Biological and Water Quality Study of the Aurora Branch Chagrin River, 2012

Aurora Country Club WRRSP Project WR390126-0013
Baseline Report

Portage County

Ohio EPA Technical Report EAS/2012-12-19

Division of Surface Water
Northeast District Office and Ecological Assessment Section
December 31, 2012

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EXECUTIVE SUMMARY

A total of three miles of the Aurora Branch Chagrin River in the vicinity of the Aurora Country Club in Aurora, Ohio (Portage County) was assessed by the Ohio EPA in 2012. The study was undertaken to assess water resource conditions in the Aurora Branch upstream, within, and downstream of the proposed Water Resources Restoration Sponsorship Program (WRRSP) project proposed by the City of Aurora and sponsored by the Northeast Ohio Regional Sewer District (WRRSP Project WR390126-0013). Approximately 1.8 miles of the Aurora Branch flows directly through the Aurora Country Club golf course, spanning the reach from river mile (RM) 13.95 to RM 12.15.

Based on the performance of the biological communities in the river, the site located within the Aurora Country Club was found to be in non-attainment of the Warmwater Habitat (WWH) aquatic life use (Table 1). Both the fish and macroinvertebrate communities at this location were impaired as compared to reference sites in the Erie Ontario Lake Plain (EOLP) ecoregion. The upstream and downstream sites used in the study were both in partial attainment of the WWH aquatic life use. At both locations, the fish communities were found to be impaired while the macroinvertebrate communities were meeting the WWH use.

Aurora Branch Chagrin River within the Aurora Country Club property.

The non-attainment at the Aurora Country Club site was a result of a combination of direct habitat alterations, nutrient enrichment, and sedimentation/siltation. Impairments to the fish community upstream of the Aurora Country Club can be attributed to a combination of downstream habitat modifications resulting in impediments to fish migration as well as nutrient enrichment and sedimentation/siltation resulting from non-point source runoff. Impairments to the fish community downstream of the Aurora Country Club appear to be the result of sedimentation/siltation and nutrient enrichment resulting from non-point source runoff and the upstream habitat alterations.

At the upstream study site located just downstream of the Sunny Lake Outlet and Pioneer Trail Rd., the macroinvertebrate community has improved from a rating of Good to Exceptional since the last Ohio EPA survey conducted in 2003 and 2004. Increases in the number of mayfly (Ephemeroptera), stonefly (Plecoptera) and caddisfly (Trichoptera) taxa (EPT taxa), sensitive taxa, and cold water indicator taxa

observed in the stream are all indicative of improved water quality conditions. This progress has likely resulted from improved water quality in the Sunny Lake Outlet. Restoration efforts were implemented in Sunny Lake to eliminate noxious algae blooms and to restore wetland ecological values in 2008. Although the fish community at this location has also measurably improved since 2003-2004, the Index of Biotic Integrity (IBI) score there remains significantly below the applicable biological water quality criterion, indicating that recovery is not yet complete.

Both the fish and macroinvertebrate communities in the Aurora Branch upstream of the Aurora Central wastewater treatment plant (WWTP) changed little since the last Ohio EPA survey in 2003-2004. Improvements in water quality from the Sunny Lake drainage upstream of the Aurora Country Club likely have minimal effect downstream of the Aurora Country Club because of the profound habitat and flow alterations within the golf course property and the resultant impacts on water quality.

Restoration efforts proposed within the Aurora Country Club will likely have a positive impact on the upstream fish communities through the elimination of migration barriers, especially during summertime low flow conditions. Recovery of the aquatic life community structure within and downstream of the Aurora Country Club property will also very likely result from the proposed stream restoration activities. Re-establishment of a wooded riparian corridor and re-connection of the stream to the adjoining floodplain, in conjunction with direct habitat improvements should result in measurable improvements in water quality, thermal regime, migration connectivity, and sediment transport dynamics in the stream.

RECOMMENDATIONS

The aquatic life use designation of WWH has been confirmed in this study and previous Ohio EPA biological and water quality studies, and should be maintained. Physical habitat conditions and river pool depths verified that the Class B Primary Contact Recreation use as defined in Rule 3745-1-07 of the Ohio Administrative Code is appropriate for the reach of the Aurora Branch included in this study. It is recommended that the Aurora Branch be monitored following the implementation of any stream restoration efforts to document the effects of the project. The recommended monitoring schedule includes repeat sampling of the three sites used in this study in the year following the completion of work and three years following the initial post-project monitoring (years 1 and 4) for habitat quality, fish, and macroinvertebrate community composition using standard Ohio EPA sampling protocols.

ACKNOWLEDGEMENTS

The following individuals are acknowledged for their contribution to this report:

Stream sampling: Paul Anderson, Angela Dripps, Kimberly Olivito, Greg Orr, and Christina Visocky
Data support: Dennis Mishne
Report preparation and analysis: Paul Anderson and Angela Dripps
Reviewers: Bill Zawiski, Holly Tucker, and Jeff DeShon

INTRODUCTION

A three mile section of the Aurora Branch Chagrin River was assessed in 2012 to evaluate the biological and habitat quality of the surface water resources. The study was undertaken to assess water resource conditions in the Aurora Branch Chagrin River upstream, within, and downstream of the proposed Water Resources Restoration Sponsorship Program (WRRSP) project proposed by the City of Aurora and sponsored by the Northeast Ohio Regional Sewer District (WRRSP Project WR390126-0013).

Specific objectives of the evaluation were to:

- assess current biological conditions in the Aurora Branch in the vicinity of the project by evaluating fish and macroinvertebrate communities and habitat quality;
- determine the aquatic life use attainment status of the Aurora Branch with regard to the WWH aquatic life use designation codified in the Ohio Water Quality Standards; and
- to develop data with respect to baseline conditions in the Aurora Branch Chagrin River prior to any stream restoration work conducted in conjunction with the proposed WRRSP project.

