

NORTHEAST OHIO REGIONAL SEWER DISTRICT

2012 Abram Creek Environmental Monitoring



Photo: 2012 NEORS D Sample Collection Site: Abram Creek at RM 4.10

Prepared by
Water Quality and Industrial Surveillance Division

Introduction

Abram Creek is a tributary to the Rocky River located in Cuyahoga County, Ohio. In the early 1990s, two wastewater treatment plants (WWTP) were decommissioned that discharged into Abram Creek. These facilities were the Brookpark WWTP, decommissioned on January 6, 1993, and the Middleburg Heights WWTP, decommissioned on December 30, 1992. The wastewater was rerouted into the newly constructed Southwest Interceptor (SWI) owned and operated by the Northeast Ohio Regional Sewer District (NEORS). In addition, in the early 2000s, the Cleveland Hopkins Airport started discharging the wastewater from the deicing process to NEORS. No assessment of the water quality has been completed since the airport expanded the runway, completed in 2004, and rerouted the deicing wastewater to NEORS.

Before and after the decommissioning of the two WWTPs, NEORS and the Ohio Environmental Protection Agency (EPA) surveyed the biological communities of Abram Creek and found that they were in non-attainment of the State of Ohio's aquatic life use designations. NEORS wanted to reevaluate Abram Creek near the historical facilities to determine if there have been any improvements in the biological communities. NEORS also conducted monitoring on the Rocky River above and below the confluence of Abram 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 Figure 1 that follow.

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Table 1. List of Sites for the NEORSD 2012 Abram Creek Environmental Monitoring.						
Water Body	River Mile	Latitude	Longitude	Location Information	USGS HUC 8 Number - Name	Purpose
Abram Creek	4.10	41.3864	-81.8364	Upstream of Sheldon Road	04110001 – Black Rocky	Evaluate water chemistry, habitat, fish & macroinvertebrates upstream of decommissioned WWTPs
Abram Creek	3.65	41.3920	-81.8383	Upstream of Railroad Tracks West of Plant Lane	04110001 – Black Rocky	Evaluate water chemistry, habitat, fish & macroinvertebrates downstream of decommissioned Midd. Hts WWTP and upstream of Brook Park WWTP
Abram Creek	0.04	41.4176	-81.8668	Upstream of the confluence with Rocky River	04110001 – Black Rocky	Evaluate water chemistry, habitat, fish & macroinvertebrates downstream of both decommissioned WWTPs
Rocky River	10.50	41.4183	-81.8676	Upstream of Abram Creek	04110001 – Black Rocky	Evaluate water chemistry, habitat, fish & macroinvertebrates above Abram Creek
Rocky River	10.20	41.4173	-81.8616	Downstream of Abram Creek	04110001 – Black Rocky	Evaluate water chemistry, habitat, fish & macroinvertebrates below Abram Creek

