



Biological and Water Quality Study of the Mahoning River, 2012

Former US Steel McDonald Facility

Trumbull County



OHIO EPA Technical Report EAS/2012-11-11

Division of Surface Water
Ecological Assessment Section
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Biological and Water Quality Study

Mahoning River

(Former US Steel McDonald Facility)

2012

Trumbull County, Ohio
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OEPA Report EAS/2012-11-11

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State of Ohio Environmental Protection Agency
Division of Environmental Response and Revitalization

prepared by
Ohio Environmental Protection Agency
Lazarus Government Center
50 West Town Street, Suite 700
Columbus, Ohio 43215

Division of Surface Water
Ecological Assessment Section
4675 Homer Ohio Lane
Groveport, Ohio 43125

John R. Kasich, Governor
State of Ohio

Scott J. Nally, Director
Environmental Protection Agency

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EXECUTIVE SUMMARY

A total of two miles of the Mahoning River in the McDonald area was assessed by the Ohio EPA in 2012. Based on the performance of the biological communities, the upper 0.5 miles of the Mahoning River study area was in partial attainment of the Warmwater Habitat (WWH) aquatic life use (Table 1). The lower 1.5 miles of river were in non-attainment of the WWH aquatic life use. The non-attainment was a result of poor macroinvertebrate communities. The urbanized condition of the Mahoning River within the study segment (municipal wastewater discharges and sewer overflows), habitat modifications (impounded river), and elevated sediment contaminants contributed to the impaired biological communities. Sediment contamination within the lower reach of the Mahoning River, which includes the Warren to stateline area, is pervasive and related to legacy discharges. These conditions do not appear associated with chemical constituents released under current conditions at the former US Steel McDonald facility.

Biological communities have improved in the Mahoning River study segment since 1994, when fish and macroinvertebrate communities were in the poor to very poor range. Results during 2012 documented marginally good to very poor results.

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, river pool depths, and recreational activity verified that the Primary Contact Recreation use is appropriate for the Mahoning River.



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Stream sampling: Mike Gray, David Altfater, Mia Hall, Chuck McKnight, Ellena Dovgopolaya

Data support: Dennis Mishne

Report preparation and analysis: David Altfater, Mike Gray

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INTRODUCTION

A two mile section of the Mahoning River was assessed during 2012, evaluating biological, sediment, and surface water resources. This study was undertaken to assess water resource conditions in the Mahoning River upstream, adjacent, and downstream from the former US Steel McDonald property. This water resource project is part of a Targeted Brownfield Assessment (TBA).

Specific objectives of the evaluation were to:

- Assess biological conditions in the Mahoning River by evaluating fish and macroinvertebrate communities,
- Evaluate surficial sediment and surface water chemical quality in the Mahoning River,
- Determine the aquatic life use attainment status of the Mahoning River with regard to the WWH aquatic life use designation codified in the Ohio Water Quality Standards, and
- Perform the work to satisfy the requirements of VAP rule OAC 3745-300-09.

The Mahoning River is located in the Erie-Ontario Lake Plain (EOLP) ecoregion. The Mahoning River is currently assigned the WWH aquatic life use designation for the lower 102 miles.

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 Mahoning River, former US Steel McDonald property area, 2012. The Index of Biotic Integrity (IBI), Modified Index of Well-being (MIwb), and Invertebrate Community Index (ICI) scores 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. River sites are located in the Erie-Ontario Lake Plain (EOLP) ecoregion. In the Ohio Water Quality Standards, the Mahoning 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	MIwb	ICI	Stream Habitat ^a	Aquatic Life Use Impairment Cause/Source
28.7	WWH	PARTIAL	36 ^{ns}	7.3*	14*	57.5 (fair)	Cause: Habitat alteration, organic enrichment, metals, PAHs Source: Impoundment, contaminated sediments, combined sewer overflows, municipal wastewater, urbanization
28.1	WWH	NON	36 ^{ns}	6.5*	<u>4*</u>	46.5 (fair)	
26.8	WWH	NON	37 ^{ns}	7.2*	<u>10*</u>	48.0 (fair)	

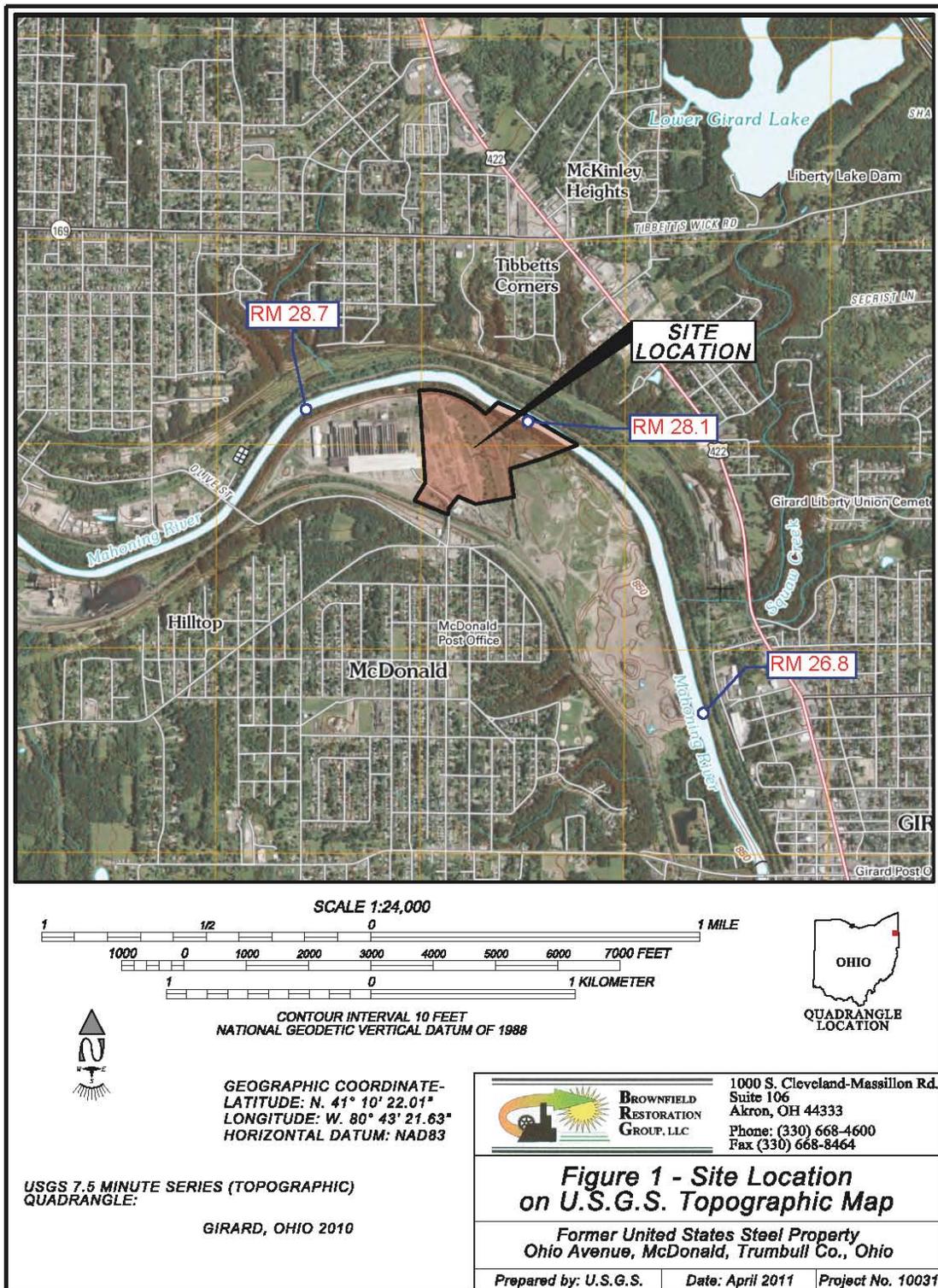
BIOCRITERIA		
INDEX - Site Type	WWH	EWB
IBI: Boat	40	48
MIwb: Boat	8.7	9.6
ICI	34	46

- * Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
- ns Nonsignificant departure from biocriterion (≤ 4 IBI or ICI units, 0.5 MIwb units).
- a Narrative habitat evaluations are based on QHEI scores as follows: Excellent =75-100, Good = 60-74, Fair = 45-59, Poor = 30-44 and Very Poor <30.

Table 2. Sampling locations in the Mahoning River, former US Steel McDonald property area, 2012. Type of sampling included fish community (F), macroinvertebrate community (M), surface water (W), and sediment (S).

River Mile	Type of Sampling	Latitude	Longitude	Landmark
28.7	F,M,W,S	41.17390	-80.73390	Upstream former US Steel McDonald property
28.1	F,M,W,S	41.17419	-80.71964	Adjacent former US Steel McDonald property
26.8	F,M,W,S	41.16065	-80.70929	Downstream former US Steel McDonald property

Figure 1. Sampling locations in the Mahoning River at the former US Steel McDonald property area, 2012. Base map was provided by Brownfield Restoration Group.



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METHODS

All chemical, physical, and biological field, EPA laboratory, data processing, and data analysis methods and procedures adhere to those specified in the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio Environmental Protection Agency 2012a), 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), Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (Ohio EPA 2006), and Ohio EPA Sediment Sampling Guide and Methodologies (Ohio EPA 2012b).

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 Mahoning 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 2006). 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.

Sediment and Surface Water Assessment

Fine grain sediment samples were collected multi-incrementally in the upper four inches of bottom material at each biological location using decontaminated stainless steel scoops. At each location, between 20 and 25 scoops of fine grained material over a 500 meter section of river were collected. Sediment incremental samples were mixed in aluminum pans (VOC sample jars were filled prior to mixing), transferred into glass jars with teflon lined lids, placed on ice (to maintain 4°C) in a cooler, and shipped to an Ohio EPA contract lab. Sediment data are reported on a dry weight basis. Decontamination of sediment sampling equipment followed the procedures outlined in the Ohio EPA sediment sampling guidance manual (Ohio EPA 2012b). Surface water samples were collected directly into appropriate containers, preserved and delivered to an Ohio EPA contract lab. Surface water samples were collected twice from each location from the upper 12 inches of water. Collected water was preserved using appropriate methods, as outlined in Parts II and III of the Manual of Ohio EPA Surveillance Methods and Quality Assurance Practices (Ohio EPA 2012a). Surface water samples were evaluated using comparisons to Ohio Water Quality Standards criteria, reference conditions, or published literature. Sediment evaluations were conducted using guidelines established in MacDonald *et al.* (2000), along with a comparison of metals results to Ohio Sediment Reference Values (Ohio EPA 2003) and Ecological Screening Values (USEPA 2003).

Macroinvertebrate Community Assessment

Macroinvertebrates were collected from artificial substrates and from the natural habitats at the Mahoning River sites. The artificial substrate collection provided quantitative data and consisted of a composite sample of five modified Hester-Dendy multiple-plate samplers colonized for six weeks. At the time of the artificial substrate collection, a qualitative multi-habitat composite sample was also collected. 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 twice at each Mahoning River site using pulsed DC boat electrofishing methods. Fish were processed in the field, and included identifying each individual to species, counting and weighing 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

Surface Water

Chemical analyses were conducted on surface water samples collected on July 24 and September 5, 2012, from three locations in the Mahoning River (Appendix Tables 1 and 2). Surface water samples were analyzed for 15 metals, PCBs, volatile organic compounds, and semivolatile organic compounds. Nearly all measurements of volatile organics and semivolatile organic compounds tested in river water at all three locations were reported as not detected. Of the parameters reported with low detectable concentrations, none of the chemicals were above Ohio water quality criteria. PCB concentrations were reported as not detected. All metals concentrations were low, and were below applicable Ohio WQS for aquatic life and human health criteria.

Nutrients, ammonia-N, dissolved oxygen and bacteriological parameters were not tested as part of this evaluation. For monitored parameters, good chemical water quality was evident in all river samples.

Sediment

Surficial sediment samples were collected at three locations in the Mahoning River by the Ohio EPA on September 5, 2012. Sampling locations were co-located with biological sampling sites. Samples were analyzed for 15 metal parameters, volatile organic compounds, semivolatile organic compounds, PCBs, and total petroleum hydrocarbons. Specific chemical parameters tested and results are listed in Appendix Table 3. Sediment data were evaluated using Ohio Sediment Reference Values (Ohio EPA 2003), along with guidelines established in *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (MacDonald *et.al.* 2000), and *Ecological Screening Levels (ESLs)* (USEPA 2003). The consensus-based sediment guidelines define two levels of ecotoxic effects. A *Threshold Effect Concentration (TEC)* is a level of sediment chemical quality below which harmful effects are unlikely to be observed. A *Probable Effect Concentration (PEC)* indicates a level above which harmful effects are likely to be observed. ESL values, considered protective benchmarks, were derived by USEPA, Region 5 using a variety of sources and methods.

Sediment samples were conservatively sampled by focusing on depositional areas of fine grain material (silts and clays). These areas typically are represented by higher contaminant levels, compared to coarse sands and gravels. Fine grained depositional areas were not a predominant substrate type at all three sites; however, fine substrates were common along the river margins.

Chemical parameters measured above screening benchmarks are presented in Table 3. Sediment collected from all three locations in the Mahoning River (upstream, adjacent, and downstream from the former US Steel McDonald property) was considered likely to be harmful to sediment-dwelling organisms (MacDonald *et.al.* 2000). At all three sediment sampling locations, highly elevated levels of polycyclic aromatic hydrocarbons (PAHs) were observed (Table 3); the highest levels were noted at the upstream (RM 28.7) and most downstream (RM 26.8) sites. Metals parameters were elevated at all three locations in the Mahoning River, with the highest levels reported upstream from the former US Steel McDonald property. PCB measurements revealed slightly elevated levels documented in the sediments at all three sampling locations. The large number of chemical compounds exceeding PEC levels at all Mahoning River locations suggest toxic sediment levels. Disturbance of the soft sediments from the Mahoning River along the shoreline released oil to the water surface. Diesel and gasoline range organics were measured at elevated levels at all Mahoning River sites (Appendix Table 3). Sediment contamination within the lower reach of the Mahoning River, which includes the Warren to stateline area, is pervasive and related to legacy discharges. The contamination of the Mahoning River sediments in the study area likely contributed to the impairment observed in the biological community in this impounded section of river.

