the course of the sampling, field blanks were collected for QA/QC purposes on July 8, 2020 and July 15, 2020, and the results were used to compare to all the samples collected on those days. Three water quality parameters were rejected due to potential field blank 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 2 lists the water quality parameters that were rejected or qualified as estimated or trend data based on Ohio EPA data validation protocol.

<b>Table 2. Potential Field Blank Contamination</b>
COD (Chemical Oxygen Demand)
BOD (Biological Oxygen Demand)
Chromium, Total
Turbidity



Duplicate samples were collected on June 24, 2020, at Baldwin Creek RM 0.20 and on July 1, 2020, at RREB RM 0.15 for QA/QC purposes. The duplicate sample collected at Baldwin Creek RM 0.20 revealed one parameter that was rejected due to an RPD that was greater than the acceptable RPD (Table 3). Possible reasons for why the parameter was rejected include the collector mishandling the sample, environmental heterogeneity, inconsistent sampling methods and/or analytical errors.

<b>Table 3. Unacceptable Duplicate RPDs</b>						
River/Creek	River Mile	Date	Parameter	Acceptable RPD (%)	Actual RPD (%)	Qualifier
Baldwin	0.20	6/24/2020	Cadmium, Total	67.7	112.7	Rejected

Paired parameters for all samples collected were also evaluated and compared for QA/QC purposes using the same RPD formula. No subset parameter exceeded the concentration of the corresponding parent parameter; therefore, all paired parameters were accepted as valid.

Rocky River East Branch and Baldwin Creek are designated as Primary Contact Recreation. The criteria for this designation are based on a statistical threshold value (STV); the *E. coli* count cannot be over 410 colony counts per 100 milliliters in more than ten percent of the samples taken over a 90-day period. A criterion for the 90-day geometric mean requires that the *E. coli* cannot be greater than 126 colony counts per 100 mL. In accordance with Ohio EPA procedure and practice to qualify *E. coli* exceedances for the Primary Contact Recreation criteria, the geometric mean and STV are only calculated and compared when a minimum of five bacteriological samples have been collected.

For the 2020 data, Table 4 shows the *E. coli* results and exceedances of the STV and 90-day geomean. In 2020, the 90-day geomean criterion was exceeded at every site. Every site also had at least 2 days which exceeded the STV. For most of the samples collected, the *E. coli* densities were elevated. High *E. coli* densities can be the result of illicit discharges, septic systems, improper connections, storm sewer runoff, and wild/domesticated animal waste.

Mercury analysis for the sampling events was 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), so it generally cannot be determined if the sites were in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine whether contamination was present above the detection limit. Based on the sampling that was completed, mercury was not present at levels above those normally found in the watershed (USEPA, 2004).

**Table 4.** 2020 Rocky River East Branch and Baldwin Creek *E. coli* Densities (MPN/100mL)

Date	RM 0.15	RM 6.25	RM 17.50	Baldwin 0.20
6/17/2020	504	254	350	1110
6/24/2020*	2000	3160	795	3920
7/01/2020	312	143	200	224
7/8/2020	496	3160	1190	318
7/17/2020	216	234	806	263
90-day Geomean	508	611	692	606

Exceeds statistical threshold value of 410 MPN/100mL  
 Exceeds geometric mean criterion for 90-day period of 126 MPN/100mL

\*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.

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). NEORSR did not assess DO swings or benthic chlorophyll *a* in 2020; however, nutrients were assessed.

Nutrients were assessed for the Rocky River East Branch and Baldwin Creek monitoring sites. Table 5 shows the results for dissolved inorganic nitrogen (DIN), total phosphorus (TP), and dissolved reactive phosphorus (DRP). The concentrations of TP and DIN were compared to Table 2 of the SNAP Analysis. Rocky River East Branch RMs 17.50, 6.25, 0.15 and Baldwin Creek RM 0.20 sites exhibited relatively low levels of TP. DIN was found to be at moderate to high levels for the 2020 sampling season. This combination can pose a moderate risk to beneficial uses and is more common of tile drained landscapes (Ohio EPA, 2015a). The reason for the increase in DIN concentrations during the 2020 monitoring season is unknown.

