

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY  
WATER RESOURCES DIVISION  
APRIL 2015

A BIOLOGICAL SURVEY OF THE  
CASS RIVER WATERSHED AND SELECTED TRIBUTARIES  
SAGINAW, TUSCOLA, AND SANILAC COUNTIES, MICHIGAN  
JULY-SEPTEMBER 2011

Qualitative biological sampling of the Cass River watershed was conducted by staff of the Surface Water Assessment Section (SWAS) between July and September 2011 as part of a five-year watershed monitoring cycle. Surveys were conducted on all major tributaries of the watershed: the North, South, and Middle Branch Cass Rivers, White, North Branch White, and South Branch White Creeks, along with the Main Branch Cass River (Figure 1). This watershed falls primarily within the Southern Michigan Northern Indiana Till Plain (SMNITP) ecoregion with the southwest-most portion in the Huron and Lake Erie Till Plain ecoregion (Omernik and Gallant, 1988). Land use in the Cass River watershed is predominantly agriculture, which has led to a high prevalence of channelization and dredging to promote quick drainage of agricultural land. The headwaters of nearly all tributaries begin as a series of agricultural drains. The Cass River is a major tributary to the Saginaw River/Bay ecosystem.

### **OBJECTIVES**

This biological survey was conducted to:

- Assess the current status condition of individual waters to determine attainment of Michigan Water Quality Standards.
- Evaluate potential impacts from National Pollutant Discharge Elimination System (NPDES)-regulated sources to water quality in the watersheds.
- Identify potential nonpoint sources (NPS) of water quality impairment.

The locations of the surveyed biological stations are illustrated in Figure 5 and Table 1. Detailed macroinvertebrate and habitat sampling results are provided in Tables 2a, and 2b, and 3, respectively. Water chemistry samples were not collected during this watershed assessment.

### **WATERSHED DESCRIPTION**

The Cass River watershed has an area of 908 square miles containing 1,352 total river miles. Of this total, only 352 linear miles are classified as perennial. In general, the Cass River watershed is relatively flat with stream flow velocities less than one foot per second.

The soil associations in the Cass River watershed are dominantly nearly level to very gently sloping and somewhat poorly drained to very poorly drained on lake plains and water-worked till plain soils (United States Department of Agriculture [USDA], 1961; 1986; and 1994). Land use within the watershed is estimated to be greater than 60 percent agriculture (United States Environmental Protection Agency [USEPA], 1996). Drainage in the watershed has been heavily modified for agricultural purposes. Many of the stream channels having been dredged and straightened to facilitate drainage.

## **HISTORY**

Earlier field studies in the watershed described the Cass River as being nutrient enriched, and possibly nitrate limited (Grant, 1974). The source of nutrients was identified as point source contributions from the communities of Bridgeport, Vassar, and Cass City. Additional nutrient loads were described as seasonal NPS-related. Phosphorus additions to the Saginaw River from the Cass River watershed were estimated at 121 tons per year based on flow and nutrient data from 1972-1974 (Grant, 1974).

Subsequent surveys in the Cass River in 1985 and 1988 indicated somewhat improved conditions over those described by Grant in 1974 (Taft, 1989); however, neither the 1974 nor the 1985 and 1988 efforts included the major tributaries to the Cass River. In addition, the biological survey work described in the 1989 report was not as intensive as the work done from 1972-1974, making conclusions based on a comparison between the two studies somewhat limited.

Morse (1992a) reported the biological integrity of the Cass River upstream from Bridgeport to be somewhat improved over this same general stretch of river reported by Grant (1974) and Taft (1989). However, urban runoff from the communities of Vassar, Frankenmuth, and Bridgeport was cited as a primary cause of habitat degradation in this (Morse, 1992a) report. The biological integrity of the tributaries within the Cass River watershed ranged from excellent in the North Fork of the North Branch of the Cass to fair in six additional tributaries including the South Fork of the North Branch, portions of both the North and South Branches of the Cass, Sucker, Millington, and Dead Creeks. Poor flow stability and subsequent problems with bank stability were seen as the primary cause for habitat impairment due to excessive sedimentation. The genesis of this flow instability was reported to be the result of intrinsic soil types with poor water infiltration characteristics that are subsequently magnified by agricultural land use that includes extensive drainage systems throughout the watershed (Morse, 1992a). Subsequent surveys of the White Creek watershed, a subwatershed to the Cass River watershed found fair to degraded conditions that were similar to other tributaries to the Cass River where extensive channel manipulation to support agricultural drainage was present (Morse, 1992b).

An additional watershed survey in 1996 (Cooper and Walterhouse, 2000) did not report substantial changes to the Cass River or its tributaries compared to the 1992 efforts. However, Duff Creek, a tributary to the South Branch of the Cass River was identified as not attaining its warmwater status primarily due to untreated sewage discharges originating from the city of Marlette. In addition, this same report (Cooper and Walterhouse, 2000) continues to cite the same watershed concerns (i.e., poor flow stability, bank stability, and sedimentation), as described by Morse (1992a) and Taft (1989) contributing to overall defects to stream habitat and the biological community.

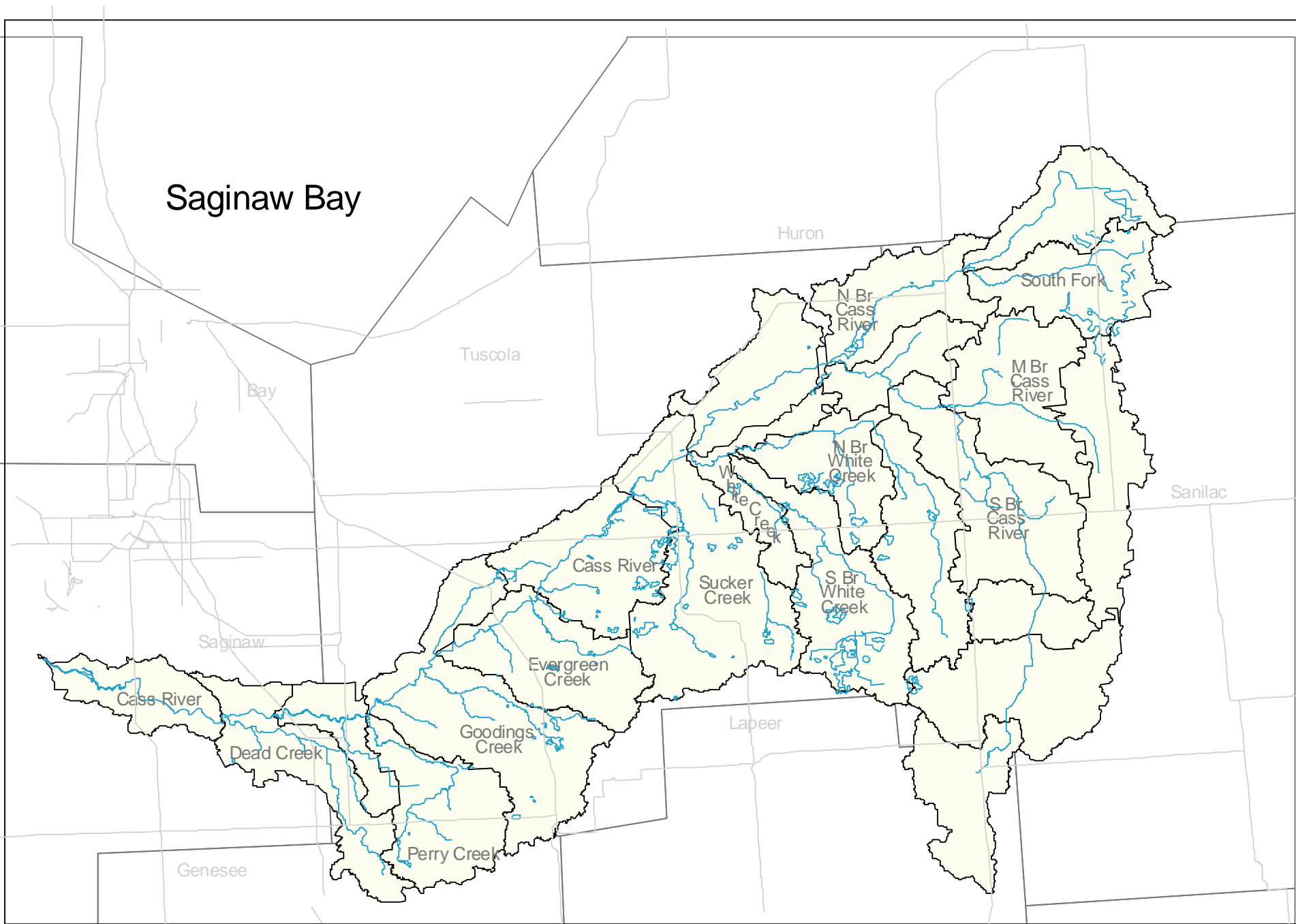


Figure 1. The Cass River watershed including the major subwatersheds.

