# NORTHEAST OHIO REGIONAL SEWER DISTRICT

## 2013 Mill Creek Environmental Monitoring: Biological, Water Quality, and Habitat Survey Results

Photo: 2013 Sample Collection Site for Mill Creek River Mile 2.75 (looking downstream)

**Prepared by**
**The Water Quality and Industrial Surveillance Division**

## Introduction

In 2013, the Northeast Ohio Regional Sewer District (NEORSD) conducted stream monitoring activities at seven sites on Mill Creek, an urbanized tributary to the Cuyahoga River. NEORSD assessed habitat and water chemistry conditions and evaluated the health of the fish and benthic macroinvertebrate communities at each site. The purpose of the 2013 monitoring was to gain an overall picture of the health of the creek and evaluate potential impacts. The seven sites, which are along Mill Creek's Main Branch, were located at river miles (RM) 10.13, 8.30, 6.80, 3.15, 2.75, 0.70, and 0.12. Mill Creek has a natural waterfall preventing the upstream migration of fish at RM 2.80. The waterfall drops approximately 48-feet from the top to the bottom. These sites were first surveyed in 1995 as part of the Mill Creek Watershed Management Project, and were all surveyed again in 2011, 2012 and 2013.

The 2013 survey sites were in support of several NEORSD capital improvement projects designed to provide wet-weather flow relief, stormwater storage capacity, and reduction/elimination of CSOs for several communities in the Mill Creek watershed. The Miles Avenue Relief Sewer (MARS) and the Lee Road Relief Sewer (LRRS) were completed in May 2012. The LRRS connects to the Mill Creek Tunnel, the third and final leg of which was completed in February 2013. In addition, NEORSD completed a bank stabilization project on Mill Creek near Warner Road (RM 0.30) in April 2013. The watershed monitoring surveys will assist in evaluating improvements in the health of Mill Creek as a result of these projects.

Stream monitoring activities were conducted at each site by NEORSD Level 3 Qualified Data Collectors certified by Ohio EPA in Fish Community Biology, Benthic Macroinvertebrate Biology, Chemical Water Quality, and Stream Habitat Assessment as explained in the NEORSD Study Plan *2013 Mill Creek Environmental Monitoring*, approved by Ohio EPA on July 10, 2013. The results obtained from these assessments were evaluated using the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI), Index of Biotic Integrity (IBI), and Invertebrate Community Index (ICI). Water chemistry data was validated per the methods outlined by the Ohio EPA (2013) and compared to the Ohio Water Quality Standards (Ohio EPA, 2011) to determine attainment of applicable uses. An examination of the biological information was used in conjunction with the water quality data and QHEI results in order to assess the health of the stream, and the results were compared to historical data to show temporal as well as spatial trends.

Figure 1 is a map of the sampling locations on Mill Creek, and Table 1 lists the sampling locations and their respective river mile, latitude/longitude, site description, and surveys conducted. A digital photo catalog of the sampling locations is available upon request by contacting the NEORSD Water Quality and Industrial Surveillance (WQIS) Division.