The Aurora Branch Chagrin River is located in the Erie-Ontario Lake Plain (EOLP) ecoregion. The Aurora Branch is currently assigned the WWH aquatic life use designation in Rule 3745-1-22 of the Ohio Administrative Code (OAC). The Aurora Branch is also designated as a State Scenic River from State Route 82 at river mile (RM) 17.8 to the mouth (see http://ohiodnr.com/watercraft/sr/tabid/2556/Default.aspx) and as an Outstanding State Water based upon ecological values in OAC 3745-1-05. The Aurora Branch Chagrin River was previously surveyed in 1995-1996 (Ohio EPA, 1997) and in 2003-2004 (Ohio EPA 2006a). Ohio EPA also has developed a Total Maximum Daily Load (TMDL) report for the Chagrin River watershed, including the Aurora Branch, which was finalized in 2007 and approved by the U.S. Environmental Protection Agency (Ohio EPA, 2007).

Aquatic life use attainment conditions are presented in Table 1, and sampling locations are detailed in Table 2 and graphically presented in Figure 1.

Table 1. Aquatic life use attainment status for sampling locations in the Aurora Branch Chagrin River in the vicinity of the Aurora Country Club, 2012. The Index of Biotic Integrity (IBI) and narrative results for the macroinvertebrate community assessment are based on the performance of the biological community. The Qualitative Habitat Evaluation Index (QHEI) is a measure of the ability of the physical habitat to support a biological community. Stream sites are located in the Erie-Ontario Lake Plain (EOLP) ecoregion. In the Ohio Water Quality Standards, the Aurora Branch Chagrin River is designated Warmwater Habitat (WWH). If biological impairment has occurred, the cause(s) and source(s) of the impairment are noted.

Sample Location (River Mile)	Aquatic Life Use Designation	Aquatic Life Attainment Status	IBI/ Fish Assessment	Macro-invertebrate Community Assessment	Stream Habitat[a]	Aquatic Life Use Impairment	
						Causes[b]	Sources[b]
14.4	WWH	**PARTIAL**	28* Fair	Exceptional	73.0 (Excellent)	Sedimentation/ siltation Nutrient/eutrophication Biological Indicators Fish-passage barrier	Upstream/ downstream source *(golf course downstream, Sunny Lake upstream)* Residential districts *(non-point runoff)*
12.8	WWH	**NON**	32* Fair	Fair*	42.0 (Poor)	Direct habitat alteration Nutrient/eutrophication Biological Indicators Sedimentation/ siltation	Golf course Upstream/ downstream source *(Sunny Lake upstream)* Residential districts *(non-point runoff)*
11.3	WWH	**PARTIAL**	34* Fair	Good	81.0 (Excellent)	Sedimentation/ siltation Nutrient/ eutrophication Biological Indicators	Upstream/ downstream source *(golf course and Sunny Lake upstream)* Residential districts *(non-point runoff)*

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)		
INDEX – Site Type	WWH	EWH
IBI: Headwater	40	50

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.

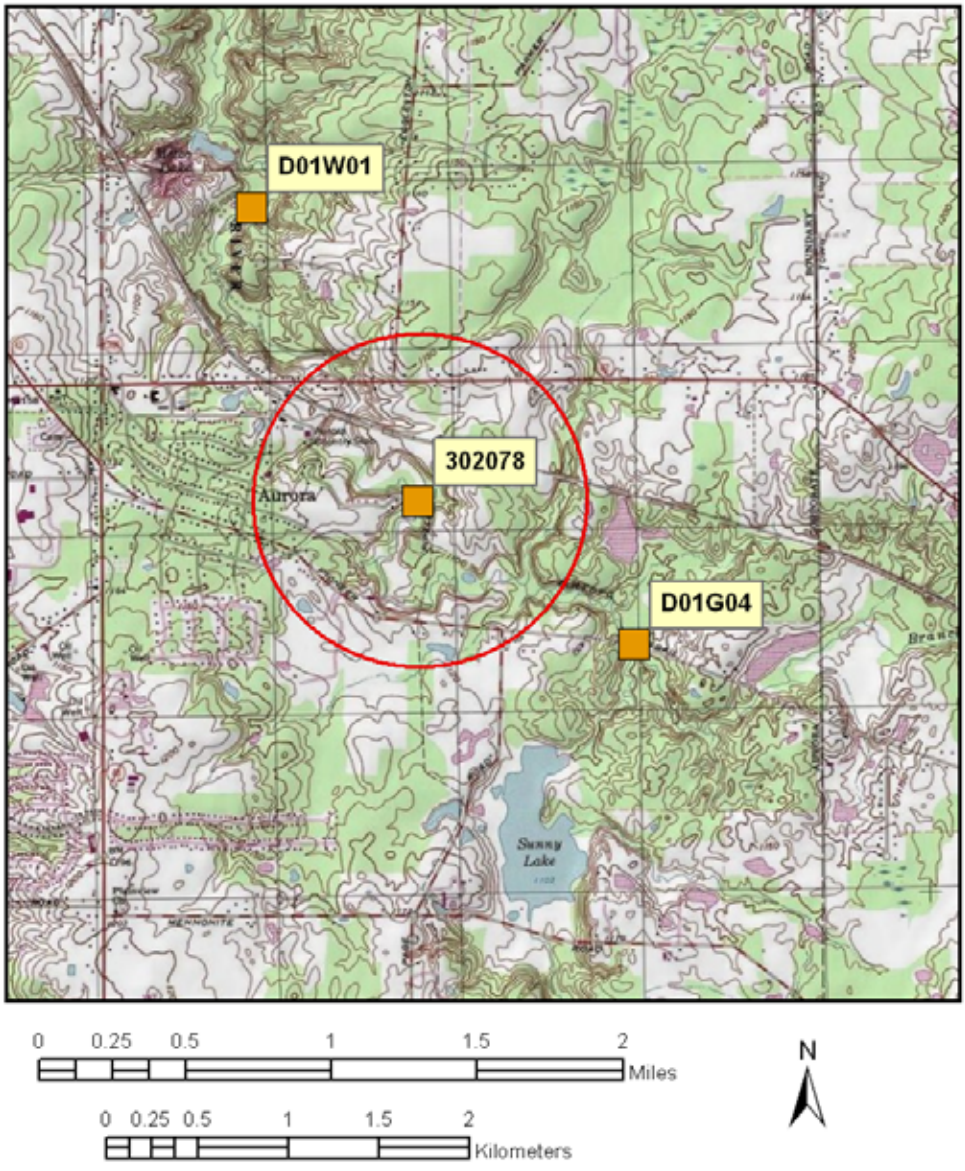
[a] Narrative habitat evaluations for headwater streams are based on QHEI scores as follows: Excellent >70, Good 55-69, Fair 43-54, Poor 30-42, and Very Poor <30.

