NORTHEAST OHIO REGIONAL SEWER DISTRICT

2011 Nine-Mile Creek Environmental Monitoring

Prepared by
Water Quality and Industrial Surveillance
Environmental Assessment Division

Introduction

During 2011, the Northeast Ohio Regional Sewer District (NEORSD) conducted water chemistry sampling, stream habitat assessments, and fish and benthic macroinvertebrate community surveys on Nine-Mile Creek at three locations. Nine-Mile Creek is an intensely urbanized stream in Cuyahoga County which flows through the cities of University Heights, South Euclid, Cleveland Heights, Cleveland and Bratenahl before emptying into Lake Erie. The majority of Nine-Mile Creek is culverted; sampling was conducted in the open sections of the creek.

It is anticipated that NEORSD construction work will begin in early 2012 on the Tunnel Dewatering Pump Station (TDPS) project, which will reduce the number of overflows per year to Nine-Mile Creek and provide wet weather flow relief in the existing collection system through diversion into the Dugway East Interceptor Relief Sewer (DIERS) and Dugway Storage Tunnel (DST). Construction on the DIERS project began in the spring of 2009 was completed on December 5, 2011.

The purpose of the study was to establish baseline monitoring data prior to construction for the TDPS project and to identify point and nonpoint sources of pollution that may be influencing the water quality at each sample location. The baseline data can then be compared with data collected after the completion of the TDPS to evaluate any changes in water quality and biological community health from the reduction of overflows to Nine-Mile Creek. Sampling was conducted by NEORSD Level 3 Qualified Data Collectors certified by Ohio EPA in Fish Community and Benthic Macroinvertebrate Biology, Chemical Water Quality, and Stream Habitat Assessments as explained in the NEORSD study plan, *2011 Nine-Mile Creek Environmental Monitoring,* approved by Ohio EPA on June 22, 2011.