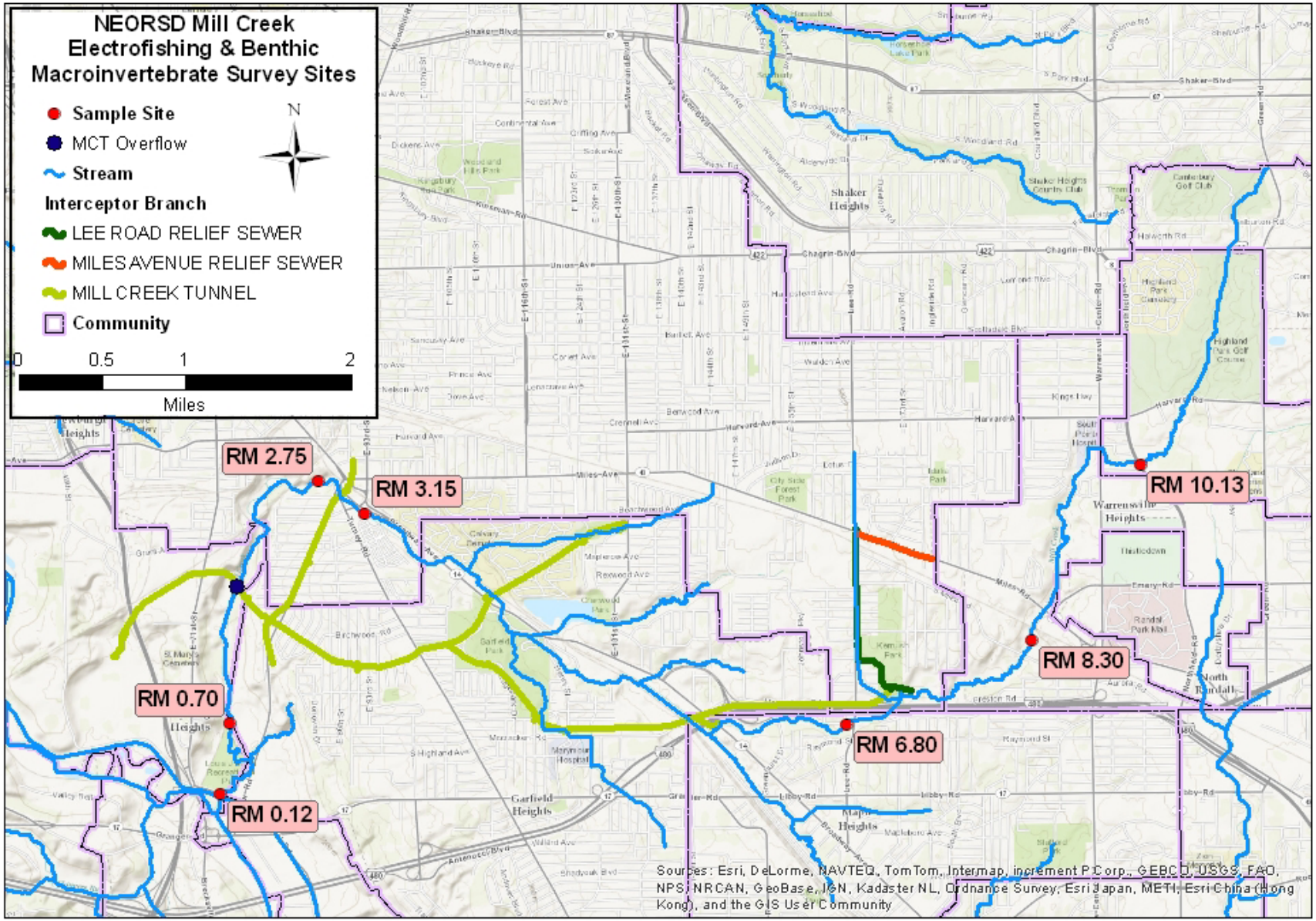



Figure 1. Sampling Locations

Table 1. 2012 Mill Creek Sampling Locations

| Location | Latitude | Longitude | River Mile | Location Information | Purpose[1] |
|---|---|---|---|---|---|
| Northfield Road | 41.4460 | -81.5312 | 10.13 | Northfield Road | Evaluate overall watershed health, monitor in support of Capital Improvement projects |
| Upstream of South Miles Road | 41.4305 | -81.5442 | 8.30 | Upstream of South Miles Road, upstream of Kerruish Park stormwater basin, first site upstream of NEORSD CSOs | Upstream of NEORSD CSOs, evaluate overall watershed health, monitor in support of Capital Improvement projects |
| Rex Avenue | 41.4233 | -81.5659 | 6.80 | Rex Avenue, upstream of Wolf Creek, downstream of Kerruish Park stormwater basin | Evaluate overall watershed health, monitor in support of Capital Improvement projects |
| Upstream of Mill Creek Falls | 41.4422 | -81.6216 | 3.15 | Broadway Avenue, upstream of Mill Creek Falls and downstream of Wolf Creek | Evaluate overall watershed health, monitor in support of Capital Improvement projects |
| Downstream of Mill Creek Falls | 41.4451 | -81.6271 | 2.75 | Downstream of the Mill Creek Falls | Evaluate overall watershed health, monitor in support of Capital Improvement projects |
| Upstream of Warner Road Tributary | 41.4240 | -81.6376 | 0.70 | Upstream of the Warner Road Tributary, adjacent to 5000 Warner Road | Evaluate overall watershed health, monitor in support of Capital Improvement projects |
| Upstream of Canal Road | 41.4178 | -81.6387 | 0.12 | Upstream of Canal Road | Evaluate overall watershed health, monitor in support of Capital Improvement projects. Site required by Ohio EPA NPDES Permit No. 3PA00002*FD[2] |

[1] Water Chemistry, habitat, fish, and benthic macroinvertebrates were evaluated at each site.
[2] Water chemistry and benthic macroinvertebrate monitoring was required at RM 0.12 by Ohio EPA NPDES Permit No. 3PA00002*FD.

## Water Chemistry Sampling

### Methods

Water chemistry and bacteriological sampling was conducted five times on Mill Creek at RMs 10.13, 8.30, 6.80, 3.15, 2.75, 0.70, and 0.12. To fulfill permit requirements under Ohio EPA NPDES Permit Number 3PA00002*FD, a sixth sample was collected at RM 0.12 on July 23, 2013. Techniques used for sampling and analyses followed the Ohio EPA *Surface Water Field Sampling Manual* (2013). Chemical water quality samples from each site were collected with a 4-liter disposable polyethylene cubitainer with a disposable polypropylene lid, three 473-mL plastic bottles and a 125-mL plastic

bottle. The first 473-mL plastic bottle was field preserved with trace nitric acid, the second was field preserved with trace sulfuric acid and the third bottle received no preservative. The sample collected in the 125-mL plastic bottle (Dissolved Reactive Phosphorus) was filtered using a 0.45-µm PVDF syringe filter. All water quality samples were collected as grab samples. Bacteriological samples were collected in sterilized plastic bottles preserved with sodium thiosulfate. At the time of sampling, measurements for dissolved oxygen, pH, temperature, and conductivity were collected using an YSI 600XL sonde. Duplicate samples and field blanks were each collected at randomly selected sites, at a frequency not less than 5% of the total samples collected. Relative percent difference (RPD) was used to determine the degree of discrepancy between the primary and duplicate sample (Formula 1).

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

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

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

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 Mill Creek was 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 typically found in the creek.