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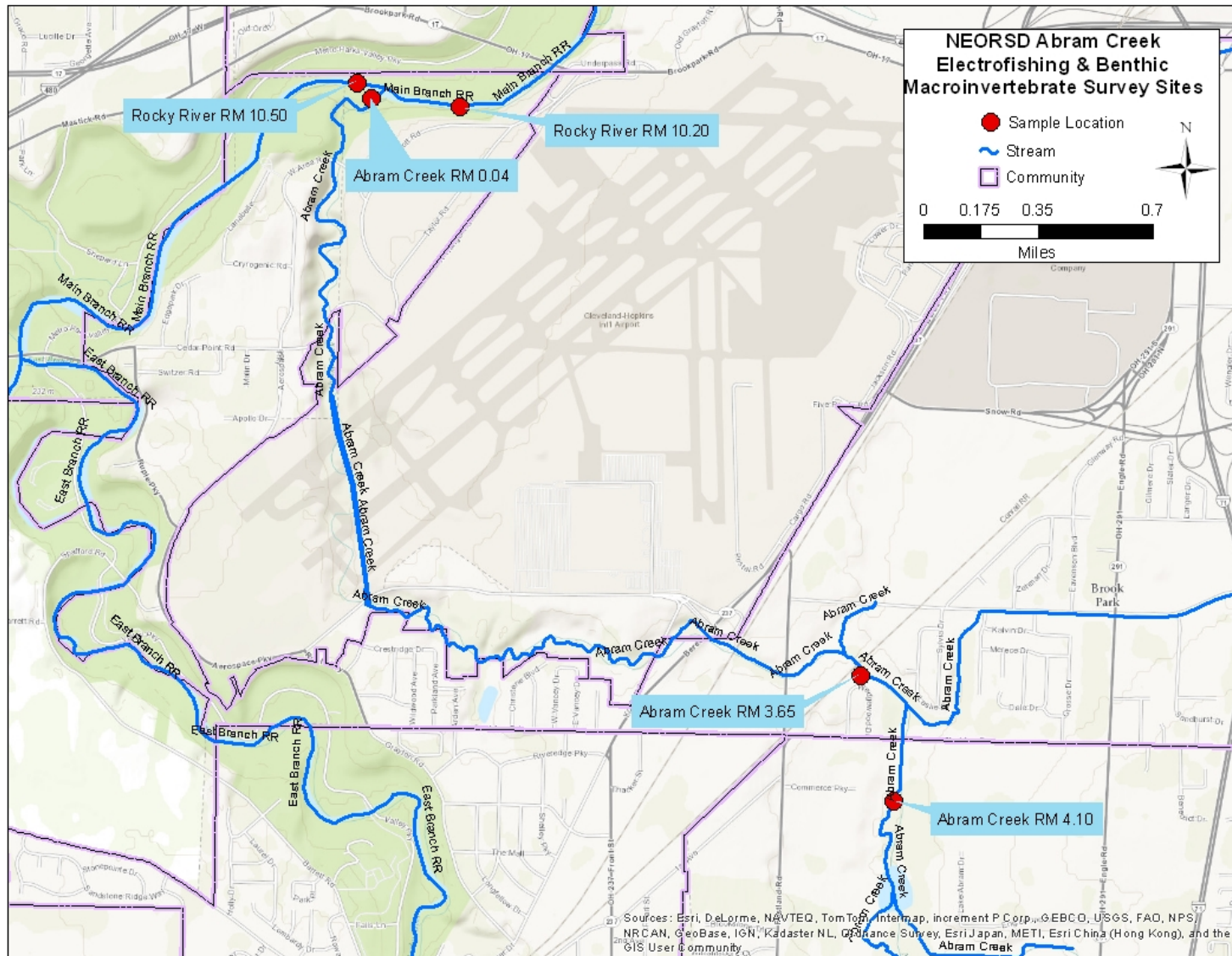


Figure 1. Map of sampling locations.

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).

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

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 Water Quality and Industrial Surveillance (WQIS) Division.

Results and Discussion

The dates and times of the water chemistry sampling can be found in Table 2. It is important to note that an insufficient number of field blanks were obtained for this study. This occurred due to the field crew on that day forgetting to obtain the samples and, as a result, a designated person from the environmental assessment section will oversee the quality assurance and quality control (QA/QC) for sample collection to ensure that an adequate number of QA/QC samples are collected during future project studies.

Table 2. Dates and Times of sampling.						
Water Body	River Mile	7/25/2012	8/1/2012	8/8/2012	8/15/2012	8/22/2012
Abram Creek	4.10	0905	0916	0920	0900	0900
Abram Creek	3.65	0850	0945	0940	0927	0926*
Abram Creek	0.04	1000	1115*	0900	1100	1040
Rocky River	10.50	1023	1025	1050	1015*	1022
Rocky River	10.20	1016	1055	1115	1030	1055
Field Blank						1000
*Duplicate sample obtained.						

