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Ohio Environmental Protection Agency
Division of Surface Water

Biological and Water Quality Study

Sugar Creek, Lagoon and Tuscarawas River

Dover Chemical

John Kasich, Governor
Mary Taylor, Lt. Governor
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Biological and Water Quality Study

Sugar Creek, Lagoon and Tuscarawas River

(Dover Chemical)

2010 Field Season

Tuscarawas County, Ohio
April 6, 2012
OEPA Report EAS/2012-4-6

prepared for
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EXECUTIVE SUMMARY

Sugar Creek and Tuscarawas River

A total of 3.5 miles of Sugar Creek and 0.5 miles of the Tuscarawas River in the Dover, Ohio area were assessed by the Ohio EPA based on stream sampling done in 2010. Based on the performance of the biological communities, the entire 0.5 miles of the Tuscarawas River and upper 1.4 miles of Sugar Creek were in full attainment of the Warmwater Habitat (WWH) aquatic life use (Table 1). The lower section of Sugar Creek from river miles (RMs) 2.1 to 0.0, downstream from the Dover Chemical effluent discharge, was in partial attainment of the WWH aquatic life use. The partial attainment in Sugar Creek was caused by low-fair macroinvertebrate communities. Pollution sensitive mayfly and caddisfly macroinvertebrate taxa richness declined from 16 upstream to 4 and 2 downstream from the Dover Chemical outfall. The percent of the sample consisting of mayflies and caddisflies also exhibited a serious decline downstream from the outfall. Mayflies and caddisflies comprised 49% of the quantitative sample upstream from the Dover Chemical outfall and only 2.0% and 0.9% downstream. The instream macroinvertebrate community sampling results corroborate Ohio EPA and Dover Chemical effluent bioassay test results, which showed chronic and acute toxicity to the macroinvertebrate *Ceriodaphnia dubia*.

Sediment collected from all three locations in Sugar Creek (upstream, adjacent, and downstream from the Dover Chemical effluent discharge) were generally below ecological screening level benchmarks considered likely to be harmful to sediment-dwelling organisms. Although below ecological screening levels, aldrin, alpha BHC, beta BHC, gamma BHC, hexachlorobenzene, heptachlor, heptachlor epoxide, 1,2,3,4-tetrachlorobenzene, and 1,2,4,5-tetrachlorobenzene were elevated in sediment samples adjacent and downstream from the Dover Chemical discharge compared with the upstream background site. Substantially elevated concentrations of oxychlordane, hexachlorobenzene, heptachlor, heptachlor epoxide, total PCBs, and 1,2,4,5-tetrachlorobenzene were documented in Tuscarawas River sediment both upstream and downstream from Sugar Creek. Only heptachlor epoxide had a notable concentration increase downstream from the Sugar Creek confluence. Chlorinated dibenzo dioxins and furans had increased levels noted in Sugar Creek sediments downstream from the Dover Chemical discharge, and these values were above ecological screening levels. Based on sediment sampling results, Sugar Creek water and sediment conditions were not negatively influencing sediment quality in the Tuscarawas River.

Whole body fish samples from Sugar Creek and the Tuscarawas River were tested for chlorinated pesticides, PCBs, and dioxins. The highest levels of PCBs occurred in fish from the Tuscarawas River. Two chemical parameters (1,2,3,4-tetrachlorobenzene and 1,2,4,5-tetrachlorobenzene) were documented at elevated levels in Sugar Creek fish downstream from Dover Chemical; however, fish flesh ecological screening criteria have not been developed for these parameters. Sugar Creek fish tissue samples collected upstream from the Dover Chemical effluent discharge were all below the dioxin fish flesh criteria. All fish tissue samples collected at the two sites in Sugar Creek located downstream from the Dover Chemical discharge exceeded the fish flesh dioxin criteria for the protection of piscivorous wildlife. Fish tissue dioxin results from the Tuscarawas River revealed nearly all samples below the fish flesh protection criteria.

Lagoon

Sediment samples were collected from four locations in the Dover Chemical lagoon during 2010. Surficial sediment results (upper four inches of bottom material) documented low levels of chlorinated pesticides, total PCBs, and chlorinated dibenzo dioxin and chlorinated dibenzo furan congeners. Of the chemical parameters tested, only DDD and DDE levels from one sample were above ecological benchmarks. Overall sediment quality of the lagoon suggests low ecological risk to aquatic organisms from chemical contaminants.

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INTRODUCTION

The lower 3.5 miles of Sugar Creek and a one mile section of the Tuscarawas River were assessed during 2010, evaluating biological, stream habitat, sediment and fish tissue resources. This study was undertaken to assess water resource conditions in Sugar Creek upstream, near-field/adjacent, and downstream from the Dover Chemical property and effluent discharge. This water resource project is part of a Natural Resource Damage Assessment.

Specific objectives of the evaluation were to:

- Assess biological conditions in Sugar Creek and the Tuscarawas River by evaluating fish and macroinvertebrate communities,
- Evaluate exposure of natural resources (fish and sediments) to selected hazardous substances potentially released from the Dover Chemical facility to Sugar Creek and the Tuscarawas River,
- Determine the aquatic life use attainment status of Sugar Creek and the Tuscarawas River with regard to the Warmwater Habitat (WWH) aquatic life use designation codified in the Ohio Water Quality Standards, and
- To the extent possible, establish relationships between hazardous substances and biological injury in Sugar Creek and the Tuscarawas River.

Sugar Creek and the Tuscarawas River are located in the Western Alleghany Plateau (WAP) ecoregion. Both Sugar Creek and the Tuscarawas River within the study area are currently assigned the WWH aquatic life use designation.

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

Additionally, the Dover Chemical lagoon was assessed during 2010, evaluating surficial sediment quality.

Table 1. Aquatic life use attainment status for sampling locations in Sugar Creek and the Tuscarawas River, 2010. 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. Stream habitat reflects the ability to support a biological community. The study area streams are located in the Western Allegheny Plateau (WAP) ecoregion. If biological impairment has occurred, the cause(s) and source(s) of the impairment are noted.

Stream	Sample Location River Mile	Sampling Type	Ecoregion	Aquatic Life Use Designation	Aquatic Life Attainment Status	IBI	MIwb	ICI[a]	Stream Habitat[a]	Cause/Source of Impairment
Sugar Creek	3.4	Wading	WAP	WWH	FULL	47	9.0	50	79.8	None
Sugar Creek	1.9	Wading	WAP	WWH	PARTIAL	42[ns]	8.5	18*	74.8	Chronic Toxicity/ Dover Chemical
Sugar Creek	1.3	Wading	WAP	WWH	PARTIAL	47	8.6	14*	84.8	Chronic Toxicity/ Dover Chemical
Tuscarawas River	58.1	Boat	WAP	WWH	FULL	53	9.8	46	80.8	None
Tuscarawas River	57.8	Boat	WAP	WWH	FULL	52	9.7	50	83.5	None

BIOCRITERIA – WAP ECOREGION		
INDEX - Site Type	WWH	EWH
IBI: Wading/Boat	44/ 40	50/ 48
MIwb: Wading/ Boat	8.4/ 8.6	9.4/ 9.6
ICI	36	46

[ns] Nonsignificant departure from biocriterion (≤4 IBI or ICI units; ≤0.5 MIwb units).
* Significant departure from biocriterion (>4 IBI or ICI units; >0.5 MIwb units). Poor and very poor results are underlined.
[a] Narrative habitat evaluations are based on QHEI scores for wading and boat sites (Excellent ≥75, Good: 60-74, Fair: 45-59, Poor: 30-44, Very Poor <30)

Table 2. Sampling locations in the Tuscarawas River and Sugar Creek, 2010. Type of sampling included fish community (F), macroinvertebrate community (M), fish tissue (T), and sediment (S).

River Mile	Type of Sampling	Latitude	Longitude	Landmark
Sugar Creek				
3.4	F,M,T,S	40.54648	-81.50527	County Road 80; upstream Dover Chemical outfall
1.9	F,M,T,S	40.52830	-81.49560	State Route 39; downstream Dover Chemical outfall
1.3	F,M,T,S	40.52109	-81.49483	Near Salwell Road; downstream State Route 39
Tuscarawas River				
58.1	F,M,T,S	40.51080	-81.47780	Upstream Sugar Creek
57.8	F,M,T,S	40.50670	-81.47690	Downstream Sugar Creek

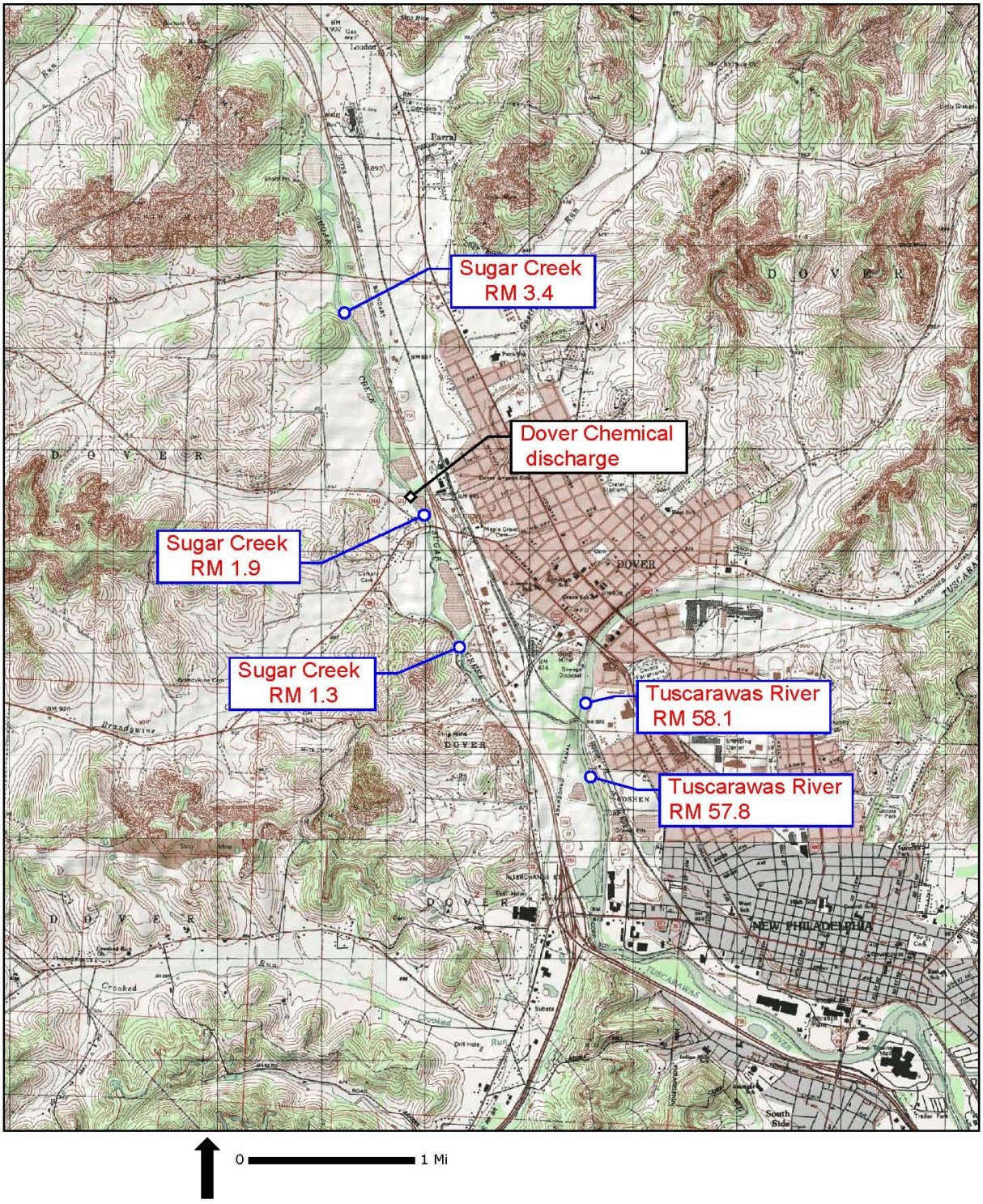

Figure 1. Sampling locations in Sugar Creek and the Tuscarawas River, 2010.

METHODS

All 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 2009a), 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 2001).

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 Tuscarawas River and Sugar Creek within the study area are currently listed as WWH in the Ohio Water Quality Standards.

Stream Habitat Evaluation

Physical habitat is evaluated using the 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 Collections

Fine grain sediment samples were collected in the upper four inches of bottom material at each biological location using decontaminated stainless steel scoops. Between four and five separate samples were collected from each biological sampling station. Sediment samples were collected from the Dover Chemical lagoon using a stainless steel Ekman dredge, and surficial sediment material was collected from the upper four inches of bottom material. Sediment samples were mixed in stainless steel pans, transferred into glass jars with teflon lined lids, placed on ice (to maintain 4 C) in a cooler, and held in a refrigerator at the Ohio EPA Groveport Field Office prior to transfer to United States Fish and Wildlife Service (USFWS) personnel. 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 2001). Chemical analyses were performed by the USFWS lab or their contract labs.

Macroinvertebrate Community Assessment

Macroinvertebrates were collected from artificial substrates and from the natural habitats at all five biological 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 Tuscarawas River site using pulsed DC boat electrofishing methods. Sugar Creek sampling locations were fished using pulsed DC wading 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).

Fish Tissue Assessment

Whole body fish samples were collected using adult fish of a size consumed by piscivorous birds and mammals. Species collected for potential analysis included rock bass, northern hog sucker, smallmouth bass, bluegill, common carp, channel catfish, largemouth bass, and central stoneroller. Of these fish species collected, only common carp and smallmouth bass were tested from each location. Individual fish were wrapped in aluminum foil, placed in a sealed plastic bag, and placed on dry ice. Fish were sampled using electrofishing wading or boat methods. Sampling and decontamination protocols followed those listed in the Ohio EPA Fish Collection Manual (2009b); however, it is not necessary to clean aluminum foil which was used directly from the roll. Fish brought back from the field were held in a freezer at the Ohio EPA Groveport Field Office prior to transfer to USFWS personnel. Chemical analyses were performed by the USFWS lab or their contract labs.

Lab Analyticals

Laboratory test procedures and quality assurance for sediment and fish tissue samples followed the guidelines documented by FWS at: http://www.fws.gov/chemistry/acf_qaqc.html

NPDES PERMIT

Dover Chemical (Ohio EPA Permit # 0IF00040)
The primary product of Dover Chemical is chlorinated paraffins, which are used as an extreme pressure lubricant, flame retardant, and process aid in plastic compounding. By-products of this process are hydrochloric acid and sodium hypochlorite. Other products include a complete line of organic phosphites with by-product hydrochloric acid. The plant also produces brominated compounds, metallic stearates, and alkyl phenol.

Description of Existing Discharge
The discharge from this facility consists of treated non-contact cooling water discharged to Sugar Creek via outfall 002 (at RM 2.10). This outfall previously authorized discharges from a small sanitary plant on-site (outfall 602), and an organic chemicals process discharge (outfall 603). Since the last permit was issued, the sanitary wastewater was tied into the City of Dover sanitary sewer system. Outfall 603 had never actually discharged; wastewaters had been drummed and hauled to a waste treatment company. That practice is projected to continue, and the wastewater treatment facilities for this process have been removed. As a result only cooling water and storm water would be allowed under this permit.

Outfall 002 contains the plant's non-contact cooling water. The source of the cooling water is a local groundwater supply, which contains chlorinated organic compounds from past disposal/ treatment practices at the site. All 002 flows are treated by settling, oil separation and air stripping. The current 002 flows average approximately 4.1 MGD. Outfall 003 discharges storm water from non-process areas of the facility to Goettge Run. This outfall is considered storm water from industrial activity, and should be submitting annual monitoring data required by Part V of the NPDES permit. This outfall is not treated.

Current Discharge Conditions
An effluent compliance sampling event was performed at the Dover Chemical plant by the Ohio EPA on October 5 and 6, 2009. The Dover Chemical Corp. was covered under NPDES modified permit 0IF00040*MD expiring October 31, 2010. The effluent sampled at Dover Chemical Corp. is discharged to Sugar Creek at RM 2.10, through outfall 002. All samples taken by Ohio EPA were preserved pursuant to Ohio EPA standard operating procedures and placed on ice. All samples were kept locked and transported to the Division of Environmental Services on October 6, 2009, under chain of custody.

Initial field parameters of pH, dissolved oxygen, conductivity and temperature were taken with a YSI 556 MPS unit which was calibrated before sampling. An ISCO automatic portable composite sampler model 3710 was used to obtain a composite effluent sample from outfall 002. The sample container was a large glass container cleaned and rinsed per Ohio EPA protocol and procedures. The composite sample was refrigerated in the ISCO sampler with ice. All tubing was inert teflon lined tubing. Reported flow during the 24-hour sample period was 4.55 mgd. Observed effluent was clear in nature. Dissolved oxygen and pH values were within permit limits at the time of the grab sampling and within the composite sample.

Carbon tetrachloride and chloroform were both within the permit limits established in the effective NPDES permit during the Ohio EPA sampling. Dover Chemical reported sample results of 98 ug/l for carbon tetrachloride and 96 ug/l for chloroform; both were NPDES permit exceedances. These samples were collected on October 7, 2009. Dover Chemical did not report pH for the time during the sampling event.

As part of the compliance sampling event, screening bioassays were conducted on two grab samples and one composite sample of the 002 effluent. The effluents were acutely toxic to *Ceriodaphnia dubia*; mortality was 30% for the mixing zone sample, 100% for the first day grab, 85% for the second day grab, and 90% for the composite effluent. The magnitude of the composite effluent toxicity in the *C. dubia* definitive acute toxicity test can be expressed as a 48-hour acute toxic unit of 0.6. No fathead minnows died or displayed other adverse effects in the effluent or ambient water. Survival in the laboratory controls was 100 percent for both species. Bioassay testing of the 003 effluent from Dover Chemical in June 2005 showed no acute toxicity to either test species.