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

## Results and Discussion

Two field blanks and two duplicate samples were collected during this study. For the field blanks, there were four parameters that showed possible contamination. It is

unclear how the field blanks became contaminated and may have been the result of inappropriate sample collection, handling, and/or contaminated blank water. Table 2 lists water quality parameters that were rejected or listed as estimated based on Ohio EPA data validation protocol. It should be noted that not all seven sites were collected by the same sampling crew each event; two groups were sometimes utilized in order to more efficiently complete the water chemistry sampling. Field blanks were only compared to samples collected by the same crew on the same day for a single study plan.

| Table 2. Data Qualified Based on Applicable Field Blank Comparison | | | | | |
|---|---|---|---|---|---|
| RM | Date | Parameter | Sample Result | Field Blank Result | Qualifier |
| 0.12 | 06/25/13 | Chromium | j0.725 | j0.26 | Reject |
| 0.12 | 07/09/13 | Antimony | j0.692 | j0.09 | Estimated |
| 0.70 | 06/25/13 | Chromium | j0.7515 | j0.26 | Reject |
| 0.70 | 07/09/13 | Antimony | j0.665 | j0.09 | Estimated |

Only one of the two duplicate samples collected had parameters in which the RPD between the sample results was greater than acceptable (Table 3). The exact reasons for the discrepancies remain unknown. Potential sources include lack of precision and consistency in sample collection and/or analytical procedures, environmental heterogeneity and/or improper handling of samples.

| Table 3. Duplicate samples with greater than acceptable RPDs | | | |
|---|---|---|---|
| RM | Date | Parameters | Qualifier |
| 6.80 | 06/25/13 | Chemical Oxygen Demand | Reject |
| 6.80 | 06/25/13 | Ammonia | Reject |

An analysis of paired parameters for all sites showed only issues with samples listed in Table 4. The only parameters qualified by the comparison were the result of the total dissolved solid (TDS) being greater than the total solids (TS). The reason for the TDS being greater is unknown, but may be due to the fact that there are two separate methods for analyzing the individual parameters.

| Table 4. Pair Parameters with greater than acceptable RPDs | | | |
|---|---|---|---|
| RM | Date | Parameters | Qualifier |
| 0.70 | 06/18/13 | TS/TDS | Estimated |
| 0.70 | 06/25/13 | TS/TDS | Estimated |
| 2.75 | 06/25/13 | TS/TDS | Estimated |
| 3.15 | 06/25/13 | TS/TDS | Estimated |

Each of the seven sites on Mill Creek are designated as warmwater habitat (WWH), agricultural water supply, industrial water supply, and Class B primary contact recreation waters. Exceedances of the water quality standards associated with these uses occurred for only bacteria. The bacteriological criteria for *E. coli* consist 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). For those streams designated Class B primary contact recreation, these criteria are 161 colony-forming units (CFU)/100mL and 523 CFU/100mL, respectively. The seasonal geometric mean criterion was exceeded at all seven sites (Table 5). The single sample maximum criterion was also exceeded in the majority of the 30-day periods that contained multiple samples at all of the sites. Wet weather[1] sampling events coincided with many of the elevated bacterial levels found during sampling.

Table 5. 2013 Mill Creek *E. coli* Densities (colony-forming units/100mL)

| Date | RM 10.13 | RM 8.30 | RM 6.80 | RM 3.15 | RM 2.75 | RM 0.70 | RM 0.12 |
|---|---|---|---|---|---|---|---|
| 06/18/13 | 265 | 175 | 375 | 2333 | 205 | 300 | 252 |
| 06/25/13* | 380 | 225 | EC 600 | 1600 | 280 | 165 | 185 |
| 07/02/13* | 100 | EC 82 | 340 | EC 417 | 395 | EC 574 | EC 891 |
| 07/09/13* | EC 633 | EC 691 | EC 1248 | EC 1126 | EC 1213 | EC 1196 | EC 1328 |
| 07/16/13 | 316 | 6400 | 170 | EC 408 | 3600 | 620 | 245 |
| 07/23/13* | -- | -- | -- | -- | -- | -- | 520 |
| Seasonal Geomean | 289.0 | 427.5 | 438.6 | 935.1 | 629.7 | 462.1 | 437.6 |

*Wet weather event
--- No sample collected
EC = Estimated Count

Mercury analysis for all of the sampling events was performed using EPA Method 245.1. The detection limit for this mercury method is above the Human Health Nondrinking Water and Protection of Wildlife Outside Mixing Zone Averages (OMZA), so it generally cannot be determined if the water body was in attainment of those criteria. Instead, this type of mercury sampling was used as a screening tool to determine whether contamination was present above the detection limit. Each site had at least one mercury result above the method detection limit (MDL). However, no site had more than two samples above the MDL and no samples were recorded above the practical quantitation limit.

In 2013, the Ohio EPA released a draft Trophic Index Criterion (TIC) designed to determine a water body's condition relative to nutrient enrichment. According to the draft document, the index identifies and ranks the following items: nutrients; periphyton; dissolved oxygen swings; and the biological communities (Ohio EPA, 2013d). NEORSD did not look at periphyton densities or dissolved oxygen swings during this study, but did measure nutrient values. The nutrient targets are assigned based on the water body's

[1]NEORSD considers a sampling event to be affected by wet weather, when: greater than 0.10 inches of rain but less than 0.25 inches, samples collected that day and the following day are considered wet weather samples; greater than 0.25 inches, the samples collected that day and the following two days are considered wet weather samples.

designated aquatic life use and its Qualitative Habitat Evaluation Index (QHEI) score. Warmwater habitat sites fall into two categories and the TIC suggests target values for both total phosphorus (TP) and dissolved inorganic nitrogen (DIN), which includes ammonia, nitrate and nitrite. The first category reflects sites with QHEI scores between 12 and 64 and sets target values of 0.13 milligram per liter (mg/L) for TP and 3.0 mg/L for DIN. The second category reflects all other QHEI scores and has target values for TP and DIN of 0.30 mg/L and 3.0 mg/L, respectively. Other parameters that are important for nutrient assessment are dissolved reactive phosphorus (DRP) and total Kjeldahl nitrogen (TKN); the results for the nutrient averages can be found in Table 6. In terms of bioavailability, DRP is the most readily available form of phosphorus, whereas TKN is a fraction of total nitrogen that remains unavailable. Only the average TP target for RM 6.80 was not met during the 2013 sampling. However, as shown below in the Habitat Assessment Section, the QHEI score was close to being in the second category and the site would have easily met the target if it was.