Water and sediment chemistry results in the Cass River watershed indicate that nutrients, particularly phosphorus, exceed the average nutrient concentrations in the SMNITP Ecoregion (Lundgren, 1994).

Survey efforts in 2001 reported an acceptable macroinvertebrate community at all stations sampled with the exception of two sites, which scored poor: one station on White Creek and one station on Duff Creek (Cooper, 2001). Both White and Duff Creeks are highly modified agricultural drains. The biological communities in both White and Duff Creeks were surveyed again in 2006 where macroinvertebrate communities rated as acceptable (Cooper, 2007). Water chemistry results indicated that nutrient concentrations in the Cass River and most of its major tributaries were not excessive and relatively comparable to sample results from a previous biosurvey in 1996 (Cooper and Walterhouse, 2000). The exception to this is Duff Creek near Marlette where nutrient concentrations were well above expected background concentrations in 2006 and twice the concentration found in 1996.

Survey efforts in 2006 reported an acceptable to excellent macroinvertebrate community at 38 of 42 survey locations (Cooper, 2007). Of the 4 locations rating poor; one was suggested to not fit the stipulations of the SWAS Procedure 51 (MDEQ, 1990; Creal et al., 1996) due to not meeting flow requirements the other location had active dredging adjacent to site location. The remaining poor locations were on Dead Creek and Turtle Creek and both were sampled in the current study.

Sediment samples taken in the Cass River and from Duff Creek in 2006 indicated slightly elevated concentrations of arsenic, copper, mercury, and zinc in the upper portions of the main branch of the Cass River and Duff Creek (Cooper, 2007). In general, metal concentrations appear similar to results from samples taken in 1996 (Cooper and Walterhouse, 2000).

## **METHODS**

Qualitative macroinvertebrate and habitat surveys were performed according to the Procedure 51. Site selection was made based on the need to gather information on a watershed-wide basis to inform decisions of attainment of Water Quality Standards, identify NPS of water quality impairment, provide information for review of the NPDES permits, and to satisfy outside monitoring requests where possible. Twenty-three sampling locations to support status were randomly selected from a pool of valley segment types represented within the Cass River watershed. Ten sites were selected from the previous survey (2006) and were resampled in the current study to develop long-term trend monitoring for these select locations. In total, 32 sites were sampled (one site was listed for both random and trend monitoring) for this study. Sites can be viewed on the study site map below (Figure 2). There were no requests for biological or water chemistry data from outside sources.

## **RESULTS**

Overall survey results indicate most sites (94 percent) have acceptable to excellent macroinvertebrate communities, with only 2 sites having poor macroinvertebrate communities. Overall habitat results show that most sites were rated marginal to good.

## Cass River Main Branch

Three sites (3, 4, and 5) were sampled on the main branch of the Cass River, all near the city of Vassar. Habitat rated good at two sites and marginal at the other. Macroinvertebrates rated excellent at one site and acceptable at two sites. Diverse mussel populations were observed with a high abundance of many species in the Main Branch Cass River off Pinkerton Road.

The North Branch Cass River originates in Bingham Township, Huron County, and flows approximately 22 miles to its confluence with the Cass River. Unlike the other major tributaries to the Cass River, most of the North Branch Cass River remains relatively unmodified but does receive drainage from several small modified tributaries. One site (13) was surveyed on North Branch Cass River and found to have marginal habitat and acceptable macroinvertebrates. A site off of South Bad Ax Road (Figure 2) was scheduled to be sampled; however, due to lack of flow, could not be sampled. This site appeared stagnant and unmoving for unapparent reasons. Further investigation of aerial imagery suggests possible beaver dams in the downstream vicinity but further investigation may be warranted.



Figure 2. North Branch Cass River at South Bad Axe Road.

The South Branch Cass River originates in Lapeer County and flows approximately 20 miles to its confluence with Middle Branch Cass River. Most of this river has been heavily modified (dredged and straightened) to enhance overland drainage. Four sites (16, 17, 18, and 19) were surveyed on the South Branch Cass River for this study. Habitat ranged from marginal to good and macroinvertebrates rated acceptable at all locations. Riparian areas throughout this watershed exhibited heavy disturbance (tree removal), while instream habitat reflected dredging activities and flashy flows. Columbus Drain, a heavily channelized headwater tributary to the South Branch Cass River, was also sampled. Habitat rated marginal and macroinvertebrates were acceptable in Columbus Drain.

The Middle Branch Cass River originates in Elmer Township, Sanilac County, and flows approximately 19 miles to its confluence with Cass River. One site (12) was surveyed near the confluence of South Branch Cass River for this study and showed good habitat and acceptable macroinvertebrates.

## Cass River Tributaries

The White Creek watershed is a major tributary to the Cass River located in Tuscola County. The main branch of White Creek is formed by the confluence of the North Branch White Creek and the South Branch White Creek and flows approximately 4 miles west to its confluence with the Cass River. White Creek did have a low overall stream flow (<.01 feet per second), similar to what was documented in previous studies (Cooper, 2001). Habitat and macroinvertebrates were rated good and acceptable, respectively, at the single surveyed location (32).

The North Branch White Creek originates as agricultural drains in Sanilac County then flows approximately 20 miles to its confluence with White Creek. Virtually all of the North Branch White Creek and its tributaries have been heavily modified (channelized) to facilitate agricultural drainage. Two sites (14 and 15) were surveyed for this study; habitat ranged from marginal to good and macroinvertebrates rated acceptable at both locations.

The South Branch White Creek originates as agricultural drains in southeast Tuscola County and flows 13 miles to its confluence with White Creek. Unlike North Branch White Creek, most of the South Branch White Creek remains unmodified though several agricultural drains empty into it. Three sites (20, 21, and 22) were surveyed on South Branch White Creek with habitat rating good at all locations. Macroinvertebrates rated acceptable at two locations and poor at one location (Phillips Road). Poor macroinvertebrate community at Phillips Road is likely due to heavy levels of fine silts that appeared to blanket most available instream substrate. Adequate substrate was present; however, it appears to not be available for most macroinvertebrates due to siltation issues. Macroinvertebrates were very common at this site; however, community composition was composed primarily of those tolerant to poor water quality.

Evergreen Creek is a small tributary to the Cass River and appeared to have relatively minimal impairments compared to many other tributaries in the Cass River watershed. Two sites (8 and 9) were sampled on Evergreen Creek. Habitat was good and excellent and macroinvertebrates were acceptable at both locations. Habitat at the downstream-most location (M-46) showed signs of very flashy flows based on signs of bank erosion and some washout areas. Instream habitat at both locations supported several riffles with cobble and gravel substrate (Figure 3).



Figure 3. Evergreen Creek at Waterman Creek.

Sanilac Huron Creek is a small, heavily modified tributary in Greenleaf Township, Sanilac County, that flows approximately five miles before its confluence to the North Branch

Cass River. Sanilac Huron Creek has undergone channel modification to facilitate overland flow drainage and also lacks extensive riparian areas with loss of complete canopy cover in many areas. Two sites (23 and 24) were evaluated for this study; both were found to have acceptable macroinvertebrate communities and habitat ranged from marginal to good. The downstream-most location (Ritter Road) contained habitat better suited to support aquatic life.