All of the samples were compared to the Ohio EPA validation standards (Ohio EPA, 2013). A total of 5 water quality parameters were rejected, listed as estimated or downgraded from credible data Level 3 to Level 2 due to potential field blank contamination based on Ohio EPA data validation protocol. It is unclear how the field blank became contaminated and may be due to inappropriate sample collection, handling, contaminated blank water, contaminated bottles and/or interference during analysis. The field blank water quality parameters that were rejected, listed as estimated or downgraded over this study were cadmium, dissolved reactive phosphorous, nitrite, nitrate+nitrite, and turbidity. Part of the parameter validation showed all of the chromium and hexavalent chromium results were qualified as rejected or estimated, except for one sample collected at Abram Creek RM 3.65 on August 8, 2012. Table 3 shows the rejected data based on the duplicate validation comparison. The duplicate collected at Abram Creek RM 0.04 on August 1, 2012 did not result in the need to qualify any of the duplicate data.

Table 3. Parameters rejected based on duplicate validation.					
Date	System	Site	Parameter	Max Allowable RPD (%)	Actual RPD (%)
08/22/12	Abram	RM 3.65	Aluminum	20.5	24.7
08/22/12	Abram	RM 3.65	Iron	13.2	17.0
08/22/12	Abram	RM 3.65	Total Suspended Solids	25.1	67.5
08/15/12	Rocky	RM 10.50	Aluminum	26.9	35.9
08/15/12	Rocky	RM 10.50	Zinc	52.1	64.2

Table 4 shows the results for the bacteriological sampling of *Escherichia coli*, which are used as an indicator for the presence of sewage. In addition, the *Escherichia coli* bacteriological criteria for each sampling water body can be found in Table 4 which consists of two components: a seasonal geometric mean and a value not to be exceeded in more than 10% of the samples collected during a 30-day period (single sample maximum). None of the criteria for *Escherichia coli* were met, except for Abram Creek RM 0.04, which met the geometric mean criterion.

Table 4. <i>Escherichia coli</i> Results (reported in colony forming units per 100 milliliter).								
Water Body	River Mile	07/25/12	08/1/12	08/8/12	08/15/12 [^]	08/22/12	Geo Mean	
Abram Creek	4.10	120	280	109	6400	230	351.8	
Abram Creek	3.65	1867	700	175	6600	230*	809.3	
Abram Creek	0.04	73	74.5*	57	800	77	113.8	
Criteria for Abram Creek		not to exceeded 523 in more than 10% of samples during any 30 day period						161
Rocky River	10.50	105	290	145	783*	195	232.1	
Rocky River	10.20	135	EC 391	170	733	255	278.6	
Criteria for Rocky River		not to exceeded 298 in more than 10% of samples during any 30 day period						126
*Result reported is an average of the duplicates. EC = stands for estimated count since the colonies were not in the ideal counting range [^] Samples were collected on a Wet Weather Day ¹								

Mercury screening was conducted at each site. The results indicated that on August 8, 2012, each site had a result above the method detection limit, but below the practical quantitation limit. It was not understood what caused the observation of mercury throughout the watershed on August 8, 2012. The only other result above the method detection limit was from Abram Creek RM 4.10 on August 22, 2012. When the mercury results were compared to the water quality standards, any detection would have been enough to cause exceedances for the wildlife (outside the mixing zone average) criterion, in addition to the Human Health Non-Drinking water criteria at all of the sites.

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. Rain data obtained from the NEORS D Rain Gauge, named RBT, at Brookpark.

Other than what is listed above the only other exceedances were for the parameter dissolved oxygen (DO). Table 5 presents the results for DO when the DO was recorded at less than 4 milligrams per liter, which is the warmwater habitat criterion. The relative shallow depth and stagnant waters of Abram Creek RM 4.10 could be the cause of the low dissolved oxygen observed. Abram Creek RM 3.65 had relatively similar DO concentrations most likely due to lack of mixing between the sites.

