

Biological and Water Quality Study of the Mahoning River, 2012

Former Warren Gasification Facility

Trumbull County



OHIO EPA Technical Report EAS/2012-12-14

Division of Surface Water
Ecological Assessment Section
November 16, 2012

Biological and Water Quality Study

Mahoning River

(Former Warren Gasification Plant)

2012

Trumbull County, Ohio
November 16, 2012
OEPA Report EAS/2012-12-14

prepared for
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

TABLE OF CONTENTS

SUMMARY	3
RECOMMENDATIONS.....	3
ACKNOWLEDGEMENTS	4
INTRODUCTION.....	5
METHODS	8
RESULTS.....	10
Surface Water	10
Sediment	10
Stream Physical Habitat.....	12
Fish Community	13
Macroinvertebrate Community	14
REFERENCES.....	15
APPENDICES	16

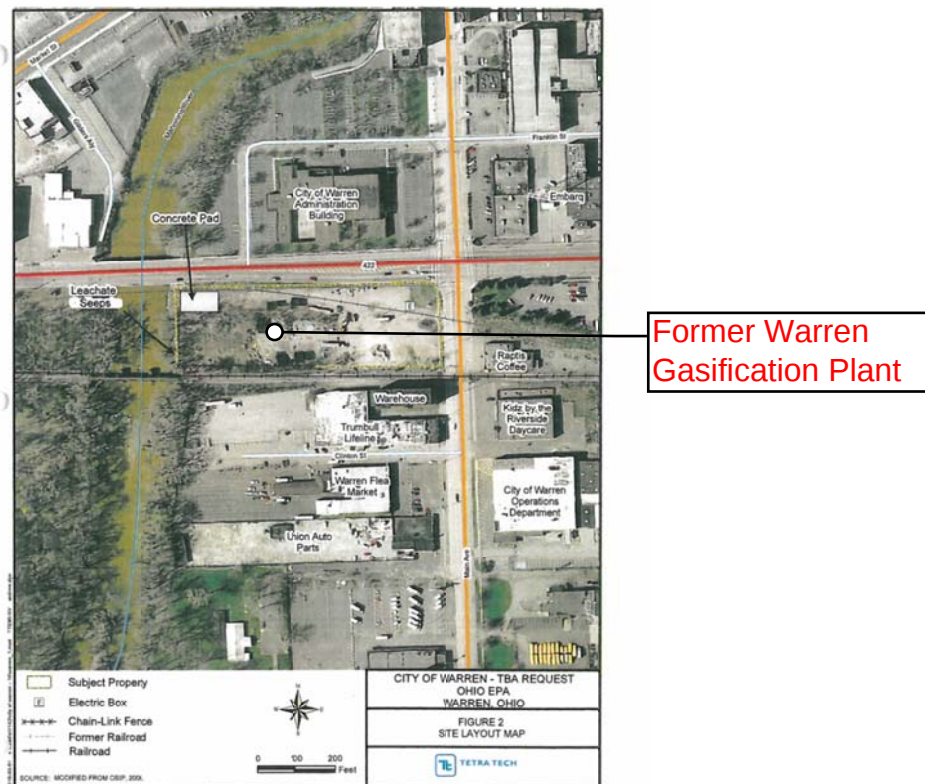
EXECUTIVE SUMMARY

A one mile section of the Mahoning River in the Warren area was assessed by the Ohio EPA in 2012. Based on the performance of the biological communities, the entire one mile of the Mahoning River study area was in full attainment of the Warmwater Habitat (WWH) aquatic life use (Table 1). Biological communities were reflective of good to very good conditions. Based on the sampling results of this survey, the former Warren Gasification property did not cause impairment to the biological communities in the Mahoning River in 2012.

Biological communities have improved in the Mahoning River study segment since 1980, when fish and macroinvertebrate communities were in the poor to fair range. Results during 2012 documented good to very good 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.



ACKNOWLEDGEMENTS

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

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

Data support: Dennis Mishne

Report preparation and analysis: David Altfater, Mike Gray

Reviewers - Jeff DeShon, Holly Tucker

INTRODUCTION

A one 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 Warren Gasification 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 Warren Gasification 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
38.2	WWH	FULL	44	8.9	40	77.5 (excellent)	None
38.0	WWH	FULL	NA	NA	36	NA	
37.6	WWH	FULL	47	9.2	42	81.5 (excellent)	

