

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2012 Plum Creek Environmental Monitoring



Photo: Looking Upstream at the 2012 Plum Creek RM 0.30 Sample Collection Site

Prepared by
Water Quality and Industrial Surveillance Division

Introduction

In the mid-1990s, the Northeast Ohio Regional Sewer District (NEORS D) completed the Olmsted Falls Connector Interceptor. Following the completion of the interceptor, the Western Ohio Utility Co., Inc. and Brentwood Subdivision wastewater treatment plants (WWTPs), which discharged to Plum Creek, a tributary to the West Branch of Rocky River (Cuyahoga County, Ohio), were decommissioned on November 1, 1997.

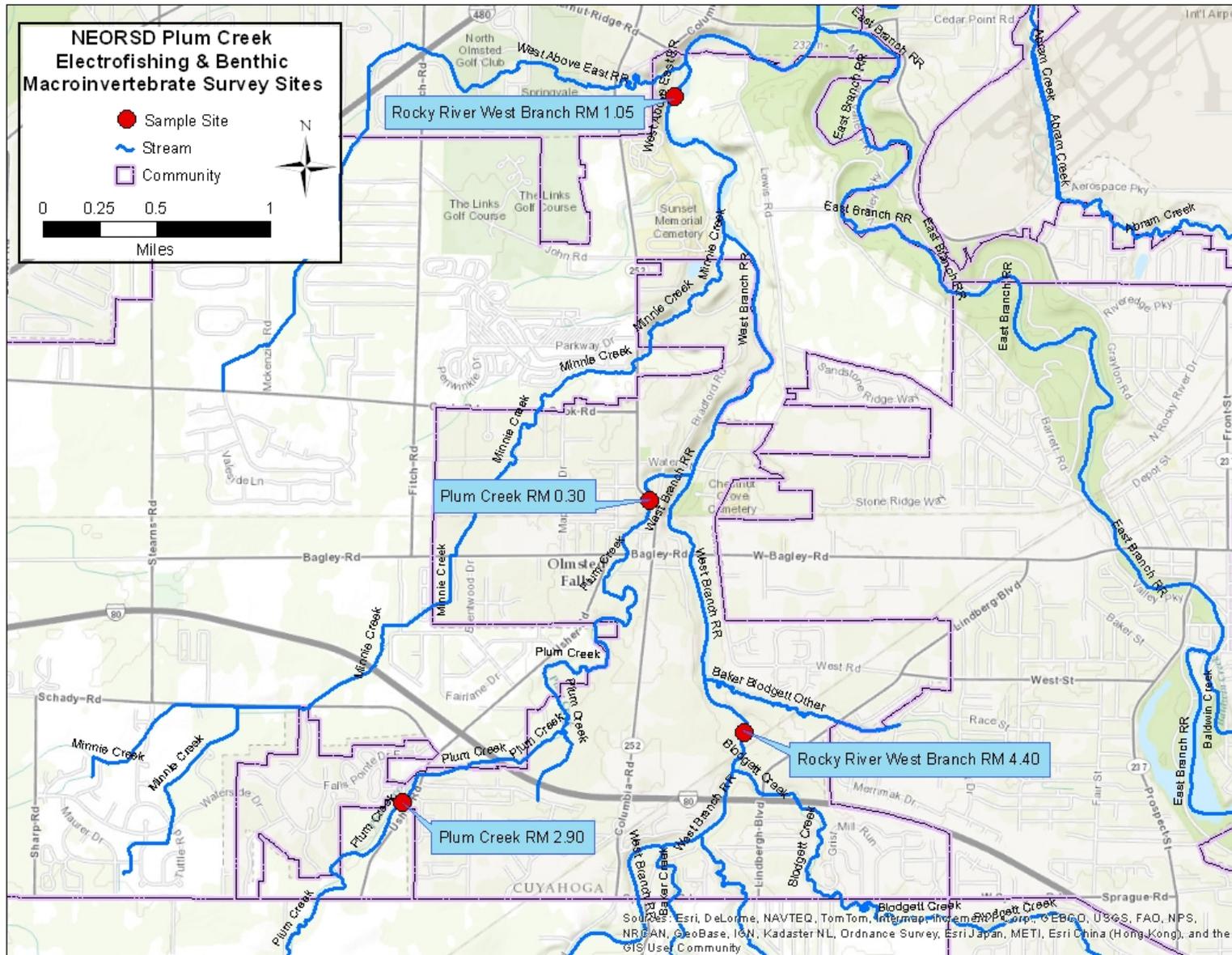
Prior to the closure of the two WWTPs, the Ohio Environmental Protection Agency (EPA) surveyed the area in 1997 and found Plum Creek to be in non-attainment for aquatic life (Ohio EPA, 1999). NEORS D determined the need to reevaluate Plum Creek above and below the facilities that were taken offline to determine if there have been any improvements to the biological communities. NEORS D also conducted monitoring on the Rocky River West Branch above and below the confluence of Plum Creek to determine if the creek is causing a negative impact on the river.