Table 6. 2013 Mill Creek Average Nutrient Concentrations (mg/L)

| | RM 10.13 | RM 8.30 | RM 6.80 | RM 3.15 | RM 2.75 | RM 0.70 | RM 0.12 |
|---|---|---|---|---|---|---|---|
| Category | 2 | 2 | 1 | 1 | 2 | 2 | 2 |
| TP | 0.074 | 0.096 | 0.177 | 0.116 | 0.104 | 0.074 | 0.067 |
| DRP | 0.036 | 0.037 | 0.131 | 0.078 | 0.068 | 0.027 | 0.107 |
| DIN | 0.456 | 0.491 | 0.755 | 0.797 | 0.721 | 1.73 | 1.47 |
| TKN | 0.657 | 0.618 | 0.668 | 0.582 | 0.594 | 1.29 | 0.782 |
| | Shading reflects that the average value met the target for that site | | | | | | |

## Habitat Assessment

### Methods

Instream habitat assessments were conducted once at each site on Mill Creek in 2013 using the 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 55 or more suggests that sufficient habitat exists to support a fish community that attains the warmwater habitat criterion (Ohio EPA, 2006). A more detailed description of the QHEI can be found in Ohio EPA's *Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI)* (2006). QHEI field sheets for each site are available upon request from the NEORSD WQIS Division.

## Results and Discussion

The QHEI scores for each of the sites are shown in Table 7. A natural waterfall is located just upstream of RM 2.75. The waterfall prevents the natural passage of fish migration upstream. The evaluation of the QHEI does, however, suggest that the current habitat could support a warmwater fish community for all sites both historically and presently, as they all met the target of 55 (Jeff DeShon and Dennis Mischne, personal communication, April 16, 2014), as seen in Table 7.

Table 7. Mill Creek QHEI scores

| Year | RM 10.13 | RM 8.30 | RM 6.80 | RM 3.15 | Mill Creek Falls | RM 2.75 | RM 0.70 | RM 0.12 |
|---|---|---|---|---|---|---|---|---|
| 1995 | 78.00 | 74.00 | 62.25 | 70.25 | | 69.50 | 70.50 | 72.00 |
| 2011 | 81.75 | 71.50 | 61.00 | 63.00 | | 74.25 | 69.75 | 68.00 |
| 2012 | 73.00 | 72.00 | 63.50 | 63.00 | | 73.25 | 72.50 | 64.75 |
| 2013 | 70.25 | 72.00 | 63.50 | 60.50 | | 78.00 | 66.00 | 64.50 |

There were areas within the fish zones at both RMs 10.13 and 0.70 that showed considerable erosion. At RM 10.13, the alluvial gravel substrate had been removed from the majority of the lower fish zone and the exposed hardpan was evident. In addition, the stream is starting to take out a hill that protects a stormwater dry basin. From changes at RM 0.70 and potentially several significant rain events, a large amount of material has been deposited on a gravel bar on river left at the site, see Figure 2. This deposition of material is forcing the creek to erode the bank on river right, which is also creating a large deep pool in the area.

Table 8 lists attributes defined by the Ohio EPA, as interpreted by NEORSD, which have both positive and negative influences on the fish community. It should be noticed that the sites that received a narrative rating of Excellent (or a score above 70 [Ohio EPA, 2006]) 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. Please note that the habitat rating is to help determine if the habitat can support a fish community and does not necessarily reflect what type of community is actually found at the site.

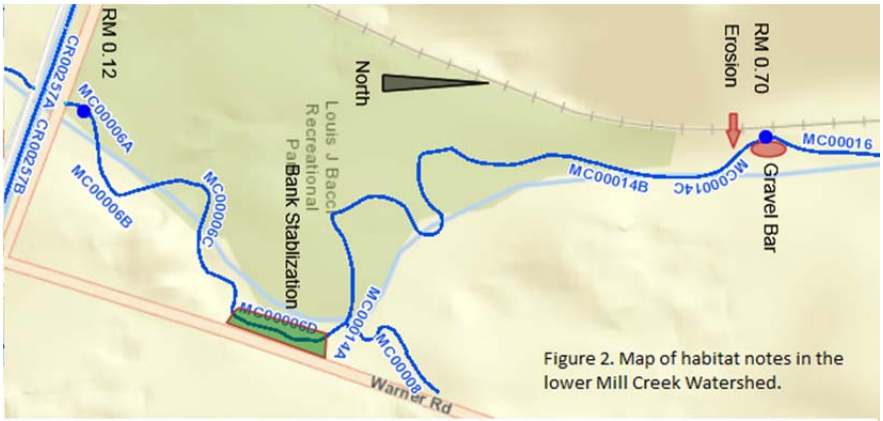


Figure 2. Map of habitat notes in the lower Mill Creek Watershed.