Table 3. Chemical parameters measured above screening levels in samples collected by Ohio EPA from surficial sediments in the Mahoning River, September, 2012. Contamination levels were determined for parameters using Ohio Sediment Reference Values (SRVs), consensus-based sediment quality guidelines (MacDonald, et.al. 2000) and ecological screening levels (USEPA 2003). Shaded numbers indicate values above the following: SRVs (blue), Threshold Effect Concentration –TEC (yellow), Probable Effect Concentration – PEC (red) and Ecological Screening Levels (orange). Sampling locations are indicated by river mile (RM).

Parameter	RM 28.7	RM 28.1	RM 26.8
Arsenic (mg/kg)	40.3	21.1	17.6
Lead (mg/kg)	474	302	169
Antimony (mg/kg)	8.53	9.29	2.84
Cadmium (mg/kg)	3.53	2.87	2.01
Chromium (mg/kg)	432	424	159
Selenium (mg/kg)	3.77	2.89	2.20
Beryllium (mg/kg)	0.869 J	0.731 J	0.818
Cobalt (mg/kg)	14.3	15.2	9.60
Nickel (mg/kg)	268	246	98.4
Silver (mg/kg)	9.52	6.02	3.52
Zinc (mg/kg)	2290	1860	985
Mercury (mg/kg)	0.802	0.497 J	0.375 J
Acetone (ug/kg)	221	75.4	51.0
2,4-Dimethylphenol (ug/kg)	908	ND	ND
Anthracene (ug/kg)	337 J	ND	ND
Benzo(a)anthracene (ug/kg)	829	523	1130 J
Benzo(k)fluoranthene (ug/kg)	555	529	952 J
Benzo(a)pyrene (ug/kg) (ug/kg)	661	560	1180 J
bis(2-Ethylhexyl)phthalate (ug/kg)	1500	606	ND
Chrysene (ug/kg)	1320	617	1280 J
Fluoranthene (ug/kg)	2170	1220	2630
Fluorene (ug/kg)	382 J	ND	ND
Naphthalene (ug/kg)	279 J	ND	ND
Phenanthrene (ug/kg)	1600	408 J	976 J
Phenol (ug/kg)	11,800	ND	ND
Pyrene (ug/kg)	2230	1080	1970
Total PAHs (ug/kg)	11,309	5543	11,388
Arochlor 1260 (ug/kg)	234	320	81.0

J - Estimated result. Result is less than the reporting limit (RL).

ND - not detected at or above the method detection limit.

Fish Community

A total of 912 fish representing 23 species were collected from the Mahoning River in the former US Steel McDonald property area between July and September, 2012. Relative numbers and species collected per location are presented in Appendix Table 4 and IBI metrics are presented in Appendix Table 5. Sampling locations were evaluated using WWH biocriteria. Fish communities ranged from fair to marginally good in the Mahoning River. Results from all three fish sampling locations indicated comparable quality from upstream to downstream, with no obvious trends associated with the former US Steel McDonald property. IBI scores were in the marginally good range in the Mahoning River, with scores of 36, 36, and 37, upstream to downstream, respectively. These IBI values, though within the nonsignificant departure range of the biocriterion, achieved the ecoregional expectations as established for WWH streams and rivers in Ohio (Table 5). Modified Index of Well-Being (MIwb) scores were in the fair range, with values of 7.3, 6.5, and 7.2, upstream to downstream, respectively. These MIwb scores did not achieve the ecoregional biocriterion established for WWH streams and rivers in Ohio. External anomalies on fish (deformities, eroded fins, lesions, tumors) occurred at low levels (0-1.7%) in the fish communities of the Mahoning River.

Table 5. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in the Mahoning River, former US Steel McDonald property area, from July and September, 2012. Relative numbers are per 1.0 km. The applicable aquatic life use designation is WWH.

Stream River Mile	Sampling Method	Species (Mean)	Species (Total)	Relative Number	QHEI	Index of Biotic Integrity	Modified Index of Well-being	Narrative Evaluation
28.7	Boat	14	17	183	57.5	36 ^{ns}	7.3*	Marginally good/ Fair
28.1	Boat	11.5	13	356	46.5	36 ^{ns}	6.5*	Marginally good/ Fair
26.8	Boat	14.5	20	373	48.0	37 ^{ns}	7.2*	Marginally good/ Fair

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)		
INDEX - Site Type	WWH	EWH
IBI: Boat	40	48
MIwb: Boat	8.7	9.6

* Significant departure from ecoregion biocriterion; poor and very poor results are underlined.
 ns Non-significant departure from ecoregion biocriterion (≤ 4 IBI units or 0.5 MIwb units).

Macroinvertebrate Community

The macroinvertebrate communities from the Mahoning River in the vicinity of the former US Steel McDonald property were sampled in 2012 using quantitative (artificial substrate) and qualitative (natural substrate multi-habitat composite) sampling protocols. Results are summarized in Table 6. The ICI metrics with the associated scores and the raw data are attached as Appendix Tables 6 and 7.

The macroinvertebrate community from the upstream sampling location was evaluated as low fair (ICI 14) while the sites adjacent to and downstream from the US Steel McDonald property were evaluated as very poor and poor with ICI scores of 4 and 10, respectively. The macroinvertebrate communities did not attain the designated WWH use at any of the sampling locations. The US Steel McDonald property did not appear to have an impact on the macroinvertebrate community. The impairment of the macroinvertebrate community can be attributed to poor habitat due to impounded conditions, and contaminated sediments throughout the study area. The slightly better macroinvertebrate community at the upstream sampling location can be attributed to the presence of slight current velocities which were absent from the adjacent and downstream sites. River current velocities enabled the development of a mayfly and caddisfly community which were absent from locations with no observable flow.

Table 6. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in the Mahoning River, 2012.

Stream/ River Mile	Density Number/ft ²	Total Taxa	Quantitative Taxa	Qualitative Taxa	Qualitative EPT ^a	ICI	Evaluation
<i>Mahoning River</i>							
28.7	397	44	27	25	3	14*	Low Fair
28.1	289	30	15	19	2	<u>4*</u>	Very Poor
26.8	748	37	26	24	1	<u>10*</u>	Poor

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)		
INDEX	WWH	EWH
ICI	34	46

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.

ns Nonsignificant departure from biocriterion (≤ 4 ICI units).

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APPENDICES – MAHONING RIVER, 2012

Appendix Table 1. Surface water chemistry results for the Mahoning River, July 24, 2012.

Appendix Table 2. Surface water chemistry results for the Mahoning River, September 5, 2012.

Appendix Table 3. Sediment chemistry results for the Mahoning River, 2012.

Appendix Table 4. Ohio EPA fish results for the Mahoning River, 2012.

Appendix Table 5. Index of Biotic Integrity (IBI) scores and metrics for the Mahoning River, 2012.

Appendix Table 6. Invertebrate Community Index (ICI) scores and metrics for the Mahoning River, 2012.

Appendix Table 7. Ohio EPA macroinvertebrate results for the Mahoning River, 2012.