Turtle Creek is a highly modified stream in central Moore Township and flows 3.8 miles to its confluence with South Branch Cass River. Canopy removal and channelization were very evident in Turtle Creek. Two sites (27 and 28) were surveyed showing marginal habitat and acceptable macroinvertebrates. Cladophora cover was heavy suggesting excess nutrients entering this system, possibly through direct sanitary sewers as described in previous reports (Cooper, 2007).

Goodings Creek is a 13-mile long stream in Milling and Tuscola Townships, Tuscola County. Though flashiness and some stream bank erosion was evident, macroinvertebrate communities scored acceptable to excellent at 2 locations (10 and 11). Riffles and stable substrate were abundant and habitat was rated good at both sampling locations.

Butternut Creek is a 4-mile long tributary in Tuscola and Ellington Townships, Tuscola County, that flows directly to the Cass River. Butternut Creek is a forested stream; however, does appear to have flashy flows based on some signs of stream bank erosion. One site (1) was surveyed on Butternut Creek; results show that habitat was good and macroinvertebrates rated acceptable.

Butternut Drain is a small tributary located in Tuscola and Ellington Townships, Tuscola County, that flows 6 miles to its confluence with White Creek. Butternut Drain has undergone heavy channelization to enhance agricultural drainage in its upper reach and headwaters. One site (2) was surveyed showing marginal habitat and acceptable macroinvertebrates.

Sucker Creek is an 18-mile long tributary to the Cass River that originates in Dayton and Caro Townships, Tuscola County. Two sites (25 and 26) were surveyed on Sucker Creek for this study. Both sites were rated having marginal habitat and acceptable macroinvertebrates.

Dead Creek originates as agricultural drains in Thetford Township, Genesee County, and flows 19.5 miles northwest to its confluence with the Cass River. Portions of Dead Creek and its tributaries have been channelized. A survey site in 2005 yielded a poor macroinvertebrate community at one location but was thought to be due to nearby dredging. Surveys conducted for this study showed good habitat and acceptable macroinvertebrates at two locations (6 and 7).

The White and Moffet Drain is one of the headwater streams to the North Branch White Creek that has been heavily modified to accelerate agricultural drainage. A site (31) was surveyed at Dennis Road in Marlette Township and showed habitat rating marginal and macroinvertebrates rating poor.

Columbus Drain is one of the headwater drains for the South Branch Cass River and is located in Burnside Township. Heavy channelization and canopy removal were observed in this subwatershed. One site (30) was surveyed in Columbus Drain and found to have marginal habitat and an acceptable macroinvertebrate community.

An unnamed tributary to the Cass River in Vassar Township, Tuscola County, was included in this study. This tributary is a small perennial stream that flows approximately four miles before its confluence with the Cass River. Evidence of flashy flow was prevalent with many areas having eroded banks and washouts yet instream habitat appeared relatively stable. One location (29) was sampled in this watershed and ratings show good habitat and acceptable macroinvertebrates.

### **TREND MONITORING**

Of the ten trend sites (sites visited in a previous monitoring study); eight had acceptable macroinvertebrates and one site each had excellent and poor macroinvertebrates. Comparing results to the previous 2006 survey showed macroinvertebrate ratings to be different at three of the ten trend locations. Both Turtle Creek (Wheeler Road) and Dead Creek (Center Road) had scores rating as acceptable compared to rating as poor in the previous study. The previous study noted concurrent dredging during the survey at the Dead Creek location, which likely contributed to the poor macroinvertebrate scores. No dredging operations were observed for the current study on Dead Creek. Turtle Creek was suggested to be a health hazard in the previous study due to suspected illicit sewer connections. Sewage odor was noted in the 2006 study; however, not observed in the current study. Cladophora was noted during the current survey suggesting nutrient additions are likely occurring. Though there was a change in macroinvertebrate ratings, it should be noted it was a subtle change in actual macroinvertebrate scores; -7 in 2006 and -2 in 2011. The current score is near the low end of what is deemed acceptable for a macroinvertebrate community.

White and Moffet Drain at Dennis Road was found to have acceptable macroinvertebrates in the previous study yet shown to have a poor macroinvertebrate community in the current study. When comparing overall scores for this site over both studies; the previous study had a macroinvertebrate score on the lower end of the acceptable scale (-1) while on the upper end of the poor scale (-5) for the current survey. The White and Moffet Drain has undergone heavy habitat alterations to facilitate agricultural drainage: loss of canopy cover and riparian areas, channelization, and dredging are evident throughout. Suitable macroinvertebrate habitat (i.e., large woody debris, cobble, etc.) were generally lacking. The stream channel was dominated by soft sediments and low flow.

A more definitive evaluation of trends within the Cass River watershed will be determined after the third consecutive monitoring cycle with trend site sampling (2016).

### **NPS MONITORING**

No NPS monitoring activities were requested or conducted in the Cass River watershed during 2011 sampling.

### **CONCLUSION**

Results for the Cass River watershed were derived from 32 aquatic macroinvertebrate stream samples (Table 1). The results indicate 94 percent of the watershed was supporting the other indigenous aquatic life and wildlife designated uses. Two locations of the 32 sampled showed poor macroinvertebrate communities.

While most of the Cass River watershed is considered to be attaining the biological portions of its respective designated use, nearly the entire watershed exhibits some degree of resource



impairment due to the practice of channel modification (i.e., dredging or channelization, Figure 4). The greatest limitation(s) to the macroinvertebrate community at many of the locations surveyed appeared to be correlated to an obvious lack of hard, stable substrate materials (cobble, gravel, and/or large woody debris). In addition, many of these modified channels have been dredged to handle high flows, which results in very slow flow velocities during base flow conditions. A lack of flow can increase silt and sediment deposition, which results in loss of suitable habitat. In some cases, low flow may also restrict reaeration rates resulting in biological impairment due to insufficient dissolved oxygen concentrations.



Figure 4. Common scenery in the Cass River watershed: heavily modified stream channels, near complete loss of canopy cover, and severe alterations to riparian and instream habitat.

Field Work By: Bill Keiper, Aquatic Biologist  
Kevin Goodwin, Aquatic Biologist  
Dawn Roush, Aquatic Biologist  
Sam Noffke, Aquatic Biologist  
Seth Wright, Aquatic Biologist  
Surface Water Assessment Section  
Water Resources Division

Report By: Bill Keiper, Aquatic Biologist  
Jeff Cooper, Aquatic Biologist  
Surface Water Assessment Section  
Water Resources Division