Water Body	River Mile	Date	DO (mg/L)	DO (%)
Abram Creek	4.10	08/01/13	3.96	46.9
Abram Creek	4.10	08/08/13	3.06	35.1
Abram Creek	3.65	08/08/13	3.32	37.5
Abram Creek	4.10	08/22/13	3.91	66.6

Prior to the sampling season, WQIS was called to investigate the condition of Abram Creek due to a complaint of unusual growth and an odor. It was later determined that this event occurs each year around April to May. The growth was identified as a fungus (by Ohio EPA Environmental Specialist Paul Anderson) that blooms in response to a high chemical oxygen demand. This fungus causes black and white material during its' die off, which also cause a high oxygen demand. This subsequently resulted in low dissolved oxygen recorded in Abram Creek and in the mixing zone with the Rocky River. The cause for the elevated chemical oxygen demand was attributed to the airport deicing activities; about two-thirds of the airfield is tributary to Abram Creek. The actual deicing pad wastewater goes to treatment and then to the sewer system. The remainder of the airfield is tributary to Rocky River (K. Granlund and T. Zabloutny, June 12, 2012, personnel communication).

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 meets 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

The QHEI scores for this study can be found in Table 6. As seen, the Rocky River and Abram Creek RM 0.04 meet the target QHEI goal of 60. Historical QHEI scores determined by the Ohio EPA are listed in Table 7. Note that sites that the Ohio EPA used are different than that of NEORSD. Table 8 lists attributes defined by the Ohio EPA, as interpreted by NEORSD, which have both positive and negative influences on the fish community. All of the sites that met the target had no negative high-influence attributes.

Table 6. 2012 NEORSD Habitat data.			
River Mile	Date	QHEI Score	Narrative
Abrams Creek			
4.10	07/24/12	40.75	<i>Poor</i>
3.65	07/24/12	49.50	<i>Fair</i>
0.04	09/24/12	65.00	<i>Good</i>
Rocky River - Main Branch			
10.50	09/25/12	79.00	<i>Excellent</i>
10.20	09/25/12	69.50	<i>Good</i>

Table 7. Historical NEORSD (1994) and Ohio EPA (1999) Habitat data.				
River Mile	Entity	Year	QHEI Score	Narrative
Abrams Creek				
4.6	Ohio EPA	1981	43.0	<i>Fair</i>
4.1	NEORSD	1992	43	<i>Fair</i>
4.0	NEORSD	1992	43	<i>Fair</i>
3.7	NEORSD	1992	50	<i>Fair</i>
3.65	NEORSD	1992	50	<i>Fair</i>
3.2	Ohio EPA	1997	42.5	<i>Fair</i>
2.8	Ohio EPA	1997	52.5	<i>Fair</i>
1.9	Ohio EPA	1997	65.5	<i>Good</i>
0.6	Ohio EPA	1997	57.5	<i>Good</i>
0.04	NEORSD	1992	72	<i>Excellent</i>
Rocky River - Main Branch				
11.1	Ohio EPA	1997	60.0	<i>Good</i>
10.0	Ohio EPA	1997	54.5	<i>Fair</i>

The Ohio EPA (2001) lists the upper reaches of Abram Creek as moderate to low restorability and lists low gradient and heavy modification as its overall limitations. In addition, RM 4.10 is greatly influenced by Lake Abram, which is located just upstream of the sampling site. The site is also located in the wetland complex that surrounds the lake, so the gradient was scored as impounded.

Abram Creek was culverted from RM 0.9 to 1.9 due to an expansion of the Cleveland Hopkins International Airport runway from 2002 to 2004. The Ohio EPA (2001) stated that after the expansion, a re-evaluation of the proper use designation would be required in the upper section, which to date has not been completed by the Ohio EPA. The creek emerges from the airport culverted section at the location seen in Figure 2, which also acts as a fish barrier. Downstream of the culvert opening is an additional fish barrier, seen in Figure 3. Both of the fish barriers and the culverted section under the airport will make it difficult for the upper reach of Abram Creek to come into full attainment of biological criteria.