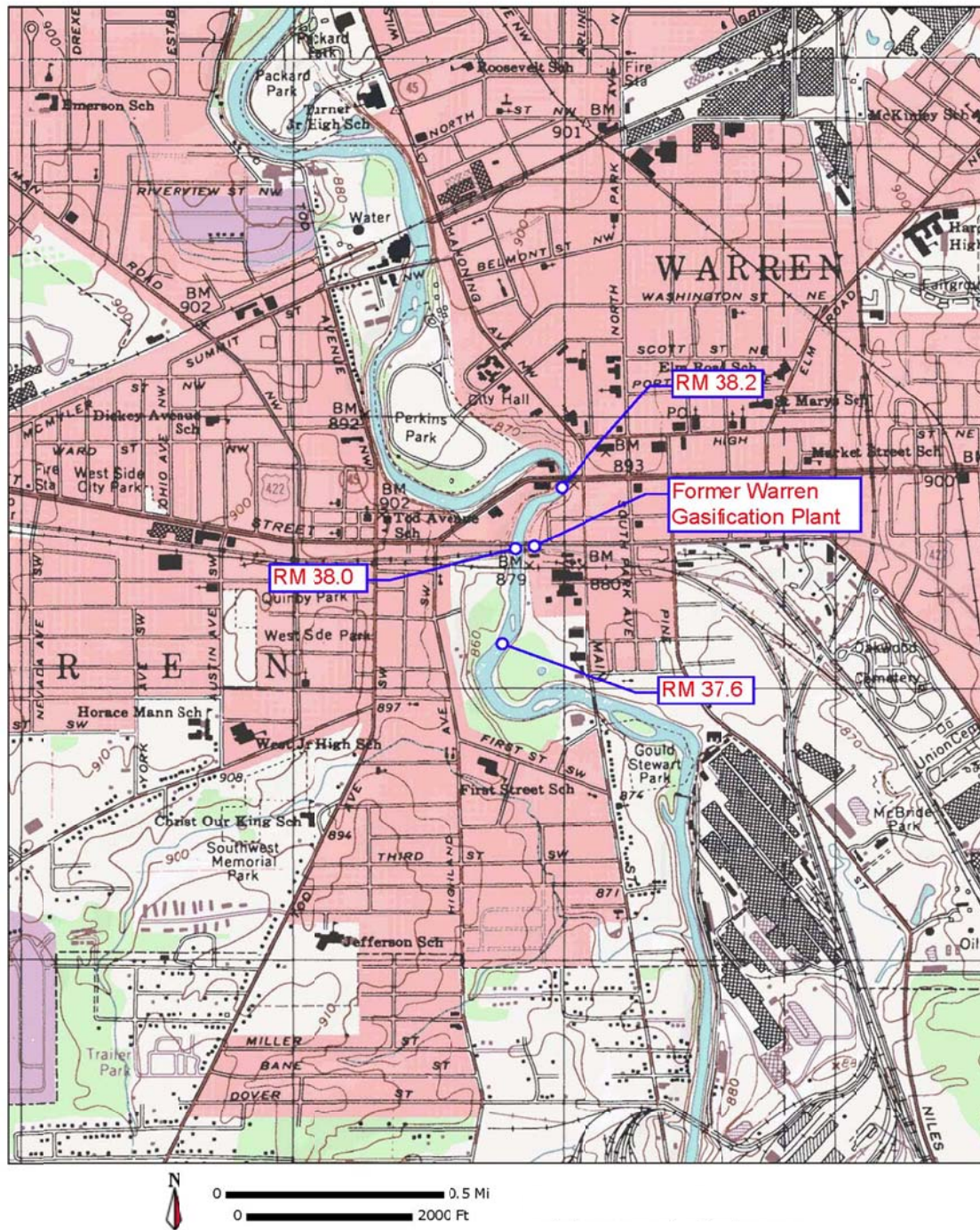
BIOCRITERIA		
INDEX - Site Type		
IBI: Boat		40
MIwb: Boat		8.7
ICI		34

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 Warren Gasification 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
38.2	F,M,W,S	41.2353	-80.8214	Upstream former Warren Gasification property
38.0	M,W,S	41.2333	-80.8231	Adjacent former Warren Gasification property
37.6	F,M,W,S	41.2283	-80.8233	Downstream former Warren Gasification property

Figure 1. Sampling locations in the Mahoning River at the former Warren Gasification property area, 2012.



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 (the sampling area at RM 38.0 was less than 30 meters in length). 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 an upstream site and a combination adjacent/downstream site in the Mahoning River site using pulsed DC boat electrofishing methods. Because of the limited length of Warren Gasification property located along the Mahoning River, a fish site located strictly within the property limits was not feasible. 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 23 and September 4, 2012 from three locations in the Mahoning River (Appendix Tables 1 and 2). Surface water samples were analyzed for total analyte list 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 4, 2012. Sampling locations were co-located with biological sampling sites. Samples were analyzed for total analyte list 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 any of the three sites and fine substrates were sparse even along the river margins.

Chemical parameters measured above ecological screening guidelines are presented in Table 3. All three sampling locations in the Mahoning River exhibited some degree of elevated sediment chemical levels. Several metal and PAH compounds were reported above PEC levels, which would suggest some impairment to biological communities. However, good biological integrity was documented at all three sampling locations where elevated PAHs and metals were noted. The sparse deposits of fine grained material at each sampling site contributed to low exposure levels of sediment contaminants to biological communities. Based on the sampling results of this survey, the Warren Gasification property did not cause impairment to the biological communities in the Mahoning 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 38.2	RM 38.0	RM 37.6
Antimony (mg/kg)	2.7	1.62	2.09
Arsenic (mg/kg)	13.4	10.9	8.93
Chromium (mg/kg)	175	104	122
Copper (mg/kg)	83	60.5	78.8
Iron (mg/kg)	42,300	32,400	30,300
Lead (mg/kg)	69.9	54.1	51.4
Manganese (mg/kg)	1520	1040	833
Nickel (mg/kg)	123	81.5	90.9
Zinc (mg/kg)	126	161	176
Mercury (mg/kg)	0.0652 J	0.190 J	0.077 J
Acetone (ug/kg)	ND	89.8	88.2
Acenaphthene (ug/kg)	ND	1580 J	ND
Benzo(a)anthracene (ug/kg)	830 J	3180	521
Benzo(ghi) perylene	ND	1750 J	315 J
Benzo(k)fluoranthene (ug/kg)	867 J	3710	541
Benzo(a)pyrene (ug/kg) (ug/kg)	811 J	3230	545
Chrysene (ug/kg)	928 J	4030	668
Fluoranthene (ug/kg)	2080	9630	1350
Fluorene (ug/kg)	ND	1290 J	ND
Indeno (1,2,3-cd)pyrene (ug/kg)	ND	1760 J	301 J
Phenanthrene (ug/kg)	1210	5300	463
Pyrene (ug/kg)	1590	7030	1030
Total PAHs (ug/kg)	8999	45,610	6296
Arochlor 1260 (ug/kg)	219	89.9	74.3