**Table 5.** 2020 Rocky River East Branch and Baldwin Creek Nutrient Analysis

River Mile	Sample Date	Total Phosphorus (mg/L)	DRP (mg/L)	Dissolved Inorganic Nitrogen (mg/L)
17.50	6/17/2020	0.12	0.074	6.016
	6/24/2020	0.069	<0.015	1.149
	7/1/2020	0.074	<0.036	4.632
	7/8/2020	0.093	<0.020	1.64
	7/15/2020	0.119	0.078	6.15
	GeoMean	0.093	0.036	3.176

<b>Table 5. 2020 Rocky River East Branch and Baldwin Creek Nutrient Analysis</b>				
River Mile	Sample Date	Total Phosphorus (mg/L)	DRP (mg/L)	Dissolved Inorganic Nitrogen (mg/L)
6.25	6/17/2020	0.083	j 0.024	7.445
	6/24/2020	0.105	0.040	2.451
	7/1/2020	0.076	j 0.035	6.006
	7/8/2020	0.151	0.075	10.764
	7/15/2020	0.102	0.054	6.347
	GeoMean	0.100	0.042	5.955
0.15	6/17/2020	0.086	<0.014	3.674
	6/24/2020	0.034	j 0.021	2.805
	7/1/2020	0.032	<0.014	4.222
	7/8/2020	0.04	<0.014	6.633
	7/15/2020	0.105	<0.014	2.972
	GeoMean	0.041	0.008	3.861
0.20	6/17/2020	0.101	j 0.018	8.935
	6/24/2020	0.103	j 0.035	2.492
	7/1/2020	0.098	j 0.024	6.546
	7/8/2020	0.081	<0.0014	10.66
	7/15/2020	0.084	j 0.019	6.278
	GeoMean	0.095	0.018	6.278

## Habitat Assessment

### Methods

Instream habitat assessments were conducted once at each site on Rocky River East Branch and Baldwin Creek in 2020 using the Qualitative Habitat Evaluation Index (QHEI). The QHEI was developed by the Ohio EPA to assess aquatic habitat conditions that may influence the presence or absence of fish species by evaluating the physical attributes of a stream. The index is based on six metrics: stream substrate, instream cover, channel morphology, riparian zone and bank condition, pool and riffle quality, and stream gradient. The QHEI has a maximum score of 100, and a score of 60 or more in streams >20 square miles or 55 for streams ≤20 square miles suggests that sufficient habitat exists to support a fish community that meets the warmwater habitat criterion (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 Ohio EPA's target score for the QHEI is 60 (or 55 for headwater sites), which means that the body of water's habitat should be able to support a community of warmwater fish species. Fish are used as an indicator of water quality; the presence and abundance of tolerant

and non-tolerant species can help to determine the health of a stream. Table 6 lists the specific QHEI attributes for each site and the resulting score and narrative rating. The attributes of each site are discussed in further detail below. All the sites surveyed met the target scores with the exception of Rocky River East Branch RM 0.15.

**Table 6.** 2020 Rocky River East Branch and Baldwin Creek QHEI Scores and Physical Attributes

Stream	River Mile	QHEI Score	Narrative Rating	WWH Attributes													High Influence		MWH Attributes														
				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 Depth < 40 cm (WD, HW sites)	Total High Influence Attributes	Recovering Channel	Heavy/Moderate Silt Cover	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 Attributes	(MWH-H.I.+1) / (WWH+1) Ratio	(MWH M.I.+1) / (WWH+1) Ratio
East Branch	17.50	67.50	Good	X		X	X	X		X	X	X	7	X			1	X		X				X							3	0	1
Rocky River	8.70	71.00	Good	X	X	X		X	X	X	X	X	8	X			1	X		X		X								2	0	0	
	6.25	72.50	Good	X		X	X	X	X	X	X		7				0	X		X						X			2	0	0		
	0.15	54.25	Fair	X					X	X	X	X	5			X	1	X	X	X	X								4	0	1		
Baldwin Ck.	0.20	80.50	Excellent	X	X	X		X	X	X	X	X	8		X		1				X								1	0	0		