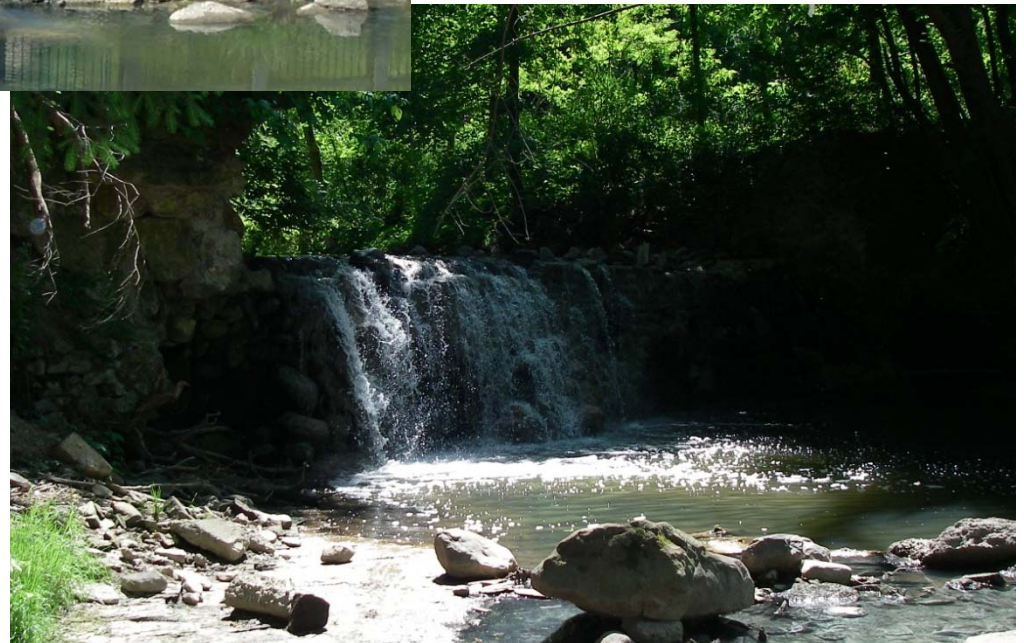
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Table 8. Qualitative Habitat Evaluation Index Physical Attributes Summary																																
		Warmwater Attributes										Modified Warmwater Attributes																				
												High Influence						Moderate Influence														
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
Abram Creek	4.10					X			X		2		X	X			2	X	X			X					X	X		X	6	8
	3.65					X			X		2			X			1	X	X			X					X	X		X	6	7
	0.04	X				X	X	X	X	X	5						0					X	X				X				3	3
Rocky River	10.50	X				X	X	X	X	X	5						0		X				X	X						3	3	
	10.20	X				X			X		3						0		X				X	X			X	X		5	5	



Figure 2. Above photo is the discharge of Abram Creek culvert from the airport expansion.

Figure 3. Right photo is a waterfall on Abram Creek between the culvert opening and the confluence with Rocky River.



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 9, while the wading sites, Rocky River West Branch can be found in Table 10.

Table 9. IBI Metrics (Headwater)
Total number of Native Species
Number of Darters & Sculpins
Number of Headwater Species
Number of Minnow Species
Number of Sensitive Species
Percent Tolerant Species
Percent Pioneering Species
Percent Omnivores
Percent Insectivores
Number of Simple Lithophils

Table 10. 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
Percent Simple Lithophils

Table 9. IBI Metrics (Headwater)
Percent DELT Anomalies
Number of Fish

Table 10. IBI Metrics (Wading)
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

Field sheets for each site are available upon request from the NEORSD WQIS Division.

Results and Discussion

The results of the fish sampling can be found in Tables 11 and 12. Only the upper sections of Abram Creek did not meet attainment for the fish criteria. The Ohio EPA (2001) lists the upper section limitations as habitat, heavy modification and the gradient.