The locations for this study can be found in Table 1 and Map 1 found below.

Table 1. A list of Sample Location for the NEORS D 2012 Plum Creek Environmental Monitoring Study.						
Water Body	Latitude	Longitude	River Mile	Location Information	USGS HUC 8 Number -Name	Purpose
Plum Creek	41.375908	-81.902062	0.30	Upstream of Columbia Road at Main Street	04110001 – Black Rocky	Evaluate water chemistry, habitat, fish & macroinvertebrates downstream of decommissioned WWTPs
Plum Creek	41.3582	-81.9221	2.90	Upstream of Usher Road	04110001 – Black Rocky	Evaluate water chemistry, habitat, fish & macroinvertebrates upstream of decommissioned WWTPs
Rocky River West Branch	41.400474	-81.90044	1.05	Adjacent to stables at Memory Lane.	04110001 – Black Rocky	Evaluate water chemistry, habitat, fish & macroinvertebrates downstream of Plum Creek
Rocky River West Branch	41.360893	-81.894397	4.40*	Downstream of Blodgett Creek; adjacent to Riverview Pointe Care Center	04110001 Rocky	Evaluate water chemistry, habitat, fish, & macroinvertebrates upstream of Plum Creek

* Site is listed as the downstream of the NEORS D 2012 Blodgett Creek Environmental Monitoring and information will be recorded under that project, but the data will be utilized for evaluation of purposes in this project as well.

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Water Chemistry

Methods

Techniques used for sampling followed the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2012) and analyses followed the *Ohio EPA Surface Water Field Sampling Manual* (2013). Chemical water quality samples from each site were collected with two 4-liter disposable polyethylene cubitainers with disposable polypropylene lids and two 473-mL plastic bottles. One of the plastic bottles was field preserved with trace nitric acid and the other was field preserved with trace sulfuric acid. All water quality samples were collected as grab samples. Bacteriological samples were collected in sterilized plastic bottles. At the time of sampling, measurements for dissolved oxygen, pH, temperature, and conductivity were collected using a YSI 600XL sonde. Duplicate samples and field blanks were collected at randomly selected sites, at a frequency not less than 10% of the total samples collected. Relative percent difference (RPD) was used to determine the degree of discrepancy between the primary and duplicate sample (Formula 1).

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

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

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

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

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

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.

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 the water bodies 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 those levels.

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

Results and Discussion

The dates and times of the water chemistry sampling can be found in Table 2. It should be noted that, typically, each stream was sampled using separate crews to effectively sample all of the site locations in both this and other concurrent studies.

Table 2. Dates and Times (in hours) of sampling.						
Water Body	River Mile	07/31/12	08/7/12	08/14/12	08/21/12	08/29/12
Plum Creek	0.30	0923	0920	0900	0905	0909*
Plum Creek	2.90	0940	0858	0925	0923	0930
Rocky West Br	1.05	0855	1100	0954	1101*	1034
Rocky West Br	4.40	1225	0905	1020	1027	0947
Field Blanks					0923 & 1101	0909
*Duplicate sample obtained.						