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

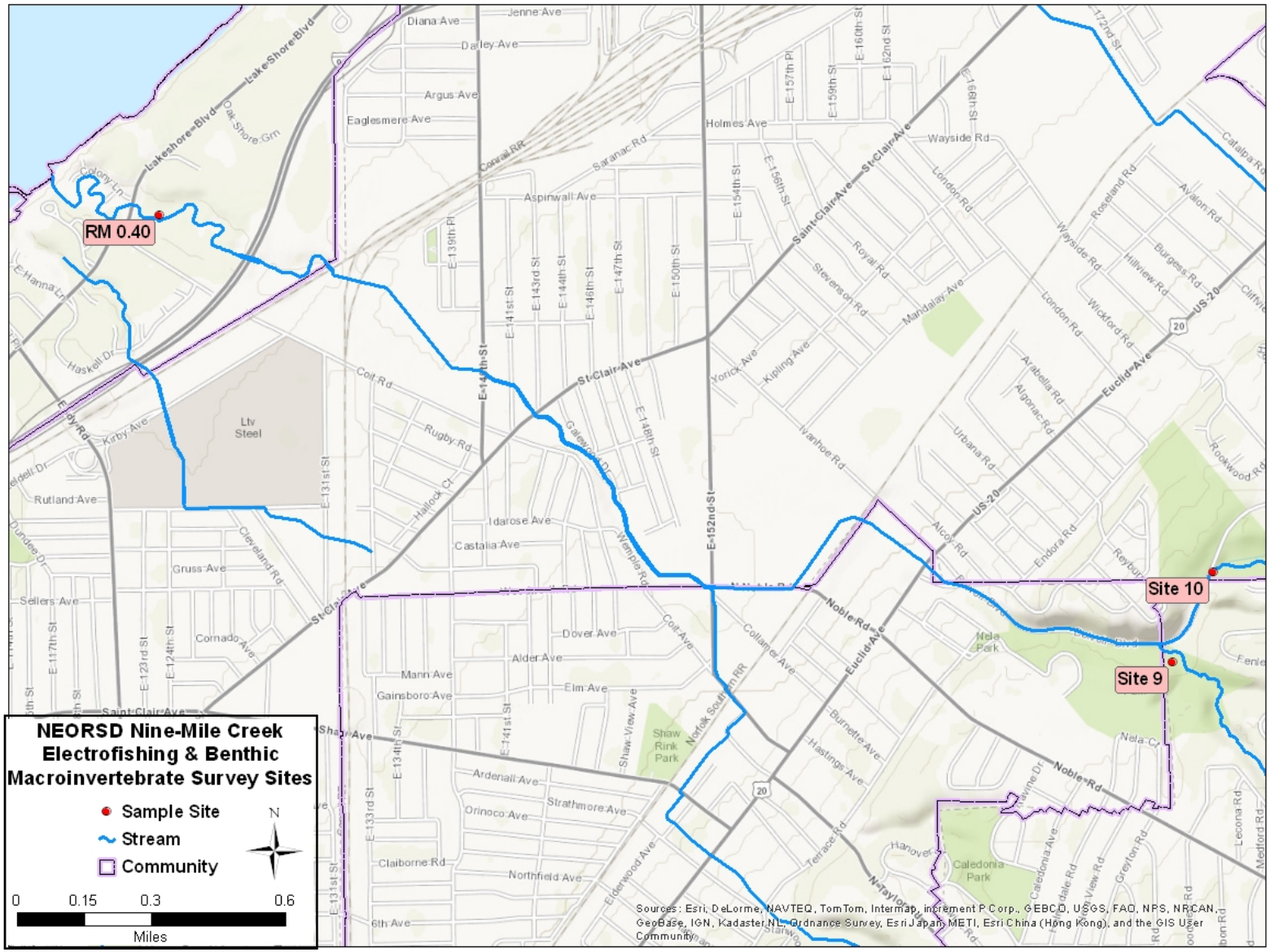


Figure 1. Map of Sampling Locations

Table 1. Nine-Mile Creek Sampling Locations

Site Location	Latitude	Longitude	River Mile	Description	Quadrangle	Purpose
Nine-Mile Creek (Site 10)	41.54572967	-81.55228433	N/A	South of Belvoir Boulevard	East Cleveland	Evaluate water chemistry, fish, habitat and macroinvertebrates
Nine-Mile Creek, Nela Park Branch (Site 9)	41.54290983	-81.55521750	N/A	South of Belvoir Boulevard on Nela Park Branch	East Cleveland	Evaluate water chemistry, fish, habitat and macroinvertebrates
Nine-Mile Creek RM 0.40	41.5574565	-81.59912283	0.40	Upstream of Lakeshore Boulevard	East Cleveland	Evaluate water chemistry, fish, habitat and macroinvertebrates

Water Chemistry and Bacteriological Sampling

Methods

Water chemistry and bacteriological samples were collected weekly during the macroinvertebrate colonization period from June 28, 2011 to August 3, 2011. Samples collected on July 20 and August 3 were associated with wet weather[1], with 0.86 inches of rain falling on July 19th and 0.93 inches of rain falling on August 3rd. A total of 22 samples were collected during the 2011 study, including field duplicates and field blanks. Techniques used for water chemistry sample collection and chemical analyses followed the *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices* (2009a). Field analyses included the use of a YSI 600XL Sonde multi-parameter meter during sampling. The sonde was calibrated weekly to measure dissolved oxygen, water temperature and conductivity, while pH was calibrated on a daily basis.

Water chemistry samples were collected in two 4-liter polyethylene cubitainers, and two 473-milliliter plastic bottles. One of the plastic bottles was field preserved with trace nitric acid and the other was field preserved with trace sulfuric acid. A NEORSD Surface Water Condition Sampling Field Data Form was completed with field parameters measured in-stream. Bacteriological samples were collected in a sterile 250-milliliter plastic bottle. All samples were placed in a cooler with ice and stored in a locked NEORSD vehicle until the samples were transferred to the NEORSD's Analytical Services (AS) sample receiving, and released to an authorized AS employee with a Chain of Custody (COC). All COCs and Surface Water Condition Sampling Field Data Forms are available upon request from NEORSD's WQIS Division.

[1] Wet weather sampling events: greater than 0.10 inches of rain but less than 0.25 inches, samples collected that day and the following day were considered wet weather samples; greater than 0.25 inches, the samples collected that day and the following two days were considered wet weather samples. Rainfall data measured at NEORSD RSO rain gauge in South Euclid.

The three sites on Nine-Mile Creek that were evaluated are designated by Ohio EPA as Warmwater Habitat (WWH), agricultural water supply, industrial water supply and Class B Primary Contact Recreation.

The quality assurance and quality control of water sample collections included obtaining sample duplicates at a frequency not less than 10% of the total samples collected. Field blanks were collected at a frequency not less than 5% of the total samples collected. A total of two sample duplicates and 2 field blanks were obtained during the sampling period. These samples were collected on July 13 and August 3, both at RM 0.40. The sample duplicate results were compared to the sample results using relative percent difference (RPD), see Formula 1.

Formula 1.

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

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

Each sample and sample duplicate was compared for each of the forty-three individual parameters reported on the Certificate of Analysis. After an RPD was calculated, any result greater than thirty percent was investigated to determine the reason for the discrepancy. A total of seven potential discrepancies were found from the duplicate samples. All seven parameter values were less than ten times their respective Practical Quantitation Limits (PQL), which are very low concentrations. Differences in very low concentrations can lead to high RPD values. Once the downgraded (Level 2) and rejected data points were culled from the data set, the remaining Level 3 data was compared to the applicable Ohio EPA Water Quality Standards (OAC 3745-1) for each site. Table 2 lists the water quality parameters that were, because they did not meet Ohio EPA's requirements for level 3 data, either downgraded to level 2 data (used for trend assessment only) or rejected from the data set.

Table 2. Rejected and Downgraded Data

Site	Date	Parameter	Action
Site #9	7/13/11	Cu	Rejected
Site #9	7/13/11	NH3	Rejected
Site #10	7/13/11	Cu	Rejected
Site #10	8/3/11	Cu (Duplicate)	Level 2
Site #10	8/3/11	NH3	Level 2
RM 0.40	7/13/11	Cu	Rejected
RM 0.40	7/13/11	Cu	Rejected
RM 0.40	7/13/11	NH3	Level 2
RM 0.40	7/13/11	NH3 (Duplicate)	Level 2

Results and Discussion

Site #10

Six weekly water chemistry samples were obtained on Nine-Mile Creek Site #10. Mercury exceeded the human health nondrinking outside mixing zone average (OMZA) criterion for three 30-day periods. Mercury analysis for all of the samples was completed using EPA Method 245.1. Because the detection limit for this method is above the criteria for the Human Health Nondrinking water and Protection of Wildlife Outside Mixing Zone Averages (OMZA), it generally cannot be determined if Nine-Mile Creek was in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine contamination above those levels typically found in the creek. For the data that was collected in 2011, Site 10 (Table 3) had mercury concentrations that resulted in 30-day averages that exceeded the Human Health Nondrinking water and Protection of Wildlife Outside Mixing Zone Averages (OMZA). It is expected that the use of EPA Method 1631E for all of the samples would have resulted in exceedances throughout the sampling.