[b] Causes and Sources relate to underlying reasons for observed non-attainment.

Table 2. Sampling locations in the Aurora Branch Chagrin River, 2012. Type of sampling included fish community (F), habitat evaluation (H), and macroinvertebrate community (M).

River Mile	Station Code	Type of Sampling	Drainage Area (mi^2)	Latitude	Longitude	Landmark
14.4	D01G04	F,H,M	14.2	41.30416	-81.31063	Pioneer Road (downstream crossing)
12.8	302078	F,H,M	12.7	41.31138	-81.32474	Aurora Country Club
11.3	D01W01	F,H,M	7.5	41.32606	-81.33543	Upstream of Aurora Central WWTP

Figure 1. Stream sampling locations surveyed in the Aurora Branch Chagrin River in the vicinity of the Aurora Country Club, 2012. The general location of the Aurora Country Club is indicated by the red circle. Stream flow is generally northward in this watershed.



METHODS

All physical, biological field, data processing, and data analysis methods and procedures adhere to those specified in the Biological Criteria for the Protection of Aquatic Life, Volumes II - III (Ohio Environmental Protection Agency 1987, 1989a, 1989b, 2008a, 2008b), The Qualitative Habitat Evaluation Index (QHEI); Rationale, Methods, and Application (Rankin 1989), and Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (Ohio EPA 2006b).

Determining Use Attainment

Use attainment status is a term describing the degree to which environmental indicators are either above or below criteria specified by the Ohio Water Quality Standards (WQS; Ohio Administrative Code 3745-1). Assessing aquatic use attainment status involves a primary reliance on the Ohio EPA biological criteria (OAC 3745-1-07; Table 7-15). These are confined to ambient assessments and apply to rivers and streams outside of mixing zones. Numerical biological criteria are based on multimetric biological indices including the Index of Biotic Integrity (IBI) and modified Index of Well-Being (MIwb), indices measuring the response of the fish community, and the Invertebrate Community Index (ICI), which indicates the response of the macroinvertebrate community. Three attainment status results are possible at each sampling location - full, partial, or non-attainment. Full attainment means that all of the applicable indices meet the biocriteria. Partial attainment means that one or more of the applicable indices fails to meet the biocriteria. Non-attainment means that none of the applicable indices meet the biocriteria or one of the organism groups reflects poor or very poor performance. An aquatic life use attainment table (Table 1) is constructed based on the sampling results and is arranged from upstream to downstream and includes the sampling locations indicated by river mile, the applicable biological indices, the use attainment status (*i.e.,* full, partial, or non-attainment), the Qualitative Habitat Evaluation Index (QHEI), and a sampling location description. Biological results were compared to WWH biocriteria. The Aurora Branch Chagrin River is currently listed as WWH in the Ohio Water Quality Standards.

Stream Habitat Evaluation

Physical habitat is evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for streams and rivers in Ohio (Rankin 1989, 1995; Ohio EPA 2006b). Various attributes of the available habitat are scored based on their overall importance to the establishment of viable, diverse aquatic faunas. Evaluations of type and quality of substrate, amount of instream cover, channel morphology, extent of riparian canopy, pool and riffle development and quality, and stream gradient are among the metrics used to evaluate the characteristics of a stream segment, not just the characteristics of a single sampling site. As such, individual sites may have much poorer physical habitat due to a localized disturbance yet still support aquatic communities closely resembling those sampled at adjacent sites with better habitat, provided water quality conditions are similar. QHEI scores from hundreds of segments around the state have indicated that values higher than 60 were generally conducive to the establishment of warmwater faunas while those which scored in excess of 75 often typify habitat conditions which have the ability to support exceptional faunas.

Macroinvertebrate Community Assessment

Macroinvertebrates were collected from the natural habitats using a qualitative multi-habitat composite sample. This sampling effort consisted of an inventory of all observed macroinvertebrate taxa from the natural habitats at each site with no attempt to quantify populations other than notations on the predominance of specific taxa or taxa groups within major macrohabitat types (*e.g.,* riffle, run, pool, margin). Detailed discussion of macroinvertebrate field and laboratory procedures is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b, 2008b).

Fish Community Assessment

Fish were sampled once at each sampling location using pulsed DC headwater electrofishing methods. Fish were processed in the field, and included identifying each individual to species, counting the fish, and recording any external abnormalities. Discussion of the fish community assessment methodology used in this report is contained in Biological Criteria for the Protection of Aquatic Life: Volume III, Standardized Biological Field Sampling and Laboratory Methods for Assessing Fish and Macroinvertebrate Communities (Ohio EPA 1989b, 2008b).