Plum Creek was in non-attainment during the Ohio EPA 1997 biological community survey. Nutrients were determined to be the cause of impairment, leading to development of a Total Maximum Daily Load (TMDL). The TMDL set targets for both phosphorus, at 0.19 mg/L, and nitrate + nitrite, at 1.3 mg/L (Ohio EPA, 2001). During the NEORSD sampling in 2012, Plum Creek RM 2.90 showed that phosphorus was higher than the target in 3 of the 5 samples. However, the phosphorus target was met for all samples at Plum Creek RM 0.30. In addition, the target for nitrate + nitrite was met at both sites for all samples. The general reduction in nutrient concentrations in the creek may be due, in part, to decommissioning of the WWTPs.

Also during the Ohio EPA survey in 1997, there was an exceedance of lead on Plum Creek and the concentration was always higher at the downstream site (Ohio EPA, 1999). This was not the case during sampling in 2012, as lead at the downstream site was always lower than the upstream site and no exceedances of the applicable criteria were observed.

In 2012, dissolved oxygen at Plum Creek RM 2.90 failed to meet the criterion of 4 mg/L on two occasions (August 7 and August 21). The highest recorded dissolved oxygen for RM 2.90 was 7.88 mg/L (August 14); the field data sheet noted that it was raining during sampling and just downstream of the sampling location was evidence of sanitary sewage. Plum Creek RM 0.30 met the criterion for dissolved oxygen during all sampling events. Other than the issues discussed below no other exceedances were noted during sampling.

Bacteriological sampling for *Escherichia coli* (*E. coli*), an indicator organism for the presence of sanitary sewage, was conducted. The *E. coli* results were higher at Plum Creek RM 0.30 than at RM 2.90, except for one sampling event (August 8). Although neither site met the criteria (Seasonal Geometric Mean of 161 colony forming units per 100 milliliter [CFU/100mL] and not more than 10% over 523 CFU/100mL in any 30 day period) for *E. coli*, it appears that there are potentially sewage inputs between the two locations, which would explain the elevated results found downstream.

The sections surveyed by NEORS D on the Rocky River West Branch were in attainment of the biological criteria during the 1997 Ohio EPA Survey (Ohio EPA, 1999) and therefore, no water chemistry targets were set. For these sites in 2012, the only exceedances were for *E. coli*. Both sites failed to meet the seasonal geometric mean criterion (126 CFU/100mL) and the single sample maximum criterion (not more than 10% over 298 CFU/100mL in any 30 day period) throughout the sampling period. Because the *E. coli* densities at the site at RM 1.05 were higher than the site at RM 4.40 and both of the sites on Plum Creek were higher than the site at RM 1.05, the creek could be a source of bacterial contamination to the river.

The source of the bacteriological concentrations was not determined by this study; however the majority of the sites had elevated densities during the dry weather sampling events, see Table 3. The source of contamination during dry sampling events may be attributed to failing household sewage treatment systems (HSTS), improper connections, and other undefined sources. The City of Olmsted Falls and Olmsted Township are in the process of placing sewers in areas that will replace a total of 325 HSTS (Rosann Jones, personal communication, March 22, 2013). The HSTS drain to Plum Creek, the West Branch of Rocky River, and Minnie Creek (a tributary just downstream of Plum Creek). The project is currently projected to be completed in 2014, and should help alleviate bacteriological contamination in the watershed.

Table 3. <i>E. coli</i> Results in CFU/100mL							
Water Body	River Mile	07/31/12	08/7/12	08/14/12 [^]	08/21/12 [^]	08/29/12 [^]	Geo Mean
Plum Creek	0.30	850	700	14800	4400	856*	2494.9
Plum Creek	2.90	417	1167	12400	1600	700	1465.4
Rocky West Br	1.05	330	250	350	1334*	667	480.8
Rocky West Br	4.40	165	250	767	1133	365	420.1
*Result reported is an average of the duplicates.							
[^] Samples were collected on a Wet Weather Day ¹							

¹ NEORS D considers a sample to be influenced by Wet Weather, if: greater than 0.10 inches of rain but less than 0.25 inches of rain, then samples collected that day and the following day are considered wet weather samples; or greater than 0.25 inches, the samples collected that day and the following two days were considered wet weather samples.