Table 3. Site #10 Mercury Results

	Mercury					
Sample Date	**Form (units)**	**Concentration**	**30-day period**	**30 Day Average Concentration**	**OMZA Criterion Nondrinking**	**OMZA Criterion Wildlife**
6/28/2011	TR (µg/L)	<0.005	6/28/11-7/28/11	0.006	0.0031	0.0013
7/6/2011	TR (µg/L)	<0.005	7/6/11-8/5/11	0.006	0.0031	0.0013
7/13/2011	TR (µg/L)	j 0.02	7/13/11-8/12/11	0.007	0.0031	0.0013
7/20/2011	TR (µg/L)	<0.005	7/20/11-8/19/2011	0.003	0.0031	0.0013
7/27/2011	TR (µg/L)	<0.005	7/27/11-8/26/11	0.003	0.0031	0.0013
8/3/2011	TR (µg/L)	<0.005	--	--	--	--

TR= Total Recoverable
j= Estimated value between PQL and MDL
Shading= 30-day period exceedance of the criterion

Additionally, Site #10 exceeded the Class B Primary Contact Recreation criterion with a seasonal geometric mean of 609 colony-forming units/100mL (cfu/100mL) (Table 10). Additionally, for all 30-day periods, the percentage of samples exceeding 523 cfu/100mL was greater than 10%, causing an exceedance of the single sample maximum (SSM) criterion. Possible explanations of these exceedances include combined sewer overflows (CSO), sanitary sewer overflows (SSO) and urban and stormwater runoff.

Site #9

Nine-Mile Creek Site #9 exceeded the Class B Primary Contact Recreation criterion with a seasonal geometric mean of 749 cfu/100mL (Table 10). Additionally, for all 30-day periods, the percentage of samples exceeding 523 cfu/100mL was greater than 10%, causing an exceedance of the single sample maximum (SSM) criterion. These exceedances were likely caused by CSOs and SSOs entering Nine-Mile Creek upstream of Site #9.

Exceedances of the protection of aquatic life outside mixing zone maximum (OMZM) for cadmium occurred on June 28, July 6, July 13, July 20, July 27, and August 3 (Table 4). This also resulted in non-attainment of the aquatic life OMZA for all 30-day periods. Similarly, selenium exceeded the water quality criteria for the protection of aquatic life OMZA for two 30-day periods (Table 6). CSOs, SSOs on the collection system, and urban runoff likely contributed to these exceedances.

Table 4. Site #9 Cadmium Results

	Cadmium Hardness based						
Sample Date	**Form (units)**	**Concentration**	**30-day period**	**30-Day Average Cd Concentration**	**30-Day Average Hardness Concentration**	**Aquatic Life OMZA Criterion**	**Aquatic Life OMZM Criterion**
6/28/2011	TR (µg/L)	19.29	6/28/11-7/28/11	25.95	166	3.67	8.00
7/6/2011	TR (µg/L)	20.53	7/6/11-8/5/11	29.30	165	3.67	7.94
7/13/2011	TR (µg/L)	7.94	7/13/11-8/12/11	31.49	161	3.68	7.73
7/20/2011	TR (µg/L)	66.88	7/20/11-8/19/11	39.34	185	3.71	9.04
7/27/2011	TR (µg/L)	15.13	7/27/11-8/26/11	25.58	155	3.65	7.40
8/3/2011	TR (µg/L)	36.02	--	--	--	--	--

TR= Total Recoverable
Shading= exceedance of the criterion

Copper exceeded the aquatic life OMZA for four 30-day periods and the aquatic life OMZM once (Table 5). Potential sources of copper entering Nine-Mile Creek may be attributable to CSOs, SSOs on the collection system, and urban runoff.

Table 5. Site #9 Copper Results

Sample Date	Copper					
	Form (units)	Concentration	30-day period	30 Day Average Cu Concentration	OMZA Criterion Aquatic Life	OMZM Criterion Aquatic Life
6/28/2011	TR (µg/L)	13.02	6/28/11-7/28/11	16.15	14.4	22.6
7/6/2011	TR (µg/L)	12.42	7/6/11-8/5/11	32.85	14.4	22.4
7/20/2011	TR (µg/L)	27.67	7/20/11-8/19/11	39.66	14.5	24.9
7/27/2011	TR (µg/L)	11.48	7/27/11-8/26/11	45.66	14.3	21.1
8/3/11	TR (µg/L)	79.83	--	--	--	--

TR= Total Recoverable
Shading= exceedance of the criterion

Table 6. Site #9 Selenium Results

Sample Date	Selenium				
	Form (units)	Concentration	30-day period	Average Concentration	OMZA Criterion Aquatic Life
6/28/2011	TR (µg/L)	j 4.7	6/28/11-7/28/11	4.6	5.0
7/6/2011	TR (µg/L)	j 3.4	7/6/11-8/5/11	4.8	5.0
7/13/2011	TR (µg/L)	j 1.5	7/13/11-8/12/11	5.2	5.0
7/20/2011	TR (µg/L)	11.2	7/20/11-8/19/11	6.4	5.0
7/27/2011	TR (µg/L)	j 2.19	7/27/11-8/26/11	4.1	5.0
8/3/2011	TR (µg/L)	5.9	--	--	--

TR= Total Recoverable
j= Estimated value between PQL and MDL
Shading= exceedance of the criterion

An exceedance of the aquatic life OMZA for zinc occurred for three 30-day periods at Nine-Mile Creek Site #9 (Table 7). Zinc most likely exceeded the criterion due to stormwater runoff and combined sewage from CSOs entering Nine-Mile Creek upstream of Site #9.