**Table 8. Qualitative Habitat Evaluation Index Physical Attributes Summary**

| | | Warmwater Attributes | | | | | | | | | | | Modified Warmwater Attributes | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | High Influence | | | | | | Moderate Influence | | | | | | | | | | | | | |
| River Mile | QHEI Score | Dominate Substrates: Boulder, Cobble and/or Gravel | Overall Substrate, Silt: Free | Overall Embeddedness: None or Normal | In-stream Cover Amount: Extensive or Moderate | Channel Sinuosity: Moderate or High | Channel Development: Excellent or Good | Channelization: None or Recovered | Maximum Site Depth greater than 40 cm | Current Velocity: Fast Current and Eddies | Riffle and Run Embeddedness: None or Low | **Total Positive Attributes** | Dominate Substrates: Silt and/or Muck | In-stream Cover Amount: Sparse or Nearly Absent | Channel Sinuosity: None | Channelization: Recent or No Recovery | Maximum Site Depth less than 40 cm | **Negative High Influence Attributes** | Dominate Substrate, Boat Sites Only: Sand | Substrate Origin: Hardpan | Overall Substrate, Silt: Heavy or Moderate | Overall Embeddedness: Moderate or Extensive | In-stream Cover Types: Only 1 or 2 Indicated | Channel Sinuosity: Low | Channel Development: Fair or Poor | Channelization: Recovering | Pool Width and Current Velocity: Less than or equal to Riffle Width and Intermittent, Respectively | Current Velocity: No Fast Current | Riffle Embeddedness: Moderate or Extensive | No Functional Riffle Indicated at the Site | **Negative Moderate Influence Attributes** | **Total Negative Influence Attributes** |
| 10.13 | 70.25 | | | | X | X | | X | X | | | 4 | | | | | | 0 | | X | | | | | X | | | X | X | | 4 | 4 |
| 8.30 | 72.00 | | | | X | X | X | X | X | | | 5 | | | | | | 0 | | | X | X | | | | | | | X | | 3 | 3 |
| 6.80 | 63.50 | X | | | | | | X | X | | | 3 | | X | | | | 1 | | | X | X | | X | X | | | | X | | 5 | 6 |
| 3.15 | 60.50 | | | | | | | X | X | | | 2 | | X | X | | | 2 | | | X | X | | | X | | | X | X | | 5 | 7 |
| 2.75 | 78.00 | | | X | X | | | X | X | | X | 5 | | | | | | 0 | | | | | | X | | | | | | | 1 | 1 |
| 0.70 | 66.00 | | | | X | X | | | X | | | 3 | | | | X | | 1 | | | X | X | | | | | | | X | | 3 | 4 |
| 0.12 | 64.50 | | | | | X | X | X | X | | | 4 | | X | | | | 1 | | | X | X | | | | | | | X | | 3 | 4 |

## Electrofishing

### Methods

One quantitative electrofishing passes was conducted at each site in 2013. A list of the dates when the surveys were completed, along with flow as measured at the United States Geological Survey gage station in Garfield Heights, is given in Table 9. Sampling was conducted using longline or backpack 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 each site. 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 and examined for the presence of anomalies, including DELTs (deformities, eroded fins, lesions, and tumors). All fish were then released to the waters from which they were collected, except for vouchers and those that could not be easily identified in the field.

Table 9. Sampling Dates and River Flows**

| Date | Sites sampled (RMs) | Daily Mean Flow (CFS*) | Method |
|---|---|---|---|
| 07/18/2013 | 0.12, 10.13 | 9.1 | Longline, Backpack Electrofishing (respectively) |
| 07/19/2013 | 0.70 | 8.8 | Longline Electrofishing |
| 07/24/2013 | 8.30 | 18.0 | Backpack Electrofishing |
| 08/13/2013 | 3.15, 6.80 | 8.2 | Backpack Electrofishing |
| 08/15/2013 | 2.75 | 8.1 | Backpack Electrofishing |
| From June 15 to October 15, 2013 Median Flow was 8.7 CFS | | | |

*Provisional data
**Measured at USGS 04208460 Mill Creek flow gauge in Garfield Heights, Ohio. (USGS, 2014)

The electrofishing results for each pass were compiled and utilized to evaluate fish community health through the application of the Ohio EPA Index of Biotic Integrity (IBI). 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 headwater sites are listed in Table 10.

| Table 10. 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 |
| Percent DELT Anomalies |
| Number of Fish |

Lists of the species, numbers, pollution tolerances and incidence of DELT anomalies for fish collected during the electrofishing passes at each site are available upon request from the NEORSD WQIS Division.

**Results and Discussion**

The WWH IBI criterion in the Erie-Ontario Lake Plain (EOLP) ecoregion is 40 for headwater sites. A site is considered in non-significant departure if it is within 4 IBI units of the criterion. Therefore, an IBI score of 36 is considered to be in attainment. The three most downstream sites were in attainment of this criterion, while the other ones failed to meet it (Table 11). Generally, no significant changes in IBI scores have occurred at the four most upstream sites since the first time that NEORSD surveyed the sites, see Table 12. For the other three sites, however, there has been an overall increase in scores. Additional sampling was completed at both RMs 0.12 and 8.30 between the watershed surveys, and those scores can be found in Figure 3.