The Ohio EPA (2013) developed new data management procedures for assessing the water chemistry and quality control samples. Using the new procedures, it was found that all of the chromium and hexavalent chromium parameters needed to be either flagged as rejected, because they did not meet the requirements for level 3 credible data, or estimated. This was most likely due to the different sampling and analytical methods used for the chromium parameters. Of the field blanks that were collected only a high turbidity result on August 29 caused qualifiers (both estimated and trend) for the Plum Creek samples; the cause for the elevated blank result was unknown. Plum Creek RM 0.30 had a duplicate sample collected on August 29, both the chemical oxygen demand and the NO₂ results were rejected based on a higher than acceptable RPD values. The Ohio EPA (Jeff Reynolds, personnel communication, February 1, 2013) has decided that they need different standards for the bacteriological criteria, so comparison of the *E. coli* results in the duplicate samples are not discussed in this report.

Habitat Assessment

Methods

Instream habitat assessments were conducted once at each site on Plum Creek and Rocky River West Branch in 2012 using the Qualitative Habitat Evaluation Index (QHEI). The QHEI was developed by the Ohio EPA to assess aquatic habitat conditions that may influence the presence or absence of fish species by evaluating the physical attributes of a stream. The index is based on six metrics: stream substrate, instream cover, channel morphology, riparian zone and bank condition, pool and riffle quality, and stream gradient. The QHEI has a maximum score of 100, and a score of 60 or more suggests that sufficient habitat exists to support a fish community that 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

A natural waterfall that is approximately 15-feet high is located at RM 0.20 on Plum Creek. The waterfall prevents the natural migration of fish upstream on Plum Creek from the Rocky River. The evaluation of the QHEI does, however, suggest that the current habitat could support a warmwater fish community for all sites, as they all met the Ohio EPA's target of 60 (Table 4). During the Ohio EPA 1997 Survey, all of the sites surveyed were in different locations, up to a mile away, and the scores were all in the mid to low 70s (Ohio EPA, 1999).

Table 4. Habitat information.			
River Mile	Date	QHEI Score	Narrative
Plum Creek			
0.30	10/04/12	64.25	<i>Good</i>
2.90	10/04/12	70.75	<i>Excellent</i>
Rocky River - West Branch			
1.05	10/04/12	67.00	<i>Good</i>
4.40	09/20/12	86.50	<i>Excellent</i>

Table 5 lists attributes defined by the Ohio EPA, as interpreted by NEORSD, which have both positive and negative influences on the fish community. It was noticed that both sites that received a narrative rating of Excellent did not have any high negative influence attributes. The negative influences have been identified as attributes that can have the greatest influence on whether the system can support a WWH fish community. Plum Creek RM 0.30 and Rocky River RM 1.05 had at least one high negative influence attribute and both sites could improve their potential for fish by increasing in-stream cover.

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Table 5. Qualitative Habitat Evaluation Index Physical Attributes Summary																																
		Warmwater Attributes										Modified Warmwater Attributes																				
												High Influence					Moderate Influence															
Stream	River Mile	Channelization: None or Recovered	Dominate Substrates: Boulder, Cobble and/or Gravel	Overall Substrate, Silt: Free	Channel Development: Excellent or Good	Channel Sinuosity: Moderate or High	In-stream Cover Amount: Extensive or Moderate	Current Velocity: Fast Current and Eddies	Overall Embeddedness: None or Normal	Maximum Site Depth greater than 40 cm	Riffle and Run Embeddedness: None or Low	Total Positive Attributes	Channelization: Recent or No Recovery	Dominate Substrates: Silt and/or Muck	Channel Sinuosity: None	In-stream Cover Amount: Sparse or Nearly Absent	Maximum Site Depth less than 40 cm	Negative High Influence Attributes	Channelization: Recovering	Overall Substrate, Silt: Heavy or Moderate	Dominate Substrate, Boat Sites Only: Sand	Substrate Origin: Hardpan	Channel Development: Fair or Poor	Channel Sinuosity: Low	In-stream Cover Types: Only 1 or 2 Indicated	Pool Width and Current Velocity: Less than or equal to Riffle Width and Intermittent, Respectively	Current Velocity: No Fast Current	Overall Embeddedness: Moderate and Extensive	Riffle Embeddedness: Moderate and Extensive	No Functional Riffle Indicated at the Site	Negative Moderate Influence Attributes	Total Negative Influence Attributes
Plum Creek	2.90	X	X				X			X	4						0		X			X	X				X	X	X		6	6
	0.30	X								X	2				X		1		X			X	X				X	X	X		6	7
Rocky River West Branch	4.40	X			X		X	X	X	X	6						0						X						X		2	2
	1.05	X								X	2			X	X		2		X			X						X	X		4	6