Rocky River East Branch RM 17.50 received a QHEI score of 67.50, resulting in a narrative rating of *Good*. River right was forested, and river left consisted of residential riparian zones. The predominant types of substrates were sand and silt; with three best types of substrate present in the pool and two in the riffle. The riffle depth was greater than 10 centimeters and the depth of the run was less than 50 centimeters. The channel sinuosity was low to moderate, with low to moderate stability. The pools were of good quality. The riffles exhibited depths greater than 10 cm, low to moderate stability and low embeddedness. Riffles are important in a stream because they supply oxygen and habitat to support aquatic life. Instream cover received a score of 16 in this section of stream and exhibited a moderate amount of undercut banks, overhanging vegetation, shallows pools, root mats, rootwads, logs and woody debris along with little to moderate bank erosion.

Rocky River East Branch RM 8.70 was surveyed and received a QHEI score of 71.00, which resulted in a narrative rating of *Good*. This area is within the Cleveland Metroparks and was forested on river right and consisted of urban riparian zone on river left. The predominant types of substrates were cobble and gravel. The riffle depth was greater than 10 centimeters and the depth of the run was greater than 50 centimeters and exhibited good stability with minimal embeddedness. Channel morphology exhibited low sinuosity with good development and



moderate to high stability. The pools were of good quality and were greater than 1 meter in depth. Instream cover included moderate amounts of undercut banks, shallows and boulders. RREB RM 8.70 will be surveyed again in 2021 to monitor progression at this site.

Rocky River East Branch RM 6.25 received a QHEI score of 72.50 resulting in a narrative rating of *Good*. This area is within the Cleveland Metroparks and was forested on both river right and left. The predominant type of substrate was bedrock. This site had all the best type substrates such as slabs, boulders, cobble, gravel, sand and bedrock in both the pool and riffle. Silt was present in both the pool and riffle; this has the potential to be a detriment to biological communities during high flows as it can block the gills of fish and macroinvertebrates. This silt can also degrade the interstitial spaces that these organisms rely on for breeding and to avoid predation. The riffle was greater than 10 centimeters and the run depth was greater than 50 centimeters. The channel sinuosity was moderate, and the development of the channel was good to fair with high stability. This site had characteristics of a very good pool. There was sparse to moderate instream cover that included deep pools, root mats and boulders. This site had little bank erosion which is beneficial for aquatic invertebrates because this improves the margin's habitat.

Rocky River East Branch RM 0.15 received a score of 54.25, which resulted in a narrative rating of *Fair*, a decrease in score from the previous year. This area is in the Cleveland Metroparks and consisted of forest on both river right and left. The predominant type of substrate was bedrock. The pool had only bedrock as best type substrate and the riffle included 5 best type substrates. Silt was present in the pool in moderate amounts. The riffle was 5- 10 centimeters and the run was less than 50 centimeters. The channel morphology and sinuosity was low with fair to poor development. Instream cover was sparse to nearly absent and included boulders and backwaters. This site had little erosion on river left and moderate erosion on river right. The decrease in score at this site is likely a result of the natural movement and deposition of materials in large streams on an annual cycle.

Baldwin Creek RM 0.20 received a high score of 80.50, resulting in a narrative rating of *Excellent*. This area is in the Cleveland Metroparks and is located between two sections of quarry rock walls. The predominant types of substrate at this site were boulders and slabs. Boulders and slabs are beneficial to a creek because they promote stability and provide excellent habitat. There were 4 best types of substrate present in the pool and 3 best types in the riffle, and the site was composed of mainly riffle with small pools. The riffle was greater than 10 centimeters and the run depth was less than 50 centimeters. The channel morphology sinuosity was low, highly stable, and exhibited good development. There was moderate to extensive instream cover that included undercut banks, shallows, root mats, and boulders. There was little bank erosion.