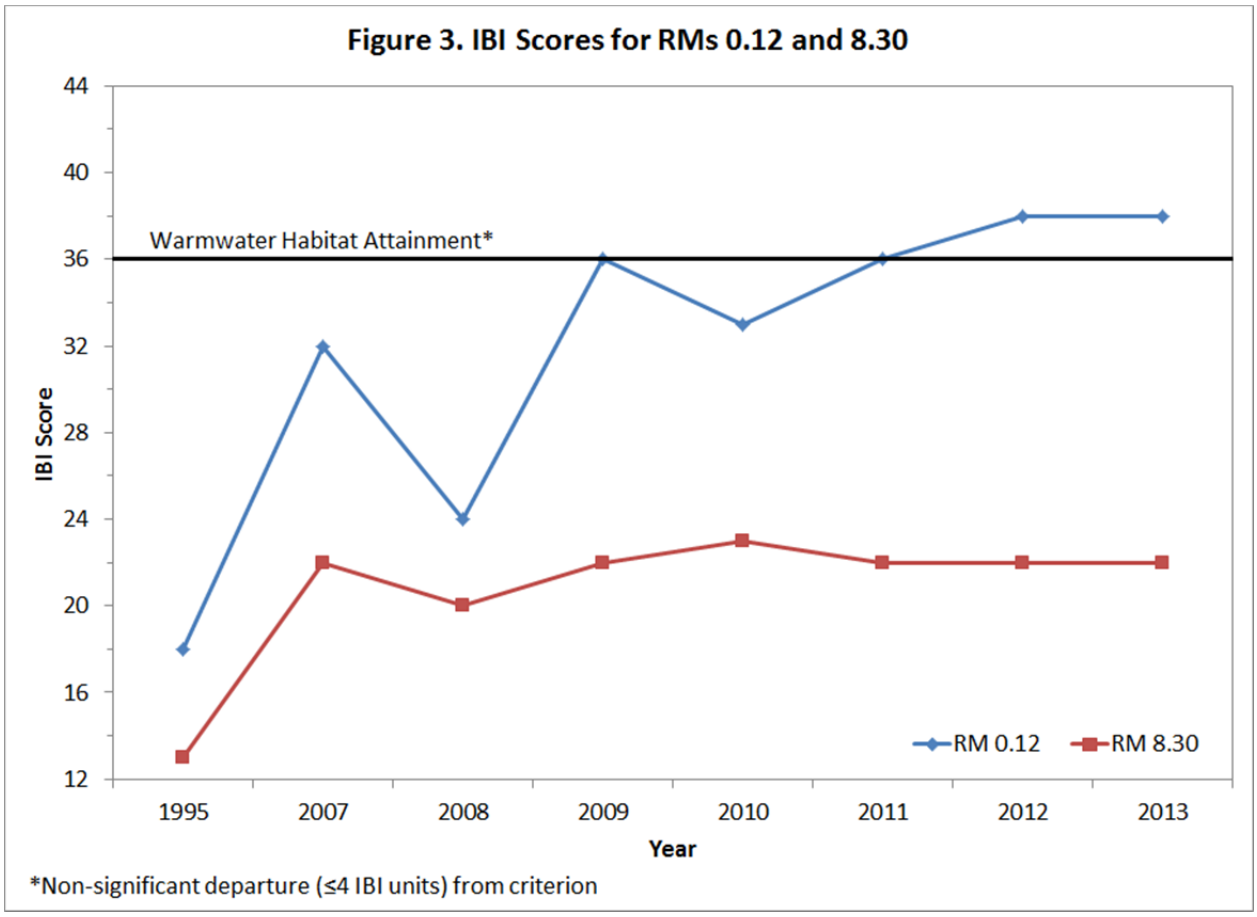
| Table 11. 2013 Mill Creek IBI Results | | | | | | |
|---|---|---|---|---|---|---|
| River Mile | IBI Score | Narrative Rating | Total No. of Species | No. of Native Species | % Tolerant Species | No. of fish collected |
| 10.13 | 22 | Poor | 4 | 3 | 98.4 | 61 |
| 8.30 | 22 | Poor | 2 | 2 | 100 | 227 |
| 6.80 | 22 | Poor | 2 | 2 | 100 | 125 |
| 3.15 | 18 | Poor | 3 | 2 | 100 | 307 |
| Mill Creek Falls | | | | | | |
| 2.75 | 38 | Marginally Good | 9 | 9 | 41.3 | 588 |
| 0.70 | 36 | Marginally Good | 16 | 15 | 32.7 | 761 |
| 0.12 | 38 | Marginally Good | 17 | 16 | 37.0 | 316 |
| WWH Criterion = 40 IBI units<br>Non-significant departure from WWH criterion = 36 IBI units | | | | | | |

| Table 12. Select Mill Creek Historic IBI scores (multiple scores are averaged) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | RM 10.13 | RM 8.30 | RM 6.80 | RM 3.15 | RM 2.75 | RM 0.70 | RM 0.12 |
| 1995 | 17 | 13 | 16 | 12 | 19 | 19 | 18 |
| 2011 | 20 | 22 | 22 | 23 | 31 | 36 | 36 |
| 2012 | 20 | 22 | 22 | 20 | 30 | 38 | 38 |
| 2013 | 22 | 22 | 22 | 18 | 38 | 36 | 38 |
| WWH Criterion = 40 IBI units<br>Non-significant departure from WWH criterion = 36 IBI units | | | | | | | |

As reflected above, the Mill Creek Falls plays a significant role in fish passage that could potentially improve scoring at the upstream sites. The sites below the falls had a far lesser percentage of tolerant species, greater number of fish species and an increase in the total number of fish collected. The removal of the log jam and railroad bridge (just prior to 2012 sampling) at RM 0.70 may have accounted for the significant increase seen in the scoring at RM 2.75. Upstream of the falls, the sites had only tolerant fish species, half of the sites had *Carassius auratus* (goldfish), and all of the sites had at least 96% of the highly tolerant species *Rhinicthvs atratulus* (western blacknose dace) and *Semotilus atromaculatus* (creek chub).

At the sites downstream of the falls, the fish community appeared healthier. For the two most downstream sites, 2013 was the third year in a row and the first year for RM 2.75 in which the IBI criterion was met. Reductions in combined and sanitary sewage, removal of the log jam and habitat stabilization may have allowed a greater number of migrating fish from the Cuyahoga River to move into and up the creek. A lack of darter and headwater species indicates, though, that there may still be some water quality issues

remaining in the creek as these species are typically found in areas with low environmental stress (Ohio EPA, 1987b).




## Macroinvertebrate Sampling

### Methods

Macroinvertebrates were sampled quantitatively using modified Hester-Dendy (HD) samplers in conjunction with a qualitative assessment of Ephemeroptera (mayfly), Plecoptera (stonefly) and Trichoptera (caddisfly), also referred to as EPT taxa, inhabiting available habitats at the time of HD retrieval. Sampling was conducted at all of the locations listed in 1. Methods for sampling followed the Ohio EPA's Biological Criteria for the Protection of Aquatic Life, Volume III (1987b). The recommended period for HDs to be installed is six weeks.