Electrofishing

Methods

One quantitative electrofishing pass was conducted at each site in 2012. Sampling was conducted using wading 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 Plum Creek) and 0.20 kilometers (for Rocky River West Branch). The methods that were used followed Ohio EPA protocol methods as detailed in *Biological Criteria for the Protection of Aquatic Life, Volumes II* (1987a) and *III* (1987b). Fish collected during the surveys were identified, weighed and examined for the presence of anomalies, including DELTs (deformities, eroded fins, lesions, and tumors). All fish were then released to the waters from which they were collected, except for vouchers and those that could not be easily identified in the field.

The electrofishing results for each pass were compiled and utilized to evaluate fish community health through the application of two Ohio EPA indices, the Index of Biotic Integrity (IBI) and the Modified Index of Well-Being (MIwb). The IBI incorporates 12 community metrics representing structural and functional attributes. The structural attributes are based upon fish community aspects such as fish numbers and diversity. Functional attributes are based upon fish community aspects such as feeding strategies, environmental tolerances, and disease symptoms. These metrics are individually scored by comparing the data collected at the survey site with values expected at reference sites located in a similar geographical region. The maximum possible IBI score is 60 and the minimum possible score is 12. The summation of the 12 individual metrics scores provides a single-value IBI score, which corresponds to a narrative rating of *Exceptional, Good, Marginally Good, Fair, Poor* or *Very Poor*. The 12 metrics utilized for the headwater sites, those on Plum Creek are in Table 6, while the wading sites, Rocky River West Branch can be found in Table 7.

Table 6. IBI Metrics (Headwater)
Total number of Native Species
Number of Darters & Sculpins
Number of Headwater Species
Number of Minnow Species
Number of Sensitive Species
Percent Tolerant Species
Percent Pioneering Species
Percent Omnivores
Percent Insectivores

Table 7. IBI Metrics (Wading)
Total number of Native Species
Number of Darter species
Number of Sunfish Species
Number of Sucker Species
Number of Intolerant Species
Percent Tolerant Species
Percent Omnivores
Percent Insectivores
Percent Top Carnivores

Table 6. IBI Metrics (Headwater)
Number of Simple Lithophils
Percent DELT Anomalies
Number of Fish

Table 7. IBI Metrics (Wading)
Percent Simple Lithophils
Percent DELT Anomalies
Number of Fish

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

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

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

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

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

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

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

n_i = Relative numbers or weight of species

N = Total number or weight of the sample

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

Results and Discussion

Neither of the Plum Creek sites was in attainment of the WWH IBI criteria in 2012. The results from RM 0.30 were similar to those obtained during the Ohio EPA's 1997 survey at a site closer to the mouth (Ohio EPA, 1999), see Table 8. This indicates that decommissioning of the WWTPs did not significantly improve the fish community at this location. No sensitive species of fish were collected on Plum Creek during the survey; most of the fish found at both sites were pioneering species and highly tolerant to pollution. It is not completely understood if the species of fish found at the site were due to the system's potentially flashy hydrology (in which pioneering species are typically found) or the species tolerance to pollution (finding only species that are tolerant to pollution). However, the proportion of *Calostomus commersonii* (Common White Suckers), notes of different size classes of the pioneering species during sorting and the substrate notes suggest that the stress is most likely related to pollution. If the cause was

just hydrology it would be more likely that the fish species would all be the same size class. In addition, several *Umbra limi* (Central Mudminnow) were found at Plum Creek RM 2.90, this pollution-tolerant species is able to withstand low dissolved oxygen (Trautman, 1981), which was routinely found at the site.