Table 7. Site #9 Zinc Results

Sample Date	Zinc					
	Form (units)	Concentration	30-day period	Average Concentration	OMZA Criterion Aquatic Life	OMZM Criterion Aquatic Life
6/28/2011	TR (µg/L)	100.1	6/28/11-7/28/11	138.4	184.4	184.1
7/6/2011	TR (µg/L)	112	7/6/11-8/5/11	183.5	184.8	183.1
7/13/2011	TR (µg/L)	44.5	7/13/11-8/12/11	201.3	185.4	179.4
7/20/2011	TR (µg/L)	347.7	7/20/11-8/19/11	253.58	186.7	201.8

	Zinc					
Sample Date	Form (units)	Concentration	30-day period	Average Concentration	OMZA Criterion Aquatic Life	OMZM Criterion Aquatic Life
7/27/2011	TR (µg/L)	87.74	7/27/11-8/26/11	206.5	183.5	173.7
8/3/2011	TR (µg/L)	325.3	--	--	--	--

TR= Total Recoverable
Shading= exceedance of the criterion

Mercury exceedances of the water quality criteria for the Lake Erie drainage basin (Table 8) occurred at Nine-Mile Creek Site #9 for all 30-day periods beginning on days when samples were collected. Sources of mercury contamination may be attributable to sanitary sewage contamination from CSOs, SSOs on the collection system, urban and stormwater runoff, and atmospheric deposition.

Table 8. Site #9 Mercury Results

	Mercury					
Sample Date	Form (units)	Concentration	30-day period	Average Concentration	OMZA Criterion Nondrinking	OMZA Criterion Wildlife
6/28/2011	TR (µg/L)	j 0.04	6/28/11-7/28/11	0.05	0.0031	0.0013
7/6/2011	TR (µg/L)	j 0.039	7/6/11-8/5/11	0.07	0.0031	0.0013
7/13/2011	TR (µg/L)	j 0.051	7/13/11-8/12/11	0.08	0.0031	0.0013
7/20/2011	TR (µg/L)	0.086	7/20/11-8/19/2011	0.09	0.0031	0.0013
7/27/2011	TR (µg/L)	j 0.033	7/27/11-8/26/11	0.09	0.0031	0.0013

TR= Total Recoverable
j= Estimated value between PQL and MDL
Shading= 30-day period exceedance of the criterion

RM 0.40

Nine-Mile Creek RM 0.40 had exceedances of the human health nondrinking and wildlife OMZA criteria for mercury (Table 9). Two samples with concentrations greater than the MDL resulted in exceedances for both criteria for the 30-day periods that included them. Because the rest of the samples were below the MDL, it is unknown if the criteria were exceeded during the other 30-day periods. Sources of mercury contamination may be attributable to sanitary sewage contamination from CSOs, urban and stormwater runoff, and atmospheric deposition.

Table 9. River Mile 0.40 Mercury Results

Sample Date	Mercury					
	Form (units)	Concentration	30-day period	Average Concentration	OMZA Criterion Nondrinking	OMZA Criterion Wildlife
6/28/2011	TR (µg/L)	j 0.008	6/28/11-7/28/11	0.008	0.0031	0.0013
7/6/2011	TR (µg/L)	<0.005	7/6/11-8/5/11	0.007	0.0031	0.0013
7/13/2011	TR (µg/L)	j 0.024	7/13/11-8/12/11	0.008	0.0031	0.0013
7/20/2011	TR (µg/L)	<0.005	7/20/11-8/19/2011	0.003	0.0031	0.0013
7/27/2011	TR (µg/L)	<0.005	7/27/11-8/26/11	0.003	0.0031	0.0013

TR= Total Recoverable
j= Estimated value between PQL and MDL
Shading= 30-day period exceedance of the criterion

Bacteria

Nine-Mile Creek RM 0.40 exceeded the Class B Primary Contact Recreation seasonal geometric mean for bacteria (Table 10). The seasonal geometric mean at RM 0.40 for the sampling period was 3,246 cfu/100mL, compared to the seasonal geometric mean criterion of 161 cfu/100mL. Additionally, for all 30-day periods, the percentage of samples exceeding 523 cfu/100mL was greater than 10%, causing an exceedance of the single sample maximum (SSM) criterion. Suspected causes of the high bacteriological densities are CSOs, and stormwater runoff.