Several changes have been implemented with the Dover Chemical NPDES effluent discharge since the 2010 biological and water quality study was completed. A Carcinogen Additivity Factor and Toxicity Equivalent permit limits implementation schedule has been established in the most recent NPDES permit modification. Dover Chemical is required to meet final effluent limits of 1.0 Admin Units for Carcinogen

Additivity Factor and an average allowable Toxicity Equivalent of 0.14 pg/l (0.000000002 kg/day) by August 1, 2012. The Carcinogen Additivity Factor is based on an equation used to protect against additive effects associated with simultaneous human exposure to multiple chemicals. The Toxicity Equivalent permit limit is based on the summation of one or more 2,3,7,8-substituted chlorinated dibenzo-p-dioxins or 2,3,7,8-substituted dibenzofurans, calculated as the 2,3,7,8-TCDD toxicity equivalence concentration (TECtcdd). Both of these additional NPDES permit requirements are based on carcinogenic effects.

Dover Chemical reported effluent monitoring results are summarized in Table 3. None of the measured chemical parameters reported in Table 3 (at 95th percentile concentrations) were above the Outside Mixing Zone Average water quality criteria for protection of aquatic life. Alpha BHC, 2,3,7,8-TCDD, and PCBs at the 95th percentile effluent concentration were above the Human Health non-drinking water quality criteria. However, this comparison does not take into account dilution effects from Sugar Creek. Chlorinated paraffins are reported in the effluent data as chlorinated hydrocarbons. Chlorinated hydrocarbons were reported at 9.6 ug/l and 46.4 ug/l at 50th and 95th percentile concentrations, respectively. Water quality criteria are not available for chlorinated hydrocarbons or paraffins.

Effluent toxicity tests are reported for *C. dubia* and fathead minnows on a bimonthly basis. Summarized results are reported in Table 3. Based on allowable toxicity calculated using wasteload allocation procedures, Dover Chemical effluent toxicity should be below 1.51 chronic toxic units (TUc = 1.51) and 0.4 acute toxic units (TUa = 0.4) for the protection of aquatic life. Effluent monitoring results documented no toxicity to fathead minnows, with 95th percentile TUa and TUc values below the level needed to protect Sugar Creek aquatic life. *Ceriodaphnia dubia* acute and chronic bioassay tests documented elevated levels of toxicity, with 95th percentile values (1.19 TUa and 10.9 TUc) exceeding stream protection levels. These results corroborated testing conducted by Ohio EPA in 2009.

Carcinogenic levels of chemicals in the effluent from outfall 002 are reported in the carcinogen additivity factor and toxicity equivalent tests. The current permit for Dover Chemical requires only monitoring for these two parameters. A permit modification in 2011 has established permit limits for these two parameters, effective August 1, 2012. Based on a comparison of test results from 2000 - 2010 (Table 3), the 95th percentile value for carcinogenic additivity factor is slightly above the new permit limit of 1.0 Admin Units. The toxicity equivalent test results from 2000 – 2010 (13 pg/l and 44.9 pg/l, 50th and 95th percentiles, respectively) are substantially above the new permit limit of 0.14 pg/l.

Table 3. Concentrations of monitored chemicals and parameters in effluent discharged from Dover Chemical to Sugar Creek. Results are reported for the time period 2000-2010.

Discharger/ Parameter	50th Percentile	95th Percentile	Permit Limit -Monthly Avg.-	Permit Limit -Maximum-
Dover Chemical - (0IL00091)				
Outfall 002 to Sugar Creek (RM 2.10)				
Temperature (°C)	20.3	22.2	Monitor	Monitor
pH (SU)	7.6 (5th percentile)	8.8	Monitor	6.5 (min)-9.0 (max)
Residue, Total Dissolved (mg/l)	524	597.4	Monitor	Monitor
Total Suspended Solids (mg/l)	0	5	9.0	18
Oil and Grease, Total (mg/l)	0	2.2	Monitor	9.0
Chloride, Total (mg/l)	51	78	-	-
Barium, Total Recoverable (ug/l)	0	0	Monitor	Monitor
Cadmium, Total (Cd) (ug/l)	0	0.078	-	-
Manganese, Total Recoverable (ug/l)	0.11	76.6	-	-
Carbon Tetrachloride (ug/l)	0	6.03	Monitor	44
Chloroform (ug/l)	1	26	44	67
Alpha BHC (ug/l)	0.17	0.34	Monitor	Monitor
Beta BHC (ug/l)	0.073	0.13	Monitor	Monitor
1,1,1-Trichloroethane (ug/l)	0	0	-	-
1,2-Dichlorobenzene (ug/l)	0	8.62	-	-
1,2,4-Trichlorobenzene (ug/l)	0	5	-	-
1,3-Dichlorobenzene (ug/l)	0	3	-	-
1,4-Dichlorobenzene (ug/l)	0	7	-	-
2,3,7,8 TCDD (ng/l)	0	0.00291	-	-
Phenol (ug/l)	0	0	-	-
Gamma-BHC, Total (ug/l)	0.02	0.04585	Monitor	Monitor
Chlordane (ug/l)	0	0	Monitor	Monitor
Heptachlor (ug/l)	0	0	Monitor	Monitor
PCBs (ug/l)	0	0.0203	Monitor	Monitor
Hexachlorobenzene (ug/l)	0	0	-	-
Chlorobenzene (ug/l)	0	0	-	-
Flow Rate (MGD)	3.95	4.88	Monitor	Monitor
Chlorine, Total Residual (mg/l)	0.01	0.03	0.017	0.027
Carcinogen Additivity Factor (Admin. Units)	0.378	1.04	Monitor	Monitor
Acute Toxicity, Ceriodaphnia dubia (TUa)	0	1.195	Monitor	Monitor
Chronic Toxicity, Ceriodaphnia dubia (TUc)	1.25	10.91	Monitor	Monitor
Acute Toxicity, Pimephales promelas (TUa)	0	0.3	-	-
Chronic Toxicity, Pimephales promelas (TUc)	0	1.47	-	-
Chlorinated Hydrocarbons, General (ug/l)	9.57	46.4	Monitor	Monitor
Toxicity Equivalent (pg/l)	13	44.9	Monitor	Monitor

RESULTS

Sediment

Surficial sediment samples were collected at three locations in Sugar Creek and two locations in the Tuscarawas River by the Ohio EPA on August 3, 4, and 12, 2010. Sampling locations were co-located with biological sampling sites. Samples were analyzed for chlorinated pesticides, PCBs, dioxins, and percent moisture. Specific chemical parameters tested and results are listed in Appendix Tables 1 and 2. Sediment data were evaluated using 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. These screening levels are consistent with the Ohio EPA Ecological Risk Assessment Guidance Manual (Ohio EPA 2008c).

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 five sites; however, fine substrates were found along the stream margins. At each biological monitoring station (3 in Sugar Creek, 2 in Tuscarawas River), four to five sediment samples were collected and individually tested. Biological monitoring stations were 200 meters in length in Sugar Creek and 500 meters in length for the Tuscarawas River.

Select chemical parameters reported above ecological screening benchmarks or of general interest are presented in Table 4. Sediment collected from all three locations in Sugar Creek (upstream, adjacent, and downstream from the Dover Chemical effluent discharge) were generally below ecological screening level benchmarks considered likely to be harmful to sediment-dwelling organisms (MacDonald *et.a*l. 2000). Although below ecological screening levels, several chemicals were elevated in sediment samples adjacent and downstream from the Dover Chemical discharge compared with the upstream background site. These chemical parameters included aldrin, alpha BHC, beta BHC, gamma BHC, hexachlorobenzene, heptachlor, heptachlor epoxide, 1,2,3,4-tetrachlorobenzene, and 1,2,4,5-tetrachlorobenzene. Two parameters, beta BHC and total PCBs, were noted at levels above screening benchmarks at locations downstream from the Dover Chemical effluent discharge.

Tuscarawas River sediments were collected from biological monitoring stations located upstream (RM 58.1) and downstream (RM 57.8) from the Sugar Creek confluence. Substantially elevated concentrations of oxychlordane, hexachlorobenzene, heptachlor, heptachlor epoxide, total PCBs, and 1,2,4,5-tetrachlorobenzene were documented in Tuscarawas River sediment both upstream and downstream from Sugar Creek. Only heptachlor epoxide had a notable concentration increase downstream from the Sugar Creek confluence. Based on sediment sampling results, Sugar Creek water and sediment conditions were not negatively influencing sediment quality in the Tuscarawas River.

2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF), and other dioxin and furan congeners were measured in the sediment of Sugar Creek and the Tuscarawas River. For each sediment sample, a 2378-TCDD Total Toxicity Equivalent (TTE) was calculated as a measure of the toxicity potential of the sample. The TTE is computed by multiplying each 2,3,7,8 chlorinated dioxin and dibenzo furan congener by its Toxicity Equivalence Factor (TEF), which is the toxicity of the congener compared to the toxicity of 2,3,7,8-TCDD (which is 1.0). These are then summed for each 2,3,7,8 congener in the sample. TEFs are listed in Ohio Administrative Code 3745-2-07. A summary of the sediment TTEs are listed in Table 5. Congener measurements below laboratory detection limits were not included in the TTE calculation. The USEPA ecological screening level for polychlorinated dibenzo-p-dioxins of 11 ppt was used to assess sediment conditions. Sugar Creek at RMs 1.9 and 1.3, downstream from the Dover Chemical effluent discharge, had sediment samples elevated above the ESL. One sediment sample at RM 1.9 had a TTE value of 245 ppt. Elevated dioxin values in sediment were measured in the Tuscarawas River upstream from the Sugar Creek confluence, with two values above the ESL. Lower dioxin TTE measurements were calculated in the Tuscarawas River downstream from the Sugar Creek confluence, and none of these values were above the ESL.

*Table 4. Select chemical parameters measured in samples collected by Ohio EPA from surficial sediments in Sugar Creek and the Tuscarawas River, August, 2010. Contamination levels were determined for parameters using consensus-based sediment quality guidelines (MacDonald, et.al. 2000) and ecological screening levels (USEPA 2003). Shaded numbers indicate values above the following: Threshold Effect Concentration –TEC (yellow), Probable Effect Concentration – PEC (red) and Ecological Screening Levels (orange). Sampling locations are indicated by stream and river mile (RM). Results are reported as dry weight (in ug/kg) and are based on average values calculated from multiple samples collected at each biological monitoring station. * - ecological screening values are not available.*

Parameter	Sugar Creek RM 3.4	Sugar Creek RM 1.9	Sugar Creek RM 1.3	Tuscarawas R. RM 58.1	Tuscarawas R. RM 57.8
Aldrin	ND	0.050	0.294	1.317	1.822
Alpha BHC	ND	3.134	0.240	0.375	0.162
Beta BHC	0.058	50.512	0.492	ND	0.236
Gamma BHC	0.034	0.451	0.062	ND	0.084
Alpha chlordane	0.716	0.265	1.522	1.385	0.888
Gamma chlordane	ND	0.151	ND	0.133	0.823
Oxychlordane	ND	0.339	ND	28.498	0.989
Hexachlorobenzene	0.391	2.346	3.794	1944.308	145.311
Heptachlor	ND	0.081	0.295	5.043	0.310
Heptachlor epoxide	ND	0.315	1.178	9.179	29.169
Total PCBs	20.487	46.770	81.599	822.370	156.645
1,2,3,4-Tetrachlorobenzene*	0.067	219.317	67.709	2.816	5.983
1,2,4,5-Tetrachlorobenzene	0.285	162.309	28.669	49.010	22.410

ND – all samples not detected at or above the method detection limit.

Table 5. 2,3,7,8-TCDD total toxicity equivalent (TTE) calculations of sediment samples collected by Ohio EPA from surficial sediments in Sugar Creek and the Tuscarawas River, August, 2010. TTEs are represented in parts per trillion (ppt). Four to five individual sediment samples were collected from each biological sampling location, and the TTE for each sample is presented in this table. Values above the polychlorinated dibenzo-p-dioxins Ecological Screening Level of 11 ppt are shaded.

	Sugar Creek RM 3.4 TTE	Sugar Creek RM 1.9 TTE	Sugar Creek RM 1.3 TTE	Tuscarawas R. RM 58.1 TTE	Tuscarawas R. RM 57.8 TTE
	0.35	245.62	7.95	45.62	7.77
	0.97	10.12	34.31	9.91	1.27
	3.69	9.84 (duplicate)	7.00	10.67	5.04
	3.70	0.27	38.14	30.09	5.82
	0.43	6.45		3.28	0.48
		9.20			
Average TTE per site	**1.83**	**54.30**	**21.85**	**19.91**	**4.08**

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 6.

Tuscarawas River sampling locations were represented by natural channel conditions, substrates predominated by cobble and sand, moderate amounts of instream cover, normal silt and bottom substrate embeddedness levels, and good pool, riffle, and run development. QHEI scores for the two Tuscarawas River sites were 80.8 and 83.5. These scores are indicative of excellent river habitat and have the ability to support WWH and EWH biological communities.

Sugar Creek sampling locations were represented by natural channel conditions, substrates predominated by cobble, gravel, and sand, moderate amounts of instream cover, and good pool, riffle, and run development. The upstream site (RM 3.4) and most downstream site (RM 1.3) had moderate levels of silt covering the stream bottom, along with moderate levels of fine grained material embedding the cobbles and gravels. Sampling results at RM 1.9, immediately downstream from the Dover Chemical effluent discharge, documented extensively embedded bottom substrates. These highly embedded conditions at RM 1.9 have the potential to impair biological communities by reducing habitat diversity within the interstitial spaces of the cobbles and gravels. The silt levels and embeddedness quality noted during 2010 were substantially improved from conditions reported during a study of Sugar Creek conducted in 1991. During 1991, a thick layer (up to two feet in depth) of fined grained material covered the Sugar Creek stream bottom for at least 1.5 miles downstream from the Dover Chemical effluent discharge (Ohio EPA 1992). QHEI scores for Sugar Creek ranged between 74.8 and 84.8. These scores are indicative of excellent river habitat and have the ability to support WWH and EWH biological communities.

Table 6. Qualitative Habitat Evaluation Index (QHEI) scores and physical attributes for fish sampling sites in the Tuscarawas River and Sugar Creek, 2010.

			WWH Attributes											**MWH Attributes**																							
														High Influence						*Moderate Influence*																		
Key QHEI Components			No Channelization or Recovered	Boulder/Cobble/Gravel Substrates	Silt Free Substrates	Good/Excellent Substrates	Moderate/High Sinuosity	Extensive/Moderate Cover	Fast Current/Eddies	Low-Normal Overall Embeddedness	Max. Depth >40 cm	Low-Normal Riffle Embeddedness	**Total WWH Attributes**	Channelized or No Recovery	Silt/Muck Substrates	No Sinuosity	Sparse/ No Cover	Max. Depth <40 cm (WD,HW sites)	**Total High Influence Attributes**	Recovering Channel	Heavy/Moderate Silt Cover	Sand Substrates (Boat)	Hardpan Substrate Origin	Fair/Poor Development	Low Sinuosity	Only 1-2 Cover Types	Intermittent & Poor Pools	No Fast Current	High/Mod. Overall Embeddedness	High/Mod. Riffle Embeddedness	No Riffle	**Total Moderate Influence Attributes**	**(MWH H.I.+1)/ (WWH+1) Ratio**	**(MWH M.I.+1)/ (WWH+1) Ratio**
River Mile	**QHEI**	**Habitat Rating**																																			
Sugar Creek Year: 2010																																					
3.4	**79.8**	Excellent	■	■		■	■	■	■		■	■	8						0		●				●			●		●	4	0.11	0.56
1.9	**74.8**	Excellent	■	■		■	■	■	■		■		7						0		●							●		●	3	0.13	0.50
1.3	**84.8**	Excellent	■	■		■	■	■	■		■	■	8						0		●				●			●			3	0.11	0.44
Tuscarawas River Year: 2010																																					
58.1	**80.8**	Excellent	■	■		■		■	■	■	■	■	8				◆		1						●						1	0.22	0.33
57.8	**83.5**	Excellent	■	■		■		■	■	■	■	■	8						0						●						1	0.11	0.22

Fish Community

A total of 2,728 fish representing 41 species were collected from the Tuscarawas River and Sugar Creek between August and September, 2010. Relative numbers and species collected per location are presented in Appendix Table 3 and IBI metrics are presented in Appendix Table 4. Sampling locations were evaluated using WWH biocriteria.

The Tuscarawas River sites sampled during 2010 upstream and downstream from the Sugar Creek confluence achieved the Exceptional Warmwater Habitat (EWH) fish biocriterion. The IBI (52 and 53) and MIwb (9.7 and 9.8) scores for the Tuscarawas River were reflective of exceptional biological quality. Five percent of the fish population in the Tuscarawas River was comprised of fish species intolerant of water pollution. These highly sensitive fish included river chub, bigeye chub, streamline chub, silver shiner, rosyface shiner, banded darter, and eastern sand darter.

Fish communities ranged from marginally good to very good in Sugar Creek. IBI and MIwb scores at all three Sugar Creek sites fully achieved the ecoregional biocriteria established for WWH streams and rivers in Ohio (Table 7). A slight decline in the IBI occurred at RM 1.9 (a site located immediately downstream from the Dover Chemical effluent) compared with the upstream and downstream sites. However, overall results at RM 1.9 were still meeting fish biological criteria. Relative weights of fish were recorded from each sampling site, and a notable decline in biomass was observed at the two sites located downstream from Dover Chemical. The decline was particularly evident in the insect feeding suckers, which depend on bottom dwelling caddisflies and mayflies for nourishment. Sucker biomass declined from 16.9 kg/km at RM 3.4, to 2.2 kg/km (RM 1.9) and 1.6 kg/km (RM 1.3). Both RM 1.9 and RM 1.3 sampling locations showed significant reductions in macroinvertebrate populations, including major declines in mayfly and caddisfly numbers. Eleven to 14 percent of the fish population in Sugar Creek was comprised of fish species intolerant of water pollution.