RESULTS

Stream Physical Habitat

Physical habitat was evaluated at each fish sampling location. Physical habitat was assessed using the Qualitative Habitat Evaluation Index (QHEI); scores are detailed in Table 3.

The habitat scores at both the upstream (RM14.4) and downstream (RM11.3) locations were rated as excellent and capable of supporting WWH fish communities. Neither location was found to have any high influence modified stream indicators, although both sites appeared to be highly affected by silt deposits. Given the low flow conditions experienced in northeast Ohio throughout the summer of 2012, it is possible that the siltation in the stream was higher than normal, but both locations appeared to be exhibiting effects of urban runoff and nutrient enrichment.

The site within the Aurora Country Club (RM 12.8) was found to have highly degraded habitat resulting from channelization, flow alteration, siltation, and the lack of wooded riparian buffer. The QHEI score for this site was rated as poor, and was 31 and 39 points lower than the sites evaluated upstream and downstream respectively. Sites with habitat degraded to the degree observed within the country club property usually do not support WWH fish communities meeting the applicable biological water quality criteria.

Table 3. Qualitative Habitat Evaluation Index (QHEI) scores and physical attributes for fish sampling sites in the Aurora Branch Chagrin River in the vicinity of the Aurora Country Club, 2012.

																				MWH Attributes																
																				High Influence															
			WWH Attributes																				*Moderate Influence*													
Key QHEI Components			No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max. Depth >40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/ No Cover	Max. Depth <40 cm (WD,HW sites)	**Total High Influence Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total Moderate Influence Attributes**	**(MWH H.I.+1)/ (WWH+1) Ratio**	**(MWH M.I.+1)/ (WWH+1) Ratio**
River Mile	**QHEI**	**Habitat Rating**																																	
Aurora Branch Chagrin River Year: 2012																																			
14.40	**73.0**	Excellent	■	■		■	■	■	■		■		7						0		●							●	●		3	0.13	0.50
12.80	**42.0**	Poor									■		1	◆	◆		◆	◆	4		●			●			●	●		●	5	2.50	5.00
11.30	**81.0**	Excellent	■	■		■	■	■	■	■	■	■	9						0		●										1	0.10	0.20

Fish Community

A total of 1,719 fish representing 18 species were collected from the Aurora Branch Chagrin River in the vicinity of the Aurora Country Club on September 17, 2012. Relative numbers and species collected per location are presented in Table 4 and IBI metric results are presented in Appendix Table 1. Fish species lists and abundance data are listed in Appendix Table 2. Sampling locations were evaluated using WWH biocriteria. The fish communities at all three sampling locations failed to meet the EOLP biological water quality criterion, and were rated fair at all three sites. The IBI scores trended slightly higher moving from upstream to downstream.

The upstream site at RM 14.4 scored lowest of all three sites despite habitat scores in the excellent range. The high relative numbers of pollution tolerant (78%) and pioneering (66%) fish species at this location were indicative of stress related to the low flow, nutrient enriched conditions at this site. The only sensitive fish species observed at this location was the rainbow darter (*Etheostoma caeruleum*). The presence of this species is significant as rainbow darters were absent from earlier (1996) Ohio EPA collections from this locale, and were present in only low numbers in a more recent 2003 collection. It was hypothesized that intermittent periods of elevated in-stream toxicity resulting from cyanobacteria (blue-green algae) in the outflow of water from the hypereutrophic Sunny Lake were affecting the fish community in the Aurora Branch. Restoration activities at Sunny Lake conducted in 2008 seem to have reduced this problem to a point where some recovery is evident. Relative numbers of rainbow darters increased from 15 per 0.3 km in 2003 to 93 per 0.3 km in 2012. However, the trend data for IBI scores in this reach of the Aurora Branch Chagrin River indicate that there has not been suitable recovery over time to achieve attainment of the WWH water quality criterion for fish (Figure 2). The composition of the fish community at this location continues to reflect a response related to nutrient enrichment and siltation. Habitat alterations within the golf course downstream of this site may also play a significant role in restricting fish migration within the upstream reach of the Aurora Branch and may in part explain the impaired condition of the fish community.

The sampling location within the Aurora Country Club (RM 12.8) was affected by channelization, flow alterations, and the lack of wooded riparian buffer. Water in the stream was ponded due to the presence of downstream rock dams installed within the golf course. Fine grained sediments were the predominant substrates at the site, and larger substrates within the channel were heavily embedded in silt and sand. The collection included fish species typical of deep pool, slow current habitats including white crappie (*Pomoxis annularis*), common carp (*Cyprinus carpio*), and rock bass (*Ambloplites ruprestris*). These species are typically found in streams with greater drainage areas than the Aurora Country Club site. There was no riffle habitat within the evaluated reach, and darter species were virtually absent, with only a single johnny darter (*Etheostoma nigrum*) captured in the electrofishing zone. Although the percentages of pollution tolerant and pioneering species at the country club site were lower than found at the upstream site, the lack of any headwater or sensitive species in the collection were indicative of nutrient enrichment and impairments obvious in the habitat score for this location.

The downstream site for this study at RM 11.3 is located just upstream of the Aurora Central WWTP. Based upon the 2012 sampling, the fish community at this location was also found to be impaired, although the IBI score was higher than those observed at the other two sampling locations. As with the upstream site, the high percentages of pollution tolerant and pioneering species, and the low number of sensitive species were notable deviations from expectations for streams with the high habitat quality in this ecoregion.