Appendix Table 1. Results of chemical surface water sampling conducted by Ohio EPA in the Mahoning River, July 24, 2012.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	7/24/2012	7/24/2012	7/24/2012
Metals (ug/l)			
Arsenic	ND	ND	ND
Lead	3.68 J	3.64 J	3.32 J
Antimony	ND	ND	ND
Barium	40.3	38.9	41.0
Selenium	ND	ND	ND
Beryllium	ND	ND	ND
Thallium	ND	ND	ND
Cadmium	ND	ND	ND
Chromium	ND	ND	ND
Cobalt	ND	ND	ND
Nickel	ND	ND	ND
Silver	ND	ND	ND
Vanadium	ND	ND	ND
Zinc	ND	ND	ND
Mercury	ND	ND	ND
Volatile Organic Analytes (ug/l)			
Acetone	ND	ND	ND
Benzene	ND	ND	ND
Bromobenzene	ND	ND	ND
Bromochloromethane	ND	ND	ND
Bromodichloromethane	ND	ND	ND
Bromoform	ND	ND	ND
Bromomethane	ND	ND	ND
2-Butanone	ND	ND	ND
n-Butylbenzene	ND	ND	ND
sec-Butylbenzene	ND	ND	ND
tert-Butylbenzene	ND	ND	ND
Carbon disulfide	ND	ND	ND
Carbon tetrachloride	ND	ND	ND
Chlorobenzene	ND	ND	ND
Chlorodibromomethane	ND	ND	ND
Chloroethane	ND	ND	ND
2-Chloroethyl vinyl ether	ND	ND	ND
Chloroform	0.244 J	0.249 J	0.210 J
Chloromethane	ND	ND	ND
2-Chlorotoluene	ND	ND	ND
4-Chlorotoluene	ND	ND	ND
1,2-Dibromo-3-chloropropane	ND	ND	ND
1,2-Dibromoethane	ND	ND	ND
Dibromomethane	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	7/24/2012	7/24/2012	7/24/2012
Volatile Organic Analytes (ug/l)			
1,1-Dichloroethane	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND
1,3-Dichloropropane	ND	ND	ND
2,2-Dichloropropane	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND
1,1-Dichloropropene	ND	ND	ND
Ethylbenzene	ND	ND	ND
n-Hexane	ND	ND	ND
2-Hexanone	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Isopropylbenzene	ND	ND	ND
p-Isopropyltoluene	ND	ND	ND
Methylene chloride	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND
Methyl t-butyl ether (MTBE)	ND	ND	ND
Naphthalene	ND	ND	ND
n-Propylbenzene	ND	ND	ND
Styrene	ND	ND	ND
1,1,1,2-Tetrachloroethane	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND
Tetrachloroethene	ND	ND	ND
Toluene	ND	ND	ND
1,2,3-Trichlorobenzene	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND
Trichloroethene	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	ND
1,2,4-Trimethylbenzene	ND	ND	ND
1,3,5-Trimethylbenzene	ND	ND	ND
Vinyl acetate	ND	ND	ND
Vinyl chloride	ND	ND	ND
o-Xylene	ND	ND	ND
m-,p-Xylene	ND	ND	ND
Semi-volatile Organic Analytes (ug/l)			
1,2,4-Trichlorobenzene	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND

Appendix Table 1. Continued.

Stream	Mahoning River 28.7	Mahoning River 28.1	Mahoning River 26.8
River Mile			
Date Sampled	7/24/2012	7/24/2012	7/24/2012
Semi-volatile Organic Analytes (ug/l)			
2,4,6-Trichlorophenol	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND
2-Chlorophenol	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND
2-Methylphenol	ND	ND	ND
2-Nitroaniline	ND	ND	ND
2-Nitrophenol	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND
3-,4-Methylphenol	ND	ND	ND
3-Nitroaniline	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND
4-Bromophenyl phenylether	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND
4-Chloroaniline	ND	ND	ND
4-Chlorophenyl phenylether	ND	ND	ND
4-Nitroaniline	ND	ND	ND
4-Nitrophenol	ND	ND	ND
Acenaphthene	ND	ND	ND
Acenaphthylene	ND	ND	ND
Anthracene	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND
Benzo(ghi)perylene	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND
Benzoic acid	ND	ND	ND
Benzyl alcohol	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND
bis(2-Chloroethyl)-ether	ND	ND	ND
bis(2-Chloroisopropyl)-ether	ND	ND	ND
bis(2-Ethylhexyl)phthalate	4.14 J	ND	ND
Butyl benzyl phthalate	ND	ND	ND
Chrysene	ND	ND	ND
Di-n-butyl phthalate	ND	ND	ND
Di-n-octyl phthalate	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND
Dibenzofuran	ND	ND	ND
Diethyl phthalate	ND	ND	ND
Dimethyl phthalate	ND	ND	ND
Fluoranthene	ND	ND	ND
Fluorene	ND	ND	ND

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	7/24/2012	7/24/2012	7/24/2012
Semi-volatile Organic Analytes (ug/l)			
Hexachlorobenzene	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND
Hexachloroethane	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND
Isophorone	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND
N-Nitrosodi-n-propyl-amine	ND	ND	ND
Naphthalene	ND	ND	ND
Nitrobenzene	ND	ND	ND
Pentachlorophenol	ND	ND	ND
Phenanthrene	ND	ND	ND
Phenol	ND	ND	ND
Pyrene	ND	ND	ND
PCBs (ug/l)			
Aroclor 1016	ND	ND	ND
Aroclor 1221	ND	ND	ND
Aroclor 1232	ND	ND	ND
Aroclor 1242	ND	ND	ND
Aroclor 1248	ND	ND	ND
Aroclor 1254	ND	ND	ND
Aroclor 1260	ND	ND	ND

J - Estimated result. Analyte was positively identified, but the quantitation was below the reporting limit (RL).

ND - not detected at or above the method detection limit.

Appendix Table 2. Results of chemical surface water sampling conducted by Ohio EPA in the Mahoning River, September 5, 2012.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	9/5/2012	9/5/2012	9/5/2012
Metals (ug/l)			
Arsenic	ND	ND	ND
Lead	ND	ND	ND
Antimony	ND	ND	ND
Barium	31.6	30.8	31.0
Selenium	ND	ND	ND
Beryllium	ND	ND	ND
Thallium	0.101 J	0.125 J	0.108 J
Cadmium	ND	ND	ND
Chromium	ND	ND	ND
Cobalt	ND	ND	ND
Nickel	ND	ND	ND
Silver	ND	ND	ND
Vanadium	ND	ND	ND
Zinc	ND	ND	ND
Mercury	ND	ND	ND
Volatile Organic Analytes (ug/l)			
Acetone	3.55 J	4.54 J	6.03 J
Benzene	ND	ND	ND
Bromobenzene	ND	ND	ND
Bromochloromethane	ND	ND	ND
Bromodichloromethane	ND	ND	ND
Bromoform	ND	ND	ND
Bromomethane	ND	ND	ND
2-Butanone	ND	ND	ND
n-Butylbenzene	ND	ND	ND
sec-Butylbenzene	ND	ND	ND
tert-Butylbenzene	ND	ND	ND
Carbon disulfide	ND	ND	ND
Carbon tetrachloride	ND	ND	ND
Chlorobenzene	ND	ND	ND
Chlorodibromomethane	ND	ND	ND
Chloroethane	ND	ND	ND
2-Chloroethyl vinyl ether	ND	ND	ND
Chloroform	0.355 J	0.491 J	0.442 J
Chloromethane	ND	ND	ND
2-Chlorotoluene	ND	ND	ND
Dibromomethane	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND
1,1-Dichloroethane	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND

Appendix Table 2. Continued.