These highly sensitive fish included river chub, bigeye chub, streamline chub, silver shiner, rosyface shiner, mimic shiner, and banded darter.

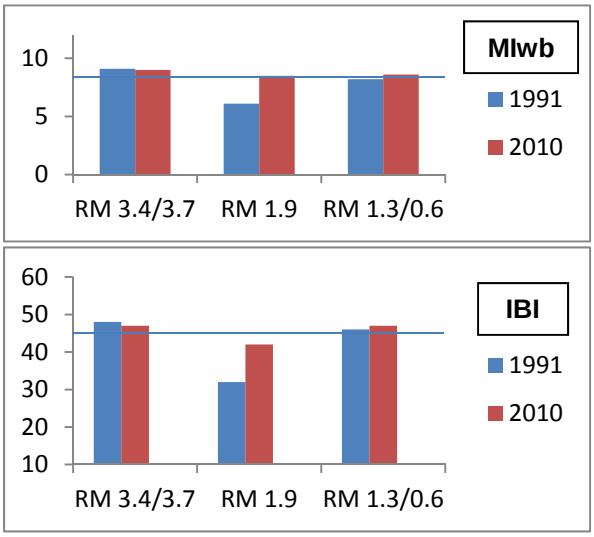

Figure 2. *Index of Biotic Integrity and Modified Index of Well-being scores for Sugar Creek, 1991 and 2010. WWH biocriteria thresholds are noted with a blue line.*

Fish community results from RM 1.9 revealed an improvement in IBI and MIwb scores between 1991 and 2010 (Figure 2), where biological condition improved from fair to good. During this time period, the silt load on the stream bottom downstream from the Dover Chemical effluent discharge was drastically reduced, and appeared to directly result in the enhanced fish community. During 1991, the severely embedded stream bottom downstream from Dover Chemical had a deleterious effect on bottom dwelling fish and macroinvertebrates (Ohio EPA 1992).

Table 7. Fish community summaries based on pulsed D.C. electrofishing sampling conducted by Ohio EPA in Sugar Creek and the Tuscarawas River, 2010. Relative numbers and weight are per 0.3 km for wading sites and 1.0 km for boat sites.

Stream	River Mile	Sampling Method	Fish Species (Total)	Relative Number	Relative Weight (kg)	QHEI (Habitat)	**IBI**	**MIwb**	Narrative Evaluation
Sugar Creek	3.4	Wading	29	514	36.7	79.8	47	9.0	Very Good
Sugar Creek	1.9	Wading	25	330	10.2	74.8	42[ns]	8.5	Marginally Good/ Good
Sugar Creek	1.3	Wading	30	408	7.9	84.8	47	8.6	Good/ Very Good
Tuscarawas River	58.1	Boat	34	458	119.3	80.8	53	9.8	Exceptional
Tuscarawas River	57.8	Boat	26	600	282.0	83.5	52	9.7	Exceptional

Ecoregion Biocriteria: Western Allegheny Plateau (WAP)		
INDEX - Site Type	WWH	EWH
IBI: Wading/ Boat	44/ 40	50/ 48
MIwb: Wading/ Boat	8.4/ 8.6	9.4/ 9.6

[ns] Non-significant departure from ecoregion biocriterion (≤4 IBI units or 0.5 MIwb units).

Macroinvertebrate Community

The macroinvertebrate communities from Sugar Creek and the Tuscarawas River were sampled in 2010 using quantitative (artificial substrate) and qualitative (natural substrate multi-habitat composite) sampling protocols. Results are summarized in Table 8. The ICI metrics with the associated scores and the raw data are attached as Appendix Tables 5 and 6.

The macroinvertebrate community from Sugar Creek upstream from Dover Chemical was evaluated as exceptional with an ICI score of 50. The macroinvertebrate communities from the two sites downstream from the Dover Chemical outfall were both evaluated as low-fair with ICI scores of 18 and 14. Mayfly and caddisfly taxa richness, many of which are pollution intolerant, declined from 16 upstream to 4 and 2 downstream from the outfall. The percent of the sample consisting of mayflies and caddisflies also exhibited a serious decline downstream from the outfall. Mayflies and caddisflies comprised 49% of the quantitative sample upstream from the Dover Chemical outfall and only 2.0% and 0.9% downstream. The decline in mayfly and caddisfly abundance downstream from Dover Chemical appears to have impacted the insectivorous fish community by reducing the biomass of suckers from the downstream sites. The percentage of macroinvertebrates tolerant of pollution in the quantitative sample rose from 0.9% upstream from the outfall to 10.4% and 14.9% downstream. Further evidence of impacts on the macroinvertebrate community from the Dover Chemical discharge is shown by a reduction in abundance of organisms in the quantitative sample. The upstream site had 3,206 organisms per square foot while the downstream sites had an order of magnitude reduction with 353 and 207 organisms per square foot. The instream macroinvertebrate community sampling results strongly correlated with Ohio EPA and Dover Chemical effluent bioassay test results, which documented adverse effects to the invertebrate test organism.

The macroinvertebrate community sampling results from the Tuscarawas River sampling locations did not show any impact from Sugar Creek. Both the upstream and downstream sites were evaluated as exceptional with ICI scores of 46 and 50.

Table 8. Summary of macroinvertebrate data collected from artificial substrates (quantitative sampling) and natural substrates (qualitative sampling) in Sugar Creek and the Tuscarawas River, 2010.

Stream	River Mile	Total Taxa	Quant. Taxa	Qual. Taxa	Qual. EPT[a] Taxa	Total Sensitive Taxa	Density Number/ft^2	**ICI**	Narrative Evaluation
Sugar Creek	3.4	68	35	57	18	29	3206	50	Exceptional
Sugar Creek	1.9	45	29	29	4	14	353	18	Low Fair
Sugar Creek	1.3	38	27	22	2	10	207	14	Low Fair
Tuscarawas River	58.1	68	46	50	19	32	2213	46	Exceptional
Tuscarawas River	57.8	72	44	62	22	34	2489	50	Exceptional

Biocriteria **:** Western Allegheny Plateau (WAP)		
INDEX	WWH	EWH
ICI	36	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).

Fish Tissue

Whole body fish tissue samples were collected from three locations in Sugar Creek and two locations in the Tuscarawas River during August, 2010. Common carp and smallmouth bass were collected from all five locations and tested for chlorinated pesticides, PCBs, 1,2,3,4-tetrachlorobenzene, 1,2,4,5-tetrachlorobenzene, percent lipid and other parameters. Results are reported in Appendix Tables 7 and 8. Individual fish were tested; none of the samples were composited prior to chemical analyses.

Whole body fish tissue results from Sugar Creek and the Tuscarawas River were compared to fish flesh criteria developed for the protection of Niagara River piscivorous wildlife by the New York State Department of Environmental Conservation (NYSDEC 1987). These criteria were developed for organochlorinated chemicals for both carcinogenic and non-carcinogenic effects. Exceedance of fish flesh criteria in some species at some locations suggests that the potential exists for toxic effects in wildlife from consumption of Sugar Creek or Tuscarawas River fish. Actual occurrence of effects would depend on the extent to which individual animals consume those fish species with residues in excess of criteria and the duration for which those species are consumed.

Table 9 lists chemical parameters tested in fish from Sugar Creek and the Tuscarawas River which exceeded the NYSDEC fish flesh criteria. Total PCBs exceeded non-carcinogenic fish flesh criteria and carcinogenic risk criteria in all fish tested from all stations. The highest levels of PCBs occurred in fish from the Tuscarawas River. Hexachlorobenzene and heptachlor epoxide levels were noted above fish flesh criteria from one fish sample in Sugar Creek downstream from Dover Chemical and from all fish samples collected from the Tuscarawas River both upstream and downstream from Sugar Creek. Two chemical parameters (1,2,3,4-tetrachlorobenzene and 1,2,4,5-tetrachlorobenzene) which were documented at elevated levels in Sugar Creek fish downstream from Dover Chemical, do not have fish flesh criteria developed.

Figure 3 is a compilation of six chemical parameters measured in whole body fish samples from Sugar Creek and the Tuscarawas River. All results were adjusted to one percent lipid content to better reflect comparisons between stations and reduce variability due to the lipophilic properties of the chemicals. The ability of an organism to bioaccumulate lipophilic organic chemicals is assumed to be proportional to its lipid content (Ohio EPA 1994). Since PCBs and chlorinated pesticides are lipophilic and lipid content varies between fish species and between individuals, lipid normalization helps to characterize relative site contamination. Normalized 1,2,3,4-tetrachlorobenzene, alpha BHC, and 1,2,4,5-tetrachlorobenzene values for common carp and smallmouth bass revealed elevated levels in Sugar Creek downstream from the Dover Chemical effluent discharge. Values declined towards the mouth of Sugar Creek and were low in the Tuscarawas River. Normalized levels for hexachlorobenzene, heptachlor epoxide, and PCBs documented the highest levels in the Tuscarawas River both upstream and downstream from Sugar Creek.

2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF), and other dioxin and furan congeners were measured in whole body fish from Sugar Creek and the Tuscarawas River. For each individual fish tissue sample, a 2378-TCDD Total Toxicity Equivalent (TTE) was calculated as a measure of the toxicity potential of the sample. The TTE is computed by multiplying each 2,3,7,8 chlorinated dioxin and dibenzo furan congener by its Toxicity Equivalence Factor (TEF), which is the toxicity of the congener compared to the toxicity of 2,3,7,8-TCDD (which is 1.0). These are then summed for each 2,3,7,8 congener in the sample. A summary of the fish tissue TTEs are listed in Table 10. Congener measurements below laboratory detection limits were not included in the TTE calculation. The NYSDEC fish flesh non-carcinogenic criterion level for dioxin of 3 ppt was used to assessed risk conditions to piscivorous wildlife. Sugar Creek fish tissue samples collected upstream (RM 3.4) from the Dover Chemical effluent discharge were all below the dioxin fish flesh criterion of 3 ppt. All ten fish tissue samples collected at the two sites (RMs 1.9 and 1.3) in Sugar Creek located downstream from the Dover Chemical discharge exceeded the fish flesh dioxin criterion for the protection of piscivorous wildlife. Two smallmouth bass measurements exceeded 30 ppt. Fish tissue sample results from the Tuscarawas River revealed 8 of 9 samples were below the 3 ppt fish flesh criterion, with five dioxin samples reported below lab detection limits. The one Tuscarawas River fish tissue sample measured above the 3 ppt fish flesh criterion occurred upstream from Sugar Creek.

Table 9. Summary of whole body fish tissue results which exceeded the NYSDEC fish flesh criterion (non-carcinogenic criterion level for dioxin of 3 ppt) for the protection of piscivorous wildlife. Complete results are reported in Appendix Tables 7 and 8.

	Sugar Creek Stations			Tuscarawas River Stations	
	RM 3.4	RM 1.9	RM 1.3	RM 58.1	RM 57.8
Hexachlorobenzene					
# Exceeding Criterion	None	None	1 of 5	5 of 5	5 of 5
Range of Values			1238 ug/kg	318 – 924 ug/kg	448 – 658 ug/kg
Heptachlor epoxide					
# Exceeding Criterion	None	None	1 of 5	5 of 5	5 of 5
Range of Values			1052 ug/kg	399 – 889 ug/kg	420 – 653 ug/kg
Total PCBs					
# Exceeding Criterion	5 of 5	4 of 4	5 of 5	5 of 5	5 of 5
Range of Values	177 – 437 ug/kg	269 – 430 ug/kg	212 – 3778 ug/kg	984 – 4593 ug/kg	1901 – 4188 ug/kg

Table 10. 2,3,7,8-TCDD total toxicity equivalent (TTE) calculations of whole body fish tissue samples collected by Ohio EPA from Sugar Creek and the Tuscarawas River, August, 2010. TTEs are represented in parts per trillion (ppt). Four to five individual fish tissue samples were collected from each biological sampling location, and the TTE for each sample is presented in this table. Values above the NYSDEC non-carcinogenic criterion level for dioxin of 3 ppt are shaded.

Fish Species	Sugar Creek RM 3.4 TTE	Sugar Creek RM 1.9 TTE	Sugar Creek RM 1.3 TTE	Tuscarawas R. RM 58.1 TTE	Tuscarawas R. RM 57.8 TTE
Common carp	ND	10.97	10.45	10.75	2.92
Common carp	ND	4.77	7.39	0.03	ND
Common carp	0.01	-	4.25	ND	0.56
Smallmouth bass	0.22	12.79	25.93	ND	ND
Smallmouth bass	ND	32.11	31.09	ND	-

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

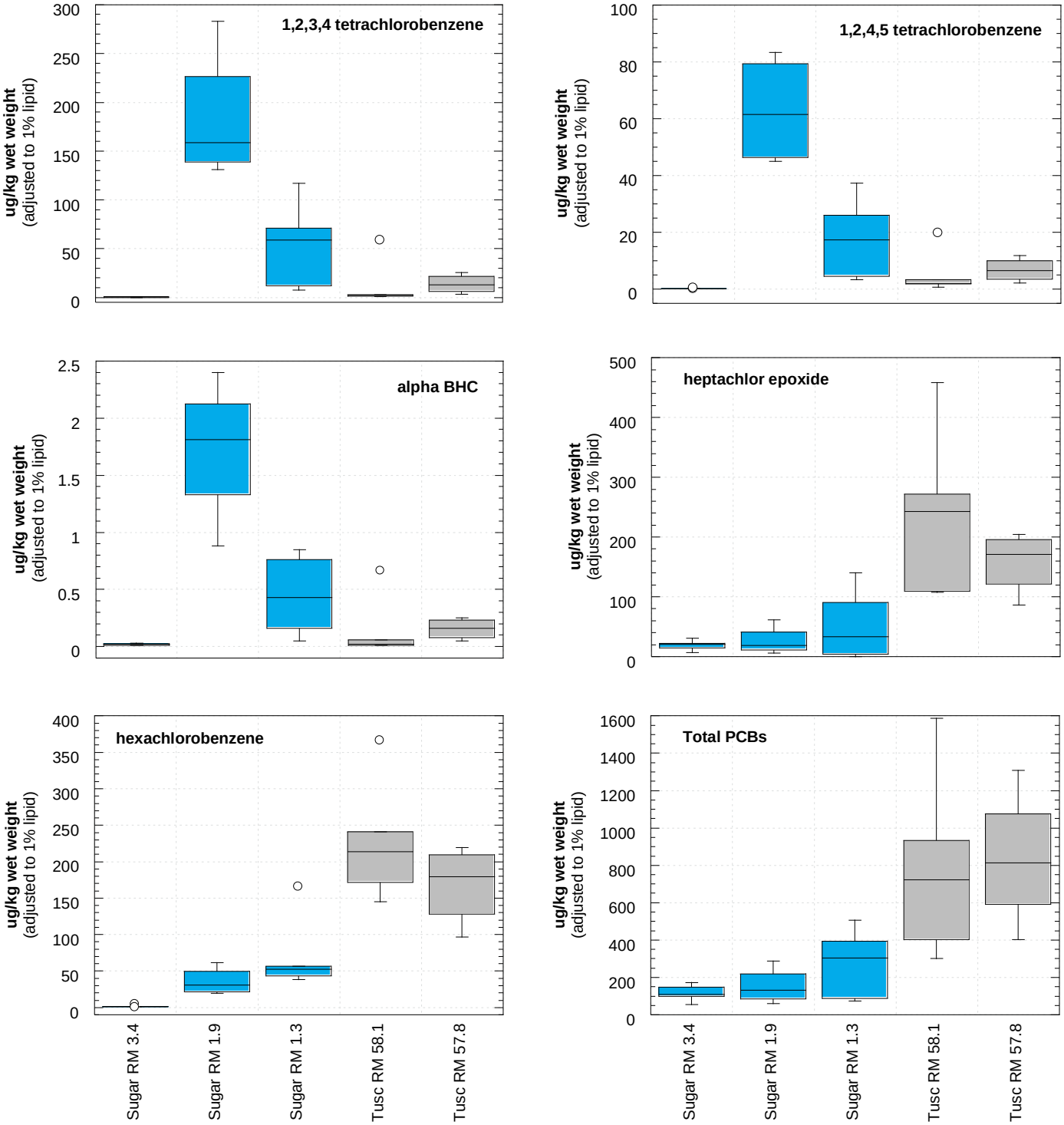

Figure 3. Lipid normalized total PCB, hexachlorobenzene, heptachlor epoxide, alpha BHC, 1,2,3,4-tetrachlorobenzene, and 1,2,4,5-tetrachlorobenzene concentrations in fish tissue samples from Sugar Creek and the Tuscarawas River, 2010. Sampling locations are reported in river miles (RM).

Lagoon

Sediment samples were collected in October, 2010 from four locations in the Dover Chemical lagoon using an Ekman dredge. A compilation of sediment sampling results by collection location is detailed in Appendix Table 9. Sampling locations are detailed in Figure 4. Surficial sediment results (upper four inches of bottom material) documented low levels of chlorinated pesticides, total PCBs, and chlorinated dibenzo dioxin and chlorinated dibenzo furan congeners. Of the chemical parameters tested, only DDD and DDE levels from one sample were above ecological benchmarks (Table 11). Overall sediment quality of the lagoon suggests low ecological risk to aquatic organisms from chemical contaminants.