## **Fish Community Biology Assessment**

### **Methods**

Two quantitative electrofishing passes were conducted for each site in 2020. A single electrofishing pass was conducted at RREB RM 8.70 after the downstream dam was removed. A

list of the dates when the surveys were completed, along with flow as measured at the United States Geological Survey gage station #04201484 in Strongsville, Ohio (Rocky River East Branch) and gage station # 04201495 in Strongsville, Ohio (Baldwin Creek) is given in Table 7. Sampling at all sites 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 at all sites was 0.20 kilometers in length, with the exception of Baldwin Creek at 0.15 kilometers in length. 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.

Table 7. Sampling Dates and Flows		
Site	Date	Daily Mean Flow (CFS) or Stream Discharge (ft <sup>3</sup> /s)*
17.50	8/14/2020	10.9
	9/28/2020	8.01
8.70	10/9/2020	13.0
6.25	7/6/2020	11.5
	9/18/2020	15.2
0.15	6/19/2020	19.0
	9/17/2020	17.9
Baldwin 0.20	6/19/2020	5.57
	7/27/2020	3.52
Flow data obtained from USGS #4201484 flow gauge in Strongsville, Ohio (RREB) and USGS # 04201495 flow gage in Strongsville, Ohio (Baldwin). (*) All data provisional; data not yet approved by USGS.		

The electrofishing results for each pass were compiled and utilized to evaluate fish community health through the application of two Ohio EPA indices, the Index of Biotic Integrity (IBI) and the Modified Index of Well-Being (MIwb). The IBI incorporates 12 community metrics representing structural and functional attributes. The structural attributes are based upon fish community aspects such as fish numbers and diversity. Functional attributes are based upon fish community aspects such as feeding strategies, environmental tolerances, and disease symptoms. These metrics are individually scored by comparing the data collected at the survey site with values expected at reference sites located in a similar geographical region. The maximum possible IBI score is 60 and the minimum possible score is 12. The summation of the 12 individual metrics scores provides a single-value IBI score, which corresponds to a narrative rating of *Exceptional, Good, Marginally Good, Fair, Poor* or *Very Poor*. The 12 metrics utilized for wading, and headwater sites are listed in Table 8. The IBI scores and their associated narrative ratings are shown in Table 9. A summary of the 2020 monitoring for each site and their representative scores are listed in Table 10.

<b>Table 8. IBI Metrics</b>	
Wading sites	Headwater sites (≤20 sq. miles)
Number of indigenous fish species	Number of indigenous fish species
Number of darter species	Number of darter species
Number of sunfish species	Number of headwater species
Number of sucker species	Number of minnow species
Number of intolerant species	Number of sensitive species
Percent tolerant species	Percent tolerant species
Percent omnivore species	Percent omnivore species
Percent insectivore species	Percent insectivore species
Percent of top carnivore species	Percent pioneering species
Number of individuals (minus tolerant sp.)	Number of individuals (minus tolerant sp.)
Percent of simple lithophilic spawners	Number of simple lithophilic species
Percent DELT anomalies	Percent DELT anomalies

<b>Table 9. Fish Community Biology Scores in the EOLP Ecoregion</b>							
Ohio EPA Narrative	Very Poor	Poor	Fair	Marginally Good	Good	Very Good	Exceptional
IBI Score - Headwater	12-17	18-27	28-35	36-39	40-45	46-49	50-60
IBI Score - Wading	12-17	18-27	28-33	34-37	38-45	46-49	50-60
MIwb Score (Wading only)	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 Narrative	Non-Attainment			NSD	Attainment		
NSD – Non-Significant Departure of WWH attainment							

The second fish index utilized by Ohio EPA is the Modified Index of Well-being (MIwb). The MIwb, Formula 3 below, incorporates four fish community measures: numbers of individuals, biomass, and the Shannon Diversity Index (H) (Formula 4 below) based on numbers and weight of fish. The MIwb is a result of a mathematical calculation based upon the formula.