J - Estimated result. Result is less than RL.

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

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 4. Mahoning River sampling locations were represented by natural, free flowing conditions. Cobble and gravel were the two predominant substrate types at each sampling location, with normal to moderate levels of silt and bottom embeddedness. Riffle and run areas comprised 30 percent of the sampling areas at each site. QHEI scores for the Mahoning River sites ranged between 77.5 and 81.5. These scores are indicative of excellent river habitat which has the potential to support WWH and EWH biological communities.

Table 4. Qualitative Habitat Evaluation Index (QHEI) scores and physical attributes for fish sampling sites in the Mahoning River, former Warren Gasification property area, 2012.

River Mile	QHEI	Habitat Rating	MWH Attributes																															
			WWH Attributes												MWH Attributes																			
															High Influence								Moderate Influence											
			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	
Mahoning River Year: 2012																																		
38.2	77.5	Excellent	■	■		■	■	■	■		■		7						0										●	●		2	0.13	0.38
37.6	81.5	Excellent	■	■		■	■	■	■		■		7						0										●	●		2	0.13	0.38

Fish Community

A total of 603 fish representing 25 species were collected from the Mahoning River in the former Warren Gasification 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 good to very good in the Mahoning River. Results from both fish sampling locations indicated comparable quality from upstream to adjacent/downstream, with no obvious impacts associated with the former Warren Gasification property. IBI scores were in the very good range in the Mahoning River, with scores of 44 and 47. These IBI values achieved the ecoregional biocriterion established for WWH streams and rivers in Ohio (Table 5). Modified Index of Well-Being (MIwb) scores were in the good to very good range, with values of 8.9 and 9.2. These MIwb scores also achieved the ecoregional biocriterion established for WWH streams and rivers in Ohio. Fish community results reflected good water quality conditions in the Mahoning River in the vicinity of the former Warren Gasification plant property.

Table 5. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in the Mahoning River, former Warren Gasification 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
38.2	Boat	17.0	20	293	77.5	44	8.9	Very good/ Good
37.6	Boat	17.0	21	310	81.5	47	9.2	Very good

Ecoregion Biocriteria: Erie Ontario Lake Plain (EOLP)			
INDEX - Site Type		WWH	EWB
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 Warren Gasification plant 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 sites upstream and adjacent to the former Warren Gasification property, were evaluated as good with ICI scores of 40 and 36, respectively. The macroinvertebrate community from the downstream sampling location was evaluated as very good with an ICI score of 42. The macroinvertebrate communities from all sampling locations attained the designated WWH use. The former Warren Gasification property did not appear to have an impact on the macroinvertebrate community. The free flowing conditions in these sampling locations created riffle habitat that enabled the development of a substantial mayfly and caddisfly community which contributed to the good and very good macroinvertebrate communities from these sampling locations.

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>							
38.2	526	62	40	41	12	40	Good
38.0	646	64	44	43	15	36	Good
37.6	333	54	40	29	11	42	Very Good

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.

REFERENCES

- MacDonald, D., C. Ingersoll, T. Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. *Arch. Environ. Contam. Toxicol.*: Vol.39, 20-31.
- Ohio Environmental Protection Agency. 2012a. Ohio EPA manual of surveillance methods and quality assurance practices, updated edition. Division of Environmental Services, Columbus, Ohio.
- Ohio Environmental Protection Agency. 2012b. Sediment sampling guide and methodologies, 3rd edition. March 2012. Division of Surface Water, Columbus, Ohio.
- Ohio Environmental Protection Agency. 2008a. 2008 updates to Biological Criteria for the Protection of Aquatic Life: Volume II and Volume II Addendum. Users manual for biological field assessment of Ohio surface waters. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.
- Ohio Environmental Protection Agency. 2008b. 2008 updates to Biological Criteria for the Protection of Aquatic Life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.
- Ohio Environmental Protection Agency. 2006. Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Tech. Bull. EAS/2006-06-1. Div. of Surface Water, Ecol. Assess. Sect., Columbus, Ohio.
- Ohio Environmental Protection Agency. 2003. Ecological risk assessment guidance manual. Feb. 2003. Division of Emergency and Remedial Response, Columbus, Ohio.
- Ohio Environmental Protection Agency. 1989a. Addendum to Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Div. Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.
- Ohio Environmental Protection Agency. 1989b. Biological criteria for the protection of aquatic life: Volume III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Div. Water Quality Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.
- Ohio Environmental Protection Agency. 1987. Biological criteria for the protection of aquatic life: Volume II. Users manual for biological field assessment of Ohio surface waters. Div. Water Qual. Monit. & Assess., Surface Water Section, Columbus, Ohio.
- Rankin, E. T. 1995. The use of habitat assessments in water resource management programs, pp. 181-208. in W. Davis and T. Simon (eds.). *Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making*. Lewis Publishers, Boca Raton, FL.
- Rankin, E.T. 1989. The qualitative habitat evaluation index (QHEI): rationale, methods, and application. Div. Water Qual. Plan. & Assess., Ecol. Assess. Sect., Columbus, Ohio.
- United States Environmental Protection Agency (2003). Region 5, final technical approach for developing ecological screening levels for RCRA Appendix IX constituents and other significant contaminants of ecological concern. August, 2003.