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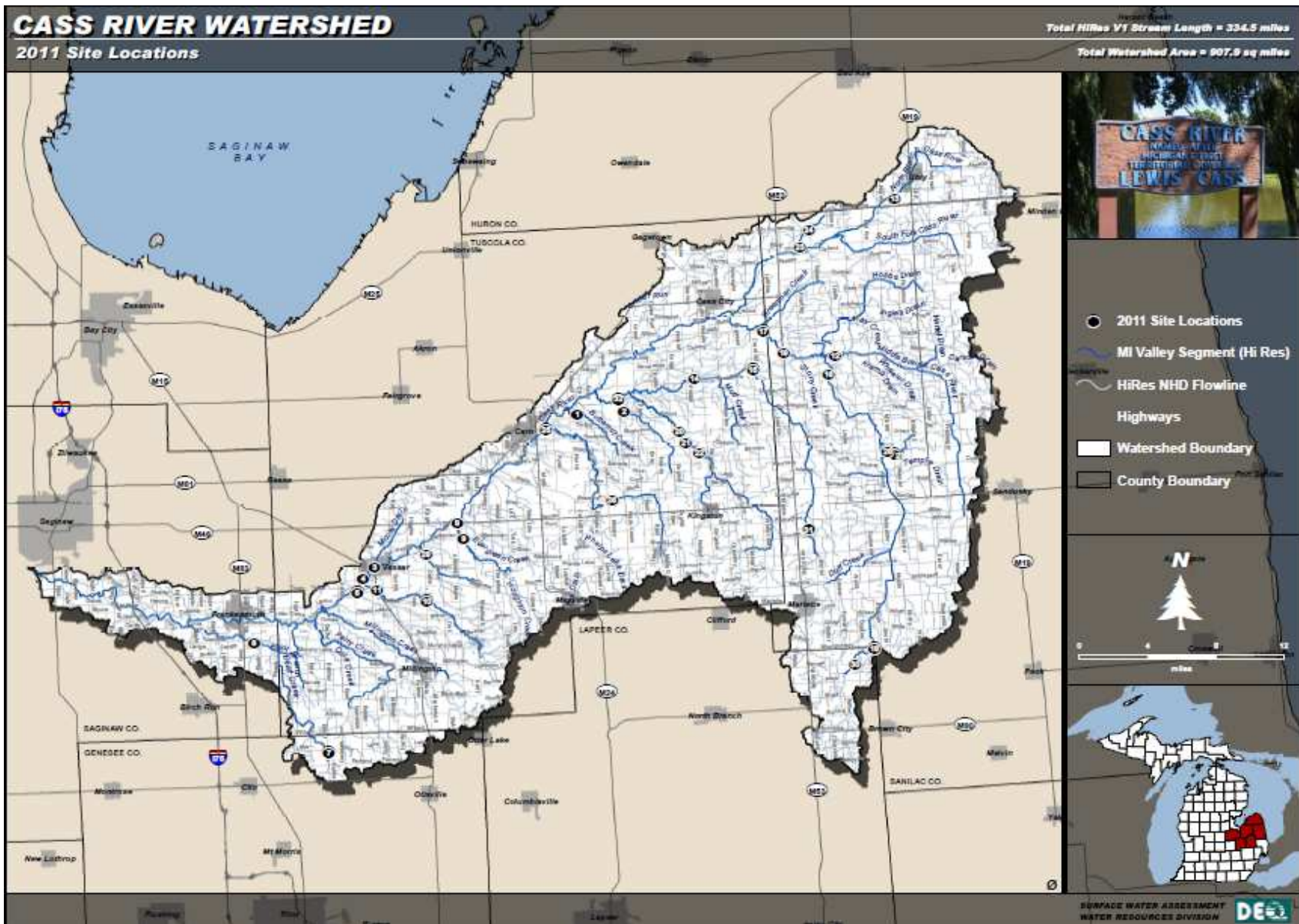


Figure 5. Sampling locations in the Cass River watershed for 2011 biological surveys.

Table 1. Site summary of stations sampled during 2011 Cass River biological survey (shaded cells represent trend monitoring locations).

Cass River Site Summary 2011							
Site	Water Body	Site	Storet	Habitat	Macroinvertebrates	Latitude	Longitude
1	Butternut Creek	Orr	790207	Good	Acceptable	43.50292	-83.33882
2	Butternut Drain	Cooklin	790169	Marginal	Acceptable	43.50442	-83.28422
3	Cass River	M15 (Huron Ave)	790043	Good	Acceptable	43.371	-83.58092
4	Cass River	1.3 mi ds Huron Ave (Frankenmuth @ Cemetary)	790160	Marginal	Acceptable	43.36106	-83.59516
5	Cass River	Pinkerton	790084	Good	Excellent	43.3492	-83.60207
6	Dead Creek	Townline	730338	Good	Acceptable	43.30584	-83.72432
7	Dead Creek	Center	250502	Good	Acceptable	43.20586	-83.64091
8	Evergreen Creek	M46 (Sanilac)	790081	Good	Acceptable	43.40892	-83.48317
9	Evergreen Creek	Waterman	790155	Excellent	Acceptable	43.39446	-83.47602
10	Goodings Creek	Caine	790205	Good	Acceptable	43.33988	-83.52145
11	Goodings Creek	M15 (State)	790153	Good	Excellent	43.35038	-83.5792
12	M B Cass River	Leslie	760188	Good	Acceptable	43.54801	-83.03491
13	N B Cass River	Stanbaugh	320051	Marginal	Acceptable	43.68742	-82.95869
14	N B White Creek	McArthur	790171	Marginal	Acceptable	43.53199	-83.20074
15	N B White Creek	Crawford	790211	Good	Acceptable	43.53854	-83.13145
16	S B Cass River	Shabbona	760217	Marginal	Acceptable	43.5317	-83.0434
17	S B Cass River	Kelly	790176	Good	Acceptable	43.57295	-83.11758
18	S B Cass River	Montgomery	440241	Marginal	Acceptable	43.2849	-83.00239
19	S B White Creek (S B Cass River)	M53 (Van Dyke)	760012	Good	Acceptable	43.55242	-83.09503
20	S B White Creek	Mushroom Rd	790204	Good	Acceptable	43.48452	-83.22045
21	S B White Creek	Phillips	790206	Good	Poor	43.47473	-83.21312
22	S B White Creek	Arthur	790210	Good	Acceptable	43.46507	-83.19778
23	Sanilac Huron Creek	Ritter	760210	Good	Acceptable	43.64738	-83.07141
24	Sanilac Huron Creek	Bay City Forestville	760211	Marginal	Acceptable	43.66222	-83.06055
25	Sucker Creek	Boy Scout (Weeden)	790145	Marginal	Acceptable	43.49029	-83.37552
26	Sucker Creek	Rossman	790209	Marginal	Acceptable	43.42513	-83.30128
27	Turtle Creek	Wheeler	790179	Marginal	Acceptable	43.45849	-82.97047
28	Turtle Creek	Snover	760260	Marginal	Acceptable	43.46098	-82.97781
29	Unnamed trib to Cass River	O Brien	790208	Good	Acceptable	43.38159	-83.52061
30	Un. trib to S B Cass River (Columbus Drain)	Index	440221	Marginal	Acceptable	43.27037	-83.02512
31	White and Moffet Drain	Dennis	760212	Marginal	Poor	43.3935	-83.0733
32	White Creek	Herds Corner	790157	Good	Acceptable	43.51571	-83.28967

Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	Dead Creek Center Road 7/13/2011 STATION 7	Turtle Creek Wheeler Road 7/14/2011 STATION 27	Sanilac Huron Creek Downstream of Ritter Road 7/14/2011 STATION 23	Sanilac Huron Creek Bay Forestville Road 7/14/2011 STATION 24
<b>ANNELIDA (segmented worms)</b>				
Hirudinea (leeches)	1	1	13	2
Oligochaeta (worms)	1	28	2	18
<b>ARTHROPODA</b>				
Crustacea				
Amphipoda (scuds)	23	40	33	
Decapoda (crayfish)	2	3	2	3
Isopoda (sowbugs)		1	5	13
Arachnoidea				
Hydracarina	9	11	9	19
Insecta				
Ephemeroptera (mayflies)				
Baetidae	1	1	1	
Caenidae	65	20	1	1
Heptageniidae	1		1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1		2
Libellulidae	1	1		1
Zygoptera (damselflies)				
Calopterygidae	1			
Coenagrionidae	1	104		1
Hemiptera (true bugs)				
Belostomatidae			3	
Corixidae	1	24	5	2
Gerridae	5	11	5	1
Mesoveliidae	1			
Veliidae	1			
Megaloptera				
Sialidae (alder flies)			1	
Trichoptera (caddisflies)				
Hydropsychidae	1		30	
Hydroptilidae			6	
Leptoceridae			2	
Limnephilidae	7		12	
Molannidae	2			
Phryganeidae	2		1	
Coleoptera (beetles)				
Dytiscidae (total)		4	3	1
Gyrinidae (adults)	1	1		1
Haliplidae (adults)			1	
Hydrophilidae (total)	4	1	4	
Dryopidae	1			
Elmidae	2	14	27	27
Gyrinidae (larvae)		1		
Diptera (flies)				
Ceratopogonidae	3	2	2	
Chaoboridae	36			
Chironomidae		41	72	117
Culicidae	1			1
Simuliidae			6	
Stratiomyidae	1			
Tabanidae	2			1
Tipulidae	1		1	1
<b>MOLLUSCA</b>				
Gastropoda (snails)				
Lymnaeidae	10	12	4	6
Physidae	74	166	51	30
Planorbidae	61	19	3	20
Pelecypoda (bivalves)				
Sphaeriidae (clams)	35		1	
<b>TOTAL INDIVIDUALS</b>	<b>360</b>	<b>507</b>	<b>307</b>	<b>268</b>