Formula 3: 
$$MIwb = 0.5 \ln N + 0.5 \ln B + \bar{H}(No.) + \bar{H}(Wt.)$$

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

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

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

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

Formula 4: 
$$\bar{H} = -\sum \left[ \left( \frac{n_i}{N} \right) \log_e \left( \frac{n_i}{N} \right) \right]$$

$n_i$  = Relative numbers or weight of species

$N$  = Total number or weight of the sample

A MIwb score  $\geq 7.9$  (*Good*) is in attainment of the WWH biocriterion for wading sites in the EOLP ecoregion. A MIwb score of 7.4 (*Marginally Good*) is also in attainment, as it is considered non-significant departure ( $\leq 0.5$  MIwb units) from the criterion. The IBI criterion for wading is 38 or greater. The non-significant departure (NSD) for the IBI is  $\leq 4$  units from the criterion.

## Results and Discussion

Rocky River East Branch RM 17.50 was in NSD of the IBI WWH criterion for 2020. Two electrofishing passes were conducted which resulted in the site receiving an average IBI score of 37 (*Marginally Good*). The site received an average MIwb score of 8.20 (*Good*). This was a slight decrease in score from 2019. This site exhibited a good diversity of fish species. The species that are intolerant to pollution collected at this site included the river chub (*Nocomis micropogon*). The presence of moderately intolerant species: golden redhorse (*Moxostoma erythrurum*), northern hog sucker (*Hypentelium nigricans*), sand shiner (*Notropis stramineus*), rainbow darter (*Etheostoma caeruleum*, and the greenside darter (*Etheostoma blenniodes*) indicate good water quality with low occurrence of common stressors. One invasive species was found at this site, the round goby (*Neogobius melanostomus*). Invasive species can be a problem for native fish because they will have to compete for limited habitat and resources. The high metric scores were a result of the number of native species (5), number of darter species (5), proportion of simple lithophils (3), carnivores (5) and number of individuals (3). The rest of the metrics received a score of 1 or 3.

Rocky River East Branch RM 9.00 was in NSD of the IBI WWH criterion for 2019. Two electrofishing passes were conducted which resulted in the site receiving an average IBI score of 37 (*Marginally Good*). In 2020, one electrofishing pass was conducted downstream at RM 8.70 which yielded a score of 44 (*Good*). The presence of moderately intolerant species: golden redhorse, northern hog sucker, sand shiner and the greenside darter indicate good water quality with low occurrence of common stressors. No invasive species were found at this site during this electrofishing pass, but the round goby (*Neogobius melanostomus*) is common in the stream. The high metric scores were a result of the number of native species (5), number of darter species (3), number of sunfish species (5), number of sucker species (3), percent tolerant (5), percent omnivores (5), percent insectivores (3), percent simple lithophils (3), percent top carnivores (3) and number of individuals (5). The rest of the metrics received a score of 1 or 3. Sampling will be conducted again at RM 8.70 during the 2021 season to monitor progress after the dam removal.



<b>Table 10.</b> 2020 Rocky River East Branch and Baldwin Creek IBI & MIwb Results				
Site	Type	Date	IBI	MIwb
RM 17.50	Wading	8/14/2020	<b>40*</b>	<b>8.4</b>
		9/29/2020	34	<b>8.0</b>
RM 6.25	Wading	7/6/2020	30	<b>7.8</b>
		9/18/2020	32	<b>8.6</b>
RM 0.15	Wading	6/19/2020	<b>34*</b>	<b>8.5</b>
		9/17/2020	<b>46</b>	<b>9.4</b>
Baldwin RM 0.20	Headwater	6/19/2020	<b>48</b>	N/A**
		7/27/2020	<b>50</b>	N/A**
IBI criteria wading $\geq 38$ ; MIwb criteria wading $\geq 7.9$				
<b>Bold</b> = meets biocriterion, ** MIwb does not apply to Headwater Sites.				
<i>Italics*</i> = Non-significant departure [IBI wading $\geq 34$ , boat $\geq 36$ ; MIwb wading $\geq 7.4$ ]				

Rocky River East Branch RM 6.25 was in non-attainment of the IBI WWH criterion for 2020, the same as in 2019. Two electrofishing passes were conducted and resulted in the site receiving an average IBI score of 31 (*Fair*). The site received an average MIwb score of 8.2 (*Good*). One intolerant species, mimic shiner (*Notropis volucellus*), was found during the second pass. Highly tolerant species that were found are as follows: common white sucker (*Catostomus commersonii*), blacknose dace (*Rhinichthys atratulus*), bluntnose minnow (*Pimephales notatus*) and green sunfish (*Lepomis cyanellus*). The high metric scores at this site were from number of native species (5), number of sunfish species (5), proportion with DELTS (5) and number of individuals (5).