*Table 11. Select chemical parameters measured in samples collected by Ohio EPA from surficial sediments in the Dover Chemical lagoon, October 2010. Contamination levels were determined for parameters using consensus-based sediment quality guidelines (MacDonald, et.al. 2000) and ecological screening levels (USEPA 2003). Shaded numbers indicate values above the following: Threshold Effect Concentration –TEC (yellow), Probable Effect Concentration – PEC (red) and Ecological Screening Levels (orange). Sampling locations are indicated by stream and river mile (RM). Results are reported in ug/kg) dry weight, unless noted. * - ecological screening values are not available.*

Parameter	Northeast Area LA-1	Southeast Area LA-2	Southeast Area – Duplicate LA-5	Southwest Area LA-3	Northwest Area LA-4
Alpha BHC	0.303	<0.056	0.552	<0.049	<0.049
Beta BHC	1.866	<0.056	0.159	0.790	<0.049
Delta BHC	1.222	<0.056	<0.047	0.114	<0.049
Gamma BHC	<0.072	<0.056	<0.047	<0.049	<0.049
Alpha chlordane	1.640	0.117	0.115	1.767	<0.049
Gamma chlordane	1.154	0.231	0.228	0.328	0.168
Oxychlordane	<0.072	<0.056	<0.047	<0.049	<0.049
Hexachlorobenzene	1.963	2.719	0.382	0.679	0.283
Heptachlor epoxide	0.462	<0.056	<0.047	0.428	0.896
Total PCBs	33.559	13.284	10.587	43.270	11.530
1,2,3,4-Tetrachlorobenzene*	0.424	0.440	1.176	0.278	0.865
1,2,4,5-Tetrachlorobenzene	1.746	0.774	1.556	0.437	0.476
Sum DDD	11.599	0.208	0.732	2.676	0.207
Sum DDE	5.084	0.740	0.719	2.022	0.269
2,3,7,8 TCDD Toxicity Equivalent (ppt)	0.967	0.435	0.951	1.280	0.242

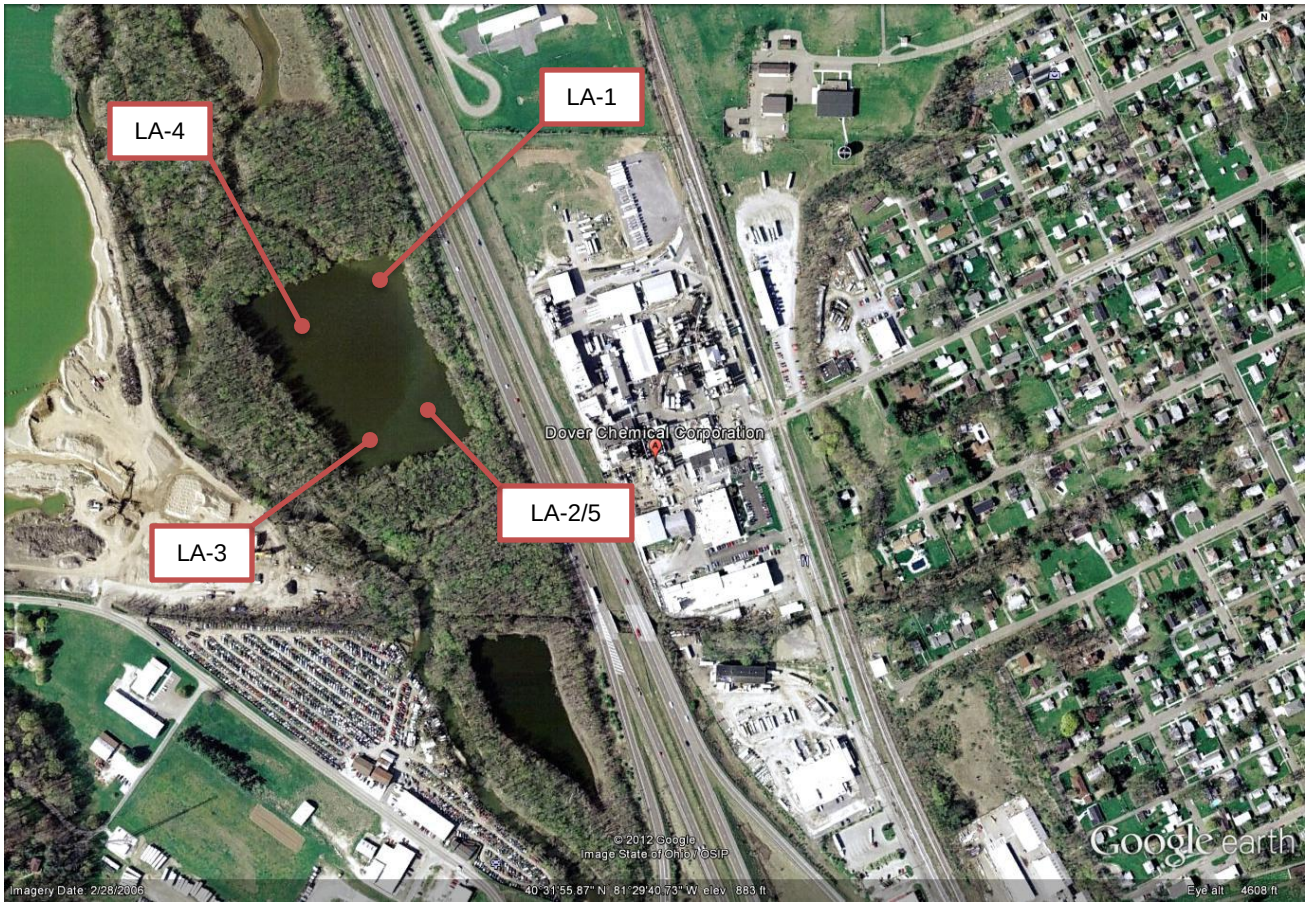

Figure 4. Lagoon sediment sampling locations, October, 2010.

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APPENDICES – SUGAR CREEK-TUSCARAWAS RIVER- LAGOON: DOVER CHEMICAL, 2010

Appendix Table 1. Organic sediment chemistry results for Sugar Creek and the Tuscarawas River, 2010.

Appendix Table 2. Dioxin sediment chemistry results for Sugar Creek and the Tuscarawas River, 2010.

Appendix Table 3. Ohio EPA fish results for Sugar Creek and the Tuscarawas River, 2010.

Appendix Table 4. Index of Biotic Integrity (IBI) scores and metrics for Sugar Creek and the Tuscarawas River, 2010.

Appendix Table 5. Invertebrate Community Index (ICI) scores and metrics for Sugar Creek and the Tuscarawas River, 2010.

Appendix Table 6. Ohio EPA macroinvertebrate results for Sugar Creek and the Tuscarawas River, 2010.

Appendix Table 7. Organic fish tissue chemistry results for Sugar Creek and the Tuscarawas River, 2010.

Appendix Table 8. Dioxin fish tissue chemistry results for Sugar Creek and the Tuscarawas River, 2010.

Appendix Table 9. Dioxin sediment chemistry results for Dover Chemical lagoon, 2010.

Appendix Table 1. Organic chemical results of sediment sampling conducted by Ohio EPA in Sugar Creek and the Tuscarawas River, August 3-12, 2010. All results are reported in ug/kg dry weight. Four to five grab samples were collected from each sampling zone (river mile) and individually tested.

Stream	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.
River Mile	3.4	3.4	3.4	3.4	3.4	1.9	1.9	1.9	1.9
Sample Number	SED25	SED26	SED27	SED28	SED29	SED20	SED21	SED21 - Duplicat	SED22
Date Sampled	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010
Percent Moisture	11.41	28.65	16.73	41.75	29.44	25.75	35.67	32.12	11.13
aldrin	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	<0.03288	<0.03804	<0.03514	<0.02746
alpha BHC	<0.02755	<0.03339	0.17774	<0.04137	<0.03455	5.28485	0.20519	12.51179	0.15978
alpha chlordane	0.1648	0.76244	0.43713	1.88498	0.3288	<0.03288	0.43836	<0.03514	0.07989
beta BHC	0.06208	<0.03339	0.12129	<0.04137	<0.03455	2.89293	0.33732	299.10725	0.08889
cis-nonachlor	<0.02755	0.13875	0.05524	0.38798	0.04677	0.22761	0.13524	0.30495	<0.02746
delta BHC	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	2.22357	0.15389	0.57307	<0.02746
dieldrin	<0.02755	0.13034	0.14051	0.48755	0.05102	0.53468	0.1912	0.18709	<0.02746
endosulfan II	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	<0.03288	<0.03804	0.49794	<0.02746
endrin	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	<0.03288	<0.03804	<0.03514	<0.02746
gamma BHC	0.02935	<0.03339	<0.02958	<0.04137	<0.03455	1.57845	<0.03804	0.98704	0.03376
gamma chlordane	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	0.42424	<0.03804	<0.03514	<0.02746
hexachlorobenzene	0.22689	0.8199	0.1357	0.67468	0.09779	0.55758	0.88606	1.25368	1.24902
heptachlor	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	<0.03288	<0.03804	<0.03514	<0.02746
heptachlor epoxide	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	1.72256	<0.03804	<0.03514	<0.02746
mirex	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	0.14545	<0.03804	<0.03514	<0.02746
o,p'-DDD	0.06547	0.39523	1.11685	0.8	<0.03455	1.99865	1.08192	0.76016	<0.02746
o,p'-DDE	<0.02755	<0.03339	0.24859	<0.04137	<0.03455	1.70236	0.09949	<0.03514	<0.02746
o,p'-DDT	<0.02755	0.38823	3.60514	1.22575	0.18707	1.72256	0.72284	0.51709	<0.02746
oxychlordane	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	<0.03288	0.17566	0.18857	<0.02746
p,p'-DDD	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	<0.03288	<0.03804	<0.03514	<0.02746
p,p'-DDE	0.08466	0.66994	0.97274	2.82918	0.33872	<0.03288	0.90471	0.71597	0.17441
p,p'-DDT	<0.02755	0.06447	0.59085	0.46009	<0.03455	<0.03288	0.07462	<0.03514	<0.02746
PCB-TOTAL	9.369	16.67835	23.77807	44.97854	10.62925	142.89562	16.94388	37.71361	3.15067
pentachloro-anisole	0.4075	0.32656	0.30743	1.01974	0.2962	0.98182	0.5192	0.54655	0.32632
toxaphene	<0.5509	<0.66772	<0.59158	<0.82734	<0.691	<0.65762	<0.76088	<0.70286	<0.54917
trans-nonachlor	0.50231	0.38402	0.1297	2.56137	0.2055	2.59933	0.87984	0.88097	0.20029
chlorpyrifos	<0.02755	<0.03339	<0.02958	<0.04137	<0.03455	<0.03288	<0.03804	<0.03514	<0.02746
1,2,3,4-Tetrachlorobenzene	0.04064	<0.03339	0.08887	<0.04137	0.12897	463.18519	5.0785	674.05274	6.48813
1,2,4,5-Tetrachlorobenzene	0.42894	0.44429	0.15131	0.25579	0.14598	196.99933	1.7348	720.54361	3.44998

Appendix Table 1. Continued.

Stream	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.
River Mile	1.9	1.9	1.3	1.3	1.3	1.3	58.1	58.1	58.1
Sample Number	SED23	SED24	SED30	SED31	SED33	SED34	SED1	SED2	SED3
Date Sampled	8/4/2010	8/4/2010	8/12/2010	8/12/2010	8/12/2010	8/12/2010	8/3/2010	8/3/2010	8/3/2010
Percent Moisture	32.43	28.28	43.8	46.82	32.33	53.41	54.56	42.97	41.61
aldrin	<0.03651	0.12828	<0.04241	1.04363	<0.03626	<0.05281	<0.04871	<0.04336	6.41206
alpha BHC	0.20423	0.43781	0.23488	0.0865	0.2394	0.39923	1.5471	<0.04336	0.20209
alpha chlordane	0.67634	0.33045	1.11388	2.08349	0.91917	1.97253	<0.04871	1.81659	1.72632
beta BHC	0.29599	0.35137	0.54448	0.43625	0.30442	0.6847	<0.04871	<0.04336	<0.04109
cis-nonachlor	0.18943	0.24819	0.63523	0.38736	0.28077	0.33484	<0.04871	0.83289	0.72101
delta BHC	0.17167	0.84216	0.57295	0.71832	0.5645	0.58596	2.22931	0.82763	0.16441
dieldrin	0.14947	0.21194	0.44484	0.37984	0.40343	0.66967	<0.04871	<0.04336	0.1901
endosulfan II	<0.03651	<0.03325	<0.04241	<0.04505	<0.03626	<0.05281	<0.04871	<0.04336	<0.04109
endrin	<0.03651	<0.03325	<0.04241	<0.04505	<0.03626	<0.05281	<0.04871	<0.04336	<0.04109
gamma BHC	<0.03651	<0.03325	<0.04241	0.11659	<0.03626	<0.05281	<0.04871	<0.04336	<0.04109
gamma chlordane	<0.03651	0.34439	<0.04241	<0.04505	<0.03626	<0.05281	<0.04871	<0.04336	0.48981
hexachlorobenzene	5.82063	4.30982	4.8452	0.98909	6.08246	3.25821	150.58099	2187.44871	3684.76965
heptachlor	0.08288	0.2691	0.1548	0.67695	0.22757	0.1202	19.78653	1.78678	2.2521
heptachlor epoxide	<0.03651	<0.03325	1.18861	1.77322	0.84085	0.90792	31.83319	<0.04336	13.93903
mirex	<0.03651	0.19381	0.33452	0.14855	0.18472	0.11161	<0.04871	0.25776	<0.04109
o,p'-DDD	0.53426	1.61182	<0.04241	0.92892	1.93882	<0.05281	15.07042	1.58162	1.77599
o,p'-DDE	1.07444	1.74289	0.91993	2.4276	1.95508	0.9809	4.09331	3.03349	2.23155
o,p'-DDT	1.22244	0.97881	1.24555	2.67582	1.296	0.68684	3.1206	4.13817	3.87395
oxychlordane	0.53426	1.07501	<0.04241	<0.04505	<0.03626	<0.05281	65.11004	18.89532	22.41993
p,p'-DDD	<0.03651	<0.03325	0.21708	0.32531	<0.03626	0.77699	7.01585	1.40628	1.26049
p,p'-DDE	0.70593	0.47964	<0.04241	<0.04505	1.03591	1.57759	19.00528	<0.04336	1.03785
p,p'-DDT	<0.03651	<0.03325	<0.04241	<0.04505	<0.03626	<0.05281	<0.04871	3.83482	4.20277
PCB-TOTAL	29.30295	50.6135	75.62278	110.94396	50.53938	89.28955	2699.16373	561.98492	372.83781
pentachloro-anisole	0.4573	1.20608	0.31851	0.42497	0.57189	0.52801	1.22579	2.79677	3.65474
toxaphene	<0.73012	<0.66491	<0.84812	<0.90101	<0.7251	<1.05629	<0.97419	<0.86719	<0.8218
trans-nonachlor	1.30827	1.68433	2.64947	3.17789	3.64416	3.36124	<0.04871	2.16903	1.39921
chlorpyrifos	<0.03651	1.67317	<0.04241	0.11659	<0.03626	<0.05281	5.42033	22.22514	2.79329
1,2,3,4-Tetrachlorobenzene	85.29081	81.80842	19.2242	17.44077	53.9205	180.24898	10.65361	1.10293	1.14403
1,2,4,5-Tetrachlorobenzene	41.03448	10.09342	14.379	11.24483	14.09783	74.95385	71.20599	64.33281	82.66655

Appendix Table 1. Continued.

Stream	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.
River Mile	58.1	58.1	57.8	57.8	57.8	57.8	57.8
Sample Number	SED4	SED5	SED6	SED7	SED8	SED9	SED10
Date Sampled	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010
Percent Moisture	41.04	39.73	45.25	31.27	34.86	54.29	27.84
aldrin	<0.04135	<0.03958	<0.04446	1.05485	4.39208	2.83308	0.78575
alpha BHC	<0.04135	<0.03958	0.31781	<0.03208	<0.02208	0.41129	<0.02643
alpha chlordane	1.78596	1.54637	1.54155	0.32737	1.0961	1.17917	0.29656
beta BHC	<0.04135	<0.03958	0.56986	<0.03208	<0.02208	0.40035	0.1566
cis-nonachlor	0.78189	0.55915	0.52603	0.12804	0.41296	0.77882	0.14412
delta BHC	0.18487	0.16924	0.62648	<0.03208	0.15966	2.5093	<0.02643
dieldrin	0.57836	0.20076	0.39087	0.0873	0.14123	0.4266	<0.02643
endosulfan II	<0.04135	0.17588	<0.04446	<0.03208	0.16119	<0.04467	<0.02643
endrin	<0.04135	<0.03958	<0.04446	<0.03208	<0.02208	1.01291	<0.02643
gamma BHC	<0.04135	<0.03958	<0.04446	<0.03208	0.0261	0.28878	<0.02643
gamma chlordane	<0.04135	0.04314	<0.04446	0.53106	1.44151	1.64297	0.45316
hexachlorobenzene	2251.87415	1446.84254	2.59543	72.82555	334.04206	230.93634	86.15438
heptachlor	0.70556	0.68525	0.47123	0.23716	0.58336	<0.04467	0.21203
heptachlor epoxide	<0.04135	<0.03958	<0.04446	9.39182	84.51182	26.08838	25.80793
mirex	<0.04135	0.18417	0.26849	<0.03208	0.06908	0.35222	<0.02643
o,p'-DDD	1.08887	0.87938	1.98721	0.35938	1.22505	1.32137	0.62084
o,p'-DDE	1.78596	1.27758	1.55068	<0.03208	<0.02208	<0.04467	<0.02643
o,p'-DDT	4.58786	3.70665	1.9653	<0.03208	2.49463	4.38416	0.64579
oxychlordane	24.28256	11.78198	3.05388	0.30845	<0.02208	1.39794	0.16075
p,p'-DDD	0.92096	0.76821	<0.04446	0.3812	0.7292	0.70663	0.31874
p,p'-DDE	<0.04135	0.4513	0.87489	0.29245	0.3408	1.68891	0.12611
p,p'-DDT	3.03087	2.02754	<0.04446	<0.03208	<0.02208	<0.04467	<0.02643
PCB-TOTAL	214.38263	263.481	75.43379	89.62607	350.01535	172.39116	95.75942
pentachloro-anisole	4.16723	1.54306	0.48037	0.34046	<0.02208	1.51827	0.57095
toxaphene	<0.82695	<0.7916	<0.88923	<0.64152	<0.44152	<0.89331	<0.52853
trans-nonachlor	1.52815	1.407	3.6274	0.4685	0.71999	3.87224	1.17794
chlorpyrifos	1.04478	0.67861	<0.04446	6.50371	5.38686	48.9499	8.32871
1,2,3,4-Tetrachlorobenzene	0.47151	0.70682	13.18356	0.19933	0.9257	15.09298	0.51275
1,2,4,5-Tetrachlorobenzene	13.29715	13.54903	8.52785	5.46923	57.21676	32.33428	8.50055

Appendix Table 2. Dioxin results in sediment collected by Ohio EPA in Sugar Creek and the Tuscarawas River, August 3-12, 2010. All results are reported in mg/kg dry weight. Four to five grab samples were collected from each sampling zone (river mile) and individually tested.