Table 11. The NEORSD 2012 IBI scores for Abram Creek.			
River Mile	Date	IBI Score	Narrative
4.10	08/23/12	22	<i>Poor</i>
3.65	09/06/12	18	<i>Poor</i>
0.04	08/23/12	36	<i>Marginally Good</i>

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Table 12. The NEORSD 2012 IBI and MIwb scores for Rocky River.					
River Mile	Date	IBI Score	Narrative	MIwb	Narrative
10.50	08/22/12	36	<i>Marginally Good</i>	8.4	<i>Good</i>
10.20	08/22/12	34	<i>Marginally Good</i>	8.8	<i>Good</i>

Abram Creek RM 3.65, as stated above, did not meet the IBI fish criterion. Only five species of fish were collected and they were all highly tolerant to pollution. Abram Creek RM 4.10 was also in non-attainment for the IBI criterion; however it had a total of eleven species of fish. Although all of the fish were tolerant, not all of them were highly tolerant. RM 4.10 is also in the wetland complex that surrounds Lake Abram, which may affect the type of species that can be found at the site.

The Rocky River locations and Abram Creek RM 0.04 were all in attainment, which shows improvement over the historical sampling done by the Ohio EPA (2001), information found in Tables 13 and 14. Only the NEORSD 1994 IBI scores are included for Abram Creek. The MIwb scores improved from the 1997 sampling of the Rocky River, which was the cause for the historical non-attainment status throughout that section of the river. Abram Creek RM 0.04 also improved since it was last sampled, demonstrating non-significant departure from the criterion.

Table 13. Historical Data from Abram Creek (Ohio EPA, 2001).					
Stream	River Mile	Entity Year	Overall Attainment Status	IBI Score	ICI Score
Abram Creek	4.20	NEORSD 1992	N/A	14	--
Abram Creek	4.10	NEORSD 1992	N/A	12	--
Abram Creek	3.65	NEORSD 1992	N/A	16	--
Abram Creek	3.2/3.4	Ohio EPA 1997	NON	16	18
Abram Creek	2.8/--	Ohio EPA 1997	NON	12	--
Abram Creek	1.9/1.9	Ohio EPA 1997	NON	12	28
Abram Creek	1.9/2.0	Ohio EPA 1992	NON	16	4
Abram Creek	0.6/0.2	Ohio EPA 1997	NON	12	26
Abram Creek	0.4/0.3	Ohio EPA 1992	NON	12	8
Warmwater Habitat Criteria				40	34
Non-significant Departure from Criteria				≤4	≤4

Table 14. Historical Data from Rocky River (Ohio EPA, 2001).						
Stream	River Mile	Year	Overall Attainment Status	IBI Score	MIwb Score	ICI Score
Rocky River	11.1/11.1	1992	NON	30	7.2	Fair
Rocky River	10.0/9.8	1992	NON	26	7.7	Fair
Rocky River	11.1/11.1	1997	NON	40	5.8	36
Rocky River	--/10.5	1997	(FULL)	--	--	38
Rocky River	10.0/10.0	1997	PARTIAL	37	7.2	Good
Warmwater Habitat Criteria				38	7.9	34
Non-significant Departure from Criteria				≤4	≤0.5	≤4

Any future sampling on this watershed should include a survey of the fish above the first fish barrier (seen in Figure 3) to determine whether the fungus resulting from the airport’s discharge is having a strong impact on that community. Specifically, to find out if the results recorded from the mouth were due to fish migration, from the Rocky River, or the community can survive year round. The only species of fish that was found at Abram Creek RM 0.04 that was not found in the Rocky River was *Rhinichthys atratulus* (Western Blacknose Dace), which is highly tolerant to pollution.

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 15), 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 15. 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

Table 16 shows the results for the 2012 benthic macroinvertebrate sampling. Both RM 4.10 and 3.65 did not meet the minimum flow requirements of 0.3 feet per second during deployment and retrieval of the HD samplers. Since the HDs did not meet the minimum flow requirements, the ICI scoring may need to be discarded and best professional judgment should be utilized to evaluate the site.