Rocky River East Branch RM 0.15 was in attainment of the IBI WWH criterion during 2020. Two electrofishing passes were conducted which resulted in the site receiving an average IBI score of 40 (*Good*). The first pass yielded a lower score of 34, while the second pass resulted in a score of 46. The site received an average MIwb score of 9.0 (*Very Good*). Sampled at this site were moderately intolerant, intolerant and highly intolerant species of fish. The 3 intolerant species were the rosyface shiner (*Notropis rubellus*), mimic shiner and stonecat madtom (*Noturus flavus*). The five moderately intolerant species were the northern hog sucker, sand shiner, smallmouth bass, rainbow darter and greenside darter. The high metric scores at this site were from number proportion of tolerant species (5), proportion of omnivores (5), proportion of insectivores (5) and proportion with DELTS (5). The invasive species the round goby was found at this site.

Baldwin Creek RM 0.20 was in attainment of the IBI WWH criterion during 2020. Two electrofishing passes were conducted which resulted in the site receiving an average IBI score of 49 (*Very Good*). The MIwb does not apply to headwater sites; therefore, no calculation is warranted. Good diversity was observed at this site in regard to pollution tolerance. The mimic shiner, a common intolerant species, was found at this site. The following are moderately intolerant species that were found in both passes: northern hog sucker, sand shiner, greenside darter and rainbow darter. This site had high metric scores of 5 in most of the categories, while the number of headwater species received a low metric score of 1. The rest of the metrics

received a score of 3. A low variation in the IBI score was observed in the two electrofishing passes conducted at this site. These results were similar to what was found in 2019.

## Macroinvertebrate Community Biology 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), 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. The recommended period for HDs to be installed is six weeks.

The macroinvertebrate samples were sent to Third Rock Consultants of Lexington, KY 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 Division.

The macroinvertebrate sampling methods followed Ohio EPA protocols 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 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 collected. The sum of the individual metric scores is used to calculate 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 12). A site is within non-significant departure if the score falls within 4 ICI units of the criterion.

<b>Table 11. ICI Metrics</b>
Total Number of Taxa
Number of Mayfly taxa
Number of Caddisfly taxa
Number of Dipteran taxa
Percent Mayflies
Percent Caddisflies
Percent Tanytarsini Midges
Percent Other Diptera and Non-Insects
Percent Tolerant Organisms (as defined)
Number of Qualitative EPT Taxa

Table 12. 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

Rocky River East Branch RM 17.50 was in attainment of the ICI WWH criterion for 2020 with an ICI score of 46 (*Exceptional*). This site exhibited 12 EPT taxa out of a total of 42 taxa in the qualitative sample. Mayflies, caddisflies and Tanytarsini tribe represented 95.19% of the quantitative sample overall. Of that figure, mayflies and the Tanytarsini tribe were the most dominant in composition. No percentage of the quantitative sample consisted of tolerant species, while 4.11% consisted of other Diptera and non-insects. The percentage of EPT taxa and lack of tolerant taxa is reflected in the high score.

Rocky River East Branch RM 9.00 was in significant departure/non-attainment for 2019 with an ICI score of 18 (*Low-Fair*). This site was confined by a dam structure which was removed in 2020. Habitat restoration also occurred at this site. No macroinvertebrate sampling was conducted at this site during the 2020 season. NEORSD will be monitoring downstream at RREB RM 8.70 during the 2021 season.

Rocky River East Branch RM 6.25 was found to be in attainment of the ICI WWH criterion for 2020 with an ICI score of 46 (*Exceptional*). This site exhibited 10 EPT taxa out of a total of 34 taxa in the qualitative sample. Mayflies, caddisflies and Tanytarsini tribe represented 87.25 % of the quantitative sample overall, with mayfly and caddisfly taxa being dominant in that composition. In contrast, only 0.37% of the quantitative sample consisted of tolerant species, while 12.70% consisted of other Diptera and non-insects. This site’s score reflects a healthy WWH community of macroinvertebrates.