APPENDICES – MAHONING RIVER, 2012

Appendix Table 1. Surface water chemistry results for the Mahoning River, July 23, 2012.

Appendix Table 2. Surface water chemistry results for the Mahoning River, September 4, 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 23, 2012.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	7/23/2012	7/23/2012	7/23/2012
Metals (ug/l)			
Aluminum	138	142	173
Antimony	ND	ND	ND
Arsenic	ND	ND	ND
Barium	29.4	29.0	29.7
Beryllium	ND	ND	ND
Cadmium	ND	ND	ND
Calcium	37,800	38,700	38,900
Chromium	ND	ND	ND
Cobalt	ND	ND	ND
Copper	ND	ND	ND
Iron	403	344	377
Lead	ND	ND	ND
Magnesium	12,200	12,400	12,400
Manganese	164	155	152
Nickel	ND	ND	ND
Potassium	4040	4080	4130
Selenium	ND	ND	ND
Silver	ND	ND	ND
Sodium	28,400	29,200	29,400
Thallium	ND	ND	ND
Vanadium	ND	ND	ND
Zinc	ND	ND	ND
Mercury	ND	ND	ND
Volatile Organic Analytes (ug/l)			
Acetone	ND	2.69 J	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	ND	ND	ND
Chloromethane	ND	ND	ND
2-Chlorotoluene	ND	ND	ND

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	7/23/2012	7/23/2012	7/23/2012
Volatile Organic Analytes (ug/l)			
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
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

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	7/23/2012	7/23/2012	7/23/2012
Volatile Organic Analytes (ug/l)			
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
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	ND	2.59 J	ND
Butyl benzyl phthalate	ND	ND	ND
Chrysene	ND	ND	ND

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	7/23/2012	7/23/2012	7/23/2012
Semi-volatile Organic Analytes (ug/l)			
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
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 4, 2012.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	9/4/2012	9/4/2012	9/4/2012
Metals (ug/l)			
Aluminum	300	192	223
Antimony	ND	ND	ND
Arsenic	ND	ND	ND
Barium	33.1	35.6	35.9
Beryllium	ND	ND	ND
Cadmium	ND	ND	ND
Calcium	33,400	37,100	37,500
Chromium	ND	ND	ND
Cobalt	ND	ND	ND
Copper	ND	ND	ND
Iron	587	345	394
Lead	6.04	2.88 J	2.97 J
Magnesium	11,600	12,800	12,800
Manganese	143	101	107
Nickel	ND	ND	ND
Potassium	3460	4000	4040
Selenium	ND	ND	ND
Silver	ND	ND	ND
Sodium	24,700	28,100	28,600
Thallium	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	ND	ND	0.156 J
Chloromethane	ND	ND	ND
2-Chlorotoluene	ND	ND	ND

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	9/4/2012	9/4/2012	9/4/2012
Volatile Organic Analytes (ug/l)			
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
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

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	9/4/2012	9/4/2012	9/4/2012
Volatile Organic Analytes (ug/l)			
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
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	ND	ND	ND
Butyl benzyl phthalate	ND	ND	ND
Chrysene	ND	ND	ND

Appendix Table 1. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	9/4/2012	9/4/2012	9/4/2012
Semi-volatile Organic Analytes (ug/l)			
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
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 4, 2012.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	9/4/2012	9/4/2012	9/4/2012
Metals (mg/kg)			
Aluminum	4550	5870	5690
Antimony	2.7	1.62	2.09
Arsenic	13.4	10.9	8.93
Barium	67.5	71.9	64.5
Beryllium	0.477 J	0.663 J	0.571 J
Cadmium	0.611 J	0.522 J	0.670 J
Calcium	3250	9430	4910
Chromium	175	104	122
Cobalt	10.8	9.43	10.1
Copper	83	60.5	78.8
Iron	42,300	32,400	30,300
Lead	69.9	54.1	51.4
Magnesium	1340	2590	2180
Manganese	1520	1040	833
Nickel	123	81.5	90.9
Potassium	464	590	581
Selenium	1.13 J	1.26 J	1.40 J
Silver	ND	ND	ND
Sodium	81.7	126	110
Thallium	0.0958	0.106	0.103
Vanadium	13.2	16.4	14.4
Zinc	126	161	176
Mercury	0.0652 J	0.190 J	0.0771 J
Volatile Organic Analytes (ug/kg)			
Acetone	ND	89.8	88.2
Benzene	ND	23.6	ND
Bromobenzene	ND	ND	ND
Bromochloromethane	ND	ND	ND
Bromodichloromethane	ND	ND	ND
Bromoform	ND	ND	ND
Bromomethane	ND	ND	ND
2-Butanone	ND	18.7 J	20.0 J
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	ND	ND	ND
Chloromethane	ND	ND	ND
2-Chlorotoluene	ND	ND	ND