Stream	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.
River Mile	3.4	3.4	3.4	3.4	3.4	1.9	1.9	1.9	1.9
Sample Number	SED25	SED26	SED27	SED28	SED29	SED20	SED21	SED21 - Duplicat	SED22
Date Sampled	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010
2,3,7,8-TCDD	<0.00000056	<0.00000069	<0.00000058	<0.00000082	<0.0000007	4.98E-06	<0.00000076	<0.0000007	<0.00000056
1,2,3,7,8-PeCDD	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	1.20E-05	<0.0000038	<0.00000352	<0.00000279
1,2,3,4,7,8-HxCDD	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	2.03E-05	<0.0000038	<0.00000352	<0.00000279
1,2,3,6,7,8-HxCDD	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	2.39E-04	<0.0000038	<0.00000352	<0.00000279
1,2,3,7,8,9-HxCDD	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	1.23E-04	<0.0000038	<0.00000352	<0.00000279
1,2,3,4,6,7,8-HpCDD	6.56E-06	2.00E-05	5.13E-05	7.96E-05	8.73E-06	0.00156307	7.10E-05	7.88E-05	6.04E-06
OCDD	2.88E-04	6.45E-04	0.00313835	0.002657	3.41E-04	0.00276916	7.98E-04	8.00E-04	1.22E-04
2,3,7,8-TCDF	<0.00000056	<0.00000069	<0.00000058	<0.00000082	<0.0000007	7.92E-05	<0.00000076	<0.0000007	<0.00000056
1,2,3,7,8-PeCDF	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	3.69E-05	<0.0000038	<0.00000352	<0.00000279
2,3,4,7,8-PeCDF	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	7.99E-05	<0.0000038	<0.00000352	<0.00000279
1,2,3,4,7,8-HxCDF	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	6.98E-04	4.80E-05	4.60E-05	<0.00000279
1,2,3,6,7,8-HxCDF	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	1.38E-04	9.64E-06	1.06E-05	<0.00000279
2,3,4,6,7,8-HxCDF	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	6.57E-05	<0.0000038	<0.00000352	<0.00000279
1,2,3,7,8,9-HxCDF	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	<0.00000336	<0.0000038	<0.00000352	<0.00000279
1,2,3,4,6,7,8-HpCDF	<0.00000279	9.81E-06	4.20E-06	1.92E-05	<0.00000349	0.0030866	2.51E-04	2.21E-04	8.21E-06
1,2,3,4,7,8,9-HpCDF	<0.00000279	<0.00000344	<0.00000289	<0.00000412	<0.00000349	1.16E-04	<0.0000038	6.19E-06	<0.00000279
OCDF	<0.00000559	2.58E-05	<0.00000578	4.91E-05	<0.00000698	0.00610532	3.36E-04	3.21E-04	1.14E-05

Appendix Table 2. Continued.

Stream	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.
River Mile	1.9	1.9	1.3	1.3	1.3	1.3	58.1	58.1	58.1
Sample Number	SED23	SED24	SED30	SED31	SED33	SED34	SED1	SED2	SED3
Date Sampled	8/4/2010	8/4/2010	8/12/2010	8/12/2010	8/12/2010	8/12/2010	8/3/2010	8/3/2010	8/3/2010
2,3,7,8-TCDD	<0.00000073	<0.00000069	<0.00000085	<0.00000092	<0.00000071	<0.00000103	<0.00000078	<0.00000085	<0.00000085
1,2,3,7,8-PeCDD	<0.00000365	<0.00000343	<0.00000424	<0.00000462	<0.00000354	<0.00000515	<0.00000388	<0.00000425	<0.00000423
1,2,3,4,7,8-HxCDD	<0.00000365	<0.00000343	<0.00000424	<0.00000462	<0.00000354	<0.00000515	4.62E-06	<0.00000425	<0.00000423
1,2,3,6,7,8-HxCDD	<0.00000365	<0.00000343	<0.00000424	8.27E-06	<0.00000354	<0.00000515	7.11E-05	<0.00000425	1.17E-05
1,2,3,7,8,9-HxCDD	<0.00000365	<0.00000343	<0.00000424	<0.00000462	<0.00000354	<0.00000515	4.49E-05	<0.00000425	8.05E-06
1,2,3,4,6,7,8-HpCDD	4.77E-05	4.63E-05	3.27E-05	1.35E-04	4.03E-05	1.33E-04	5.59E-04	2.08E-04	1.72E-04
OCDD	9.37E-04	0.00125474	7.01E-04	0.00258556	7.97E-04	0.00281455	0.00475176	0.00243398	0.00220928
2,3,7,8-TCDF	<0.00000073	<0.00000069	<0.00000085	<0.00000092	6.21E-06	2.96E-05	2.29E-05	2.98E-05	5.82E-06
1,2,3,7,8-PeCDF	<0.00000365	<0.00000343	<0.00000424	8.65E-06	<0.00000354	1.05E-05	1.94E-05	<0.00000425	<0.00000423
2,3,4,7,8-PeCDF	<0.00000365	<0.00000343	4.80E-06	1.20E-05	<0.00000354	1.67E-05	1.01E-05	<0.00000425	<0.00000423
1,2,3,4,7,8-HxCDF	2.62E-05	3.60E-05	2.53E-05	1.12E-04	2.72E-05	1.14E-04	2.20E-05	<0.00000425	1.18E-05
1,2,3,6,7,8-HxCDF	7.10E-06	9.62E-06	<0.00000424	2.97E-05	6.80E-06	2.96E-05	2.82E-05	<0.00000425	<0.00000423
2,3,4,6,7,8-HxCDF	4.00E-06	3.76E-06	<0.00000424	1.15E-05	<0.00000354	1.16E-05	1.25E-05	<0.00000425	7.02E-06
1,2,3,7,8,9-HxCDF	<0.00000365	<0.00000343	<0.00000424	<0.00000462	<0.00000354	<0.00000515	1.45E-05	<0.00000425	<0.00000423
1,2,3,4,6,7,8-HpCDF	1.09E-04	2.21E-04	1.74E-04	6.39E-04	1.53E-04	5.59E-04	4.35E-04	1.43E-04	1.46E-04
1,2,3,4,7,8,9-HpCDF	6.51E-06	<0.00000343	<0.00000424	2.09E-05	3.84E-06	1.59E-05	9.02E-05	2.91E-05	2.57E-05
OCDF	1.53E-04	3.32E-04	2.48E-04	0.00120177	2.11E-04	8.97E-04	0.00193552	6.96E-04	5.86E-04

Appendix Table 2. Continued.

Stream	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.
River Mile	58.1	58.1	57.8	57.8	57.8	57.8	57.8
Sample Number	SED4	SED5	SED6	SED7	SED8	SED9	SED10
Date Sampled	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010
2,3,7,8-TCDD	1.19E-06	<0.00000081	<0.00000089	<0.00000061	<0.00000051	<0.00000088	<0.00000048
1,2,3,7,8-PeCDD	<0.00000422	<0.00000403	<0.00000445	<0.00000304	<0.00000253	<0.00000438	<0.0000024
1,2,3,4,7,8-HxCDD	7.97E-06	<0.00000403	<0.00000445	<0.00000304	<0.00000253	<0.00000438	<0.0000024
1,2,3,6,7,8-HxCDD	4.02E-05	<0.00000403	<0.00000445	<0.00000304	<0.00000253	<0.00000438	<0.0000024
1,2,3,7,8,9-HxCDD	2.23E-05	<0.00000403	<0.00000445	<0.00000304	2.93E-06	<0.00000438	<0.0000024
1,2,3,4,6,7,8-HpCDD	5.18E-04	8.90E-05	5.80E-05	2.80E-05	9.16E-05	1.03E-04	1.46E-05
OCDD	0.00647507	0.00144948	0.00126831	4.96E-04	0.00113294	0.00180026	2.02E-04
2,3,7,8-TCDF	<0.00000084	<0.00000081	<0.00000089	<0.00000061	3.22E-06	<0.00000088	<0.00000048
1,2,3,7,8-PeCDF	<0.00000422	<0.00000403	<0.00000445	<0.00000304	<0.00000253	<0.00000438	<0.0000024
2,3,4,7,8-PeCDF	<0.00000422	<0.00000403	<0.00000445	<0.00000304	<0.00000253	<0.00000438	<0.0000024
1,2,3,4,7,8-HxCDF	1.90E-05	<0.00000403	2.87E-05	<0.00000304	5.22E-06	<0.00000438	<0.0000024
1,2,3,6,7,8-HxCDF	1.17E-05	<0.00000403	7.85E-06	<0.00000304	3.84E-06	<0.00000438	<0.0000024
2,3,4,6,7,8-HxCDF	1.37E-05	<0.00000403	4.75E-06	<0.00000304	2.61E-06	<0.00000438	<0.0000024
1,2,3,7,8,9-HxCDF	<0.00000422	<0.00000403	<0.00000445	<0.00000304	<0.00000253	<0.00000438	<0.0000024
1,2,3,4,6,7,8-HpCDF	4.53E-04	5.76E-05	1.51E-04	2.71E-05	7.95E-05	2.38E-04	1.03E-05
1,2,3,4,7,8,9-HpCDF	3.85E-05	1.15E-05	5.11E-06	5.82E-06	1.58E-05	1.51E-05	<0.0000024
OCDF	8.40E-04	2.52E-04	2.35E-04	1.70E-04	2.54E-04	4.61E-04	3.19E-05

River Code: **17-400**	Stream: **Sugar Creek**	Sample Date: **2010**
River Mile: **3.40**	Location: dst. Co. Rd. 80	Date Range: 08/04/2010
Time Fished: 4445 sec	Drainage: 340.0 sq mi	Thru: 09/21/2010
Dist Fished: 0.40 km	Basin: Muskingum River No of Passes: 2	Sampler Type: D

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		15	11.25	2.19	1.32	3.60	117.33
Northern Pike	F	P	M		1	0.75	0.15	0.10	0.28	138.00
Silver Redhorse	R	I	S	M	3	2.25	0.44	2.79	7.59	1,238.67
Golden Redhorse	R	I	S	M	18	13.50	2.62	3.51	9.56	260.00
Northern Hog Sucker	R	I	S	M	139	104.25	20.26	9.69	26.39	92.96
Smallmouth Redhorse	R	I	S	M	13	9.75	1.90	0.92	2.50	94.23
Common Carp	G	O	M	T	10	7.50	1.46	13.11	35.70	1,747.50
River Chub	N	I	N	I	7	5.25	1.02	0.18	0.48	33.86
Bigeye Chub	N	I	S	I	6	4.50	0.87	0.02	0.06	5.00
Streamline Chub	N	I	S	R	2	1.50	0.29	0.02	0.05	11.50
Gravel Chub	N	I	S	M	5	3.75	0.73	0.03	0.09	9.00
Rosyface Shiner	N	I	S	I	1	0.75	0.15	0.00	0.00	2.00
Spotfin Shiner	N	I	M		47	35.25	6.85	0.11	0.31	3.23
Sand Shiner	N	I	M	M	67	50.25	9.77	0.12	0.34	2.46
Mimic Shiner	N	I	M	I	7	5.25	1.02	0.01	0.03	2.14
Bluntnose Minnow	N	O	C	T	62	46.50	9.04	0.18	0.48	3.78
Central Stoneroller	N	H	N		1	0.75	0.15	0.02	0.04	20.00
Brook Silverside		I	M	M	1	0.75	0.15	0.00	0.01	3.00
Rock Bass	S	C	C		3	2.25	0.44	0.07	0.20	32.67
Smallmouth Bass	F	C	C	M	10	7.50	1.46	0.85	2.32	113.70
Largemouth Bass	F	C	C		4	3.00	0.58	0.54	1.47	180.00
Green Sunfish	S	I	C	T	1	0.75	0.15	0.00	0.01	5.00
Bluegill Sunfish	S	I	C	P	16	12.00	2.33	0.53	1.43	43.88
Logperch	D	I	S	M	18	13.50	2.62	0.16	0.44	11.94
Johnny Darter	D	I	C		9	6.75	1.31	0.02	0.05	2.78
Greenside Darter	D	I	S	M	86	64.50	12.54	0.15	0.42	2.37
Banded Darter	D	I	S	I	69	51.75	10.06	0.09	0.25	1.74
Sauger X Walleye	E	P			1	0.75	0.15	0.34	0.92	450.00
Freshwater Drum			M	P	2	1.50	0.29	1.76	4.80	1,175.00
Mottled Sculpin		I	C		62	46.50	9.04	0.07	0.18	1.44
	Mile Total				686	514.50		36.72		
	Number of Species				29					
	Number of Hybrids				1					

River Code: **17-400**	Stream: **Sugar Creek**	Sample Date: **2010**
River Mile: **1.90**	Location: upst. St. Rt. 39	Date Range: 08/04/2010
Time Fished: 4868 sec	Drainage: 348.0 sq mi	Thru: 09/21/2010
Dist Fished: 0.40 km	Basin: Muskingum River No of Passes: 2	Sampler Type: D

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		3	2.25	0.68	0.03	0.27	12.33
Northern Pike	F	P	M		3	2.25	0.68	0.41	4.02	182.67
Golden Redhorse	R	I	S	M	8	6.00	1.82	0.67	6.53	111.25
Northern Hog Sucker	R	I	S	M	49	36.75	11.14	1.44	14.09	39.18
Smallmouth Redhorse	R	I	S	M	3	2.25	0.68	0.07	0.70	32.00
Common Carp	G	O	M	T	1	0.75	0.23	1.61	15.78	2,150.00
Streamline Chub	N	I	S	R	3	2.25	0.68	0.03	0.26	12.00
Gravel Chub	N	I	S	M	5	3.75	1.14	0.03	0.26	7.00
Spotfin Shiner	N	I	M		39	29.25	8.86	0.06	0.63	2.21
Sand Shiner	N	I	M	M	44	33.00	10.00	0.07	0.70	2.18
Bluntnose Minnow	N	O	C	T	44	33.00	10.00	0.07	0.68	2.09
Central Stoneroller	N	H	N		8	6.00	1.82	0.09	0.87	14.75
Yellow Bullhead		I	C	T	1	0.75	0.23	0.01	0.07	10.00
Brook Silverside		I	M	M	1	0.75	0.23	0.00	0.01	2.00
Rock Bass	S	C	C		17	12.75	3.86	0.79	7.73	62.00
Smallmouth Bass	F	C	C	M	11	8.25	2.50	1.22	11.97	148.24
Largemouth Bass	F	C	C		3	2.25	0.68	0.14	1.39	63.33
Green Sunfish	S	I	C	T	5	3.75	1.14	0.06	0.59	16.00
Bluegill Sunfish	S	I	C	P	23	17.25	5.23	0.53	5.20	30.78
Logperch	D	I	S	M	4	3.00	0.91	0.05	0.46	15.75
Johnny Darter	D	I	C		17	12.75	3.86	0.02	0.17	1.35
Greenside Darter	D	I	S	M	42	31.50	9.55	0.10	0.93	3.02
Banded Darter	D	I	S	I	42	31.50	9.55	0.04	0.40	1.29
Freshwater Drum			M	P	2	1.50	0.45	2.59	25.32	1,725.00
Mottled Sculpin		I	C		62	46.50	14.09	0.10	0.96	2.11
	Mile Total				440	330.00		10.22		
	Number of Species				25					
	Number of Hybrids				0					

River Code: **17-400**	Stream: **Sugar Creek**	Sample Date: **2010**
River Mile: **1.30**	Location: Gino's property	Date Range: 08/12/2010
Time Fished: 4422 sec	Drainage: 348.0 sq mi	Thru: 09/21/2010
Dist Fished: 0.40 km	Basin: Muskingum River No of Passes: 2	Sampler Type: D