Rocky River East Branch RM 0.15 was in attainment of the ICI WWH criterion for 2020 with an ICI score of 36 (*Good*). This site exhibited 7 EPT taxa out of a total of 38 taxa in the qualitative sample. Mayflies, caddisflies and Tanytarsini tribe represented 74.39% of the quantitative sample overall, with the caddisfly taxa being dominant in that composition at 60.55%. Only 0.79% of the quantitative sample consisted of tolerant species, while 25.56% consisted of other Diptera and non-insects. A high percentage composition of EPT taxa and very low percentage of tolerant taxa is reflected in the score of 36.

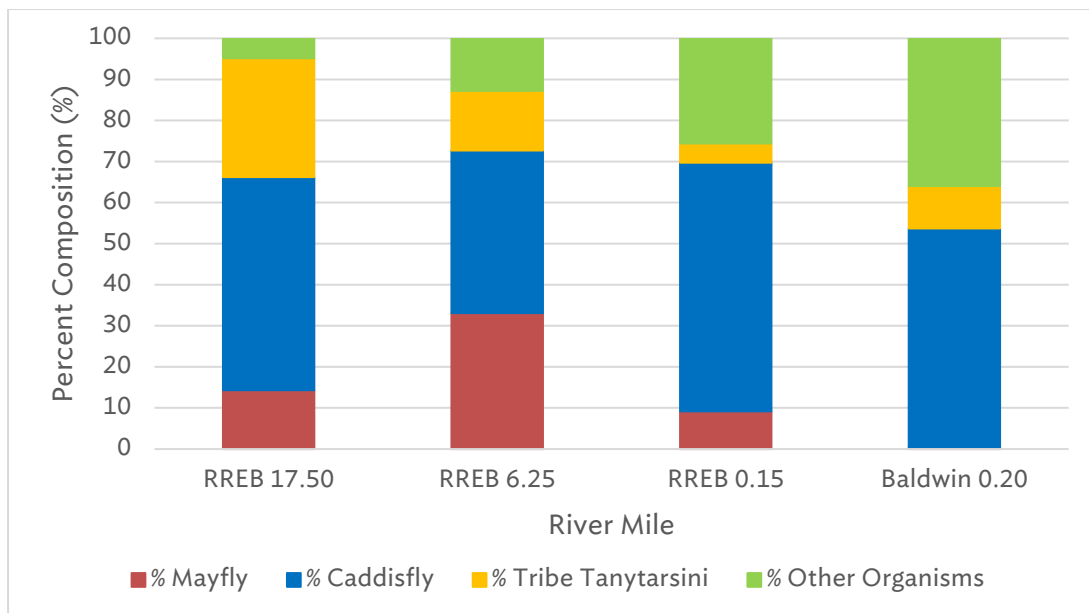
Baldwin Creek RM 0.20 was in attainment for 2020 with an ICI score of 40 (*Good*). This site exhibited 7 EPT taxa out of a total of 33 taxa in the qualitative sample. Mayflies, caddisflies and Tanytarsini tribe represented 63.96 % of the quantitative sample overall. Of that figure caddisflies

were the most dominant in composition at 53.27%. In contrast, 7.99% of the quantitative sample consisted of tolerant species, while 35.88% consisted of other Diptera and non-insects. The high percentage of EPT taxa and low percentages of other Diptera and non-insects and tolerant taxa is reflected in the high score. In 2019, with a score of 24 (*Fair*), the percent composition for caddisflies was 6.34% percent of the sample. Percent composition of caddisflies for 2020 was 53.3%, while the percent composition of other EPT taxa remained nearly the same. The large increase in the caddisflies percent composition was responsible for the 2020 score increase, as well as the large decreases in the percent tolerant and percent other Diptera and non-insects metrics.

Overall, an increase in ICI scores was observed during the 2020 monitoring season- a possible reason for this may be due to increased flows and oxygenation which may have allowed for more efficient transport of macroinvertebrates to the HD unit. These values and the percent composition of the macroinvertebrate communities are shown in Table 13 and Figure 3.