Comparison of historical fish data from the Aurora Branch with the present data set (Figure 2) indicates that the pattern of non-attainment of the IBI biological criterion has not changed significantly over time in the section of the stream upstream of the Aurora Central WWTP. This is a strong indicator that pollution abatement and habitat protection and restoration activities are still needed in this watershed to achieve the water quality standards and the goals for reductions in nutrient and sediment loadings and habitat improvement as called for in the Chagrin River TMDL report (Ohio EPA, 2007).

Table 4. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in the Aurora Branch Chagrin River in the vicinity of the Aurora Country Club in September, 2012. Relative numbers are per 1.0 km. The applicable aquatic life use designation is WWH.

Stream **River Mile**	**Sampling Method**	**Species**	**Percent Pioneering**	**Percent Tolerants**	**Relative Number[a]**	**QHEI**	**IBI**	**Narrative Evaluation**
14.4	Long Line	13	66%	78%	531	73.0	28*	Fair
12.8	Long Line	12	8%	41%	447	42.0	32*	Fair
11.3	Long Line	12	37%	51%	825	81.0	34*	Fair

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)		
INDEX – Site Type	WWH	EWH
IBI: Headwater	40	50

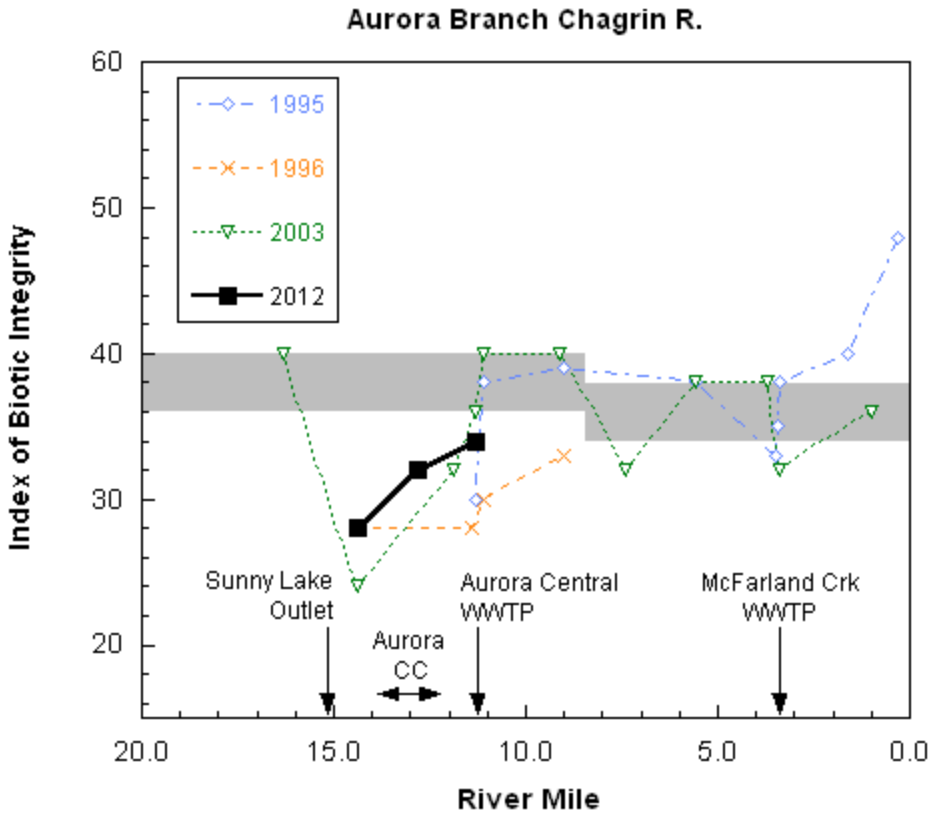


Figure 2. Fish community trends for the Index of Biotic Integrity in the Aurora Branch Chagrin River, 1995-2012.

Macroinvertebrate Community

The macroinvertebrate communities from the Aurora Branch in the vicinity of the Aurora Country Club were sampled in 2012 using qualitative (natural substrate multi-habitat composite) sampling protocols. Results are summarized in Table 5. The raw data are attached as Appendix Table 3.

The macroinvertebrate community from the upstream sampling location at Pioneer Trail (RM 14.48) was evaluated as "exceptional", with a high number of EPT taxa, a high percentage of sensitive (pollution intolerant) taxa, and four cold water indicator taxa present. The macroinvertebrate community at this location has improved significantly since the last Ohio EPA survey in 2003-04 (Figure 3).

There was a pronounced impairment in the quality of the macroinvertebrate community at the site within the Aurora Country Club (RM 12.90). The macroinvertebrate community at this location was given a narrative ranking of "fair", and was not attaining the WWH aquatic life use. All of the indicators of ecological quality within the macroinvertebrate community declined at this location, with a 47.6% decrease in the total number of taxa observed, a 65% reduction in EPT taxa, and no cold water indicator taxa observed. The monotonic nature of the habitat, lack of shading, and predominance of silt laden substrates all likely contributed to the degradation of the macroinvertebrate community.

There was a significant recovery of the macroinvertebrate community observed at RM 11.30 just upstream of the Aurora Central WWTP, meeting a narrative ranking of "good". This result indicates attainment of the WWH aquatic life use. However, the community at RM 11.30 was significantly different than the exceptional community observed at RM 14.48 (Pioneer Trail). It is likely that impacts of habitat degradation within the stream reach flowing through the Aurora Country Club in combination with other non-point pollution effects relating to suburban land use in the watershed are having observable impacts on the downstream biological communities. These impacts likely include changes in the thermal regime of the stream (warming due to lack of woody riparian cover) and elevated nutrient and sediment loadings from runoff entering the stream. The lack of floodplain connectivity within the golf course upstream of the RM 11.30 site very likely also exacerbates the transport of sediment and nutrients through the system by reducing the pollution assimilation capacity of the stream.