The Rocky River West Branch was in attainment for fish criteria during this survey, as seen in Table 9, which was the same outcome as the Ohio EPA (1999) survey. Both sites had similar fish communities; however RM 4.40 had greater total numbers of fish. Although Rocky River RM 1.05 was in attainment, additional in-stream cover may further improve the IBI score at the site. Based on these results, it does not appear that Plum Creek is having a significant impact on the fish community in the West Branch of the Rocky River.

Table 8. Plum Creek Fish Survey Results.			
River Mile	Date	IBI Score	Narrative
Plum Creek			
0.30	08/30/12	16	<i>Very Poor</i>
2.90	08/30/12	22	<i>Poor</i>

Table 9. Rocky River Fish Survey Results.					
River Mile	Date	IBI Score	Narrative	MIwb	Narrative
Rocky River - West Branch					
1.05	08/31/12	40	<i>Good</i>	8.1	<i>Good</i>
4.40	08/27/12	50	<i>Exceptional</i>	9.0	<i>Very Good</i>

Benthic Macroinvertebrates

Methods

Macroinvertebrates were sampled quantitatively using modified Hester-Dendy (HD) samplers in conjunction with a qualitative assessment of the 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 the map above. Methods for sampling followed the Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987b). The recommended period for HDs to be installed is six weeks.

The macroinvertebrate samples were sent to Midwest Biodiversity Institute (MBI) of Columbus, Ohio, 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 Ohio EPA’s Invertebrate Community Index (ICI) (OEPA 1987a). 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. ICI Metrics	
1.	The total number of taxa on HD.
2.	Total number of Ephemeroptera taxa on HD.
3.	Total number of Trichoptera taxa on HD.
4.	Total number of Dipteran taxa on HD.
5.	Percent of Ephemeroptera in HD sample.
6.	Percent Trichoptera in HD sample.
7.	Percent Tribe Tanytarsini midges in HD sample.
8.	Percent Dipterans (excluding Tribe Tanytarsini) and all non-insects in HD sample.
9.	Percent Tolerant organisms (as defined by metric) in HD sample.
10.	Total number of Ephemeroptera, Plecoptera and Trichoptera collected in the qualitative sample.

Results and Discussion

The benthic macroinvertebrates failed to meet the WWH criterion at the Plum Creek sites, whereas the Rocky River West Branch sites were in attainment, as seen in Table 11.

Table 11. Summary of the Macroinvertebrate Collections.					
Water Body	River Mile	Retrieval Date	Drainage mi ²	ICI Score ¹	Narrative Rating
Plum Creek	0.30	09/11/12	18.5	18	<i>Fair</i>
Plum Creek	2.90	09/11/12	17.1	24	<i>Fair</i>
Rocky River West Br	1.05	09/17/12	185	38	<i>Good</i>
Rocky River West Br	4.40	09/12/12	160	38	<i>Good</i>
¹ The ICI Criterion for WWH is ≥ 34 units.					

The Ohio EPA (1987b) recommends that the qualitative samples for Plum Creek have a total EPT taxa and sensitive taxa of, as a minimum, 9 and 10, respectively. In the Rocky River, the minimum EPT taxa and sensitive taxa targets are both 12. Although NEORSD believes these numbers are ambitious, it does provide a possible best case scenario on the taxa composition. The site at RM 4.40 met the target for the number of EPT taxa, and was close for sensitive taxa. However, none of the other sites met either of their targets. A breakdown of the taxa collected at each site can be found in Table 12. The results from the 1997 Ohio EPA survey can be found in Table 13 (table shows the information for the sampling that was available). The downstream site on Plum Creek and both of the Rocky River West Branch segments appear to have stayed fairly consistent between surveys. However Plum Creek RM 2.90 lost about half of its EPT taxa.