Table 10. Nine-Mile Creek *E. coli* Densities

		***E. coli* 30-Day Average (cfu/100mL)**		
30-Day Period	**Seasonal Geometric Mean Criterion**	**RM 0.40**	**Site #9**	**Site #10**
6/28/11-7/28/11	--	1600	576	445
7/6/11-8/5/11	--	3600	1294	1325
7/13/11-8/12/11	--	1370	1518	1564
7/20/11-8/19/11	--	EC 8300	1840	1892
7/27/11-8/26/11	--	1520	2255	2479
Seasonal Geometric Mean	161	3246	749	608

EC=Estimated Count
Shading= Season geometric mean exceedance

Habitat Assessment

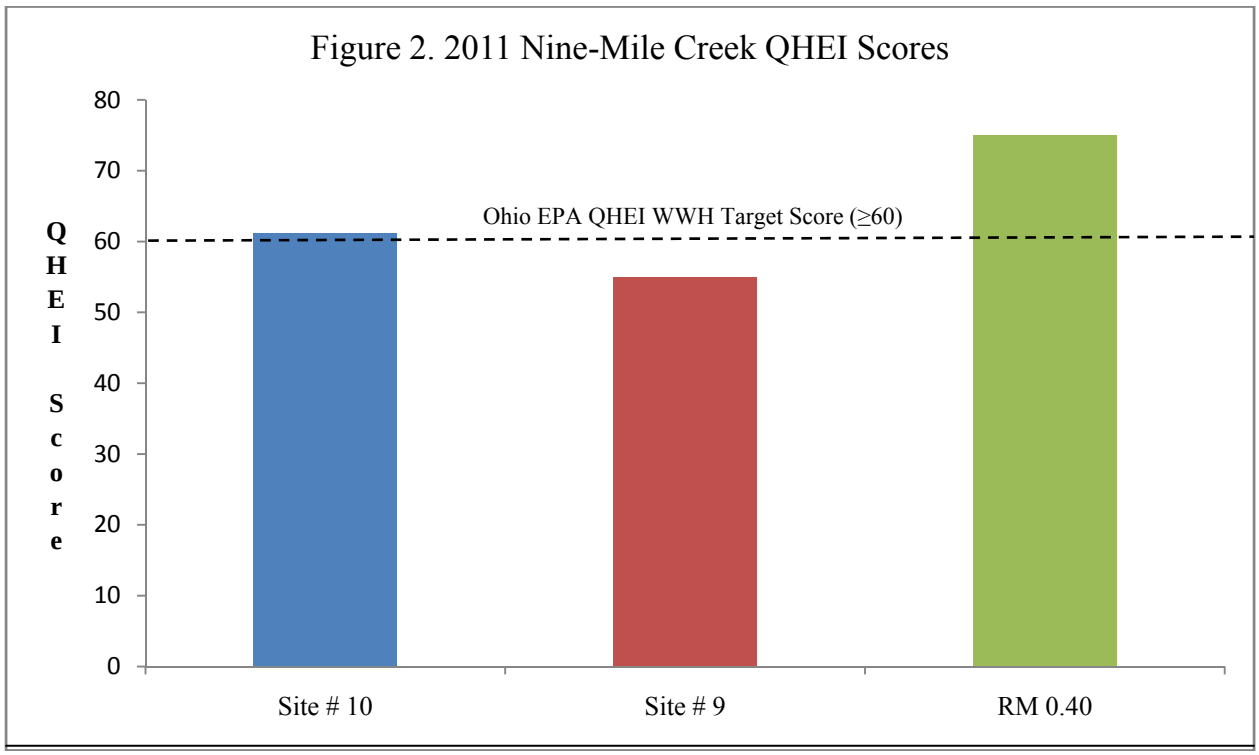
Methods

Qualitative Habitat Evaluation Index scores (QHEI) were determined for each site in 2011 following the techniques described in the Ohio EPA's (2006) *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)*. The QHEI measures the stream substrate, instream cover, stream channel morphology, riparian and bank condition, pool and riffle quality and stream gradient in relation to fish community health. The Ohio EPA has set a QHEI target score of 60 for Warmwater Habitat (WWH) designation. A QHEI score ≥60 indicates that the stream has adequate habitat diversity and should be able to attain a WWH fish community as long as no other aquatic life use impairments exist (Rankin, 1989). QHEI field sheets from each site are available upon request from NEORSD's WQIS Division.

Results and Discussion

Site #10

Nine-Mile Creek Site #10, south of Belvoir Boulevard, obtained a QHEI score of 61.25 (*Good*) (Figure 2). Consisting mainly of gravel and bedrock, the site was free of silt with normal embeddedness. Instream cover was sparse, consisting of shallows, rootwads, boulders and woody debris. Channel development was rated fair to low due to low sinuosity and the lack of deep pools and runs. Bank erosion was moderate to severe and riparian width was wide to moderate. Although riffle areas and runs were stable to moderately stable, they tended to shift during elevated flows due to the high gradient of the stream. The site is surrounded by forest and residential/park/new field. This site exceeded Ohio EPA's target score of 60 for WWH streams.



Site #9

Nine-Mile Creek Site #9, which is located on the Nela Park Branch, south of Belvoir Boulevard, obtained a QHEI score of 55 (*Fair*) (Figure 2). The predominant substrates were gravel and cobble with normal silt quality and embeddedness. Instream cover was sparse, consisting of undercut banks, shallows, rootmats, rootwads, and boulders. Channel development was poor due to the lack of a functional riffle, deep pools (>70 cm) and deep runs. The channel is in a recovered state with low stability. Bank erosion was little to none and the riparian width was greater than 50 meters, consisting of forest/swamp and residential/park/new field.