The macroinvertebrate samples were sent to Third Rock Consulting (TRC) of Lexington, Kentucky, for identification and enumeration. Specimens were identified to the lowest practical taxonomic level as defined by the Ohio EPA (1987b). Lists of the

species collected during the quantitative and qualitative sampling at each site are available upon request from the NEORSD WQIS Division.

The overall aquatic macroinvertebrate community in the stream was evaluated using Ohio EPA's Invertebrate Community Index (ICI) (OEPA, 1987a, 2013). The ICI consists of ten community metrics (Table 13), 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.

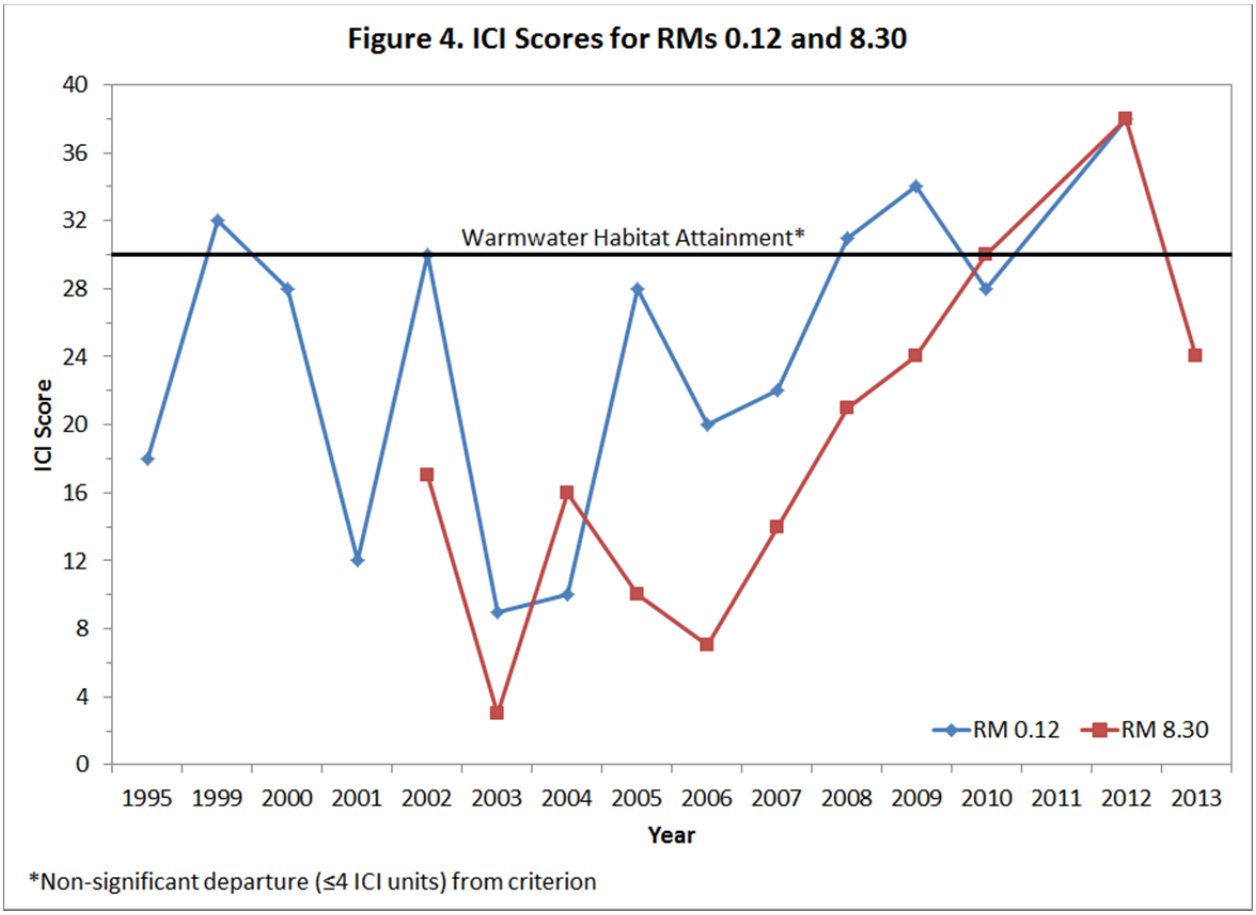
| Table 13. ICI Metrics | |
|---|---|
| 1. | The total number of taxa on HD. |
| 2. | Total number of Ephemeroptera taxa on HD. |
| 3. | Total number of Trichoptera taxa on HD. |
| 4. | Total number of Dipteran taxa on HD. |
| 5. | Percent of Ephemeroptera in HD sample. |
| 6. | Percent Trichoptera in 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 WWH ICI criterion in the EOLP ecoregion is 34. A site is considered in non-significant departure if it is within 4 ICI units of the criterion and therefore would also be in attainment. None of the sites met the narrative rating of *Marginally Good* or were in attainment for the benthic macroinvertebrate criterion (Table 14). Table 15 shows the historic ICI scores and narrative rating, when the HDs could be found. Additional sampling was completed at both RMs 0.12 and 8.30 between the watershed surveys, and those scores can be found in Figure 4.