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		7	5.25	1.29	0.63	7.87	119.00
Golden Redhorse	R	I	S	M	1	0.75	0.18	0.16	2.00	212.00
Northern Hog Sucker	R	I	S	M	37	27.75	6.80	1.48	18.68	53.43
Common Carp	G	O	M	T	1	0.75	0.18	1.58	19.83	2,100.00
River Chub	N	I	N	I	3	2.25	0.55	0.06	0.77	27.33
Bigeye Chub	N	I	S	I	33	24.75	6.07	0.08	0.98	3.12
Streamline Chub	N	I	S	R	2	1.50	0.37	0.01	0.17	9.00
Gravel Chub	N	I	S	M	2	1.50	0.37	0.01	0.09	4.50
Silver Shiner	N	I	S	I	2	1.50	0.37	0.05	0.57	30.00
Rosyface Shiner	N	I	S	I	18	13.50	3.31	0.05	0.65	3.83
Spotfin Shiner	N	I	M		124	93.00	22.79	0.23	2.89	2.46
Sand Shiner	N	I	M	M	64	48.00	11.76	0.12	1.55	2.56
Mimic Shiner	N	I	M	I	6	4.50	1.10	0.01	0.18	3.17
Bluntnose Minnow	N	O	C	T	8	6.00	1.47	0.04	0.55	7.25
Central Stoneroller	N	H	N		70	52.50	12.87	0.66	8.37	12.66
Yellow Bullhead		I	C	T	4	3.00	0.74	0.17	2.13	56.25
White Crappie	S	I	C		1	0.75	0.18	0.00	0.03	3.00
Rock Bass	S	C	C		22	16.50	4.04	0.79	9.90	47.64
Smallmouth Bass	F	C	C	M	9	6.75	1.65	0.53	6.63	78.00
Largemouth Bass	F	C	C		7	5.25	1.29	0.19	2.37	35.79
Warmouth Sunfish	S	C	C		2	1.50	0.37	0.02	0.19	10.00
Green Sunfish	S	I	C	T	2	1.50	0.37	0.04	0.48	25.50
Bluegill Sunfish	S	I	C	P	64	48.00	11.76	0.58	7.32	12.10
Green Sf X Bluegill Sf					3	2.25	0.55	0.13	1.67	59.00
Blackside Darter	D	I	S		3	2.25	0.55	0.01	0.11	3.67
Logperch	D	I	S	M	4	3.00	0.74	0.04	0.54	14.25
Johnny Darter	D	I	C		9	6.75	1.65	0.03	0.42	4.89
Greenside Darter	D	I	S	M	12	9.00	2.21	0.04	0.47	4.08
Banded Darter	D	I	S	I	14	10.50	2.57	0.02	0.21	1.57
Freshwater Drum			M	P	1	0.75	0.18	0.15	1.94	205.00
Mottled Sculpin		I	C		9	6.75	1.65	0.04	0.51	6.00
Mile Total					544	408.00		7.94		
Number of Species					30					
Number of Hybrids					1					

River Code: **17-500**	Stream: **Tuscarawas River**	Sample Date: **2010**
River Mile: **58.10**	Location: upst. Sugar Creek/dst. Dover WWTP	Date Range: 08/03/2010
Time Fished: 3047 sec	Drainage: 1413.0 sq mi	Thru: 09/20/2010
Dist Fished: 1.00 km	Basin: Muskingum 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
Gizzard Shad		O	M		48	48.00	10.48	8.50	7.13	177.14
Northern Pike	F	P	M		1	1.00	0.22	1.08	0.90	1,075.00
Highfin Carpsucker	C	O	M		2	2.00	0.44	1.60	1.34	800.00
Silver Redhorse	R	I	S	M	20	20.00	4.37	4.26	3.57	212.80
Golden Redhorse	R	I	S	M	46	46.00	10.04	6.62	5.55	143.96
Northern Hog Sucker	R	I	S	M	33	33.00	7.21	6.61	5.54	200.21
Smallmouth Redhorse	R	I	S	M	54	54.00	11.79	29.81	24.98	551.95
Common Carp	G	O	M	T	16	16.00	3.49	41.15	34.49	2,571.88
River Chub	N	I	N	I	8	8.00	1.75	0.16	0.13	19.88
Bigeye Chub	N	I	S	I	1	1.00	0.22	0.00	0.00	3.00
Creek Chub	N	G	N	T	1	1.00	0.22	0.01	0.01	11.00
Silver Shiner	N	I	S	I	1	1.00	0.22	0.02	0.02	19.00
Rosyface Shiner	N	I	S	I	1	1.00	0.22	0.00	0.00	2.00
Spotfin Shiner	N	I	M		55	55.00	12.01	0.19	0.16	3.36
Sand Shiner	N	I	M	M	10	10.00	2.18	0.03	0.02	2.50
Bluntnose Minnow	N	O	C	T	4	4.00	0.87	0.02	0.02	5.50
Central Stoneroller	N	H	N		2	2.00	0.44	0.01	0.01	7.00
Channel Catfish	F		C		4	4.00	0.87	6.67	5.59	1,667.50
Brook Silverside		I	M	M	5	5.00	1.09	0.02	0.01	3.00
White Crappie	S	I	C		11	11.00	2.40	1.67	1.40	151.73
Rock Bass	S	C	C		21	21.00	4.59	0.97	0.81	46.05
Smallmouth Bass	F	C	C	M	16	16.00	3.49	1.94	1.63	121.25
Largemouth Bass	F	C	C		6	6.00	1.31	1.15	0.96	190.83
Green Sunfish	S	I	C	T	1	1.00	0.22	0.07	0.06	72.00
Bluegill Sunfish	S	I	C	P	48	48.00	10.48	2.00	1.68	41.69
Orangespotted Sunfish	S	I	C		2	2.00	0.44	0.02	0.01	8.00
Green Sf X Bluegill Sf					1	1.00	0.22	0.06	0.05	55.00
Blackside Darter	D	I	S		2	2.00	0.44	0.01	0.01	5.50
Logperch	D	I	S	M	12	12.00	2.62	0.21	0.17	17.08
Eastern Sand Darter [S]	D	I	S	R	1	1.00	0.22	0.00	0.00	2.00
Johnny Darter	D	I	C		3	3.00	0.66	0.01	0.01	2.00
Greenside Darter	D	I	S	M	4	4.00	0.87	0.02	0.02	5.75
Banded Darter	D	I	S	I	13	13.00	2.84	0.02	0.02	1.46
Sauger X Walleye	E	P			3	3.00	0.66	3.71	3.11	1,238.00
Freshwater Drum			M	P	1	1.00	0.22	0.73	0.61	725.00
Mottled Sculpin		I	C		1	1.00	0.22	0.00	0.00	3.00
Mile Total					458	458.00		119.32		
Number of Species					34					
Number of Hybrids					2					

River Code: **17-500**	Stream: **Tuscarawas River**	Sample Date: **2010**
River Mile: **57.80**	Location: dst. Arizona Chemical outfall	Date Range: 08/03/2010
Time Fished: 3620 sec	Drainage: 1770.0 sq mi	Thru: 09/20/2010
Dist Fished: 1.00 km	Basin: Muskingum 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
Bowfin		P	C		2	2.00	0.33	1.50	0.53	750.00
Gizzard Shad		O	M		14	14.00	2.33	3.55	1.26	253.57
Silver Redhorse	R	I	S	M	19	19.00	3.17	15.66	5.55	824.21
Golden Redhorse	R	I	S	M	31	31.00	5.17	20.06	7.12	647.23
Northern Hog Sucker	R	I	S	M	155	155.00	25.83	33.63	11.93	216.96
Smallmouth Redhorse	R	I	S	M	174	174.00	29.00	95.93	34.02	551.32
Common Carp	G	O	M	T	29	29.00	4.83	69.17	24.53	2,385.26
River Chub	N	I	N	I	7	7.00	1.17	0.17	0.06	24.43
Bigeye Chub	N	I	S	I	1	1.00	0.17	0.00	0.00	4.00
Streamline Chub	N	I	S	R	13	13.00	2.17	0.17	0.06	12.69
Gravel Chub	N	I	S	M	4	4.00	0.67	0.02	0.01	5.00
Silver Shiner	N	I	S	I	3	3.00	0.50	0.05	0.02	15.00
Spotfin Shiner	N	I	M		38	38.00	6.33	0.18	0.06	4.67
Sand Shiner	N	I	M	M	14	14.00	2.33	0.04	0.01	2.93
Bluntnose Minnow	N	O	C	T	1	1.00	0.17	0.00	0.00	4.00
Channel Catfish	F		C		10	10.00	1.67	20.63	7.31	2,062.50
Flathead Catfish	F	P	C		1	1.00	0.17	0.23	0.08	227.00
White Crappie	S	I	C		2	2.00	0.33	0.32	0.11	158.00
Rock Bass	S	C	C		8	8.00	1.33	0.83	0.29	103.13
Smallmouth Bass	F	C	C	M	14	14.00	2.33	1.74	0.62	123.93
Green Sunfish	S	I	C	T	1	1.00	0.17	0.00	0.00	4.00
Bluegill Sunfish	S	I	C	P	6	6.00	1.00	0.40	0.14	66.33
Logperch	D	I	S	M	34	34.00	5.67	0.64	0.23	18.91
Greenside Darter	D	I	S	M	1	1.00	0.17	0.00	0.00	4.00
Banded Darter	D	I	S	I	3	3.00	0.50	0.00	0.00	1.33
Sauger X Walleye	E	P			9	9.00	1.50	6.22	2.21	691.33
Freshwater Drum			M	P	6	6.00	1.00	10.85	3.85	1,808.33
	Mile Total				600	600.00		281.99		
	Number of Species				26					
	Number of Hybrids				1					

Appendix Table 4. Index of Biotic Integrity (IBI) scores and metrics for Sugar Creek and the Tuscarawas River, 2010.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Sunfish species	Sucker species	Intolerant species	Darter species	Percent of Individuals: Simple Lithophils	Tolerant fishes	Omni-vores	Top carnivores	Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(0.3km)	IBI	Modified Iwb
Sugar Creek - (17400)																	
Year: 2010																	
3.40	D	08/04/2010	340	21(3)	2(3)	4(3)	3(3)	4(3)	48(5)	6(5)	10(5)	9.2(5)	80(5)	0.0(5)	216(3)	48	8.5
3.40	D	09/21/2010	340	26(5)	3(3)	4(3)	5(3)	4(3)	54(5)	12(5)	13(5)	0.9(1)	85(5)	0.2(5)	704(3)	46	9.4
1.90	D	08/04/2010	348	21(3)	3(3)	3(3)	2(1)	4(3)	33(3)	8(5)	8(5)	6.4(5)	81(5)	0.5(5)	282(3)	44	8.6
1.90	D	09/21/2010	348	18(3)	3(3)	2(1)	1(1)	3(1)	38(5)	15(5)	13(5)	8.9(5)	77(5)	0.0(5)	302(3)	42	8.3
1.30	D	08/12/2010	348	26(5)	4(5)	2(1)	6(5)	5(3)	32(3)	3(5)	5(5)	8.0(5)	80(5)	0.0(5)	327(3)	50	8.6
1.30	D	09/21/2010	348	22(3)	3(3)	1(1)	6(5)	5(3)	18(1)	3(5)	1(5)	6.9(5)	74(5)	0.0(5)	467(3)	44	8.6

na - Qualitative data, Modified Iwb not applicable.

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

● - One or more species excluded from IBI calculation.

Appendix Table 4. Index of Biotic Integrity (IBI) scores and metrics for Sugar Creek and the Tuscarawas River, 2010.

River Mile	Type	Date	Drainage area (sq mi)	Number of: Total species	Number of: Sunfish species	Number of: Sucker species	Number of: Intolerant species	Percent of Individuals: Rnd-bodied suckers	Percent of Individuals: Simple Lithophils	Percent of Individuals: Tolerant fishes	Percent of Individuals: Omni-vores	Percent of Individuals: Top carnivores	Percent of Individuals: Insect-ivores	DELT anomalies	Rel.No. minus tolerants /(1.0 km)	IBI	Modified Iwb
Tuscarawas River - (17-500)																	
Year: 2010																	
58.10	A	08/03/2010	1413	24(5)	4(5)	5(3)	2(3)	36(3)	41(5)	5(5)	7(5)	10(3)	81(5)	0.0(5)	428(5)	52	9.7
58.10	A	09/20/2010	1413	29(5)	5(5)	4(3)	6(5)	31(3)	41(5)	5(5)	23(3)	11(5)	64(5)	0.0(5)	444(5)	54	9.7
57.80	A	08/03/2010	1770	20(3)	4(5)	4(3)	2(3)	60(5)	68(5)	6(5)	7(5)	5(3)	87(5)	0.0(5)	554(5)	52	9.3
57.80	A	09/20/2010	1770	22(5)	3(3)	4(3)	5(5)	66(5)	78(5)	4(5)	8(5)	6(3)	82(5)	1.0(3)	584(5)	52	10.0

♦ - IBI is low end adjusted.

* - < 200 Total individuals in sample

** - < 50 Total individuals in sample

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			
Sugar Creek (17-400)													
Year: 2010													
3.40	340.0	35(4)	7(4)	9(6)	11(4)	12.0(2)	37.2(6)	37.3(6)	13.2(6)	0.9(6)	18(6)	4	50
1.90	348.0	29(4)	2(0)	2(2)	19(6)	0.1(2)	1.9(2)	2.7(2)	93.3(0)	10.4(0)	4(0)	4	18
1.30	348.0	27(4)	0(0)	2(2)	14(4)	0.0(0)	0.9(2)	2.6(2)	93.6(0)	14.9(0)	2(0)	4	14
Tuscarawas River (17-500)													
Year: 2010													
58.10	1413	46(6)	10(6)	9(6)	12(6)	32.7(6)	21.4(4)	18.1(4)	26.9(2)	5.8(0)	19(6)	4	46
57.80	1770	44(6)	9(6)	10(6)	10(4)	20.7(6)	31.2(4)	24.6(6)	22.1(4)	2.7(2)	22(6)	4	50

Appendix Table 6. Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Sugar Creek
dst. Co. Rd. 80

Collection Date: 09/21/2010 River Code: 17-400 RM: 3.40

Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	1
01320	*Hydra sp*	16
01801	*Turbellaria*	+
03121	*Paludicella articulata*	+
03360	*Plumatella sp*	1 +
03600	*Oligochaeta*	32 +
05800	*Caecidotea sp*	+
06700	*Crangonyx sp*	+
06810	*Gammarus fasciatus*	+
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	+
08601	*Hydrachnidia*	400 +
11130	*Baetis intercalaris*	985 +
12200	*Isonychia sp*	75 +
13000	*Leucrocuta sp*	+
13100	*Nixe sp*	+
13400	*Stenacron sp*	97 +
13510	*Maccaffertium exiguum*	289 +
13561	*Maccaffertium pulchellum*	196 +
13570	*Maccaffertium terminatum*	12
16700	*Tricorythodes sp*	264 +
17200	*Caenis sp*	+
21200	*Calopteryx sp*	+
21300	*Hetaerina sp*	+
22300	*Argia sp*	+
34710	*Agnetina capitata*	3 +
43570	*Neoplea sp*	+
45400	*Trichocorixa sp*	+
50315	*Chimarra obscura*	1481 +
51300	*Neureclipsis sp*	84 +
51600	*Polycentropus sp*	+
52200	*Cheumatopsyche sp*	2695 +
52430	*Ceratopsyche morosa group*	1190 +
52540	*Hydropsyche dicantha*	258 +
52570	*Hydropsyche simulans*	237
52580	*Hydropsyche valanis*	+
52801	*Potamyia flava*	1
53800	*Hydroptila sp*	5
59510	*Oecetis avara*	17 +
60300	*Dineutus sp*	+
68201	*Scirtidae*	+
68708	*Dubiraphia vittata group*	+
68901	*Macronychus glabratus*	41 +
69400	*Stenelmis sp*	+
72700	*Anopheles sp*	+
74100	*Simulium sp*	34
78450	*Nilotanypus fimbriatus*	96
78655	*Procladius (Holotanypus) sp*	+
80370	*Corynoneura lobata*	16
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	96
81825	*Rheocricotopus (Psilocricotopus) robacki*	771 +
83840	*Microtendipes pedellus group*	96 +
84100	*Paracladopelma sp*	+
84450	*Polypedilum (Uresipedilum) flavum*	289 +
84470	*Polypedilum (P.) illinoense*	96
84540	*Polypedilum (Tripodura) scalaenum group*	+
85500	*Paratanytarsus sp*	+
85625	*Rheotanytarsus sp*	5592 +
85800	*Tanytarsus sp*	+
85821	*Tanytarsus glabrescens group sp 7*	386 +
85840	*Tanytarsus sepp*	+
86100	*Chrysops sp*	+
87540	*Hemerodromia sp*	161 +
93200	*Hydrobiidae*	+
93900	*Elimia sp*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	17 +
97601	*Corbicula fluminea*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 35 Total Taxa: 68
No. Qualitative Taxa: 57 ICI: **50**
Number of Organisms: 16030 Qual EPT: 18

Appendix Table 6. Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Sugar Creek
upst. St. Rt. 39