RM 0.40

Nine-Mile Creek RM 0.40, which is located upstream of Lakeshore Boulevard, received a QHEI score of 75 (*Excellent*) (Figure 2). The best substrate types were gravel and sand with moderate instream cover consisting of undercut banks, overhanging vegetation, shallows, deep pools (>70 cm), rootwads, boulders and woody debris. Channel development was good with deep runs and moderately stable riffles consisting of large gravel. Bank erosion was moderate, and riparian width was narrow to wide, consisting of forest/swamp and residential/park/new field. This site exceeded the Ohio EPA target score of 60 for WWH streams.

Fish Community Assessment

Methods

In 2011, electrofishing passes were conducted twice at Nine-Mile Creek RM 0.40 and once each at Site #9 and Site #10. NEORSD Environmental Assessment staff concluded that second passes were not necessary at Sites #9 and #10 due to extremely low numbers of fish sampled during the first pass at each site. Electrofishing methods followed Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III: Standardized Biological Field Sampling Laboratory Methods for Assessing Fish and Macroinvertebrate Communities* (1987b).

At each site, longline electrofishing techniques were utilized to shock all habitat types within the sampling zone. The sampling zone was 0.15 kilometers and was sampled in a downstream to upstream manner. Fish were identified to the species level, counted and examined for the presence of external anomalies including deformities, erosions, lesions, and tumors (DELTs). Lists of the species, numbers, pollution tolerances and incidence of DELT anomalies are available upon request from NEORSD's WQIS Division.

Results from electrofishing sampling were used to calculate the Index of Biotic Integrity (IBI). The IBI, originally proposed by Karr (1981) is used to assess fish community health at a sampling site. Twelve metrics comprise the IBI:

1. Number of Native Species
2. Number of Darter Species
3. Proportion of Headwater Species
4. Minnow Species
5. Sensitive Species
6. Proportion of Tolerant Species
7. Proportion of Omnivores
8. Proportion of Insectivores
9. Pioneering Species
10. Number of Individuals
11. Number of Simple Lithophilic Species
12. Proportion that are Deformed, have Eroded fins, Lesions or Tumors (DELTs)

The maximum possible IBI score when considering WWH designation is 60 and the minimum possible score is 12. The summation of the twelve individual metric scores provides a single-value IBI score, which corresponds to a narrative rating of *Exceptional, Good, Marginally Good, Fair, Poor* or *Very Poor.* An IBI score of ≥40 at headwater sites indicates attainment of the WWH biocriteria in the Erie Ontario Lake Plain ecoregion. An IBI score between 36 and 39 indicates the site is within non-significant

departure (≤ 4 IBI units) of the WWH biocriterion for headwater sites and is therefore considered to be in attainment of the biocriterion.

Results and Discussion

Site #10

The first and only sampling pass at Site #10 was performed on June 30, 2011 and consisted of one species, the creek chub (100%). Creek chubs are highly tolerant to pollution and favor a substrate of sand, gravel, boulders and bedrock (Trautman, 1981). The QHEI supports this species' habitat preference, with gravel and bedrock being the most prominent substrate types. Although the QHEI at Site #10 was slightly higher than the target score of 60 (QHEI=61.25, *Good*); the site was not expected to support a healthy community of warmwater habitat fish, which is evidenced by an IBI score of 20 (*Poor)* (Table 11). Additionally, CSO 212 (on Belvoir Boulevard, opposite Quilliams Avenue) which is approximately one half mile upstream of Site #10 averages an estimated 32 overflows per year. This suggests that bacterial contamination may be preventing a healthy fish community from existing at this site.

Table 11. Nine-Mile Creek IBI Scores

	IBI Scores				
River Mile/Site	**Score**			**Narrative Rating**	
	1st Pass	2nd Pass	Average	1st Pass	2nd Pass
Site #10	20	NA	20	Poor	NA
Site #9	12	NA	12	Very Poor	NA
RM 0.40	18	22	20	Poor	Poor

Site #9

One electrofishing pass was conducted on Nine-Mile Creek Site #9 on June 30, 2011. No fish were collected at Site #9, resulting in an IBI score of 12 and a narrative rating of *Very Poor* (Figure 3). Habitat limitations may be a possible reason for the lack of fish; the QHEI at this site was the lowest of all three sites (QHEI=55 *Fair*). Site #9 lacked key habitat features including functional riffle habitat and deep pools necessary to support a fish community. Additionally, water quality exceedances for mercury, bacteria, copper, and cadmium may have negatively affected the fish community at this site.

Average cadmium concentrations over the five sampling events at each site are shown in Table 12. Normal concentrations of total cadmium in rivers, streams and lakes range from 0.01 µg/L - 0.07 µg/L (NPS, 1997). It is evident that all sites show higher than normal levels of total average cadmium; however, Site #9 was the only site in non-