Appendix Table 3. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	9/4/2012	9/4/2012	9/4/2012
Volatile Organic Analytes (ug/kg)			
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
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	103	ND
n-Hexane	ND	ND	ND
2-Hexanone	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Isopropylbenzene	ND	37.7	ND
p-Isopropyltoluene	ND	2.87 J	ND
Methylene chloride	ND	ND	2.62 J
4-Methyl-2-pentanone	ND	ND	ND
Methyl t-butyl ether (MTBE)	ND	ND	ND
Naphthalene	ND	105	ND
n-Propylbenzene	ND	7.28 J	ND
Styrene	ND	ND	ND
1,1,1,2-Tetrachloroethane	ND	ND	ND
1,1,1,2,2-Tetrachloroethane	ND	ND	ND
Tetrachloroethene	ND	ND	ND
Toluene	ND	1.52J	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	112	ND
1,3,5-Trimethylbenzene	ND	22.4	ND
Vinyl acetate	ND	ND	ND
Vinyl chloride	ND	ND	ND

Appendix Table 3. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	9/4/2012	9/4/2012	9/4/2012
Volatile Organic Analytes (ug/kg)			
o-Xylene	ND	11.1	ND
m-,p-Xylene	ND	27.6	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
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	1580 J	ND
Acenaphthylene	ND	ND	ND
Anthracene	ND	ND	ND
Benzo(a)anthracene	830 J	3180	521
Benzo(a)pyrene	811 J	3230	545
Benzo(b)fluoranthene	683 J	3120	562
Benzo(ghi)perylene	ND	1750 J	315 J
Benzo(k)fluoranthene	867 J	3710	541
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	ND	ND	ND
Butyl benzyl phthalate	ND	ND	ND
Chrysene	928 J	4030	668

Appendix Table 3. Continued.

Stream	Mahoning River	Mahoning River	Mahoning River
River Mile	38.2	38.0	37.6
Date Sampled	9/4/2012	9/4/2012	9/4/2012
Semi-volatile Organic Analytes (ug/kg)			
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	2080	9630	1350
Fluorene	ND	1290 J	ND
Hexachlorobenzene	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Hexachlorocyclopentadiene	ND	ND	ND
Hexachloroethane	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ND	1760 J	301 J
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	1210	5300	463
Phenol	ND	ND	ND
Pyrene	1590	7030	1030
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	219	89.9	74.3
Other Parameters			
Diesel Range Organics (C10-C28) - mg/kg	35.8	129.0 J	68.6 J
Gasoline Range Organics (C6-C12) - ug/kg	ND	2330	ND
Percent Solids	53.9	50.9	42.6

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 4. Fish Species List

River Code: 18-001	Stream: Mahoning River	Sample Date: 2012
River Mile: 38.20	Location: West Market St.	Date Range: 07/23/2012
Time Fished: 3921 sec	Drainage: 594.0 sq mi	Thru: 09/04/2012
Dist Fished: 1.00 km	Basin: Mahoning River	No of Passes: 2
		Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Muskellunge [S]	F	P	M		2	2.00	0.68	14.90	13.68	7,450.00
Silver Redhorse	R	I	S	M	6	6.00	2.05	9.40	8.63	1,566.67
Golden Redhorse	R	I	S	M	8	8.00	2.73	4.43	4.06	553.13
Northern Hog Sucker	R	I	S	M	55	55.00	18.77	12.58	11.55	228.75
Spotted Sucker	R	I	S		1	1.00	0.34	0.48	0.44	478.00
Common Carp	G	O	M	T	12	12.00	4.10	40.34	37.04	3,361.46
River Chub	N	I	N	I	31	31.00	10.58	1.69	1.55	54.35
Spotfin Shiner	N	I	M		6	6.00	2.05	0.05	0.05	8.33
Channel Catfish	F		C		2	2.00	0.68	2.43	2.23	1,212.50
Yellow Bullhead		I	C	T	2	2.00	0.68	0.39	0.36	194.00
Stonecat Madtom		I	C	I	1	1.00	0.34	0.01	0.01	12.00
Black Crappie	S	I	C		1	1.00	0.34	0.17	0.16	172.00
Rock Bass	S	C	C		36	36.00	12.29	4.10	3.77	113.97
Smallmouth Bass	F	C	C	M	96	96.00	32.76	16.68	15.32	173.74
Bluegill Sunfish	S	I	C	P	8	8.00	2.73	0.48	0.44	60.00
Walleye	F	P	S		4	4.00	1.37	0.64	0.58	158.75
Logperch	D	I	S	M	3	3.00	1.02	0.08	0.07	26.00
Greenside Darter	D	I	S	M	9	9.00	3.07	0.04	0.04	4.44
Banded Darter	D	I	S	I	8	8.00	2.73	0.02	0.02	2.13
Fantail Darter	D	I	C		2	2.00	0.68	0.01	0.00	2.50
<i>Mile Total</i>					293	293.00		108.89		
<i>Number of Species</i>					20					
<i>Number of Hybrids</i>					0					