Stream	Mahoning River 28.7	Mahoning River 28.1	Mahoning River 26.8
River Mile			
Date Sampled	9/5/2012	9/5/2012	9/5/2012
Volatile Organic Analytes (ug/l)			
cis-1,2-Dichloroethene	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND
1,3-Dichloropropane	ND	ND	ND
2,2-Dichloropropane	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND
1,1-Dichloropropene	ND	ND	ND
Ethylbenzene	ND	ND	ND
n-Hexane	ND	ND	ND
2-Hexanone	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Isopropylbenzene	ND	ND	ND
p-Isopropyltoluene	ND	ND	ND
Methylene chloride	ND	ND	ND
4-Methyl-2-pentanone	ND	ND	ND
Naphthalene	ND	ND	ND
n-Propylbenzene	ND	ND	ND
Styrene	ND	ND	ND
1,1,1,2-Tetrachloroethane	ND	ND	ND
1,1,2,2-Tetrachloroethane	ND	ND	ND
Tetrachloroethene	ND	ND	ND
Toluene	ND	ND	ND
1,2,3-Trichlorobenzene	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND
Trichloroethene	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	ND
1,2,4-Trimethylbenzene	ND	ND	ND
1,3,5-Trimethylbenzene	ND	ND	ND
Vinyl acetate	ND	ND	ND
Vinyl chloride	ND	ND	ND
o-Xylene	ND	ND	ND
m-,p-Xylene	ND	ND	ND
Semi-volatile Organic Analytes (ug/l)			
1,2,4-Trichlorobenzene	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND

Appendix Table 2. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	9/5/2012	9/5/2012	9/5/2012
Semi-volatile Organic Analytes (ug/l)			
2,4-Dinitrotoluene	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND
2-Chlorophenol	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND
2-Methylphenol	ND	ND	ND
2-Nitroaniline	ND	ND	ND
2-Nitrophenol	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND
3-,4-Methylphenol	ND	ND	ND
3-Nitroaniline	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND
4-Bromophenyl phenylether	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND
4-Chloroaniline	ND	ND	ND
4-Chlorophenyl phenylether	ND	ND	ND
4-Nitroaniline	ND	ND	ND
4-Nitrophenol	ND	ND	ND
Acenaphthene	ND	ND	ND
Acenaphthylene	ND	ND	ND
Anthracene	ND	ND	ND
Benzo(a)anthracene	ND	ND	ND
Benzo(a)pyrene	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND
Benzo(ghi)perylene	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND
Benzoic acid	ND	ND	ND
Benzyl alcohol	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND
bis(2-Chloroethyl)-ether	ND	ND	ND
bis(2-Chloroisopropyl)-ether	ND	ND	ND
bis(2-Ethylhexyl)phthalate	3.20 J	ND	ND
Butyl benzyl phthalate	ND	ND	ND
Chrysene	ND	ND	ND
Di-n-butyl phthalate	ND	ND	ND
Di-n-octyl phthalate	ND	ND	ND
Dibenzo(a,h)anthracene	ND	ND	ND
Dibenzofuran	ND	ND	ND
Diethyl phthalate	ND	ND	ND
Dimethyl phthalate	ND	ND	ND
Fluoranthene	ND	ND	ND
Fluorene	ND	ND	ND
Hexachlorobenzene	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND
Hexachloroethane	ND	ND	ND

Appendix Table 2. Continued.

Stream	Mahoning River 28.7	Mahoning River 28.1	Mahoning River 26.8
River Mile			
Date Sampled	9/5/2012	9/5/2012	9/5/2012
Semi-volatile Organic Analytes (ug/l)			
Indeno(1,2,3-cd)pyrene	ND	ND	ND
Isophorone	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND
N-Nitrosodi-n-propyl-amine	ND	ND	ND
Naphthalene	ND	ND	ND
Nitrobenzene	ND	ND	ND
Pentachlorophenol	ND	ND	ND
Phenanthrene	ND	ND	ND
Phenol	ND	ND	ND
Pyrene	ND	ND	ND
PCBs (ug/l)			
Aroclor 1016	ND	ND	ND
Aroclor 1221	ND	ND	ND
Aroclor 1232	ND	ND	ND
Aroclor 1242	ND	ND	ND
Aroclor 1248	ND	ND	ND
Aroclor 1254	ND	ND	ND
Aroclor 1260	ND	ND	ND

J - Estimated result. Analyte was positively identified, but the quantitation was below the reporting limit (RL).

ND - not detected at or above the method detection limit.

Appendix Table 3. Results of sediment sampling conducted by Ohio EPA in the Mahoning River, September 5, 2012.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	9/5/2012	9/5/2012	9/5/2012
Metals (mg/kg)			
Arsenic	40.3	21.1	17.6
Lead	474	302	169
Antimony	8.53	9.29	2.84
Barium	132	99.3	100
Selenium	3.77	2.89	2.20
Beryllium	0.869 J	0.731 J	0.818
Thallium	1.42	0.906	0.851
Cadmium	3.53	2.87	2.01
Chromium	432	424	159
Cobalt	14.3	15.2	9.60
Nickel	268	246	98.4
Silver	9.52	6.02	3.52
Vanadium	37.6	31.0	20.8
Zinc	2290	1860	985
Mercury	0.802	0.497 J	0.375 J
Volatile Organic Analytes (ug/kg)			
Acetone	221	75.4	51.0
Benzene	ND	ND	ND
Bromobenzene	ND	ND	ND
Bromochloromethane	ND	ND	ND
Bromodichloromethane	ND	ND	ND
Bromoform	ND	ND	ND
Bromomethane	ND	ND	ND
2-Butanone	ND	15.3 J	12.3 J
n-Butylbenzene	ND	ND	ND
sec-Butylbenzene	11.5 E	ND	ND
tert-Butylbenzene	ND	ND	ND
Carbon disulfide	16.6 J	ND	ND
Carbon tetrachloride	ND	ND	ND
Chlorobenzene	ND	ND	ND
Chlorodibromomethane	ND	ND	ND
Chloroethane	ND	ND	ND
2-Chloroethyl vinyl ether	ND	ND	ND
Chloroform	ND	ND	ND
Chloromethane	ND	ND	ND
2-Chlorotoluene	ND	ND	ND
4-Chlorotoluene	ND	ND	ND
1,2-Dibromo-3-chloropropane	ND	ND	ND
1,2-Dibromomethane	ND	ND	ND
Dibromomethane	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
Dichlorodifluoromethane	ND	ND	ND