Table 2B. Macroinvertebrate metric evaluation of

METRIC	Dead Creek Center Road 7/13/2011 STATION 7		Turtle Creek Wheeler Road 7/14/2011 STATION 27		Sanilac Huron Creek Downstream of Ritter Road 7/14/2011 STATION 23		Sanilac Huron Creek Bay Forestville Road 7/14/2011 STATION 24	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	34	1	22	1	30	1	21
NUMBER OF MAYFLY TAXA	3	1	2	1	3	1	1	0
NUMBER OF CADDISFLY TAXA	4	1	0	-1	5	1	0	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	18.61	1	4.14	0	0.98	-1	0.37	-1
PERCENT CADDISFLY COMP.	3.33	-1	0.00	-1	16.61	0	0.00	-1
PERCENT DOMINANT TAXON	20.56	0	32.74	0	23.45	0	43.66	-1
PERCENT ISOPOD, SNAIL, LEECH	40.56	-1	39.25	-1	24.76	-1	26.49	-1
PERCENT SURF. AIR BREATHERS	14.17	0	8.09	0	6.84	1	2.24	1
TOTAL SCORE		1		-2		1		-4
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	White & Moffatt Drain Dennis Road 7/13/2011 STATION 31	North Branch White Creek McArthur Road 7/15/2011 STATION 14	North Branch White Creek Crawford Road 9/14/2011 STATION 15	Cass River Off Pinkerton Road 7/13/2011 STATION 5
PORIFERA (sponges)				1
PLATYHELMINTHES (flatworms)				
Turbellaria			1	
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1	1	
Oligochaeta (worms)		2		1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)		3		12
Decapoda (crayfish)	3	11	3	1
Isopoda (sowbugs)	103	33	20	16
Arachnoidea				
Hydracarina	3	1		1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	1	34	8	38
Caenidae	1		4	1
Ephemereflidae				12
Ephemeridae				5
Heptageniidae		33	81	18
Isonychiidae				7
Potamanthidae				1
Tricorythidae				6
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	2	1	
Zygoptera (damselflies)				
Calopterygidae	1		2	
Coenagrionidae	1			
Plecoptera (stoneflies)				
Perlodidae				1
Hemiptera (true bugs)				
Corixidae	71	41	1	1
Gerridae			1	2
Mesoveliidae			1	
Notonectidae	1			
Veliidae	1	1		
Megaloptera				
Corydalidae (dobson flies)				1
Sialidae (alder flies)	1		2	
Trichoptera (caddisflies)				
Brachycentridae				2
Helicopsychidae				4
Hydropsychidae	3	35	133	69
Leptoceridae				1
Limnephilidae	8	3	1	1
Philopotamidae				1
Polycentropodidae			1	8
Uenoidea				2
Coleoptera (beetles)				
Dytiscidae (total)		1		
Gyrinidae (adults)				1
Haliplidae (adults)	5			
Hydrophilidae (total)	1	3		1
Psephenidae (adults)		1		
Dryopidae		1		
Elmidae	23	27	8	38
Gyrinidae (larvae)			1	3
Psephenidae (larvae)			1	
Scirtidae (larvae)				1
Diptera (flies)				
Ceratopogonidae	3			
Chironomidae	74	38	39	21
Culicidae	2			
Simuliidae			3	1
Tabanidae			2	
Tipulidae				1
MOLLUSCA				
Gastropoda (snails)				

Ancylidae (limpets)		1	14	
Physidae		3	2	4
Planorbidae	9			
Pleuroceridae				14
Viviparidae				1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	6	5	1	2
Unionidae (mussels)		1	1	1
<hr/>				
TOTAL INDIVIDUALS	324	281	333	302



Table 2B. Macroinvertebrate metric evaluation of

METRIC	White & Moffatt Drain		North Branch White Creek		North Branch White Cree		Cass River	
	Dennis Road		McArthur Road		Crawford Road		Off Pinkerton Road	
	7/13/2011		7/15/2011		9/14/2011		7/13/2011	
	STATION 31		STATION 14		STATION 15		STATION 5	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	23	0	23	0	26	1	38	1
NUMBER OF MAYFLY TAXA	2	0	2	0	3	0	8	1
NUMBER OF CADDISFLY TAXA	2	0	2	0	3	0	8	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	1	1
PERCENT MAYFLY COMP.	0.62	-1	23.84	1	27.93	1	29.14	1
PERCENT CADDISFLY COMP.	3.40	-1	13.52	0	40.54	1	29.14	1
PERCENT DOMINANT TAXON	31.79	0	14.59	1	39.94	-1	22.85	0
PERCENT ISOPOD, SNAIL, LEEC	34.88	-1	13.52	-1	11.11	-1	11.59	-1
PERCENT SURF. AIR BREATHER	25.00	-1	16.73	0	0.90	1	1.66	1
TOTAL SCORE		-5		0		1		6
MACROINV. COMMUNITY RATING		POOR		ACCEPT.		ACCEPT.		EXCELLEN

Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	South Branch Cass River	South Branch Cass River	South Branch Cass River	North Branch Cass River
	Montgomery Road 8/2/2011 STATION 18	Kelly Road 7/14/2011 STATION 17	Shabonna Road 7/14/2011 STATION 16	Stanbaugh Road 8/1/2011 STATION 13
<b>ANNELIDA (segmented worms)</b>				
Hirudinea (leeches)				7
Oligochaeta (worms)	5	11		13
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
Amphipoda (scuds)	30	32	22	
Decapoda (crayfish)	1	5	1	1
Isopoda (sowbugs)		15	2	
<b>Arachnoidea</b>				
Hydracarina	7	18	22	10
<b>Insecta</b>				
<b>Ephemeroptera (mayflies)</b>				
Baetidae	1	1		
Caenidae	41	19	17	
Ephemeridae		5	1	
Heptageniidae	7	22	2	
Tricorythidae		2		
<b>Odonata</b>				
<b>Anisoptera (dragonflies)</b>				
Aeshnidae	1	1	1	4
Gomphidae			1	
Libellulidae			2	
<b>Zygoptera (damselflies)</b>				
Calopterygidae	4		1	1
Coenagrionidae	146	16	19	77
<b>Hemiptera (true bugs)</b>				
Belostomatidae		3	1	3
Corixidae		84	2	1
Gerridae			2	1
Mesoveliidae	6			
Nepidae				1
Pleidae	1	1	1	
Veliidae		2	1	
<b>Megaloptera</b>				
Sialidae (alder flies)		2	2	
<b>Trichoptera (caddisflies)</b>				
Helicopsychidae				1
Hydropsychidae		3		3
Hydroptilidae				2
Leptoceridae				3
Limnephilidae			2	2
Phryganeidae		2	1	
Polycentropodidae	5	2		
<b>Lepidoptera (moths)</b>				
Pyalidae		1		
<b>Coleoptera (beetles)</b>				
Dytiscidae (total)				2
Gyrinidae (adults)	1	2	1	
Haliplidae (adults)	1	2	11	5
Hydrophilidae (total)			1	
Scirtidae (adults)		1		
Elmidae	53	27	112	12
<b>Diptera (flies)</b>				
Ceratopogonidae	4	4	5	2
Chironomidae	37	57	27	86
Simuliidae				1
Tabanidae		1		
<b>MOLLUSCA</b>				
<b>Gastropoda (snails)</b>				
Hydrobiidae		11		
Lymnaeidae			1	
Physidae	6	15	2	31
Planorbidae	1	4	1	
<b>Pelecypoda (bivalves)</b>				
Sphaeriidae (clams)	2	1		5
Unionidae (mussels)	1		1	
<b>TOTAL INDIVIDUALS</b>	<b>361</b>	<b>372</b>	<b>265</b>	<b>274</b>