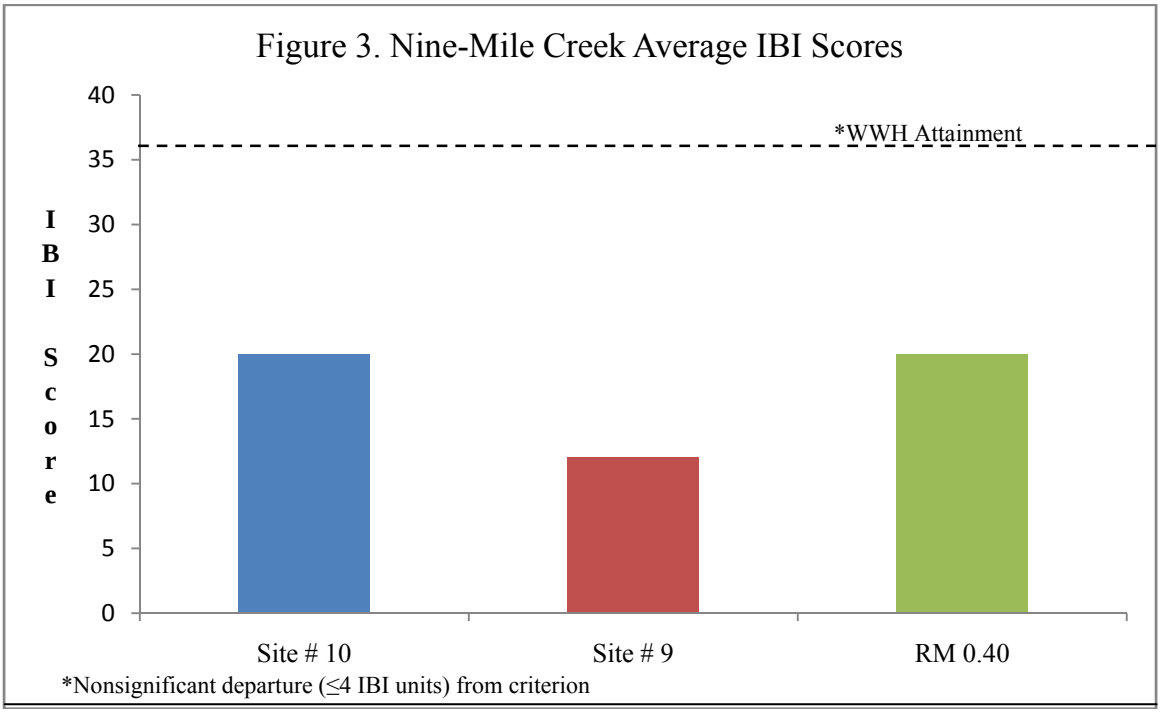
attainment for all thirty-day periods (Table 12). The high average concentration of cadmium at Site #9 may be a factor in the absent fish community.

Table 12. Nine-Mile Creek Average Cadmium Concentrations

Site	Average Cadmium Concentration (µg/L)
RM 0.40	0.920
Site #9	27.63
Site #10	0.091

According to Lake Simcoe Region Conservation Authority's Uxbridge Brook Watershed Plan, copper concentrations greater than 5 µg/L may be toxic to fish (as cited in Jones, Palmer, Motkaluk & Walters, 2002). All copper concentrations at Site #9 exceeded 5 µg/L during the sampling period (Table 4). Therefore, copper may have also contributed to the non-existent fish population. On April 25-26, 2012, WQIS Investigators conducted a facility inspection of General Electric Nela Park due to its proximity to Nine-Mile Creek. The investigation revealed that a buried landfill containing various light bulb manufacturing components is located on the property. Further investigation will be necessary to indicate whether the landfill is negatively impacting the water quality in Nine-Mile Creek.

Figure 3. Nine-Mile Creek Average IBI Scores



RM 0.40

Two electrofishing passes were conducted at RM 0.40. The first pass occurred on June 30, 2011, with the second pass occurring on August 18, 2011. The first sampling event yielded seven species of fish totaling 117 individuals and an IBI score of 18 (*Poor*). The majority of the fish collected during the first pass consisted of highly pollution-tolerant species including creek chub (76%) and white sucker (19%). The second electrofishing pass on Nine-Mile Creek RM 0.40 was conducted on August 8, 2011, with 297 individuals sampled and an IBI score of 22 (*Poor*) (Table 11). Again, the sample was dominated by pollution-tolerant species including creek chub (60%) and white sucker (19%). CSO 211 (east of Coit Road), which is located a little over half a mile upstream of RM 0.40, averages an estimated 77 overflows annually Overflows from this CSO may contain pollutants that may be negatively impacting the fish community at this site.

Macroinvertebrate Sampling

Methods

A modified Hester-Dendy artificial substrate sampler (HD), a type of passive sampling that has been utilized by the Ohio EPA since 1973 (DeShon, 1995), was installed at RM 0.40 in 2011. However, the HD could not be located at the time of retrieval and is believed to have either become buried or washed out during the colonization period. HDs were not installed at Site #9 or Site #10 in 2011 based on low drainage area and unsuccessful retrievals in 2010 due to the samplers being buried or washed away in high water events. Because of these issues, qualitative sampling only was performed at all three sites in August 2011. NEORSD Macroinvertebrate field sheets are available upon request from NEORSD's WQIS Division.

Macroinvertebrate qualitative samples were sent to MBI for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as recommended in Ohio EPA's *Biological Criteria for the Protection of Aquatic Life, Volume III* (1987, updated September 30, 1989; November 8, 2006; and August 26, 2008). The taxa lists and enumerations are available upon request from NEORSD's WQIS Division.