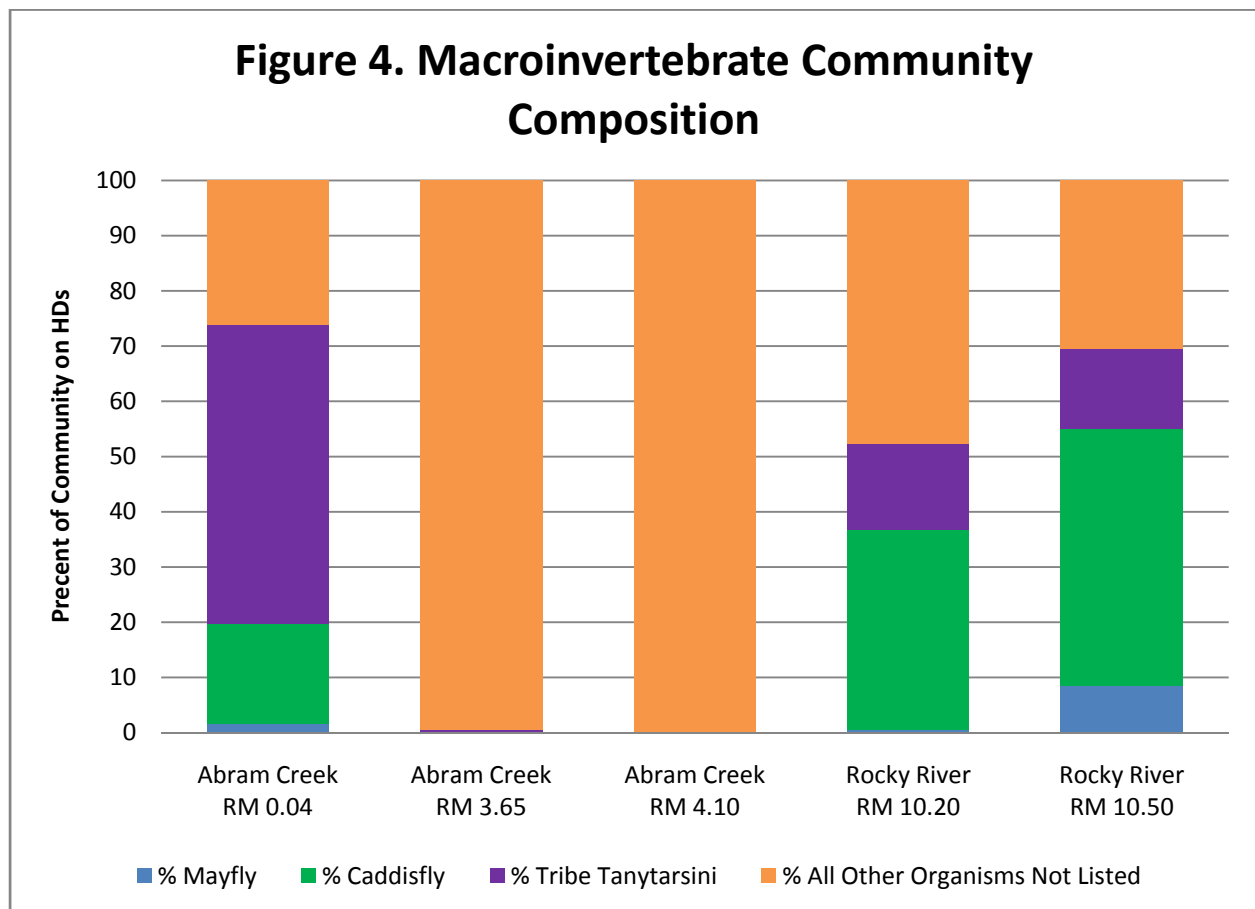
Table 16. Summary of the Macroinvertebrate Collections.				
Water Body	River Mile	Retrieval Date	Drainage mi ²	ICI Score ¹
Abram Creek	4.10	09/10/12	4.4	6
Abram Creek	3.65	09/12/12	7.3	6
Abram Creek	0.04	09/11/12	10.8	42
Rocky River	10.50	09/13/12	268	42
Rocky River	10.20	09/12/12	280	34

¹The ICI Criterion for WWH is ≥ 34 units.