Appendix Table 3. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	9/5/2012	9/5/2012	9/5/2012
Volatile Organic Analytes (ug/kg)			
1,1-Dichloroethane	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND
trans-1,2-Dichloroethene	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND
1,3-Dichloropropane	ND	ND	ND
2,2-Dichloropropane	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND
trans-1,3-Dichloropropene	ND	ND	ND
1,1-Dichloropropene	ND	ND	ND
Ethylbenzene	ND	ND	ND
n-Hexane	13.2 J	ND	ND
2-Hexanone	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Isopropylbenzene	ND	ND	ND
p-Isopropyltoluene	9.62 E	ND	ND
4-Methyl-2-pentanone	ND	ND	ND
Methylene chloride	ND	3.99 J	2.84 J
Naphthalene	37.4 E	ND	ND
n-Propylbenzene	ND	ND	ND
Styrene	ND	ND	ND
1,1,1,2-Tetrachloroethane	ND	ND	ND
1,1,1,2-Tetrachloroethane	ND	ND	ND
Tetrachloroethene	ND	ND	ND
Toluene	ND	ND	ND
1,2,3-Trichlorobenzene	ND	ND	ND
1,2,4-Trichlorobenzene	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND
Trichloroethene	ND	ND	ND
Trichlorofluoromethane	ND	ND	ND
1,2,3-Trichloropropane	ND	ND	ND
1,2,4-Trimethylbenzene	58.0 E	ND	ND
1,3,5-Trimethylbenzene	21.8 E	ND	ND
Vinyl acetate	ND	ND	ND
Vinyl chloride	ND	ND	ND
o-Xylene	6.53 J	ND	ND
m-,p-Xylene	ND	ND	ND
Semi-volatile Organic Analytes (ug/kg)			
1,2,4-Trichlorobenzene	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND
1,3-Dichlorobenzene	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND

Appendix Table 3. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	9/5/2012	9/5/2012	9/5/2012
Semi-volatile Organic Analytes (ug/kg)			
2,4-Dichlorophenol	ND	ND	ND
2,4-Dimethylphenol	908	ND	ND
2,4-Dinitrophenol	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND
2,6-Dinitrotoluene	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND
2-Chlorophenol	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND
2-Methylphenol	ND	ND	ND
2-Nitroaniline	ND	ND	ND
2-Nitrophenol	ND	ND	ND
3,3'-Dichlorobenzidine	ND	ND	ND
3-,4-Methylphenol	387J	280 J	ND
3-Nitroaniline	ND	ND	ND
4,6-Dinitro-2-methylphenol	ND	ND	ND
4-Bromophenyl phenylether	ND	ND	ND
4-Chloro-3-methylphenol	ND	ND	ND
4-Chloroaniline	ND	ND	ND
4-Chlorophenyl phenylether	ND	ND	ND
4-Nitroaniline	ND	ND	ND
4-Nitrophenol	ND	ND	ND
Acenaphthene	ND	ND	ND
Acenaphthylene	ND	ND	ND
Anthracene	337 J	ND	ND
Benzo(a)anthracene	829	523	1130 J
Benzo(a)pyrene	661	560	1180 J
Benzo(b)fluoranthene	946	606	1270 J
Benzo(ghi)perylene	ND	ND	ND
Benzo(k)fluoranthene	555	529	952 J
Benzoic acid	ND	ND	ND
Benzyl alcohol	ND	ND	ND
bis(2-Chloroethoxy)methane	ND	ND	ND
bis(2-Chloroethyl)-ether	ND	ND	ND
bis(2-Chloroisopropyl)-ether	ND	ND	ND
bis(2-Ethylhexyl)phthalate	1500	606	ND
Butyl benzyl phthalate	ND	ND	ND
Chrysene	1320	617	1280 J
Di-n-butyl phthalate	545	ND	ND
Di-n-octyl phthalate	ND	415 J	ND
Dibenzo(a,h)anthracene	ND	ND	ND
Dibenzofuran	ND	ND	ND
Diethyl phthalate	ND	ND	ND
Dimethyl phthalate	ND	ND	ND
Fluoranthene	2170	1220	2630

Appendix Table 3. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	28.7	28.1	26.8
Date Sampled	9/5/2012	9/5/2012	9/5/2012
Semi-volatile Organic Analytes (ug/kg)			
Fluorene	382 J	ND	ND
Hexachlorobenzene	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND
Hexachloroethane	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	ND	ND
Isophorone	ND	ND	ND
N-Nitrosodiphenylamine	ND	ND	ND
N-Nitrosodipropylamine	ND	ND	ND
Naphthalene	279 J	ND	ND
Nitrobenzene	ND	ND	ND
Pentachlorophenol	ND	ND	ND
Phenanthrene	1600	408 J	976 J
Phenol	11,800	ND	ND
Pyrene	2230	1080	1970
PCBs (ug/kg)			
Aroclor 1016	ND	ND	ND
Aroclor 1221	ND	ND	ND
Aroclor 1232	ND	ND	ND
Aroclor 1242	ND	ND	ND
Aroclor 1248	ND	ND	ND
Aroclor 1254	ND	ND	ND
Aroclor 1260	234	320	81.0
Other Parameters			
Diesel Range Organics (C10-C28) - mg/kg	8,520	4,370	418
Gasoline Range Organics (C6-C12) - ug/kg	6690	1500	2960
Percent Solids	37.0	41.1	47.8

J - Estimated result. Analyte was positively identified, but the quantitation was below the reporting limit (RL).

E - Estimated concentration due to sample matrix interference.

ND - not detected at or above the method detection limit.

Appendix Table 4. Fish Species List

River Code: 18-001	Stream: Mahoning River	Sample Date: 2012
River Mile: 28.70	Location: dst. Olive St.	Date Range: 07/24/2012
Time Fished: 4070 sec	Drainage: 857.0 sq mi	Thru: 09/05/2012
Dist Fished: 1.00 km	Basin: Mahoning River	Sampler Type: A
	No of Passes: 2	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Silver Redhorse	R	I	S	M	3	3.00	1.64	2.79	4.76	930.67
Golden Redhorse	R	I	S	M	1	1.00	0.55	0.41	0.70	410.00
White Sucker	W	O	S	T	1	1.00	0.55	0.13	0.22	132.00
Common Carp	G	O	M	T	12	12.00	6.56	39.35	67.07	3,279.17
Spotfin Shiner	N	I	M		53	53.00	28.96	0.24	0.42	4.61
Bluntnose Minnow	N	O	C	T	2	2.00	1.09	0.00	0.01	1.50
Channel Catfish	F		C		9	9.00	4.92	9.90	16.87	1,100.00
Yellow Bullhead		I	C	T	1	1.00	0.55	0.03	0.05	28.00
Blackstripe Topminnow		I	M		2	2.00	1.09	0.00	0.01	2.00
Black Crappie	S	I	C		7	7.00	3.83	1.50	2.56	214.29
Rock Bass	S	C	C		7	7.00	3.83	0.59	1.01	84.29
Smallmouth Bass	F	C	C	M	8	8.00	4.37	1.13	1.93	141.25
Largemouth Bass	F	C	C		2	2.00	1.09	0.25	0.43	125.00
Green Sunfish	S	I	C	T	9	9.00	4.92	0.38	0.65	42.22
Bluegill Sunfish	S	I	C	P	29	29.00	15.85	0.90	1.53	31.03
Pumpkinseed Sunfish	S	I	C	P	31	31.00	16.94	0.55	0.93	17.58
Bluegill X Pumpkinseed					1	1.00	0.55	0.13	0.22	130.00
Yellow Perch			M		5	5.00	2.73	0.38	0.65	76.20
<i>Mile Total</i>					183	183.00		58.67		
<i>Number of Species</i>					17					
<i>Number of Hybrids</i>					1					