Results and Discussion

Site #10

At Site #10, 14 taxa were collected (Figure 4). The sample consisted of four EPT taxa, while the remainder was composed of dipterans and non-insects. Five taxa (35% of the sample) were considered moderately tolerant to tolerant of pollution. Although riffle

quality was fair (better than RM 0.40 and Site #9), the margin quality was poor with a lack of suitable margin habitat to sample. Additionally, the site may not be ideal for a stable macroinvertebrate community as the substrate tends to shift during elevated flows. This may cause the macroinvertebrate community to be easily scoured, thus reducing the chances of a population to properly colonize the site.

Site #9

A total of 9 taxa were collected at Site #9, four of which were pollution tolerant (44% of the sample). Only two EPT taxa were collected and the rest of the sample consisted of dipteran and non-insect taxa. Site #9 had six water quality exceedances which were for *E. coli*, cadmium, copper, selenium, zinc, and mercury. Water pollution caused by metals may cause toxicity to macroinvertebrates through individual level responses such as mortality, decreased growth and reproduction. At the community level, reduced density and species richness may occur. Metal contamination may also cause a shift in the macroinvertebrate community to more tolerant organisms, which may be occurring at Site #9 (LeJeune et al., 2000).

RM 0.40

A total of 21 taxa collected during the qualitative sampling, with three taxa classified as EPT taxa. Nine taxa (43% of the sample) were considered pollution tolerant. Poor riffle and margin habitat created by shifting substrates may have contributed to the relatively poor macroinvertebrate community at RM 0.40.

Conclusions

The purpose of this study was to collect baseline data on Nine-Mile Creek before construction of the TDPS project and to identify point and non-point source pollution affecting Nine-Mile Creek. The data collected in 2011 will be compared to data collected post-construction when the number of overflows per year to Nine-Mile Creek is expected to be reduced.

Water chemistry results at Nine-Mile Creek RM 0.40 and Site #10 indicate problems only with *E. coli* contamination and possible mercury exceedances. However, Site #9 had severe water quality issues, which may be attributed to continued instances of combined sewage entering Nine-Mile Creek just upstream of Site #9.

Site #9 obtained a QHEI score of 55 (*Fair),* which is below Ohio EPA's WWH target score of 60, while RM 0.40 and Site #10 both slightly exceeded the WWH target score of 60. Although habitat scores suggest Nine-Mile Creek could support a healthy warmwater fish community, water quality exceedances combined with the unstable

nature of the substrate at all sampling locations have led to non-attainment for fish and macroinvertebrates.

It is anticipated that the water quality and biological scores on Nine-Mile Creek will improve once construction is complete and the TDPS, DIERS and DST are fully operational. Wet weather flow relief in the collection system, as well as a reduction of overflows as a result of these projects may help to improve the biological community and water quality of Nine-Mile Creek. Further sampling will determine the effectiveness of the projects and any improvement in water quality, habitat and biological communities.

Acknowledgments

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

Jonathan Brauer, Author
Kristina Granlund
Seth Hothem
Ron Maichle
Jill Novak
Francisco Rivera
John Rhoades
Tom Zablotny

Analytical Services Division – Completed analysis for all water chemistry sampling

References

DeShon, J.E. (1995). Development and Application of the Invertebrate Community Index (ICI). In: Davis and Simon, editors. Biological assessment and criteria, tools for water resource planning and decision making. Boca Raton, FL: Lewis Publishers; 1995. p 217-43.

Jones, C., Palmer, R.M., Motkaluk, S., & Walters, M. (2002). *Watershed health monitoring: Emerging technologies*. Boca Raton, FL: Lewis Publishers.

Karr, J.R. (1981). Assessment of biotic integrity using fish communities. *Fisheries, 6*, 21-27.

LeJeune, K., Podrabsky, T., Lipton, J., Cacela, D., Maest, A., & Beltman, D. (2000). Report of Injury Assessment and Injury Determination: Coeur D'Alene Basin Natural Resource Damage Assessment. Prepared for United States Department of the Interior, Fish and Wildlife Service, United States Department of Agriculture, Forest Service and Coeur D'Alene Tribe. Boulder, CO: Stratus Consulting Incorporated.

National Park Service (NPS). (1997). Environmental Contaminants Encyclopedia, Cadmium Entry. Fort Collins, CO: Water Resources Divisions, Water Operations Branch.

Ohio Environmental Protection Agency (OEPA). (1987b, updated September 1989; March 2001; November 2006; and August 2008). *Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities.* Columbus, Ohio: Division of Water Quality Monitoring and Assessment.

Ohio Environmental Protection Agency (OEPA). (1999). Biological and Water Quality Study of the Cuyahoga River and Selected Tributaries Volume 1. Columbus, Ohio: Division of Surface Water. Ohio EPA Technical Report MAS/1997-12-4.

Ohio Environmental Protection Agency (OEPA). (2006). *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI).* Columbus, Ohio: Division of Surface Water; Division of Ecological Assessment Section. Ohio EPA Technical Bulletin EAS/2006-06-1.

Ohio Environmental Protection Agency (OEPA). (2009a). *Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices.* Columbus, Ohio: Division of Surface Water.

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

Rankin, E. T. (1989). *The Qualitative Habitat Evaluation Index (QHEI): rationale, methods, and application*. Columbus, Ohio: Ohio EPA, Division of Surface Water.

Trautman, M.B. (1981). The fishes of Ohio. Columbus, OH: The Ohio State University Press in collaboration with the Ohio Sea Grant Program Center for Lake Erie Area Research.