| Table 14. 2013 Macroinvertebrate Results | | | | | | | |
|---|---|---|---|---|---|---|---|
| River Mile | ICI Score | Narrative Rating | Total Number of Taxa | Number of Qualitative Taxa | Number of Qualitative EPT Taxa | Number of Qualitative Sensitive Taxa | Density (Organisms per square foot) |
| 10.13 | 28 | *Fair* | 33 | 21 | 5 | 1 | 333.2 |
| 8.30 | 24 | *Fair* | 29 | 19 | 2 | 0 | 407.4 |
| 6.80 | 28 | *Fair* | 32 | 25 | 3 | 2 | 241.6 |
| 3.15 | 26 | *Fair* | 41 | 28 | 3 | 0 | 144.6 |
| 2.75 | -- | *Fair* | n/a | 23 | 4 | 0 | n/a |
| 0.70 | -- | *Fair* | n/a | 28 | 7 | 1 | n/a |
| 0.12 | -- | *Fair* | n/a | 33 | 5 | 3 | n/a |
| WWH criterion is ≥ 34 ICI units<br>Non-significant departure from WWH criterion is ≥30 ICI units | | | | | | | |

| Table 15. Mill Creek Historic ICI scores or Narrative ratings | | | | | | | |
|---|---|---|---|---|---|---|---|
| Year | RM 10.13 | RM 8.30 | RM 6.80 | RM 3.15 | RM 2.75 | RM 0.70 | RM 0.12 |
| 1995 | 22 | --- | --- | --- | 38 | 20 | 18 |
| 2011 | 32 | *Fair* | *Poor* | *Poor* | 40 | 34 | *Fair* |
| 2012 | 36 | 38 | 30 | 34 | 40 | 36 | 38 |
| 2013 | 28 | 24 | 28 | 26 | *Fair* | *Fair* | *Fair* |
| WWH criterion is ≥ 34 ICI units<br>Non-significant departure from WWH criterion is ≥30 ICI units<br>--- No ICI score or narrative rating available | | | | | | | |




There was a significant change in the macroinvertebrate scores at all sampling locations, except RM 6.80, in 2013. All of the sites went from attainment to non-attainment. The ICI score at RM 6.80 only decreased from 30 to 28, but this was still enough to change the site status to non-attainment.

No HDs were collected downstream of the Mill Creek Falls in 2013, as they were all missing during planned retrievals. Assigning a narrative rating based on best professional judgment was very difficult for these sites, especially for RM 0.12. The qualitative samples collected from RM 0.12 in 2012 and 2013 were almost identical. Mill Creek was in attainment at RM 0.12 in 2012, due mostly to the community composition and makeup on the HD and not the organisms found in the qualitative sample. By not having an HD for additional information, the 2013 qualitative sample at RM 0.12 by itself was assigned a *Fair* narrative rating based on the following factors: EPT taxa, tolerant taxa (total 9), sensitive taxa, field narrative rating (*Poor*), predominant organisms (midges), density (low for all habitats) and diversity (low for all habitats). Using the same evaluation process for both RM 0.70 and 2.75, a narrative rating of *Fair* was assigned to both sites. Some argument could be made to further lower the narrative

rating at RM 2.75 to a *Poor* rating; however in light of the total EPT taxa collected, it was decided that the site should score the higher of the two ratings.

The reason for the significant decline in the benthic macroinvertebrate community throughout the entire watershed in 2013 is not understood. Weather could be one possible explanation for why this happened. There were three storms that had more than one inch of precipitation during a single 24-hour period (NEORSD Southerly WWTC rain gauge information) spread evenly throughout the period in which the HDs were installed. These storms could have resulted in a scouring of the bugs from the creek, which may not have recovered prior to collection of the HDs and qualitative samples.

## Conclusions

The Mill Creek watershed was evaluated in 2013 to continue documentation on the health of the watershed as several capital improvement projects have been recently completed on the stream. Biological surveys of fish and macroinvertebrate showed there may still be some impact to those communities, see Table 16. Exceedances of the bacteriological criteria indicate the presence of combined and sanitary sewage within the creek that could be one source of impairment. Severe erosion problems were also an issue at two of the sites in the watershed.

Mill Creek Falls may be the greatest factor preventing establishment of a healthy fish community in the upper section of the river, as the available habitat should be capable of supporting one. It is not understood as to the reason for the great decline in the macroinvertebrate community in 2013, but may have been a function of the large storm events spread evenly over the colonization period. These sites will be monitored in 2014 to determine if there is a continued decline in the macroinvertebrate community or if some other factor caused a temporary dip in scores.

| Table 16. 2013 Mill Creek Survey Results. | | | | | |
|---|---|---|---|---|---|
| River Mile | Aquatic Life Use Attainment Status | IBI Score (Narrative Rating) | ICI Score (Narrative Rating) | Habitat (Narrative Rating) | Water Quality Exceedences |
| 10.13 | NON | 22 *Poor* | 28 *Fair* | 70.25 *Excellent* | *E. coli* |
| 8.30 | NON | 22 *Poor* | 24 *Fair* | 72.00 *Excellent* | *E. coli* |
| 6.80 | NON | 22 *Poor* | 28 *Fair* | 63.50 *Good* | *E. coli* |
| 3.15 | NON | 18 *Poor* | 26 *Fair* | 60.50 *Good* | *E. coli* |
| 2.75 | PARTIAL | 38 *Marginally Good* | *Fair* | 78.00 *Excellent* | *E. coli* |
| 0.70 | PARTIAL | 36 *Marginally Good* | *Fair* | 66.00 *Good* | *E. coli* |
| 0.12 | PARTIAL | 38 *Marginally Good* | *Fair* | 64.50 *Good* | *E. coli* |
| Warmwater Habitat Criteria | | 40 | 34 | | |
| Non-significant Departure from Criteria | | ≤4 | ≤4 | | |
| Target | | | | 55 | |

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