Appendix Table 4. Fish Species List

River Code: 18-001	Stream: Mahoning River	Sample Date: 2012
River Mile: 28.10	Location: adj. U.S. Steel McDonald property	Date Range: 07/24/2012
Time Fished: 4885 sec	Drainage: 858.0 sq mi	Thru: 09/05/2012
Dist Fished: 1.00 km	Basin: Mahoning River	Sampler Type: A
	No of Passes: 2	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Common Carp	G	O	M	T	12	12.00	3.37	39.50	76.02	3,291.67
Spotfin Shiner	N	I	M		17	17.00	4.78	0.11	0.22	6.71
Bluntnose Minnow	N	O	C	T	14	14.00	3.93	0.07	0.14	5.18
Yellow Bullhead		I	C	T	1	1.00	0.28	0.14	0.27	140.00
Blackstripe Topminnow		I	M		2	2.00	0.56	0.01	0.01	2.50
Rock Bass	S	C	C		12	12.00	3.37	0.72	1.38	59.83
Smallmouth Bass	F	C	C	M	3	3.00	0.84	1.38	2.66	460.00
Largemouth Bass	F	C	C		2	2.00	0.56	0.05	0.09	23.50
Green Sunfish	S	I	C	T	12	12.00	3.37	0.25	0.48	20.83
Bluegill Sunfish	S	I	C	P	70	70.00	19.66	2.27	4.37	32.47
Pumpkinseed Sunfish	S	I	C	P	189	189.00	53.09	5.21	10.03	27.57
Green Sf X Pumpkinseed					1	1.00	0.28	0.02	0.04	20.00
Walleye	F	P	S		2	2.00	0.56	0.27	0.52	135.00
Yellow Perch			M		19	19.00	5.34	1.96	3.77	103.16
<i>Mile Total</i>					356	356.00		51.96		
<i>Number of Species</i>					13					
<i>Number of Hybrids</i>					1					

Appendix Table 4. Fish Species List

River Code: 18-001	Stream: Mahoning River	Sample Date: 2012
River Mile: 26.80	Location: dst. Squaw Creek	Date Range: 07/24/2012
Time Fished: 4099 sec	Drainage: 880.0 sq mi	Thru: 09/05/2012
Dist Fished: 1.00 km	Basin: Mahoning River	Sampler Type: A
	No of Passes: 2	

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Gizzard Shad		O	M		1	1.00	0.27	0.22	0.31	220.00
Northern Pike	F	P	M		1	1.00	0.27	0.28	0.39	280.00
White Sucker	W	O	S	T	1	1.00	0.27	0.59	0.82	590.00
Spotted Sucker	R	I	S		1	1.00	0.27	0.29	0.40	290.00
Common Carp	G	O	M	T	14	14.00	3.75	51.15	70.95	3,653.57
Spotfin Shiner	N	I	M		15	15.00	4.02	0.09	0.13	6.20
Bluntnose Minnow	N	O	C	T	7	7.00	1.88	0.01	0.02	1.71
Channel Catfish	F		C		6	6.00	1.61	9.20	12.76	1,533.33
Yellow Bullhead		I	C	T	3	3.00	0.80	0.27	0.37	90.00
Blackstripe Topminnow		I	M		2	2.00	0.54	0.00	0.00	1.50
White Crappie	S	I	C		3	3.00	0.80	0.45	0.62	150.00
Black Crappie	S	I	C		4	4.00	1.07	0.30	0.42	75.00
Rock Bass	S	C	C		6	6.00	1.61	0.49	0.68	81.67
Smallmouth Bass	F	C	C	M	2	2.00	0.54	0.90	1.25	450.00
Largemouth Bass	F	C	C		8	8.00	2.14	2.10	2.91	262.50
Warmouth Sunfish	S	C	C		1	1.00	0.27	0.02	0.03	23.00
Green Sunfish	S	I	C	T	5	5.00	1.34	0.14	0.20	28.80
Bluegill Sunfish	S	I	C	P	81	81.00	21.72	1.66	2.30	20.52
Pumpkinseed Sunfish	S	I	C	P	183	183.00	49.06	2.75	3.81	15.02
Green Sf X Bluegill Sf					3	3.00	0.80	0.14	0.19	46.67
Yellow Perch			M		26	26.00	6.97	1.03	1.43	39.62
<i>Mile Total</i>					373	373.00		72.10		
<i>Number of Species</i>					20					
<i>Number of Hybrids</i>					1					

Appendix Table 5. Index of Biotic Integrity (IBI) scores and metrics for the Mahoning River, 2012.

River Mile	Type	Date	Drainage area (sq mi)	Number of				Percent of Individuals						DELTA anomalies	Rel.No. minus tolerants /(1.0 km)	Modified IBI	lwb
				Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omnivores	Top carnivores	Insect- ivores				
Mahoning River - (18-001)																	
Year: 2012																	
28.70	A	07/24/2012	857	12(3)	5(5)	2(1)	0(1)	1(1)	2(1)	9(5)	4(5)	8(3)	80(5)	1.7(3)	210(3)	36	7.6
28.70	A	09/05/2012	857	14(3)	5(5)	2(1)	0(1)	4(1)	4(1)	22(3)	15(5)	12(5)	65(5)	1.5(5)	106(1) *	36	6.9
28.10	A	07/24/2012	858	12(3)	4(5)	0(1)	0(1)	0(1)	1(1)	12(5)	8(5)	5(1)	81(5)	0.0(5)	398(3)	36	7.0
28.10	A	09/05/2012	858	9(1)	4(5)	0(1)	0(1)	0(1)	0(1)	10(5)	7(5)	6(3)	82(5)	0.0(5)	236(3)	36	6.0
26.80	A	07/24/2012	880	11(3)	5(5)	0(1)	0(1)	0(1)	0(1)	8(5)	6(5)	2(1)	78(5)	0.5(5)	346(3)	36	7.0
26.80	A	09/05/2012	880	16(3)	6(5)	2(1)	0(1)	1(1)	1(1)	8(5)	6(5)	8(3)	81(5)	0.0(5)	340(3)	38	7.3

* - < 200 Total individuals in sample

Appendix Table 6. Invertebrate Community Index (ICI) scores and metrics for the Mahoning River, 2012.

River Mile	Drainage Area (sq mi)	Number of				Percent:					Qual. EPT	Eco-region	ICI
		Total Taxa	Mayfly Taxa	Caddisfly Taxa	Dipteran Taxa	Mayflies	Caddisflies	Tany-tarsini	Other Dipt/NI	Tolerant Organisms			
Mahoning River (18-001)													
Year: 2012													
28.70	857.0	27(4)	1(0)	4(4)	11(4)	10.2(2)	1.5(0)	0.0(0)	87.5(0)	28.2(0)	3(0)	3	14
28.10	858.0	15(2)	0(0)	0(0)	6(2)	0.0(0)	0.0(0)	0.0(0)	97.2(0)	11.5(0)	2(0)	3	4
26.80	880.0	26(4)	1(0)	1(0)	11(4)	0.0(2)	0.5(0)	0.0(0)	95.7(0)	14.7(0)	1(0)	3	10

**Appendix Table 7. Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection**

Site: Mahoning River
dst. Olive St.