Table 12. 2012 Plum Creek Environmental Monitoring Macroinvertebrate Results

<u>River Mile</u>	All Taxa			EPT Taxa		Sen. Taxa			Tolerant Taxa		
	<u>Total</u>	<u>Qt.</u>	<u>Ql.</u>	<u>Total</u>	<u>Ql.</u>	<u>Total</u>	<u>Qt.</u>	<u>Ql.</u>	<u>Total</u>	<u>Qt.</u>	<u>Ql.</u>
Plum Creek											
0.30	39	23	21	2	2	0	0	0	10	6	5
2.90	42	25	33	3	2	1	0	1	12	8	9
Rocky River West Branch											
1.05	58	33	51	11	11	7	4	6	13	3	13
4.40	59	34	52	12	12	12	6	11	14	3	14

Sen. = Sensitive

Qt. = Quantitative

Ql. = Qualitative

Table 13. 1997 Ohio EPA Benthic Macroinvertebrate Survey Results

<u>River Mile</u>	All Taxa		EPT Taxa		Narrative Evaluation	ICI Score
	<u>Qt.</u>	<u>Ql.</u>	<u>Total</u>	<u>Ql.</u>		
Plum Creek						
0.20		23		2	Fair	
2.90		32		6	Marginally Good	
Rocky River West Branch						
2.10	39	38		10		46
4.80	35	44		11		44

Sen. = Sensitive

Qt. = Quantitative

Ql. = Qualitative

The loss of EPT taxa could be due to the low dissolved oxygen or other pollution. The Ephemeroptera are typically one of the first groups to disappear under pollution stresses, where Trichoptera can have a wide range of pollution tolerances but will also decrease under pollution stresses. The only sensitive species noted on Plum Creek was a

fresh dead mussel shell for *Strophitus undulatus*, which was found at RM 2.90. *Strophitus undulatus* is noted as one of the most ubiquitous species of freshwater mussels. Two additional species of freshwater mussels were also found at Rocky River West Branch RM 4.40: *Lasmigona costata*; and *Lampsilis cardium*. The other benthic macroinvertebrates found at the Rocky River West Branch sites are typical for segments in attainment.

Conclusions

The TMDL stated that it was expected that the Plum Creek watershed would be in full attainment during the next round of sampling (Ohio EPA, 2001). As shown in Table 14, Plum Creek continues to be in non-attainment for the applicable biological criteria. These results are similar to the Ohio EPA (1999) 1997 survey that occurred over a decade prior. Issues that continue on Plum Creek include evidence of sanitary sewage and chronic low dissolved oxygen.

The Rocky River was in full attainment for both locations, and the results are summarized in Table 15. Plum Creek does not appear to be negatively impacting the biological community on the Rocky River West Branch. The IBI score for Rocky River West Branch RM 1.05 is most likely due to habitat limitations that occur at the site and not the result of Plum Creek. Plum Creek, however, may be negatively impacting the Rocky River West Branch's water chemistry.

Although decommissioning of the WWTPs has not resulted in improvements to the biological community on Plum Creek, it may have led to a reduction in the nutrient load to the creek, a potential cause of impairment. The Ohio EPA has also stated its intent to resurvey the Rocky River watershed in 2014, which may provide further insight into the conditions in the creek and sources of impairment.

Table 14. Attainment Status of the Plum Creek Sites in 2012, as indicated by NEORS sampling results.					
Stream	River Mile	Attainment Status	IBI Score	ICI Score	Potential Impairments
Plum Creek	0.30	NON	16	18	Septic Systems, Urbanization
Plum Creek	2.90	NON	22	24	Septic Systems, Urbanization
Warmwater Habitat Criteria			40	34	
Nonsignificant Departure from Criteria			≤4	≤4	

Table 15. Attainment Status of the Rocky River West Branch Sites in 2012, as indicated by NEORSD sampling results.						
Stream	River Mile	Attainment Status	IBI Score	MIwb Score	ICI Score	Potential Impairments
Rocky River West Br	1.05	FULL	40	8.1	38	Septic Systems, Urbanization
Rocky River West Br	4.40	FULL	50	9.0	38	Septic Systems, Urbanization
Warmwater Habitat Criteria			38	7.9	34	
Nonsignificant Departure from Criteria			≤4	≤0.5	≤4	

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