Collection Date: 09/20/2010 River Code: 17-400 RM: 1.90

Taxa Code	Taxa	Quant/Qual
03360	*Plumatella sp*	+
03600	*Oligochaeta*	65 +
05800	*Caecidotea sp*	+
06700	*Crangonyx sp*	+
08260	*Orconectes (Crokerinus) sanbornii sanbornii*	+
08601	*Hydrachnidia*	32
11130	*Baetis intercalaris*	1
13400	*Stenacron sp*	+
13561	*Maccaffertium pulchellum*	1
21200	*Calopteryx sp*	+
21300	*Hetaerina sp*	+
22300	*Argia sp*	+
50315	*Chimarra obscura*	28 +
52200	*Cheumatopsyche sp*	6 +
52430	*Ceratopsyche morosa group*	+
68601	*Ancyronyx variegata*	2
68901	*Macronychus glabratus*	23 +
69400	*Stenelmis sp*	9 +
74100	*Simulium sp*	8 +
77750	*Hayesomyia senata or Thienemannimyia norena*	521 +
78140	*Labrundinia pilosella*	+
78450	*Nilotanypus fimbriatus*	+
80370	*Corynoneura lobata*	8
80410	*Cricotopus (C.) sp*	16
80420	*Cricotopus (C.) bicinctus*	16 +
80430	*Cricotopus (C.) tremulus group*	16
81825	*Rheocricotopus (Psilocricotopus) robacki*	163 +
82121	*Thienemanniella lobapodema*	8
83040	*Dicrotendipes neomodestus*	16 +
83300	*Glyptotendipes (G.) sp*	244 +
84315	*Phaenopsectra flavipes*	16
84450	*Polypedilum (Uresipedilum) flavum*	49 +
84460	*Polypedilum (P.) fallax group*	65
84470	*Polypedilum (P.) illinoense*	+
84540	*Polypedilum (Tripodura) scalaenum group*	114
84700	*Stenochironomus sp*	65
85500	*Paratanytarsus sp*	16
85625	*Rheotanytarsus sp*	16
85821	*Tanytarsus glabrescens group sp 7*	16
87540	*Hemerodromia sp*	188
93900	*Elimia sp*	+
95100	*Physella sp*	+
96900	*Ferrissia sp*	37 +
97601	*Corbicula fluminea*	+
98600	*Sphaerium sp*	+

No. Quantitative Taxa: 29 Total Taxa: 45
No. Qualitative Taxa: 29 ICI: **18**
Number of Organisms: 1765 Qual EPT: 4

Appendix Table 6. Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Sugar Creek
dst. Dover Chemical at Saltwell Rd. access

Collection Date: 09/21/2010 River Code: 17-400 RM: 1.30

Taxa Code	Taxa	Quant/Qual		Taxa Code	Taxa	Quant/Qual
01200	*Cordylophora lacustris*	4				
01801	*Turbellaria*		+			
03121	*Paludicella articulata*	1	+			
03600	*Oligochaeta*	128	+			
06700	*Crangonyx sp*		+			
08260	*Orconectes (Crokerinus) sanbornii sanbornii*		+			
08601	*Hydrachnidia*	180	+			
13500	*Maccaffertium sp*		+			
21200	*Calopteryx sp*		+			
22300	*Argia sp*		+			
23909	*Boyeria vinosa*		+			
26700	*Macromia sp*		+			
34710	*Agnetina capitata*	3				
50315	*Chimarra obscura*	1	+			
52001	*Hydropsychidae*	8				
60300	*Dineutus sp*		+			
68601	*Ancyronyx variegata*	20				
68901	*Macronychus glabratus*	3	+			
69400	*Stenelmis sp*	4	+			
77120	*Ablabesmyia mallochi*	5				
77750	*Hayesomyia senata or Thienemannimyia norena*	197	+			
80410	*Cricotopus (C.) sp*	4				
80440	*Cricotopus (C.) trifascia*		+			
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	9				
81240	*Nanocladius (N.) distinctus*	9				
81825	*Rheocricotopus (Psilocricotopus) robacki*	183				
83300	*Glyptotendipes (G.) sp*	14				
84450	*Polypedilum (Uresipedilum) flavum*		+			
84460	*Polypedilum (P.) fallax group*	4				
84470	*Polypedilum (P.) illinoense*	5	+			
84540	*Polypedilum (Tripodura) scalaenum group*	14				
84700	*Stenochironomus sp*	9	+			
85625	*Rheotanytarsus sp*	23				
85800	*Tanytarsus sp*	4				
87540	*Hemerodromia sp*	193				
93900	*Elimia sp*	1	+			
95100	*Physella sp*	1				
96900	*Ferrissia sp*	7	+			

No. Quantitative Taxa: 27 Total Taxa: 38
No. Qualitative Taxa: 22 ICI: **14**
Number of Organisms: 1034 Qual EPT: 2

Appendix Table 6. Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Tuscarawas River

Collection Date: 09/16/2010 River Code: 17-500 RM: 58.10 upst. Sugar Creek/dst. Dover WWTP

Taxa Code	Taxa	Quant/Qual	
01320	*Hydra sp*	18	
01801	*Turbellaria*	101	+
03221	*Pectinatella magnifica*	1	
03360	*Plumatella sp*	1	+
03600	*Oligochaeta*	576	+
04637	*Batracobdella phalera*	1	
06810	*Gammarus fasciatus*	19	+
08601	*Hydrachnidia*	48	+
11130	*Baetis intercalaris*	90	+
11620	*Paracloeodes minutus*		+
11670	*Procloeon viridoculare*		+
12200	*Isonychia sp*	2	+
13000	*Leucrocuta sp*	21	
13400	*Stenacron sp*	98	
13510	*Maccaffertium exiguum*		+
13550	*Maccaffertium mexicanum integrum*	171	+
13561	*Maccaffertium pulchellum*	594	+
13570	*Maccaffertium terminatum*	116	+
16700	*Tricorythodes sp*	2502	+
17200	*Caenis sp*	19	+
17600	*Baetisca sp*		+
18100	*Anthopotamus sp*	1	+
22300	*Argia sp*	2	+
34600	*Perlinella sp*		+
34710	*Agnetina capitata*	1	+
51206	*Cyrnellus fraternus*	43	
52200	*Cheumatopsyche sp*	1950	+
52430	*Ceratopsyche morosa group*	55	+
52520	*Hydropsyche bidens*	41	
52560	*Hydropsyche orris*	42	+
52570	*Hydropsyche simulans*	1	
52580	*Hydropsyche valanis*		+
52801	*Potamyia flava*	6	+
53800	*Hydroptila sp*	197	
59001	*Leptoceridae*	32	
68601	*Ancyronyx variegata*	2	
68901	*Macronychus glabratus*	36	+
69400	*Stenelmis sp*	65	+
74100	*Simulium sp*		+
77130	*Ablabesmyia rhamphe group*		+
77750	*Hayesomyia senata or Thienemannimyia norena*	245	
78750	*Rheopelopia paramaculipennis*	49	
80310	*Cardiocladius obscurus*		+
80430	*Cricotopus (C.) tremulus group*	98	+
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	49	
81240	*Nanocladius (N.) distinctus*	49	
82220	*Tvetenia discoloripes group*		+
82820	*Cryptochironomus sp*		+
83040	*Dicrotendipes neomodestus*	98	
83300	*Glyptotendipes (G.) sp*	881	+
83820	*Microtendipes "caelum" (sensu Simpson & Bode, 1980)*		+
84020	*Parachironomus carinatus*		+
84300	*Phaenopsectra obediens group*	147	+
84450	*Polypedilum (Uresipedilum) flavum*	490	+
84470	*Polypedilum (P.) illinoense*		+
84480	*Polypedilum (P.) laetum group*		+
84520	*Polypedilum (Tripodura) halterale group*		+
84540	*Polypedilum (Tripodura) scalaenum group*		+
84612	*Saetheria tylus*		+
85265	*Cladotanytarsus vanderwulpi group Type 5*		+
85625	*Rheotanytarsus sp*	1958	+
85800	*Tanytarsus sp*		+
85821	*Tanytarsus glabrescens group sp 7*	49	
87540	*Hemerodromia sp*	82	+
94400	*Fossaria sp*	2	+
95100	*Physella sp*		+
96900	*Ferrissia sp*	16	
97601	*Corbicula fluminea*		+

No. Quantitative Taxa: 46 Total Taxa: 68

No. Qualitative Taxa: 50 ICI: **46**

Number of Organisms: 11065 Qual EPT: 19

Appendix Table 6. Ohio EPA/DSW Ecological Assessment Section
Macroinvertebrate Collection

Site: Tuscarawas River
dst. Sugar Creek

Collection Date: 09/16/2010 River Code: 17-500 RM: 57.80

Taxa Code	Taxa	Quant/Qual
01320	*Hydra sp*	98 +
01801	*Turbellaria*	196 +
03221	*Pectinatella magnifica*	1
03360	*Plumatella sp*	2 +
03600	*Oligochaeta*	272 +
04666	*Helobdella triserialis*	+
06810	*Gammarus fasciatus*	20 +
08601	*Hydrachnidia*	80
11130	*Baetis intercalaris*	125 +
11620	*Paracloeodes minutus*	+
11670	*Procloeon viridoculare*	+
12200	*Isonychia sp*	21 +
13000	*Leucrocuta sp*	+
13400	*Stenacron sp*	49 +
13510	*Maccaffertium exiguum*	2
13550	*Maccaffertium mexicanum integrum*	308 +
13561	*Maccaffertium pulchellum*	1027 +
13570	*Maccaffertium terminatum*	102 +
16700	*Tricorythodes sp*	919 +
17200	*Caenis sp*	21 +
18100	*Anthopotamus sp*	+
22300	*Argia sp*	1 +
24900	*Gomphus sp*	+
34600	*Perlinella sp*	+
34710	*Agnetina capitata*	20 +
48410	*Corydalus cornutus*	+
50315	*Chimarra obscura*	33 +
51206	*Cyrnellus fraternus*	+
51300	*Neureclipsis sp*	17
52200	*Cheumatopsyche sp*	2393 +
52430	*Ceratopsyche morosa group*	434 +
52510	*Hydropsyche aerata*	52
52560	*Hydropsyche orris*	842 +
52570	*Hydropsyche simulans*	+
52801	*Potamyia flava*	68 +
53501	*Hydroptilidae*	36
59407	*Nectopsyche candida*	1 +
59500	*Oecetis sp*	1
60300	*Dineutus sp*	+
68601	*Ancyronyx variegata*	4 +
68901	*Macronychus glabratus*	71 +
69400	*Stenelmis sp*	82 +
74100	*Simulium sp*	17 +
77120	*Ablabesmyia mallochi*	+
77750	*Hayesomyia senata or Thienemannimyia norena*	204 +
78140	*Labrundinia pilosella*	+
80310	*Cardiocladius obscurus*	+
80440	*Cricotopus (C.) trifascia*	+
81231	*Nanocladius (N.) crassicornus or N. (N.) "rectinervis"*	51 +
81240	*Nanocladius (N.) distinctus*	51
81825	*Rheocricotopus (Psilocricotopus) robacki*	+
82220	*Tvetenia discoloripes group*	+
82730	*Chironomus (C.) decorus group*	+
82820	*Cryptochironomus sp*	+
83040	*Dicrotendipes neomodestus*	+
83300	*Glyptotendipes (G.) sp*	204 +
84000	*Parachironomus sp*	102
84060	*Parachironomus pectinatellae*	51 +
84300	*Phaenopsectra obediens group*	+
84450	*Polypedilum (Uresipedilum) flavum*	204 +
84480	*Polypedilum (P.) laetum group*	+
84520	*Polypedilum (Tripodura) halterale group*	+
84540	*Polypedilum (Tripodura) scalaenum group*	+
85265	*Cladotanytarsus vanderwulpi group Type 5*	+
85625	*Rheotanytarsus sp*	3067 +
87540	*Hemerodromia sp*	1158
93200	*Hydrobiidae*	+
93900	*Elimia sp*	4 +
95100	*Physella sp*	17 +
97601	*Corbicula fluminea*	16 +
98600	*Sphaerium sp*	+
99680	*Leptodea fragilis*	+

No. Quantitative Taxa: 44 Total Taxa: 72
No. Qualitative Taxa: 62 ICI: **50**
Number of Organisms: 12444 Qual EPT: 22

Appendix Table 7. Results of fish tissue sampling conducted by Ohio EPA in Sugar Creek and the Tuscarawas River, August 3-12, 2010. All results are reported in ug/kg wet weight and based on whole body analyses of individual fish.

Stream	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.
River Mile	3.4	3.4	3.4	3.4	3.4	1.9	1.9	1.9	1.9
Sample Number	SC3.4-1	SC3.4-2	SC3.4-3	SC3.4-20	SC3.4-22	SC1.9-12	SC1.9-13	SC1.9-14	SC1.9-15
Fish Species	common carp	common carp	common carp	smallmouth bass	smallmouth bass	common carp	common carp	smallmouth bass	smallmouth bass
Date Sampled	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010
Percent Lipid	5.31	2.37	4.46	1.92	1.6	4.53	3.39	2.38	1.49
aldrin	<0.04975	2.345	3.214	<0.04873	0.706	1.653	6.587	1.376	<0.04995
alpha BHC	<0.04975	<0.04859	<0.04596	<0.04873	<0.04831	4.01	6.021	4.395	3.58
alpha chlordane	7.019	6.844	12.706	5.678	2.56	6.285	15.365	2.281	1.595
beta BHC	2.083	<0.04859	<0.04596	<0.04873	<0.04831	<0.04625	<0.0499	<0.04975	2.28
cis-nonachlor	5.024	3.998	7.489	5.45	2.964	2.501	5.096	4.758	2.899
delta BHC	<0.04975	0.186	0.163	<0.04873	<0.04831	<0.04625	1.846	<0.04975	0.769
dieldrin	5.49	3.608	6.108	6.277	1.844	0.886	6.192	4.6	3.573
endosulfan II	0.208	<0.04859	<0.04596	<0.04873	<0.04831	<0.04625	<0.0499	1.135	<0.04995
endrin	<0.04975	1.67	<0.04596	<0.04873	<0.04831	1.46	2.801	1.169	0.366
gamma BHC	0.686	0.18	0.936	0.464	<0.04831	1.713	1.193	0.522	0.957
gamma chlordane	4.723	3.252	6.266	2.762	1.321	2.183	4.955	<0.04975	1.516
hexachlorobenzene	6.218	3.43	18.2	0.079	2.587	87.561	81.032	90.089	91.623
heptachlor	0.599	<0.04859	<0.04596	<0.04873	<0.04831	<0.04625	<0.0499	<0.04975	<0.04995
heptachlor epoxide	37.068	73.269	66.856	43.589	32.354	26.174	55.323	51.132	91.48
mirex	0.556	<0.04859	0.935	0.581	0.226	0.806	<0.0499	<0.04975	0.384
o,p'-DDD	1.594	3.54	4.305	2.669	1.983	3.728	3.677	2.212	2.442
o,p'-DDE	1.39	<0.04859	<0.04596	<0.04873	<0.04831	<0.04625	1.088	<0.04975	<0.04995
o,p'-DDT	1.418	<0.04859	<0.04596	4.809	<0.04831	3.545	<0.0499	<0.04975	<0.04995
oxychlordane	2.192	2.638	4.048	3.557	2.904	1.728	<0.0499	3.984	3.643
p,p'-DDD	9.575	5.133	12.741	8.649	2.79	<0.04625	9.309	3.967	2.214
p,p'-DDE	37.82	59.677	76.59	31.055	20.229	<0.04625	99.569	21.059	26.232
p,p'-DDT	0.307	0.947	1.319	2.828	1.2	2.032	1.512	1.91	2.009
PCB-TOTAL	294.7	347.6	437.4	331.3	176.8	268.7	368.5	361.9	430.1
pentachloro-anisole	4.648	3.372	5.333	1.984	1.153	2.613	4.957	3.541	2.019
toxaphene	<0.99502	<0.97182	<0.91912	<0.97466	<0.96618	<0.92507	<0.998	<0.99502	<0.999
trans-nonachlor	15.742	11.458	26.45	17.209	7.815	0.792	19.459	11.367	7.532
chlorpyrifos	0.297	2.025	1.762	1.084	1.501	4.641	5.417	<0.04975	1.36
1,2,3,4-Tetrachlorobenzene	0.231	1.838	3.115	<0.04873	0.525	665.672	576.031	312.143	421.376
1,2,4,5-Tetrachlorobenzene	0.669	0.339	0.171	0.499	0.199	204.104	255.034	113.557	124.123

Appendix Table 7. Continued.