Table 2B. Macroinvertebrate metric evaluation of

METRIC	South Branch Cass River		South Branch Cass River		South Branch Cass Rive		North Branch Cass River	
	Montgomery Road		Kelly Road		Shabonna Road		Stanbaugh Road	
	8/2/2011		7/14/2011		7/14/2011		8/1/2011	
	STATION 18		STATION 17		STATION 16		STATION 13	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	22	0	32	1	30	1	24	0
NUMBER OF MAYFLY TAXA	3	0	5	1	3	0	0	-1
NUMBER OF CADDISFLY TAXA	1	-1	3	0	2	0	5	1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	13.57	0	13.17	0	7.55	0	0.00	-1
PERCENT CADDISFLY COMP.	1.39	-1	1.88	-1	1.13	-1	4.01	0
PERCENT DOMINANT TAXON	40.44	-1	22.58	0	42.26	-1	31.39	0
PERCENT ISOPOD, SNAIL, LEECH	1.94	1	12.10	-1	2.26	1	13.87	-1
PERCENT SURF. AIR BREATHERS	2.49	1	25.54	-1	7.55	0	4.74	1
TOTAL SCORE		-2		-2		-1		-2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	South Branch White Creek	South Branch White Creek	South Branch White Creek	Turtle Creek
	Arthur Road 9/14/2011 STATION 22	Mushroom Road 7/15/2011 STATION 20	Phillips Road 7/15/2011 STATION 21	Snover Road 8/2/2011 STATION 28
PORIFERA (sponges)			1	
ANNELIDA (segmented worms)				
Hirudinea (leeches)		3	2	9
Oligochaeta (worms)	1	1	22	19
ARTHROPODA				
Crustacea				
Amphipoda (scuds)		2	15	18
Decapoda (crayfish)	8	3	4	6
Isopoda (sowbugs)			1	
Arachnoidea				
Hydracarina	1	3	2	15
Insecta				
Ephemeroptera (mayflies)				
Baetidae	32	28		
Caenidae	11			75
Heptageniidae	98	8	1	7
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1	1	1	3
Gomphidae		1		
Zygoptera (damselflies)				
Calopterygidae	4	2		
Coenagrionidae		1	7	132
Plecoptera (stoneflies)				
Chloroperlidae		1		
Hemiptera (true bugs)				
Corixidae		4	208	13
Gerridae		2		4
Mesoveliidae			1	
Nepidae	1			
Pleidae			2	
Veliidae	1	2		
Megaloptera				
Corydalidae (dobson flies)	4	1		
Sialidae (alder flies)		1	2	
Trichoptera (caddisflies)				
Hydropsychidae	24	62		
Hydroptilidae			1	
Leptoceridae		1		2
Limnephilidae		1	1	
Coleoptera (beetles)				
Dytiscidae (total)		2	1	
Gyrinidae (adults)				1
Halplidae (adults)			3	
Hydrophilidae (total)		2		1
Scirtidae (adults)			1	
Dryopidae		1		
Elmidae	46	37	52	9
Gyrinidae (larvae)				7
Diptera (flies)				
Ceratopogonidae	1		6	
Chironomidae	12	64	100	16
Culicidae		1	1	2
Dixidae				1
Simuliidae	1	1		
Tabanidae		2		
Tipulidae	7	1	3	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	4	1	4	
Physidae		3	70	
Planorbidae	1	1	1	2
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	1	2	
Unionidae (mussels)			1	
TOTAL INDIVIDUALS	259	245	516	342

Table 2B. Macroinvertebrate metric evaluation of

METRIC	South Branch White Creek		South Branch White Creek		South Branch White Cree		Turtle Creek	
	Arthur Road		Mushroom Road		Phillips Road		Snover Road	
	9/14/2011		7/15/2011		7/15/2011		8/2/2011	
	STATION 22		STATION 20		STATION 21		STATION 28	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	20	0	33	1	29	1	19	1
NUMBER OF MAYFLY TAXA	3	0	2	0	1	-1	2	1
NUMBER OF CADDISFLY TAXA	1	-1	3	0	2	0	1	0
NUMBER OF STONEFLY TAXA	0	-1	1	1	0	-1	0	-1
PERCENT MAYFLY COMP.	54.44	1	14.69	0	0.19	-1	23.98	1
PERCENT CADDISFLY COMP.	9.27	0	26.12	0	0.39	-1	0.58	-1
PERCENT DOMINANT TAXON	37.84	-1	26.12	0	40.31	-1	38.60	-1
PERCENT ISOPOD, SNAIL, LEECH	1.93	1	3.27	1	15.12	-1	3.22	1
PERCENT SURF. AIR BREATHERS	0.77	1	5.31	1	42.05	-1	6.14	1
TOTAL SCORE		0		4		-6		2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		POOR		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	South Branch Cass River M-53 (Van Dyke) 8/2/2011 STATION 19	Goodings Creek M-15 @ Park 9/14/2011 STATION 11	Goodings Creek Caine Road 8/24/2011 STATION 10	Butternut Drain Conklin Road 8/25/2011 STATION 2
<b>PLATYHELMINTHES (flatworms)</b>				
Turbellaria		1		
<b>NEMATOMORPHA (roundworms)</b>				
				1
<b>ANNELIDA (segmented worms)</b>				
Hirudinea (leeches)	2			1
Oligochaeta (worms)		1	1	2
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
Amphipoda (scuds)	29	53		1
Decapoda (crayfish)	3	3		10
Isopoda (sowbugs)	2			
<b>Arachnoidea</b>				
Hydracarina		1		1
<b>Insecta</b>				
<b>Ephemeroptera (mayflies)</b>				
Baetidae	1	23		7
Caenidae	8			30
Ephemerellidae		4		
Heptageniidae	14	22	43	33
Potamanthidae	1			
<b>Odonata</b>				
<b>Anisoptera (dragonflies)</b>				
Aeshnidae	1	9	2	7
Cordulegastridae				1
Gomphidae		1	19	
Libellulidae			2	1
<b>Zygoptera (damselflies)</b>				
Calopterygidae		19	15	7
Coenagrionidae	18			6
<b>Plecoptera (stoneflies)</b>				
Perlidae		1	1	
<b>Hemiptera (true bugs)</b>				
Belostomatidae	1	1		
Corixidae	27	9		5
Gerridae	2			
Mesoveliidae	14	1		
Naucoridae	1			
Nepidae		1		
Notonectidae				1
Pleidae	3			
Saldidae		1		
Veliidae			7	
<b>Megaloptera</b>				
Corydalidae (dobson flies)			9	
Sialidae (alder flies)		3	2	1
<b>Trichoptera (caddisflies)</b>				
Helicopsychidae				4
Hydropsychidae		39	54	72
Leptoceridae	1		9	
Limnephilidae	1		2	2
Philopotamidae				2
Polycentropodidae	7			
Uenoidae	1	8	1	
<b>Coleoptera (beetles)</b>				
Dytiscidae (total)	1			
Haliplidae (adults)	13			
Hydrophilidae (total)	3	1		
Dryopidae			8	
Elmidae	61	33	100	30
Psephenidae (larvae)		4	15	
<b>Diptera (flies)</b>				
Ceratopogonidae	2	1		1
Chironomidae	17	12	13	33
Simuliidae		2		
Tabanidae		6	2	7
Tipulidae		4	3	1
<b>MOLLUSCA</b>				
<b>Gastropoda (snails)</b>				
Ancylidae (limpets)		8	5	1

Lymnaeidae	2			
Physidae		1		4
Planorbidae	1			
Pelecypoda (bivalves)				
Sphaeriidae (clams)		21	2	11
<hr/>				
TOTAL INDIVIDUALS	237	294	315	283

Table 2B. Macroinvertebrate metric evaluation of

METRIC	South Branch Cass River M-53 (Van Dyke) 8/2/2011 STATION 19		Goodings Creek M-15 @ Park 9/14/2011 STATION 11		Goodings Creek Caine Road 8/24/2011 STATION 10		Butternut Drain Conklin Road 8/25/2011 STATION 2	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	28	1	31	1	22	0	29	1
NUMBER OF MAYFLY TAXA	4	1	3	0	1	-1	3	0
NUMBER OF CADDISFLY TAXA	4	0	2	0	4	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	1	1	1	1	0	-1
PERCENT MAYFLY COMP.	10.13	0	16.67	0	13.65	0	24.73	1
PERCENT CADDISFLY COMP.	4.22	0	15.99	0	20.95	0	28.27	0
PERCENT DOMINANT TAXON	25.74	0	18.03	1	31.75	0	25.44	0
PERCENT ISOPOD, SNAIL, LEECH	2.95	1	3.06	1	1.59	1	2.12	1
PERCENT SURF. AIR BREATHERS	27.43	-1	4.76	1	2.22	1	2.12	1
TOTAL SCORE		1		5		2		3
MACROINV. COMMUNITY RATING		ACCEPT.		EXCELLENT		ACCEPT.		ACCEPT.



Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	Cass River M-15 (Huron Avenue) 9/14/2011 STATION 3	Cass River Frankenmuth Rd @ Cemetery 9/14/2011 STATION 4	Columbus Drain Index Road 8/2/2011 STATION 30	Sucker Creek Weeden Rd 8/25/2011 STATION 25
<b>PLATYHELMINTHES (flatworms)</b>				
Turbellaria		1		
<b>ANNELIDA (segmented worms)</b>				
Hirudinea (leeches)	1	1	3	
Oligochaeta (worms)		3	8	1
<b>ARTHROPODA</b>				
<b>Crustacea</b>				
Amphipoda (scuds)	13	2	6	8
Decapoda (crayfish)	3		6	
<b>Arachnoidea</b>				
Hydracarina	1		4	2
<b>Insecta</b>				
<b>Ephemeroptera (mayflies)</b>				
Baetiscidae	1	1		
Baetidae	5		2	15
Caenidae	3	13	39	3
Ephemerellidae	2	4		
Ephemeridae	6			
Heptageniidae	25	9	40	1
Potamanthidae	9	14		
<b>Odonata</b>				
<b>Anisoptera (dragonflies)</b>				
Aeshnidae	1			2
Cordulegastridae				4
Corduliidae		1		
Gomphidae	3	4		
Macromiidae		3		
<b>Zygoptera (damselflies)</b>				
Calopterygidae	2		1	16
Coenagrionidae	216	74	41	6
Lestidae		6		
<b>Hemiptera (true bugs)</b>				
Belostomatidae				2
Corixidae	11	14		74
Gerridae			1	3
Mesoveliidae		1	1	
Nepidae	2			1
Notonectidae	1	1		1
Pleidae	1		1	1
Saldidae			1	
Veliidae				2
<b>Megaloptera</b>				
Corydalidae (dobson flies)				1
Sialidae (alder flies)	1			
<b>Trichoptera (caddisflies)</b>				
Helicopsychidae	1			
Hydropsychidae			1	1
Hydroptilidae		1		1
Leptoceridae			2	1
Limnephilidae		1		
Polycentropodidae			9	
<b>Coleoptera (beetles)</b>				
Dytiscidae (total)		2	2	1
Haliplidae (adults)	1	5	42	12
Hydrophilidae (total)	4			1
Dryopidae				1
Elmidae	38	16	55	9
Gyrinidae (larvae)		1		
Haliplidae (larvae)				1
<b>Diptera (flies)</b>				
Ceratopogonidae		3	3	2
Chironomidae	33	149	17	29
Culicidae				2
Tabanidae	3	1	1	1
Tipulidae		1		
<b>MOLLUSCA</b>				
<b>Gastropoda (snails)</b>				
Ancylidae (limpets)	1	2	1	
Lymnaeidae			2	

Physidae	11	3	4	
Planorbidae				12
Pleuroceridae	40			
Valvatidae				3
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1		1	3
Unionidae (mussels)			2	
<hr/>				
TOTAL INDIVIDUALS	440	337	296	223

Table 2B. Macroinvertebrate metric evaluation of

METRIC	Cass River M-15 (Huron Avenue) 9/14/2011 STATION 3		Cass River Frankenmuth Rd @ Cemete 9/14/2011 STATION 4		Columbus Drain Index Road 8/2/2011 STATION 30		Sucker Creek Weeden Rd 8/25/2011 STATION 25	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	30	1	29	1	28	1	33
NUMBER OF MAYFLY TAXA	7	1	5	1	3	0	3	0
NUMBER OF CADDISFLY TAXA	1	-1	2	0	3	0	3	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	11.59	0	12.17	0	27.36	1	8.52	0
PERCENT CADDISFLY COMP.	0.23	-1	0.59	-1	4.05	0	1.35	-1
PERCENT DOMINANT TAXON	49.09	-1	44.21	-1	18.58	1	33.18	0
PERCENT ISOPOD, SNAIL, LEECH	12.05	-1	1.78	1	3.38	1	6.73	0
PERCENT SURF. AIR BREATHERS	4.55	1	6.82	1	16.22	0	44.84	-1
TOTAL SCORE		-2		1		3		-2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	Evergreen Creek Waterman Rd 8/24/2011 STATION 9	Evergreen Creek M-46 8/24/2011 STATION 8	White Creek Hurds Corner 8/1/2011 STATION 32	Butternut Creek Orr Road 8/25/2011 STATION 1
<b>ANNELIDA (segmented worms)</b>				
Oligochaeta (worms)		6	8	1
<b>ARTHROPODA</b>				
Crustacea				
Amphipoda (scuds)	55	14	1	
Decapoda (crayfish)			7	4
Isopoda (sowbugs)		1	3	
Arachnoidea				
Hydracarina		5		
Insecta				
Ephemeroptera (mayflies)				
Baetidae	16	1	2	
Caenidae	4		18	1
Heptageniidae	11	1	14	62
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	12	16	1	5
Gomphidae		6		9
Libellulidae				1
Zygoptera (damselflies)				
Calopterygidae	23	26		33
Hemiptera (true bugs)				
Belostomatidae	1			
Gerridae			1	1
Pleidae	1			
Veliidae	3	1		2
Megaloptera				
Corydalidae (dobson flies)				12
Sialidae (alder flies)	2	7	8	6
Trichoptera (caddisflies)				
Glossosomatidae		1		
Helicopsychidae	9	1		
Hydropsychidae	9	38		15
Lepidostomatidae				13
Leptoceridae	4			
Limnephilidae	1		2	13
Molannidae				10
Phryganeidae		1		
Polycentropodidae	1			
Uenoidae	5	4		
Coleoptera (beetles)				
Dytiscidae (total)	1			
Gyrinidae (adults)		1		
Hydrophilidae (total)	1	1	1	
Ptilodactylidae (adults)	2			
Elmidae	44	7	21	29
Diptera (flies)				
Ceratopogonidae		4		2
Chaoboridae		119		
Chironomidae	28		33	43
Culicidae			1	
Psychodidae	1			
Simuliidae	13	8		
Tabanidae	2	2		7
Tipulidae	1	7		1
<b>MOLLUSCA</b>				
Gastropoda (snails)				
Ancylidae (limpets)	26	3	1	1
Physidae	7	16		
Planorbidae	1	3		
Pleuroceridae		3		
Pelecypoda (bivalves)				
Sphaeriidae (clams)	10	4		1
Unionidae (mussels)			1	
<b>TOTAL INDIVIDUALS</b>	<b>294</b>	<b>307</b>	<b>123</b>	<b>272</b>

Table 2B. Macroinvertebrate metric evaluation of

METRIC	Evergreen Creek		Evergreen Creek		White Creek		Butternut Creek	
	Waterman Rd		M-46		Hurds Corner		Orr Road	
	8/24/2011		8/24/2011		8/1/2011		8/25/2011	
	STATION 9		STATION 8		STATION 32		STATION 1	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	29	1	29	1	17	0	23	0
NUMBER OF MAYFLY TAXA	3	0	2	0	3	0	2	0
NUMBER OF CADDISFLY TAXA	6	1	5	1	1	-1	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	10.54	0	0.65	-1	27.64	1	23.16	1
PERCENT CADDISFLY COMP.	9.86	0	14.66	0	1.63	-1	18.75	0
PERCENT DOMINANT TAXON	18.71	1	38.76	-1	26.83	0	22.79	0
PERCENT ISOPOD, SNAIL, LEECH	11.56	-1	8.47	0	3.25	1	0.37	1
PERCENT SURF. AIR BREATHERS	3.06	1	39.74	-1	2.44	1	1.10	1
TOTAL SCORE		2		-2		0		2
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for