Appendix Table 4. Fish Species List

River Code: 18-001	Stream: Mahoning River	Sample Date: 2012
River Mile: 37.60	Location: upst. WCI diffuser	Date Range: 07/23/2012
Time Fished: 3762 sec	Drainage: 602.0 sq mi	Thru: 09/04/2012
Dist Fished: 1.00 km	Basin: Mahoning River	No of Passes: 2
		Sampler Type: A

Species Name / ODNR status	IBI Grp	Feed Guild	Breed Guild	Tol	# of Fish	Relative Number	% by Number	Relative Weight	% by Weight	Ave(gm) Weight
Muskellunge [S]	F	P	M		2	2.00	0.65	14.00	10.46	7,000.00
Silver Redhorse	R	I	S	M	13	13.00	4.19	19.24	14.38	1,480.22
Golden Redhorse	R	I	S	M	22	22.00	7.10	14.06	10.51	639.09
Northern Hog Sucker	R	I	S	M	94	94.00	30.32	20.15	15.06	214.36
White Sucker	W	O	S	T	1	1.00	0.32	0.25	0.19	248.00
Common Carp	G	O	M	T	6	6.00	1.94	23.08	17.25	3,845.83
River Chub	N	I	N	I	37	37.00	11.94	1.72	1.29	46.54
Striped Shiner	N	I	S		1	1.00	0.32	0.02	0.01	20.00
Spotfin Shiner	N	I	M		14	14.00	4.52	0.10	0.08	7.43
Bluntnose Minnow	N	O	C	T	1	1.00	0.32	0.00	0.00	3.00
Grass Carp	E		M		3	3.00	0.97	16.55	12.37	5,516.67
Channel Catfish	F		C		9	9.00	2.90	15.29	11.43	1,699.07
Brook Silverside		I	M	M	1	1.00	0.32	0.00	0.00	2.00
Rock Bass	S	C	C		10	10.00	3.23	0.99	0.74	99.10
Smallmouth Bass	F	C	C	M	61	61.00	19.68	6.75	5.04	110.57
Bluegill Sunfish	S	I	C	P	1	1.00	0.32	0.02	0.02	24.00
Walleye	F	P	S		3	3.00	0.97	1.26	0.94	420.67
Logperch	D	I	S	M	8	8.00	2.58	0.22	0.16	27.25
Greenside Darter	D	I	S	M	4	4.00	1.29	0.03	0.03	8.50
Banded Darter	D	I	S	I	15	15.00	4.84	0.03	0.03	2.27
Fantail Darter	D	I	C		4	4.00	1.29	0.01	0.01	2.25
<i>Mile Total</i>					310	310.00		133.79		
<i>Number of Species</i>					21					
<i>Number of Hybrids</i>					0					

Appendix Table 5. Fish 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							Rel.No. minus tolerants /(1.0 km)	IBI	Modified lwb
				Total species	Sunfish species	Sucker species	Intolerant species	Rnd-bodied suckers	Simple Lithophils	Tolerant fishes	Omni- vores	Top carnivores	Insect- ivores	DELT anomalies			
Mahoning River - (18-001)																	
Year: 2012																	
38.20	A	07/23/2012	594	15(3)	2(3)	3(3)	2(3)	23(3)	28(3)	6(5)	4(5)	48(5)	48(3)	0.0(5)	274(3)	44	8.7
38.20	A	09/04/2012	594	17(3)	3(3)	3(3)	3(3)	25(3)	36(3)	4(5)	4(5)	47(5)	49(3)	0.0(5)	284(3)	44	9.1
37.60	A	07/23/2012	602	17(3)	2(3)	4(3)	2(3)	48(5)	60(5)	2(5)	2(5)	15(5)	77(5)	0.7(5)	292(3)	50	9.3
37.60	A	09/04/2012	602	14(3)	1(1)	3(3)	2(3)	36(3)	44(3)	3(5)	3(5)	33(5)	61(5)	0.0(5)	312(3)	44	9.2

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	Caddis- flies	Tany- tarsini	Other Dipt/NI	Tolerant Organisms			
Mahoning River (18-001)													
Year: 2012													
38.20	594.0	40(6)	7(4)	4(4)	18(6)	40.5(6)	23.8(4)	1.4(2)	32.0(2)	5.0(2)	12(4)	3	40
38.00	594.0	44(6)	7(4)	5(4)	22(6)	42.9(6)	10.8(2)	3.6(2)	41.7(2)	13.2(0)	15(4)	3	36
37.60	602.0	40(6)	6(4)	5(4)	19(6)	43.2(6)	20.5(4)	4.9(2)	29.1(4)	2.6(4)	11(2)	3	42

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

Site: Mahoning River
West Market St.