Collection Date: 09/05/2012 River Code: 18-001 RM: 28.70

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
00401	<i>Spongillidae</i>	+	<hr/> No. Quantitative Taxa: 27 Total Taxa: 44 No. Qualitative Taxa: 25 ICI: 14 Number of Organisms: 1986 Qual EPT: 3		
01320	<i>Hydra sp</i>	1			
01801	<i>Turbellaria</i>	1			
05800	<i>Caecidotea sp</i>	1 +			
06810	<i>Gammarus fasciatus</i>	53 +			
11200	<i>Callibaetis sp</i>	+			
11245	<i>Centroptilum sp</i>	+			
13400	<i>Stenacron sp</i>	202			
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	13 +			
24900	<i>Gomphus sp</i>	+			
27307	<i>Epitheca (Epicordulia) princeps</i>	+			
27406	<i>Neurocordulia obsoleta</i>	2 +			
50906	<i>Psychomyia flavida</i>	9			
51600	<i>Polycentropus sp</i>	4			
52200	<i>Cheumatopsyche sp</i>	8			
57900	<i>Pycnopsyche sp</i>	+			
59100	<i>Ceraclea sp</i>	8			
60900	<i>Peltodytes sp</i>	+			
68601	<i>Ancyronyx variegata</i>	+			
68901	<i>Macronychus glabratus</i>	3 +			
72700	<i>Anopheles sp</i>	+			
77120	<i>Ablabesmyia mallochii</i>	+			
77130	<i>Ablabesmyia rhamphe group</i>	94			
77750	<i>Hayesomyia senata or Thienemannimyia norena</i>	24			
77800	<i>Helopelopia sp</i>	12			
78655	<i>Procladius (Holotanypus) sp</i>	+			
80410	<i>Cricotopus (C.) sp</i>	12			
81200	<i>Nanocladius sp</i>	12			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	12			
82730	<i>Chironomus (C.) decorus group</i>	+			
82800	<i>Cladopelma sp</i>	+			
83002	<i>Dicrotendipes modestus</i>	+			
83040	<i>Dicrotendipes neomodestus</i>	130 +			
83050	<i>Dicrotendipes lucifer</i>	212			
84450	<i>Polypedilum (Uresipedilum) flavum</i>	+			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	83			
84700	<i>Stenochironomus sp</i>	24			
84790	<i>Tribelos fuscicorne</i>	307			
93200	<i>Hydrobiidae</i>	123 +			
95100	<i>Physella sp</i>	492 +			
96100	<i>Menetus (Micromenetus) sp</i>	76			
96900	<i>Ferrissia sp</i>	68			

**Appendix Table 7. Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection**

Site: Mahoning River

Collection Date: 09/06/2012 River Code: 18-001 RM: 28.10

adj. U.S. Steel McDonald property

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
00401	<i>Spongillidae</i>	+			
01320	<i>Hydra sp</i>	21			
01801	<i>Turbellaria</i>	73			
03600	<i>Oligochaeta</i>	109			+
04960	<i>Mooreobdella sp</i>				+
06810	<i>Gammarus fasciatus</i>	1			+
11200	<i>Callibaetis sp</i>				+
22001	<i>Coenagrionidae</i>				+
22300	<i>Argia sp</i>	41			+
27307	<i>Epitheca (Epicordulia) princeps</i>				+
57900	<i>Pycnopsyche sp</i>				+
60900	<i>Peltodytes sp</i>				+
77120	<i>Ablabesmyia mallochi</i>				+
77130	<i>Ablabesmyia rhamphe group</i>	24			
78655	<i>Procladius (Holotanypus) sp</i>				+
79030	<i>Tanypus "punctipennis" (sensu Roback, 1977)</i>				+
81231	<i>Nanocladius (N.) crassicornus or N. (N.) "rectinervis"</i>	6			
82800	<i>Cladopelma sp</i>				+
83002	<i>Dicrotendipes modestus</i>				+
83040	<i>Dicrotendipes neomodestus</i>				+
83050	<i>Dicrotendipes lucifer</i>	65			
84470	<i>Polypedilum (P.) illinoense</i>				+
84540	<i>Polypedilum (Tripodura) scalaenum group</i>	12			
84700	<i>Stenochironomus sp</i>	6			
84790	<i>Tribelos fuscicorne</i>	360			
93200	<i>Hydrobiidae</i>	589			+
95100	<i>Physella sp</i>	53			
96002	<i>Helisoma anceps anceps</i>				+
96100	<i>Menetus (Micromenetus) sp</i>	81			
96900	<i>Ferrissia sp</i>	5			

No. Quantitative Taxa: 15 Total Taxa: 30

No. Qualitative Taxa: 19 ICI: 4

Number of Organisms: 1446 Qual EPT: 2

**Appendix Table 7. Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection**

Site: Mahoning River
dst. Squaw Creek

Collection Date: 09/05/2012 River Code: 18-001 RM: 26.80

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01320	<i>Hydra sp</i>	25			
01801	<i>Turbellaria</i>	27 +			
03600	<i>Oligochaeta</i>	434 +			
04666	<i>Helobdella triserialis</i>	+			
04960	<i>Mooreobdella sp</i>	+			
06810	<i>Gammarus fasciatus</i>	19 +			
11200	<i>Callibaetis sp</i>	1 +			
22001	<i>Coenagrionidae</i>	115 +			
22300	<i>Argia sp</i>	22			
27307	<i>Epitheca (Epicordulia) princeps</i>	1 +			
27610	<i>Epitheca (Tetragoneuria) cynosura</i>	+			
28500	<i>Libellula sp</i>	+			
28955	<i>Plathemis lydia</i>	+			
43300	<i>Ranatra sp</i>	+			
54300	<i>Oxyethira sp</i>	18			
60900	<i>Peltodytes sp</i>	+			
65800	<i>Berosus sp</i>	1			
68901	<i>Macronychus glabratus</i>	1			
74501	<i>Ceratopogonidae</i>	16			
77120	<i>Ablabesmyia mallochi</i>	25 +			
77130	<i>Ablabesmyia rhamphe group</i>	175 +			
78655	<i>Procladius (Holotanypus) sp</i>	25 +			
82730	<i>Chironomus (C.) decorus group</i>	25 +			
82800	<i>Cladopelma sp</i>	100 +			
83002	<i>Dicrotendipes modestus</i>	250 +			
83003	<i>Dicrotendipes fumidus</i>	+			
83040	<i>Dicrotendipes neomodestus</i>	350			
83050	<i>Dicrotendipes lucifer</i>	725			
84302	<i>Phaenopsectra punctipes</i>	75			
84470	<i>Polypedilum (P.) illinoense</i>	+			
84790	<i>Tribelos fuscicorne</i>	650			
85800	<i>Tanytarsus sp</i>	+			
93200	<i>Hydrobiidae</i>	567 +			
95100	<i>Physella sp</i>	32			
95900	<i>Gyraulus sp</i>	+			
96264	<i>Planorbella (Pierosoma) pilsbryi</i>	1			
96900	<i>Ferrissia sp</i>	58			

No. Quantitative Taxa: 26 Total Taxa: 37

No. Qualitative Taxa: 24 ICI: **10**

Number of Organisms: 3738 Qual EPT: 1