Comparison of historical Ohio EPA data for the Aurora Branch to the 2012 data set indicates that the macroinvertebrate community at the RM 14.48 location (Pioneer Trail) has improved dramatically since the last Ohio EPA survey in 2003-04 (Figure 3). Increases were observed for the number of macroinvertebrate taxa collected, as well as in the numbers of EPT taxa, sensitive taxa, and the number of cold water indicator taxa. This improvement can be attributed largely to the restoration efforts undertaken in Sunny Lake and its watershed and associated improvements in the water quality of drainage entering the Aurora Branch from this sub-watershed. In contrast, the macroinvertebrate community at the downstream site (RM 11.30) has shown no improvement since the 2003-04 Ohio EPA survey (Figure 3). As discussed above, the detrimental water quality impacts from the highly modified reach within the Aurora Country Club likely is contributing to water quality degradation in the Aurora Branch downstream, hindering full recovery of the biological community to the upstream condition.

Table 5. Macroinvertebrate community summaries based on qualitative multi-habitat composite sampling conducted by Ohio EPA in the Aurora Branch Chagrin River in the vicinity of the Aurora Country Club in September, 2012. The applicable aquatic life use designation is WWH.

Stream/ River Mile	Qualitative Taxa	Sensitive Taxa	EPT[a] Taxa	Cold Water Taxa	Evaluation
14.48	63	12	20	4	Exceptional
12.90	33	4	7	0	Fair*
11.30	47	7	12	1	Good

a EPT=total Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) taxa richness, a measure of pollution sensitive organisms.

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.

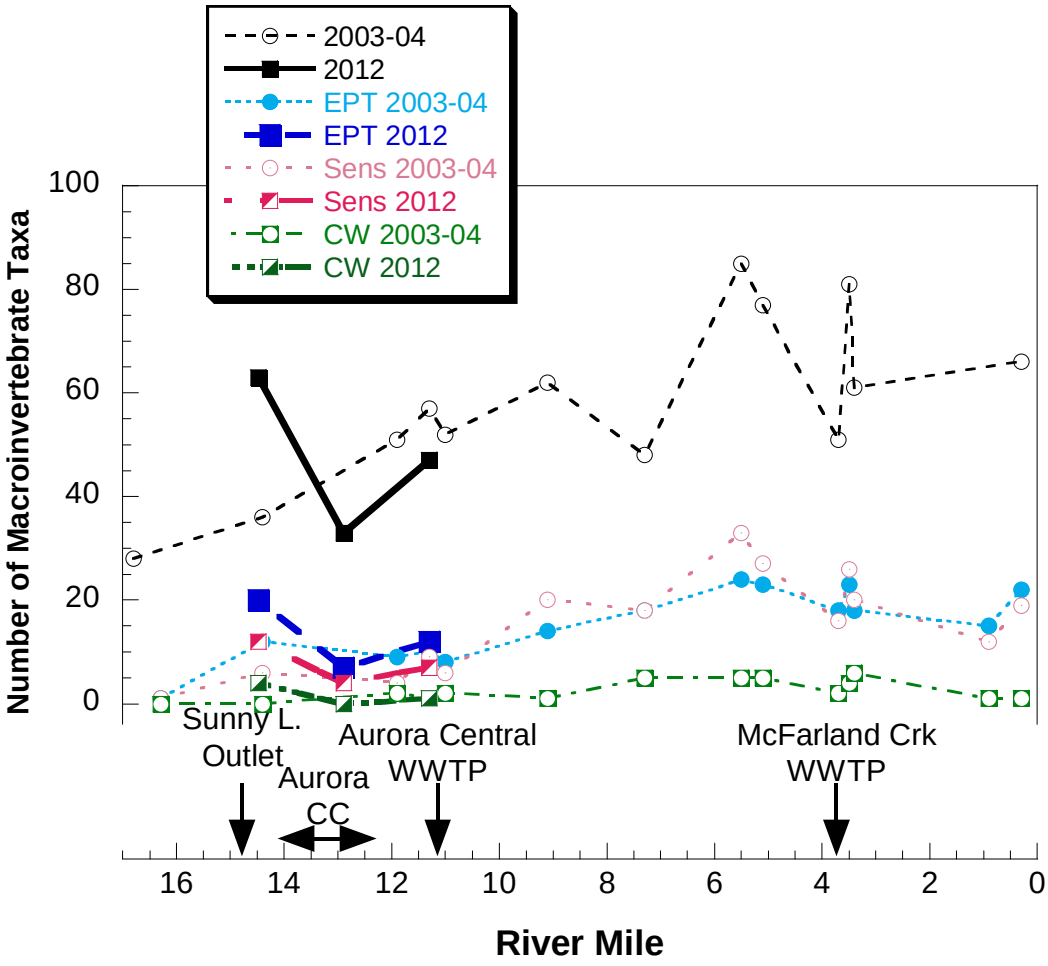


Figure 3. Historical comparison of selected macroinvertebrate community indicators in the Aurora Branch Chagrin River to data collected in 2012. Key: data indicated by year alone = total number of taxa collected; "EPT" = number of EPT taxa; "Sens" = number of sensitive taxa, "CW" = number of cold water taxa. Stream flow goes from higher river miles to the mouth at river mile 0 (left to right in figure).

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APPENDICES – AURORA BRANCH CHAGRIN RIVER, 2012

Appendix Table 1	Index of Biotic Integrity (IBI) scores and metrics for the Aurora Branch Chagrin River, 2012.
Appendix Table 2	Ohio EPA fish results for the Aurora Branch Chagrin River, 2012.
Appendix Table 3	Ohio EPA macroinvertebrate results for the Aurora Branch Chagrin River, 2012.