The low score found at Abram Creek RM 4.10 can be explained as it is part of the wetland complex that surrounds Lake Abram. The wetland conditions found at the site are not conducive to sampling with HDs and the macroinvertebrate community is different than would be typically found in a stream environment. Abram Creek RM 3.65

is more stream-like than RM 4.10, the site upstream. Although the gradient does not change significantly from RM 4.10 to RM 3.65, the stream channel narrows, loses aquatic macrophytes, and the canopy is completely closed.

In 2012, the Rocky River showed similar results to those collected by the Ohio EPA in 2001, whereas the mouth of Abram Creek improved greatly. Unfortunately, no additional information was available other than the ICI score from the Ohio EPA data and the NEORSD (1994) data was incomplete. The breakdown of the HD group percentages for each site sampled in 2012 can be found in Figure 4. All of the sites that were in attainment for the warmwater criterion had at least 50 percent of what are considered to be the sensitive groups. These sensitive groups typically decrease in percentage under water quality stresses. Other than water quality, flow over the HD has the greatest effect on the organisms found on the HD (DeShon, 1995). Abram Creek RM 3.65 and 4.10 had very few, if any, sensitive groups on the HDs.



Conclusions

As seen in Tables 17 and 18, the Rocky River sites and Abram Creek mouth site were in full attainment of applicable criteria. The Rocky River Basin TMDL (2001) identified Abram Creek as having little chance to meet attainment in the upper watershed due to the following reasons: low stream gradient; stream realignment; channelization; loss of riparian zones; and the use of culverts. Other impairments in the watershed that were listed included home septic systems and the airport deicing activities.

When comparing the Abram Creek sites that were in nonattainment for biological criteria, it was noted that RM 4.10 sources and causes of impairment were natural, the wetland complex. However, the impairments of RM 3.65 are not affected by the wetland complex and appear to stem from the lack of functional habitat. This should be taken into account during future evaluations of the Abram Creek.

Table 17. Attainment Status of the Abram Creek Sites in 2012, as indicated by NEORSD sampling results.				
Stream	River Mile	Attainment Status	IBI Score	ICI Score
Abram Creek	4.10	NON	22	6
Abram Creek	3.65	NON	18	6
Abram Creek	0.04	FULL	36	42
Warmwater Habitat Criteria			40	34
Non-significant Departure from Criteria			≤4	≤4

Table 18. Attainment Status of the Rocky River Sites in 2012, as indicated by NEORSD sampling results.					
Stream	River Mile	Attainment Status	IBI Score	MIwb Score	ICI Score
Rocky River	10.50	FULL	36	8.4	42
Rocky River	10.20	FULL	34	8.8	34
Warmwater Habitat Criteria			38	7.9	34
Non-significant Departure from Criteria			≤4	≤0.5	≤4

Abram Creek does not appear to be negatively impacting Rocky River as seen by the full attainment status at each site. However it was noted that between April and May Abram Creek may cause low dissolved oxygen to occur in Rocky River (K. Granlund and

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T. Zabloutny, June 12, 2012, personnel communication). The upper portions of Abram Creek, prior to the wetland complex of Abram Lake, need to be evaluated to determine if that section can support a warmwater habitat community. The wetland complex of Abram Lake has a natural condition which is the main cause of impairment and not necessarily subject to restoration.

NEORSRD has started a comprehensive survey of Abram Creek to complete a pilot stormwater master plan to identify problems and prioritize future projects. The Ohio EPA has also stated its intent to resurvey the Rocky River watershed in 2014, to determine designated uses and help identify sources of impairment.

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