Table 13. 2020 Rocky River East Branch and Baldwin Creek Macroinvertebrate Results							
Location	RM	ICI Score	Density per (ft <sup>2</sup> ) (Qt.)	Total Taxa	EPT Taxa (QI.)	% Tolerant (Qt.)	Narrative Rating/ WWH Status
Rocky River East Br.	17.50	<b>46</b>	3018	52	12	0.0	Exceptional, Attainment
	6.25	<b>46</b>	2165	52	10	0.37	Exceptional, Attainment
	0.15	<b>36</b>	6459	48	7	0.79	Good, Attainment
Baldwin Creek	0.20	<b>40</b>	3041	47	7	7.99	Good, Attainment

\* Significant departure from biocriterion (score >4 ICI units)  
**Bold** indicates attainment of WWH Criterion (34)



**Figure 2.** 2020 Rocky River East Branch and Baldwin Creek Macroinvertebrate Composition



## Conclusions

The Rocky River East Branch was in partial attainment overall. Of the three locations sampled, two were found to be in full attainment of the WWH criteria (RREB RMs 17.50 and 0.15). The remaining site was in partial attainment (RREB RM 6.25). All sampling locations had *E. coli* water quality exceedances throughout the six-week sampling period. One day of sampling was conducted during wet weather for each site on the same day which resulted in *E. coli* densities exceeding the STV at all sites. Possible sources are illicit discharges, septic systems, improper connections, storm sewer runoff, and wild/domesticated animal waste. Most of the Rocky River East Branch sampling locations exhibited high quality habitat to support healthy fish and macroinvertebrate populations with the exception of RREB RM 0.15. However, RREB RM 0.15 QHEI and ICI scores were calculated at 54.25 (*Fair*) and 36 (*Good*), respectively, which shows that it is possible for a diverse macroinvertebrate community to exist in less than ideal habitat conditions. RREB RM 6.25 IBI scores were calculated at 31, with a narrative rating of *Fair*. Possible reasons for the low IBI score could be due to the time of sampling during the monitoring season and high flows encountered during those times.

Baldwin Creek RM 0.20 was in full attainment. The IBI and QHEI scores were calculated at 49 (*Very Good*) and 80.50 (*Excellent*), respectively. The ICI score was calculated at 40 (*Good*). This is an improvement from the 2019 season and may be attributed to seasonally higher flows and water quality improvements within the watershed. Table 14 summarizes the findings of the 2020 monitoring season.

<b>Table 14. 2020 Rocky River East Branch and Baldwin Creek Survey Results</b>						
River Mile	Attainment Status	IBI score (Narrative Rating)	MIwb score (Narrative Rating)	ICI score (Narrative Rating)	QHEI score (Narrative Rating)	Water Quality Exceedance (s)
<b>Rocky River East Branch</b> (WWH Existing)						
17.50	FULL	37 <i>(Marginally Good)</i>	8.20 <i>(Good)</i>	46 <i>(Excellent)</i>	67.50 <i>(Good)</i>	<i>E. coli</i>
6.25	PARTIAL	<b>31</b> <i>(Fair)</i>	8.20 <i>(Good)</i>	46 <i>(Excellent)</i>	72.50 <i>(Good)</i>	<i>E. coli</i>
0.15	FULL	40 <i>(Good)</i>	9.00 <i>(Very Good)</i>	36 <i>(Good)</i>	54.25 <i>(Fair)</i>	<i>E. coli</i>
<b>Baldwin Creek</b> (WWH Existing)						
0.20	FULL	49 <i>(Very Good)</i>	N/A	<b>40</b> <i>(Good)</i>	80.5 <i>(Excellent)</i>	<i>E. coli</i>
Significant departure in <b>BOLD</b> (> 4ICI; > 4IBI; > 0.5 MIwb units) Underlined scores are in the <i>Poor</i> or <i>Very Poor</i> narrative range *Non-Significant Departure from biocriterion ( $\leq 4IBI$ ; $\leq 0.5$ MIwb units)						

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