Appendix Table 1 Index of Biotic Integrity (IBI) scores and metrics for the Aurora Branch Chagrin River, 2012.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Minnow species	Headwater species	Sensitive species	Darter & Sculpin species	Simple Lithophils	Percent of Individuals: Tolerant fishes	Omni-vores	Pioneering fishes	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI
Aurora Branch - (15-005)																
Year: 2012																
14.40	E	09/17/2012	7.5	13(3)	4(3)	0(1)	1(1)	2(3)	3(3)	78(1)	48(1)	66(1)	21(3)	0.0(5)	531(3)	28
12.80	E	09/17/2012	12.7	11(3)	2(1)	0(1)	0(1)	1(1)	2(1)	41(3)	31(3)	8(5)	63(5)	0.0(5)	447(3)	32
11.30	E	09/17/2012	14.1	12(3)	5(3)	1(1)	2(1)	2(1)	5(3)	51(3)	23(3)	37(3)	46(3)	0.0(5)	825(5)	34

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 2 Ohio EPA fish results for the Aurora Branch Chagrin River, 2012.

Species List

River Code: **15-005**	Stream: **Aurora Branch**	Sample Date: **2012**
River Mile: **14.40**	Location: dst. Pioneer Trail, dst. Sunny Lake Outlet	Date Range: 09/17/2012
Time Fished: 3922 sec	Drainage: 7.5 sq mi	
Dist Fished: 0.10 km	Basin: Chagrin River No of Passes: 1	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Redfin Pickerel		P	M	P	1	3.00	0.13			
White Sucker	W	O	S	T	156	468.00	19.60			
Creek Chub	N	G	N	T	231	693.00	29.02			
Common Shiner	N	I	S		45	135.00	5.65			
Bluntnose Minnow	N	O	C	T	226	678.00	28.39			
Central Stoneroller	N	H	N		10	30.00	1.26			
Yellow Bullhead		I	C	T	3	9.00	0.38			
Largemouth Bass	F	C	C		5	15.00	0.63			
Green Sunfish	S	I	C	T	3	9.00	0.38			
Bluegill Sunfish	S	I	C	P	8	24.00	1.01			
Pumpkinseed Sunfish	S	I	C	P	9	27.00	1.13			
Johnny Darter	D	I	C		68	204.00	8.54			
Rainbow Darter	D	I	S	M	31	93.00	3.89			
Mile Total					796	2,388.00				
Number of Species					13					
Number of Hybrids					0					

Species List

River Code: **15-005**	Stream: **Aurora Branch**	Sample Date: **2012**
River Mile: **12.80**	Location: Aurora Country Club	Date Range: 09/17/2012
Time Fished: 3095 sec	Drainage: 12.7 sq mi	
Dist Fished: 0.10 km	Basin: Chagrin River No of Passes: 1	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
White Sucker	W	O	S	T	66	198.00	25.98			
Common Carp	G	O	M	T	11	33.00	4.33			
Common Shiner	N	I	S		1	3.00	0.39			
Bluntnose Minnow	N	O	C	T	2	6.00	0.79			
Yellow Bullhead		I	C	T	8	24.00	3.15			
White Crappie	S	I	C		1	3.00	0.39			
Rock Bass	S	C	C		3	9.00	1.18			
Largemouth Bass	F	C	C		11	33.00	4.33			
Green Sunfish	S	I	C	T	18	54.00	7.09			
Bluegill Sunfish	S	I	C	P	130	390.00	51.18			
Pumpkinseed Sunfish	S	I	C	P	2	6.00	0.79			
Johnny Darter	D	I	C		1	3.00	0.39			
Mile Total					254	762.00				
Number of Species					12					
Number of Hybrids					0					

Species List

River Code: **15-005**	Stream: **Aurora Branch**	Sample Date: **2012**
River Mile: **11.30**	Location: upst. Aurora WWTP	Date Range: 09/17/2012
Time Fished: 3558 sec	Drainage: 14.1 sq mi	
Dist Fished: 0.12 km	Basin: Chagrin River No of Passes: 1	Sampler Type: E

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Northern Hog Sucker	R	I	S	M	1	2.50	0.15			
White Sucker	W	O	S	T	133	332.50	19.88			
Western Blacknose Dace	N	G	S	T	47	117.50	7.03			
Creek Chub	N	G	N	T	122	305.00	18.24			
Common Shiner	N	I	S		107	267.50	15.99			
Bluntnose Minnow	N	O	C	T	21	52.50	3.14			
Central Stoneroller	N	H	N		40	100.00	5.98			
Green Sunfish	S	I	C	T	16	40.00	2.39			
Bluegill Sunfish	S	I	C	P	19	47.50	2.84			
Pumpkinseed Sunfish	S	I	C	P	1	2.50	0.15			
Johnny Darter	D	I	C		85	212.50	12.71			
Rainbow Darter	D	I	S	M	77	192.50	11.51			
Mile Total					669	1,672.50				
Number of Species					12					
Number of Hybrids					0					

Appendix Table 3 Ohio EPA macroinvertebrate results for the Aurora Branch Chagrin River, 2012.