Collection Date: 09/04/2012 River Code: 18-001 RM: 38.20

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	<i>Turbellaria</i>	11 +	82220	<i>Tvetenia discoloripes group</i>	139 +
01900	<i>Nemertea</i>	1	83002	<i>Dicrotendipes modestus</i>	+
03600	<i>Oligochaeta</i>	+	83040	<i>Dicrotendipes neomodestus</i>	+
05800	<i>Caecidotea sp</i>	+	84300	<i>Phaenopsectra obediens group</i>	9
06810	<i>Gammarus fasciatus</i>	7 +	84450	<i>Polypedilum (Uresipedilum) flavum</i>	167
08230	<i>Orconectes (Crockerinus) obscurus</i>	+	84460	<i>Polypedilum (P.) fallax group</i>	19
08601	<i>Hydrachnidia</i>	8 +	84470	<i>Polypedilum (P.) illinoense</i>	+
11130	<i>Baetis intercalaris</i>	177 +	84700	<i>Stenochironomus sp</i>	37
13000	<i>Leucrocota sp</i>	+	84790	<i>Tribelos fuscicorne</i>	9
13400	<i>Stenacron sp</i>	243 +	85625	<i>Rheotanytarsus sp</i>	37
13510	<i>Maccaffertium exiguum</i>	30	85800	<i>Tanytarsus sp</i>	+
13561	<i>Maccaffertium pulchellum</i>	193 +	93900	<i>Elimia sp</i>	3 +
13570	<i>Maccaffertium terminatum</i>	139 +	96900	<i>Ferrissia sp</i>	67 +
16700	<i>Tricorythodes sp</i>	277 +	97601	<i>Corbicula fluminea</i>	+
17200	<i>Caenis sp</i>	8 +	98200	<i>Pisidium sp</i>	4
21300	<i>Hetaerina sp</i>	+	98600	<i>Sphaerium sp</i>	8
22001	<i>Coenagrionidae</i>	+			
22300	<i>Argia sp</i>	10 +	No. Quantitative Taxa: 40		Total Taxa: 60
24501	<i>Gomphidae</i>	+	No. Qualitative Taxa: 41		ICI: 40
43570	<i>Neoplea sp</i>	+	Number of Organisms: 2632		Qual EPT: 12
47600	<i>Sialis sp</i>	+			
50906	<i>Psychomyia flavida</i>	+			
51600	<i>Polycentropus sp</i>	+			
52200	<i>Cheumatopsyche sp</i>	372 +			
52430	<i>Ceratopsyche morosa group</i>	190 +			
52530	<i>Hydropsyche depravata group</i>	11 +			
53800	<i>Hydroptila sp</i>	53			
60400	<i>Gyrinus sp</i>	+			
68708	<i>Dubiraphia vittata group</i>	+			
68901	<i>Macronychus glabratus</i>	29 +			
69400	<i>Stenelmis sp</i>	20 +			
77750	<i>Hayesomyia senata or Thienemannimyia norena</i>	9			
78655	<i>Procladius (Holotanypus) sp</i>	+			
78750	<i>Rheopelopia paramaculipennis</i>	19 +			
80310	<i>Cardiocladius obscurus</i>	9 +			
80350	<i>Corynoneura sp</i>	+			
80370	<i>Corynoneura lobata</i>	60			
80410	<i>Cricotopus (C.) sp</i>	19			
80420	<i>Cricotopus (C.) bicinctus</i>	46 +			
81690	<i>Paratrachocladius sp</i>	19			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	93			
82070	<i>Synorthocladius semivirens</i>	56			
82130	<i>Thienemanniella similis</i>	8			
82141	<i>Thienemanniella xena</i>	16			

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

Collection Date: 09/04/2012 River Code: 18-001 RM: 38.00			Site: Mahoning River adj. Warren Gasification property		
Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
00401	<i>Spongillidae</i>	+	82220	<i>Tvetenia discoloripes</i> group	+
01801	<i>Turbellaria</i>	67 +	82730	<i>Chironomus (C.) decorus</i> group	+
03600	<i>Oligochaeta</i>	88	83040	<i>Dicrotendipes neomodestus</i>	29 +
04960	<i>Mooreobdella</i> sp	+	84300	<i>Phaenopsectra obediens</i> group	71
05800	<i>Caecidotea</i> sp	+	84450	<i>Polypedilum (Uresipedilum) flavum</i>	86 +
06810	<i>Gammarus fasciatus</i>	338 +	84460	<i>Polypedilum (P.) fallax</i> group	21
08230	<i>Orconectes (Crockerinus) obscurus</i>	+	84470	<i>Polypedilum (P.) illinoense</i>	+
08601	<i>Hydrachnidia</i>	+	84540	<i>Polypedilum (Tripodura) scalaenum</i> group	64
11130	<i>Baetis intercalaris</i>	28 +	84700	<i>Stenochironomus</i> sp	7
13000	<i>Leucrocuta</i> sp	+	84790	<i>Tribelos fuscicorne</i>	7
13400	<i>Stenacron</i> sp	138 +	85625	<i>Rheotanytarsus</i> sp	36
13510	<i>Maccaffertium exiguum</i>	23 +	85800	<i>Tanytarsus</i> sp	50
13561	<i>Maccaffertium pulchellum</i>	488 +	85821	<i>Tanytarsus glabrescens</i> group sp 7	29
13570	<i>Maccaffertium terminatum</i>	109 +	87540	<i>Hemerodromia</i> sp	8
16700	<i>Tricorythodes</i> sp	582 +	93200	<i>Hydrobiidae</i>	+
17200	<i>Caenis</i> sp	16	93900	<i>Elimia</i> sp	+
22001	<i>Coenagrionidae</i>	+	95100	<i>Physella</i> sp	1 +
22300	<i>Argia</i> sp	1 +	96100	<i>Menetus (Micromenetus) sp</i>	32
50906	<i>Psychomyia flavida</i>	+	96900	<i>Ferrissia</i> sp	182 +
51600	<i>Polycentropus</i> sp	2 +	97601	<i>Corbicula fluminea</i>	18 +
52200	<i>Cheumatopsyche</i> sp	320 +			
52430	<i>Ceratopsyche morosa</i> group	26 +	No. Quantitative Taxa: 44		Total Taxa: 64
52530	<i>Hydropsyche depravata</i> group	1 +	No. Qualitative Taxa: 43		ICI: 36
52540	<i>Hydropsyche dicantha</i>	+	Number of Organisms: 3229		Qual EPT: 15
53501	<i>Hydroptilidae</i>	1			
54000	<i>Leucotrichia pictipes</i>	+			
57900	<i>Pycnopsyche</i> sp	+			
60300	<i>Dineutus</i> sp	+			
68075	<i>Psephenus herricki</i>	+			
68708	<i>Dubiraphia vittata</i> group	+			
68901	<i>Macronychus glabratus</i>	7 +			
69400	<i>Stenelmis</i> sp	25 +			
77130	<i>Ablabesmyia rhamphe</i> group	7			
77150	<i>Ablabesmyia simpsoni</i>	7			
77500	<i>Conchapelopia</i> sp	7 +			
77750	<i>Hayesomyia senata</i> or <i>Thienemannimyia norena</i>	14			
78655	<i>Procladius (Holotanypus) sp</i>	+			
80370	<i>Corynoneura lobata</i>	56			
80410	<i>Cricotopus (C.) sp</i>	43			
80420	<i>Cricotopus (C.) bicinctus</i>	135 +			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	29 +			
82070	<i>Synorthocladius semivirens</i>	14			
82130	<i>Thienemanniella similis</i>	8			
82141	<i>Thienemanniella xena</i>	8			