Stream	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.
River Mile	1.3	1.3	1.3	1.3	1.3	57.8	57.8	57.8	57.8
Sample Number	SC1.3-36	SC1.3-37	SC1.3-38	SC1.3-29	SC1.3-30	TRDSC-2	TRDSC-5	TRDSC-1	TRDSC-17
Fish Species	common carp	common carp	common carp	smallmouth bass	smallmouth bass	common carp	common carp	common carp	smallmouth bass
Date Sampled	8/12/2010	8/12/2010	8/12/2010	8/12/2010	8/12/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010
Percent Lipid	2.4	3.07	7.48	1.54	1.03	5.93	3	3.2	2.25
aldrin	1.181	1.794	<0.04739	0.586	0.544	9.79	3.234	<0.0478	1.375
alpha BHC	1.028	2.347	6.393	0.244	<0.04808	0.281	0.647	0.361	0.578
alpha chlordane	4.624	0.465	23.243	3.506	3.173	10.381	14.156	18.775	6.797
beta BHC	<0.04583	<0.04575	25.493	<0.04883	<0.04808	0.749	<0.04771	33.99	<0.04695
cis-nonachlor	3.287	3.378	11.747	5.295	3.582	0.596	7.21	15.006	7.152
delta BHC	0.299	0.336	0.505	<0.04883	<0.04808	<0.04566	0.628	0.134	0.205
dieldrin	1.378	3.129	8.672	3.773	3.595	4.747	4.656	5.754	6.009
endosulfan II	<0.04583	<0.04575	2.438	1.614	0.78	<0.04566	<0.04771	2.646	<0.04695
endrin	<0.04583	0.84	2.878	1.077	<0.04808	<0.04566	<0.04771	4.12	0.573
gamma BHC	0.165	0.382	1.864	<0.04883	<0.04808	1.347	0.214	<0.0478	<0.04695
gamma chlordane	3.676	<0.04575	17.658	2.385	2.121	11.597	11.624	14.775	5.172
hexachlorobenzene	93.095	161.369	1238.165	66.304	58.249	572.908	658.196	509.901	448.295
heptachlor	<0.04583	<0.04575	4.794	<0.04883	0.431	<0.04566	<0.04771	5.985	<0.04695
heptachlor epoxide	11.191	1.15	1052.343	51.755	93.262	512.091	467.737	652.83	420.495
mirex	1.182	<0.04575	1.823	<0.04883	0.89	<0.04566	1.05	2.781	0.802
o,p'-DDD	2.457	3.353	9.057	2.721	<0.04808	4.989	7.098	8.915	4.676
o,p'-DDE	0.972	<0.04575	26.349	<0.04883	<0.04808	2.175	<0.04771	3.138	<0.04695
o,p'-DDT	<0.04583	<0.04575	3.052	1.994	0.694	49.675	<0.04771	5.164	<0.04695
oxychlordane	1.355	<0.04575	8.644	4.733	3.59	9.952	9.392	14.769	14.331
p,p'-DDD	5.918	4.713	31.714	3.958	2.676	14.131	14.958	26.234	6.847
p,p'-DDE	36.372	44.773	43.616	23.317	21.375	21.31	54.662	79.053	31.369
p,p'-DDT	1.321	1.029	1.073	2.446	2.417	24.144	<0.04771	<0.0478	1.197
PCB-TOTAL	212.4	226	3778.4	467.8	405.4	2383.4	2344.7	4188.3	1901.3
pentachloro-anisole	2.029	1.967	7.104	0.905	0.954	4.194	4.143	3.561	2.548
toxaphene	<0.91659	<0.91491	<0.94787	<0.97656	<0.96154	<0.91324	<0.9542	<0.95602	<0.93897
trans-nonachlor	8.81	10.771	34.101	17.242	11.254	21.44	27.878	38.959	38.823
chlorpyrifos	1.968	3.948	<0.04739	1.07	0.846	<0.04566	4.217	<0.0478	1.972
1,2,3,4-Tetrachlorobenzene	170.894	359.479	442.167	18.764	7.924	18.534	52.887	27.461	57.387
1,2,4,5-Tetrachlorobenzene	62.44	114.551	130.469	6.998	3.378	12.783	24.638	15.435	26.528

Appendix Table 7. Continued.

Stream	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.
River Mile	58.1	58.1	58.1	58.1	58.1
Sample Number	TRUSC-1	TRUSC-2	TRUSC-5	TRUSC-19	TRUSC-20
Fish Species	common carp	common carp	common carp	smallmouth bass	smallmouth bass
Date Sampled	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010
Percent Lipid	6.36	3.27	4.26	0.87	2.39
aldrin	<0.04735	<0.04643	4.786	0.781	<0.04822
alpha BHC	4.203	<0.04643	<0.04985	<0.04883	<0.04822
alpha chlordane	33.439	<0.04643	17.947	6.106	12.432
beta BHC	11.885	<0.04643	<0.04985	<0.04883	<0.04822
cis-nonachlor	16.31	0.803	6.227	5.45	9.275
delta BHC	0.394	0.373	0.694	0.328	<0.04822
dieldrin	10.196	4.742	7.02	3.497	6.596
endosulfan II	<0.04735	2.232	<0.04985	<0.04883	<0.04822
endrin	2.79	<0.04643	<0.04985	0.327	<0.04822
gamma BHC	1.221	0.165	<0.04985	<0.04883	<0.04822
gamma chlordane	30.848	<0.04643	14.263	4.678	7.676
hexachlorobenzene	923.996	699.25	730.964	318.46	577.02
heptachlor	5.575	4.561	<0.04985	<0.04883	<0.04822
heptachlor epoxide	683.219	888.73	464.816	399.041	581.556
mirex	1.427	2.542	0.656	0.866	0.787
o,p'-DDD	9.967	21.912	8.115	3.803	5.487
o,p'-DDE	38.563	10.25	<0.04985	<0.04883	<0.04822
o,p'-DDT	2.375	9.808	<0.04985	<0.04883	<0.04822
oxychlordane	8.073	<0.04643	<0.04985	9.063	<0.04822
p,p'-DDD	42.062	<0.04643	4.923	7.48	16.139
p,p'-DDE	104.411	62.204	45.63	16.959	39.292
p,p'-DDT	0.76	<0.04643	0.504	1.299	1.044
PCB-TOTAL	4593.5	984.4	1715.3	1381.4	2232
pentachloro-anisole	6.562	2.185	4.242	1.536	2.911
toxaphene	<0.94697	<0.92851	<0.99701	<0.97656	<0.96432
trans-nonachlor	55.451	38.763	35.216	23.297	43.998
chlorpyrifos	0.704	<0.04643	2.159	1.123	2.029
1,2,3,4-Tetrachlorobenzene	372.131	2.867	5.243	2.458	5.951
1,2,4,5-Tetrachlorobenzene	125.014	2.324	7.922	2.922	4.953

Appendix Table 8. Results of dioxins and furans testing in fish tissue samples collected by Ohio EPA in Sugar Creek and the Tuscarawas River, August 3-12, 2010. All results are reported in mg/kg wet weight and based on whole body analyses of individual fish.

Stream	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.
River Mile	3.4	3.4	3.4	3.4	3.4	1.9	1.9	1.9	1.9
Sample Number	SC3.4-1	SC3.4-2	SC3.4-3	SC3.4-20	SC3.4-22	SC1.9-12	SC1.9-13	SC1.9-14	SC1.9-15
Fish Species	common carp	common carp	common carp	smallmouth bass	smallmouth bass	common carp	common carp	smallmouth bass	smallmouth bass
Date Sampled	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010	8/4/2010
2,3,7,8-TCDD	<0.00000098	<0.00000097	<0.00000092	<0.00000098	<0.00000097	<0.00000092	<0.000001	<0.00000099	<0.000001
1,2,3,7,8-PeCDD	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
1,2,3,4,7,8-HxCDD	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
1,2,3,6,7,8-HxCDD	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
1,2,3,7,8,9-HxCDD	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
1,2,3,4,6,7,8-HpCDD	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
OCDD	<0.0000098	<0.00000972	1.14E-05	<0.00000984	<0.00000966	2.48E-05	1.81E-05	<0.00000995	<0.00000999
2,3,7,8-TCDF	<0.00000098	<0.00000097	<0.00000092	2.20E-06	<0.00000097	<0.00000092	<0.000001	7.40E-06	3.01E-05
1,2,3,7,8-PeCDF	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
2,3,4,7,8-PeCDF	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	1.94E-05	9.50E-06	2.41E-05	3.02E-05
1,2,3,4,7,8-HxCDF	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	1.16E-05	<0.00000499	<0.00000497	1.40E-04
1,2,3,6,7,8-HxCDF	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
2,3,4,6,7,8-HxCDF	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
1,2,3,7,8,9-HxCDF	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
1,2,3,4,6,7,8-HpCDF	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	8.20E-06	<0.00000499	<0.00000497	<0.000005
1,2,3,4,7,8,9-HpCDF	<0.0000049	<0.00000486	<0.0000046	<0.00000492	<0.00000483	<0.00000462	<0.00000499	<0.00000497	<0.000005
OCDF	<0.0000098	<0.00000972	<0.00000919	<0.00000984	<0.00000966	<0.00000925	<0.00000998	<0.00000995	<0.00000999

Appendix Table 8. Continued.

Stream	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Sugar Cr.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.
River Mile	1.3	1.3	1.3	1.3	1.3	57.8	57.8	57.8	57.8
Sample Number	SC1.3-36	SC1.3-37	SC1.3-38	SC1.3-29	SC1.3-30	TRDSC-2	TRDSC-5	TRDSC-1	TRDSC-17
Fish Species	common carp	common carp	common carp	smallmouth bass	smallmouth bass	common carp	common carp	common carp	smallmouth bass
Date Sampled	8/12/2010	8/12/2010	8/12/2010	8/12/2010	8/12/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010
2,3,7,8-TCDD	<0.00000092	<0.00000092	<0.00000095	<0.00000098	<0.00000096	<0.00000091	<0.00000095	<0.00000095	<0.00000094
1,2,3,7,8-PeCDD	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	<0.00000476	<0.0000047
1,2,3,4,7,8-HxCDD	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	<0.00000476	<0.0000047
1,2,3,6,7,8-HxCDD	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	<0.00000476	<0.0000047
1,2,3,7,8,9-HxCDD	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	<0.00000476	<0.0000047
1,2,3,4,6,7,8-HpCDD	<0.00000458	<0.00000458	<0.00001446	<0.00000488	<0.00000481	9.87E-06	<0.00000477	<0.00000476	<0.0000047
OCDD	<0.00000917	1.23E-05	2.80E-05	<0.00000977	<0.00000961	1.19E-05	<0.00000955	1.58E-05	<0.00000939
2,3,7,8-TCDF	<0.00000092	<0.00000092	<0.00000095	5.12E-05	4.44E-05	<0.00000091	<0.00000095	<0.00000095	<0.00000094
1,2,3,7,8-PeCDF	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	1.07E-05	<0.0000047
2,3,4,7,8-PeCDF	2.09E-05	1.23E-05	8.40E-06	3.78E-05	2.06E-05	5.60E-06	<0.00000477	<0.00000476	<0.0000047
1,2,3,4,7,8-HxCDF	<0.00000458	1.23E-05	<0.00000476	<0.00000488	1.47E-04	<0.00000457	<0.00000477	<0.00000476	<0.0000047
1,2,3,6,7,8-HxCDF	<0.00000458	<0.00000458	<0.00000476	1.90E-05	1.64E-05	<0.00000457	<0.00000477	<0.00000476	<0.0000047
2,3,4,6,7,8-HxCDF	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	<0.00000476	<0.0000047
1,2,3,7,8,9-HxCDF	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	<0.00000476	<0.0000047
1,2,3,4,6,7,8-HpCDF	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	<0.00000476	<0.0000047
1,2,3,4,7,8,9-HpCDF	<0.00000458	<0.00000458	<0.00000476	<0.00000488	<0.00000481	<0.00000457	<0.00000477	<0.00000476	<0.0000047
OCDF	<0.00000917	<0.00000915	1.92E-05	1.19E-05	1.05E-05	1.04E-05	<0.00000955	1.22E-05	<0.00000939

Appendix Table 8. Continued.

Stream	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.	Tuscarawas R.
River Mile	58.1	58.1	58.1	58.1	58.1
Sample Number	TRUSC-1	TRUSC-2	TRUSC-5	TRUSC-19	TRUSC-20
Fish Species	common carp	common carp	common carp	smallmouth bass	smallmouth bass
Date Sampled	8/3/2010	8/3/2010	8/3/2010	8/3/2010	8/3/2010
2,3,7,8-TCDD	<0.00000093	<0.00000093	<0.000001	<0.00000098	<0.00000096
1,2,3,7,8-PeCDD	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,4,7,8-HxCDD	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,6,7,8-HxCDD	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,7,8,9-HxCDD	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,4,6,7,8-HpCDD	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
OCDD	1.68E-05	1.74E-05	<0.00000997	<0.00000977	<0.00000964
2,3,7,8-TCDF	<0.00000093	<0.00000093	<0.000001	<0.00000098	<0.00000096
1,2,3,7,8-PeCDF	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
2,3,4,7,8-PeCDF	2.01E-05	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,4,7,8-HxCDF	6.80E-06	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,6,7,8-HxCDF	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
2,3,4,6,7,8-HxCDF	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,7,8,9-HxCDF	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,4,6,7,8-HpCDF	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
1,2,3,4,7,8,9-HpCDF	<0.00000463	<0.00000464	<0.00000499	<0.00000488	<0.00000482
OCDF	<0.00000925	1.29E-05	<0.00000997	<0.00000977	<0.00000964

Appendix Table 9. Results of sediment sampling conducted by Ohio EPA in the Dover Chemical Co. lagoon, October 18, 2010. All results are reported in mg/kg dry weight.

Lagoon Location	Northeast	Southeast	Southeast	Southwest	Northwest
Sample Number	LA-1	LA-2	LA-5 (duplicate)	LA-3	LA-4
Latitude	40.533806	40.532556	40.532556	40.532306	40.533361
Longitude	81.497806	81.497194	81.497194	81.498194	81.498944
Date Sampled	10/18/2010	10/18/2010	10/18/2010	10/18/2010	10/18/2010
Percent Moisture	66.03	56.34	56.55	56.09	58.37
Percent Gravel	0	0	0	0	0
Percent Sand	40.02	20.74	4.99	5.26	5.37
Percent Silt	58.85	56.25	65.87	63.16	63.38
Percent Clay	1.13	23.01	29.14	31.58	31.25
Total Organic Carbon (percent)	1.81	2.73	1.33	1.52	1.51
aldrin	< 7.176E-5	< 5.576E-5	1.15E-04	< 4.951E-5	< 4.932E-5
alpha BHC	3.03E-04	< 5.576E-5	5.52E-04	< 4.951E-5	< 4.932E-5
alpha chlordane	0.00163968	1.17E-04	1.15E-04	0.00176725	< 4.932E-5
beta BHC	0.00186635	< 5.576E-5	1.59E-04	7.90E-04	< 4.932E-5
cis-nonachlor	3.86E-04	< 5.576E-5	8.98E-05	2.62E-04	< 4.932E-5
delta BHC	0.00122167	< 5.576E-5	< 4.712E-5	1.14E-04	< 4.932E-5
dieldrin	0.00123933	7.10E-05	5.75E-05	3.78E-04	< 4.932E-5
endosulfan II	< 7.176E-5	< 5.576E-5	1.43E-04	< 4.951E-5	< 4.932E-5
endrin	< 7.176E-5	< 5.576E-5	< 4.712E-5	< 4.951E-5	< 4.932E-5
gamma BHC	< 7.176E-5	< 5.576E-5	< 4.712E-5	< 4.951E-5	< 4.932E-5
gamma chlordane	0.00115396	2.31E-04	2.28E-04	3.28E-04	1.68E-04
hexachlorobenzene	0.0019635	0.00271874	3.82E-04	6.79E-04	2.83E-04
heptachlor	< 7.176E-5	1.26E-04	< 4.712E-5	< 4.951E-5	< 4.932E-5
heptachlor epoxide	4.62E-04	< 5.576E-5	< 4.712E-5	4.28E-04	8.96E-04
mirex	2.83E-04	< 5.576E-5	1.04E-04	8.65E-05	5.53E-05
o,p'-DDD	0.00377686	< 5.576E-5	3.61E-04	0.00159189	1.25E-04
o,p'-DDE	8.51E-04	2.57E-04	1.04E-04	< 4.951E-5	6.49E-05
o,p'-DDT	8.39E-04	< 5.576E-5	< 4.712E-5	1.69E-04	< 4.932E-5
oxychlordane	< 7.176E-5	< 5.576E-5	< 4.712E-5	< 4.951E-5	< 4.932E-5
p,p'-DDD	0.00782161	2.08E-04	3.71E-04	0.00108404	8.17E-05
p,p'-DDE	0.00423315	4.83E-04	6.15E-04	0.00202232	2.04E-04
p,p'-DDT	0.00249632	< 5.576E-5	1.17E-04	0.00191073	8.41E-05
PCB-TOTAL	0.03355902	0.01328447	0.01058688	0.04327033	0.01153015
pentachloro-anisole	4.27E-04	2.20E-04	7.83E-05	1.82E-04	5.53E-05
toxaphene	< 0.00143529	< 0.00111511	< 9.4246E-4	< 9.9017E-4	< 9.8649E-4
trans-nonachlor	0.00195467	2.22E-04	1.70E-04	3.28E-04	8.41E-05
chlorpyrifos	< 7.176E-5	< 5.576E-5	< 4.712E-5	< 4.951E-5	< 4.932E-5
1,2,3,4-Tetrachlorobenzene	4.24E-04	4.40E-04	0.00117606	2.78E-04	8.65E-05
1,2,4,5-Tetrachlorobenzene	0.00174566	7.74E-04	0.00155581	4.37E-04	4.76E-04
2,3,7,8-TCDD	< 1.29E-6	< 1.05E-6	< 1.01E-6	< 1.03E-6	< 1.19E-6
1,2,3,7,8-PeCDD	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
1,2,3,4,7,8-HxCDD	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
1,2,3,6,7,8-HxCDD	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
1,2,3,7,8,9-HxCDD	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
1,2,3,4,6,7,8-HpCDD	2.36E-05	9.16E-06	1.69E-05	2.47E-05	7.71E-06
OCDD	4.16E-04	1.95E-04	4.61E-04	8.29E-04	1.65E-04
2,3,7,8-TCDF	< 1.29E-6	< 1.05E-6	< 1.01E-6	< 1.03E-6	< 1.19E-6
1,2,3,7,8-PeCDF	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
2,3,4,7,8-PeCDF	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
1,2,3,4,7,8-HxCDF	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6

Appendix Table 9. Continued.

Lagoon Location	Northeast	Southeast	Southeast	Southwest	Northwest
Sample Number	LA-1	LA-2	LA-5 (duplicate)	LA-3	LA-4
Latitude	40.533806	40.532556	40.532556	40.532306	40.533361
Longitude	81.497806	81.497194	81.497194	81.498194	81.498944
Date Sampled	10/18/2010	10/18/2010	10/18/2010	10/18/2010	10/18/2010
1,2,3,6,7,8-HxCDF	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
2,3,4,6,7,8-HxCDF	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
1,2,3,7,8,9-HxCDF	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
1,2,3,4,6,7,8-HpCDF	2.77E-05	1.33E-05	2.67E-05	1.78E-05	< 5.95E-6
1,2,3,4,7,8,9-HpCDF	< 6.45E-6	< 5.24E-6	< 5.06E-6	< 5.17E-6	< 5.95E-6
OCDF	3.80E-05	1.58E-05	5.36E-05	2.57E-05	< 1.189E-5