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Aurora Branch

Collection Date: 09/26/2012 River Code: 15-005 RM: 14.48

Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+
03360	*Plumatella sp*	+
03600	*Oligochaeta*	+
06201	*Hyalella azteca*	+
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
11200	*Callibaetis sp*	+
12200	*Isonychia sp*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
13530	*Maccaffertium ithaca*	+
14950	*Leptophlebia sp or Paraleptophlebia sp*	+
17200	*Caenis sp*	+
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
34130	*Acroneuria frisoni*	+
45100	*Palmacorixa sp*	+
45300	*Sigara sp*	+
47600	*Sialis sp*	+
50301	*Chimarra aterrima*	+
50315	*Chimarra obscura*	+
51400	*Nyctiophylax sp*	+
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	+
52440	*Ceratopsyche slossonae*	+
52530	*Hydropsyche depravata group*	+
55300	*Ptilostomis sp*	+
57400	*Neophylax sp*	+
58505	*Helicopsyche borealis*	+
63300	*Hydroporini*	+
63700	*Ilybius sp*	+
68130	*Helichus sp*	+
69400	*Stenelmis sp*	+
70700	*Dicranota sp*	+
71900	*Tipula sp*	+
72340	*Dixella sp*	+
72700	*Anopheles sp*	+
74100	*Simulium sp*	+
74501	*Ceratopogonidae*	+
77120	*Ablabesmyia mallochi*	+
77500	*Conchapelopia sp*	+
77800	*Helopelopia sp*	+
78655	*Procladius (Holotanypus) sp*	+
80420	*Cricotopus (C.) bicinctus*	+
81650	*Parametriocnemus sp*	+
82141	*Thienemanniella xena*	+
82200	*Tvetenia bavarica group*	+
82730	*Chironomus (C.) decorus group*	+
82835	*Cryptotendipes pseudotener*	+
83840	*Microtendipes pedellus group*	+
84210	*Paratendipes albimanus or P. duplicatus*	+
84470	*Polypedilum (P.) illinoense*	+
84750	*Stictochironomus sp*	+
85500	*Paratanytarsus sp*	+
85625	*Rheotanytarsus sp*	+
85800	*Tanytarsus sp*	+
86100	*Chrysops sp*	+
94603	*Pseudosuccinea columella*	+
96900	*Ferrissia sp*	+
98200	*Pisidium sp*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 0 Total Taxa: 63
No. Qualitative Taxa: 63 ICI:
Number of Organisms: 0 Qual EPT: 20

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Aurora Branch

Collection Date: 09/26/2012 River Code: 15-005 RM: 12.90

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	*Turbellaria*	+			
03000	*Ectoprocta*	+			
03600	*Oligochaeta*	+			
05800	*Caecidotea sp*	+			
06201	*Hyalella azteca*	+			
06700	*Crangonyx sp*	+			
11200	*Callibaetis sp*	+			
11670	*Procloeon viridocular e*	+			
13400	*Stenacron sp*	+			
13521	*Stenonema femoratum*	+			
17200	*Caenis sp*	+			
22001	*Coenagrionidae*	+			
27500	*Somatochlora sp*	+			
45100	*Palmacorixa sp*	+			
45300	*Sigara sp*	+			
45400	*Trichocorixa sp*	+			
45900	*Notonecta sp*	+			
48220	*Chauliodes rastricornis*	+			
51400	*Nyctiophylax sp*	+			
51600	*Polycentropus sp*	+			
60400	*Gyrinus sp*	+			
68075	*Psephenus herricki*	+			
68201	*Scirtidae*	+			
68601	*Ancyronyx variegata*	+			
68708	*Dubiraphia vittata group*	+			
71700	*Pilaria sp*	+			
72700	*Anopheles sp*	+			
82730	*Chironomus (C.) decorus group*	+			
84470	*Polypedilum (P.) illinoense*	+			
84700	*Stenochironomus sp*	+			
85800	*Tanytarsus sp*	+			
94400	*Fossaria sp*	+			
95100	*Physella sp*	+			

No. Quantitative Taxa: 0	Total Taxa: 33
No. Qualitative Taxa: 33	ICI:
Number of Organisms: 0	Qual EPT: 7

Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Aurora Branch
upst. Aurora WWTP

Collection Date: 09/26/2012 River Code: 15-005 RM: 11.30

Taxa Code	Taxa	Quant/Qual
00401	*Spongillidae*	+
01801	*Turbellaria*	+
03600	*Oligochaeta*	+
04935	*Erpobdella punctata punctata*	+
06700	*Crangonyx sp*	+
08250	*Orconectes (Procericambarus) rusticus*	+
11120	*Baetis flavistriga*	+
11130	*Baetis intercalaris*	+
11250	*Centroptilum sp (w/o hindwing pads)*	+
11670	*Procloeon viridoculare*	+
13400	*Stenacron sp*	+
13521	*Stenonema femoratum*	+
13590	*Maccaffertium vicarium*	+
21200	*Calopteryx sp*	+
22001	*Coenagrionidae*	+
22300	*Argia sp*	+
23600	*Aeshna sp*	+
23909	*Boyeria vinosa*	+
27500	*Somatochlora sp*	+
45300	*Sigara sp*	+
50301	*Chimarra aterrima*	+
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	+
52530	*Hydropsyche depravata group*	+
57400	*Neophylax sp*	+
60900	*Peltodytes sp*	+
61400	*Agabus sp*	+
63300	*Hydroporini*	+
68075	*Psephenus herricki*	+
68130	*Helichus sp*	+
68700	*Dubiraphia sp*	+
69400	*Stenelmis sp*	+
71900	*Tipula sp*	+
71910	*Tipula abdominalis*	+
74100	*Simulium sp*	+
77120	*Ablabesmyia mallochi*	+
77800	*Helopelopia sp*	+
78655	*Procladius (Holotanypus) sp*	+
81650	*Parametriocnemus sp*	+
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83840	*Microtendipes pedellus group*	+
84750	*Stictochironomus sp*	+
85800	*Tanytarsus sp*	+
85821	*Tanytarsus glabrescens group sp 7*	+
87400	*Stratiomys sp*	+
96900	*Ferrissia sp*	+

No. Quantitative Taxa: 0
No. Qualitative Taxa: 47
Number of Organisms: 0

Total Taxa: 47
ICI:
Qual EPT: 12