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

Collection Date: 09/04/2012 River Code: 18-001 RM: 37.60 Site: Mahoning River
upst. WCI diffuser

Taxa Code	Taxa	Quant/Qual	Taxa Code	Taxa	Quant/Qual
01801	<i>Turbellaria</i>	43 +	84470	<i>Polypedilum (P.) illinoense</i>	+
03600	<i>Oligochaeta</i>	6 +	84540	<i>Polypedilum (Tripodura) scalaenum group</i>	5
06810	<i>Gammarus fasciatus</i>	6 +	84700	<i>Stenochironomus sp</i>	16
08230	<i>Orconectes (Crockerinus) obscurus</i>	+	85625	<i>Rheotanytarsus sp</i>	71 +
08601	<i>Hydrachnidia</i>	5 +	85800	<i>Tanytarsus sp</i>	5
11130	<i>Baetis intercalaris</i>	253 +	85821	<i>Tanytarsus glabrescens group sp 7</i>	5
13000	<i>Leucrocuta sp</i>	+	93900	<i>Elimia sp</i>	+
13400	<i>Stenacron sp</i>	44 +	95100	<i>Physella sp</i>	1
13510	<i>Maccaffertium exiguum</i>	47	96900	<i>Ferrissia sp</i>	14 +
13561	<i>Maccaffertium pulchellum</i>	233 +	97601	<i>Corbicula fluminea</i>	+
13570	<i>Maccaffertium terminatum</i>	37 +	98600	<i>Sphaerium sp</i>	+
16700	<i>Tricorythodes sp</i>	106 +			
21300	<i>Hetaerina sp</i>	1	No. Quantitative Taxa: 40		Total Taxa: 54
22001	<i>Coenagrionidae</i>	+	No. Qualitative Taxa: 29		ICI: 42
22300	<i>Argia sp</i>	+	Number of Organisms: 1665		Qual EPT: 11
28955	<i>Plathemis lydia</i>	+			
50000	<i>Trichoptera</i>	8			
50906	<i>Psychomyia flavida</i>	+			
51600	<i>Polycentropus sp</i>	1			
52200	<i>Cheumatopsyche sp</i>	167 +			
52430	<i>Ceratopsyche morosa group</i>	109 +			
52530	<i>Hydropsyche depravata group</i>	57 +			
53400	<i>Protoptila sp</i>	+			
60300	<i>Dineutus sp</i>	1			
68901	<i>Macronychus glabratus</i>	35			
69400	<i>Stenelmis sp</i>	1 +			
72700	<i>Anopheles sp</i>	+			
77750	<i>Hayesomyia senata</i> or <i>Thienemannimyia norena</i>	6			
78450	<i>Nilotanytus fimbriatus</i>	6			
78655	<i>Procladius (Holotanytus) sp</i>	+			
78750	<i>Rheopelopia paramaculipennis</i>	11			
80370	<i>Corynoneura lobata</i>	44			
80410	<i>Cricotopus (C.) sp</i>	5			
80420	<i>Cricotopus (C.) bicinctus</i>	16			
81231	<i>Nanocladius (N.) crassicornus</i> or <i>N. (N.) "rectinervis"</i>	4			
81825	<i>Rheocricotopus (Psilocricotopus) robacki</i>	77			
82130	<i>Thienemanniella similis</i>	8			
82141	<i>Thienemanniella xena</i>	24			
82220	<i>Tvetenia discoloripes group</i>	77			
82730	<i>Chironomus (C.) decorus group</i>	+			
83050	<i>Dicrotendipes lucifer</i>	11			
84450	<i>Polypedilum (Uresipedilum) flavum</i>	93			
84460	<i>Polypedilum (P.) fallax group</i>	6			