TAXA	Unnamed Tributary to Cass River	Sucker Creek	Main Branch Cass River
	Obrien Road 8/24/2011 STATION 29	Rossman Road 9/29/2011 STATION 26	Leslie 8/1/2011 STATION 12
PORIFERA (sponges)			1
ANNELIDA (segmented worms)			
Hirudinea (leeches)	1		
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	124	1	40
Decapoda (crayfish)	1	13	2
Isopoda (sowbugs)			5
Arachnoidea			
Hydracarina	1	2	
Insecta			
Ephemeroptera (mayflies)			
Baetidae		25	
Caenidae	1	114	2
Ephemeridae		1	
Heptageniidae	13	27	17
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	9	5	
Gomphidae	8	2	
Zygoptera (damselflies)			
Calopterygidae	41	56	
Coenagrionidae		14	
Hemiptera (true bugs)			
Belostomatidae	1	8	
Corixidae			21
Gerridae		1	
Mesoveliidae			3
Nepidae	1	22	
Veliidae	2		
Megaloptera			
Corydalidae (dobson flies)	1		
Sialidae (alder flies)	1		
Trichoptera (caddisflies)			
Helicopsychidae		8	
Hydropsychidae	4	1	
Limnephilidae	1		1
Phryganeidae	1	4	
Coleoptera (beetles)			
Haliplidae (adults)		1	2
Elmidae	24	51	10
Diptera (flies)			
Ceratopogonidae	2	3	
Chironomidae	11	10	7
Dixidae		6	
Tipulidae		2	
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)	7	6	
Physidae		5	
Planorbidae		1	
Pleuroceridae	1		
Viviparidae	6		
Pelecypoda (bivalves)			
Sphaeriidae (clams)	10	2	
Unionidae (mussels)		4	1
TOTAL INDIVIDUALS	272	395	112

Table 2B. Macroinvertebrate metric evaluation of

METRIC	Unnamed Tributary to Cass River		Sucker Creek		Main Branch Cass River		
	Obrien Road		Rossman Road		Leslie		
	Value	Score	Value	Score	Value	Score	
	8/24/2011 STATION 29		9/29/2011 STATION 26		8/1/2011 STATION 12		
TOTAL NUMBER OF TAXA	24	1	28	1	13	0	
NUMBER OF MAYFLY TAXA	2	1	4	1	2	0	
NUMBER OF CADDISFLY TAXA	3	0	3	0	1	-1	
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	
PERCENT MAYFLY COMP.	5.15	0	42.28	1	16.96	0	
PERCENT CADDISFLY COMP.	2.21	-1	3.29	-1	0.89	-1	
PERCENT DOMINANT TAXON	45.59	-1	28.86	0	35.71	0	
PERCENT ISOPOD, SNAIL, LEECH	5.51	0	3.04	1	4.46	0	
PERCENT SURF. AIR BREATHERS	1.47	1	8.10	0	23.21	-1	
TOTAL SCORE		0		2		-4	
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 2A. Qualitative macroinvertebrate sampling results for  
 Dead Creek  
 Townline Road  
 7/13/2011  
 STATION 6

TAXA	
<b>PLATYHELMINTHES (flatworms)</b>	
Turbellaria	2
<b>ARTHROPODA</b>	
Crustacea	
Amphipoda (scuds)	35
Decapoda (crayfish)	7
Isopoda (sowbugs)	13
Arachnoidea	
Hydracarina	2
Insecta	
Ephemeroptera (mayflies)	
Baetidae	1
Heptageniidae	2
Leptophlebiidae	1
Tricorythidae	1
Odonata	
Anisoptera (dragonflies)	
Aeshnidae	4
Zygoptera (damselflies)	
Calopterygidae	1
Coenagrionidae	5
Hemiptera (true bugs)	
Belostomatidae	1
Gerridae	2
Veliidae	3
Trichoptera (caddisflies)	
Brachycentridae	1
Helicopsychidae	11
Hydropsychidae	6
Leptoceridae	1
Limnephilidae	2
Molannidae	1
Phryganeidae	4
Uenoidae	1
Coleoptera (beetles)	
Hydrophilidae (total)	1
Elmidae	129
Psephenidae (larvae)	2
Diptera (flies)	
Chironomidae	15
Culicidae	1
<b>MOLLUSCA</b>	
Gastropoda (snails)	
Hydrobiidae	6
Physidae	31
Planorbidae	1
Pleuroceridae	47
Viviparidae	1
Pelecypoda (bivalves)	
Sphaeriidae (clams)	8
<b>TOTAL INDIVIDUALS</b>	<b>349</b>



Table 2B. Macroinvertebrate metric evaluation of

Dead Creek  
Townline Road  
7/13/2011  
STATION 6

METRIC	Value	Score
TOTAL NUMBER OF TAXA	34	1
NUMBER OF MAYFLY TAXA	4	1
NUMBER OF CADDISFLY TAXA	8	1
NUMBER OF STONEFLY TAXA	0	-1
PERCENT MAYFLY COMP.	1.43	-1
PERCENT CADDISFLY COMP.	7.74	0
PERCENT DOMINANT TAXON	36.96	-1
PERCENT ISOPOD, SNAIL, LEECH	28.37	-1
PERCENT SURF. AIR BREATHERS	2.29	1

TOTAL SCORE 0

MACROINV. COMMUNITY RATING ACCEPT. ACCEPT. ACCEPT. ACCEPT.

Table 3. Habitat evaluation for	Dead Creek		Turtle Creek		Sanilac Huron Creek		White & Moffatt Drain		Sanilac Huron Creek
	Center Road		Wheeler Road		Downstream of Ritter Road		Dennis Road		Bay Forestville Road
	RIFFLE/RUN		GLIDE/POOL		RIFFLE/RUN		GLIDE/POOL		GLIDE/POOL
<b>HABITAT METRIC</b>									
<b>Substrate and Instream Cover</b>									
Epifaunal Substrate/ Avail Cover (20)	12		6		12		4		7
Embeddedness (20)*	11				17				
Velocity/Depth Regime (20)*	10				10				
Pool Substrate Characterization (20)**			6				6		15
Pool Variability (20)**			5				2		3
<b>Channel Morphology</b>									
Sediment Deposition (20)	16		16		19		5		15
Flow Status - Maint. Flow Volume (10)	9		9		9		9		9
Flow Status - Flashiness (10)	9		6		9		4		9
Channel Alteration (20)	10		8		9		8		6
Frequency of Riffles/Bends (20)*	6				16				
Channel Sinuosity (20)**			4				3		1
<b>Riparian and Bank Structure</b>									
Bank Stability (L) (10)	8		4		8		3		3
Bank Stability (R) (10)	8		4		8		6		3
Vegetative Protection (L) (10)	5		3		4		4		3
Vegetative Protection (R) (10)	5		3		4		7		3
Riparian Veg. Zone Width (L) (10)	1		2		4		2		1
Riparian Veg. Zone Width (R) (10)	2		2		7		5		1
<b>TOTAL SCORE (200):</b>	<b>112</b>		<b>78</b>		<b>136</b>		<b>68</b>		<b>79</b>
<b>HABITAT RATING:</b>									
	GOOD		MARGINAL		GOOD		MARGINAL		MARGINAL
	(SLIGHTLY IMPAIRED)		(MODERATELY IMPAIRED)		(SLIGHTLY IMPAIRED)		(MODERATELY IMPAIRED)		(MODERATELY IMPAIRED)
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).									
Date:	7/13/2011		7/14/2011		7/14/2011		7/13/2011		7/14/2011
Weather:	Partly Cloudy		Sunny		Cloudy		Sunny		Sunny
Air Temperature:	65 Deg. F.		64 Deg. F.		74 Deg. F.		74 Deg. F.		72 Deg. F.
Water Temperature:	64 Deg. F.		66 Deg. F.		72 Deg. F.		72 Deg. F.		64 Deg. F.
Ave. Stream Width:	3 Feet		6 Feet		4 Feet		12 Feet		4 Feet
Ave. Stream Depth:	0.5 Feet		1 Feet		0.75 Feet		0.75 Feet		0.75 Feet
Surface Velocity:	0.1 Ft./Sec.		0.1 Ft./Sec.		0.5 Ft./Sec.		0.2 Ft./Sec.		0.2 Ft./Sec.
Estimated Flow:	0.15 CFS		0.6 CFS		1.5 CFS		1.8 CFS		0.6 CFS
Stream Modifications:	Canopy Removal		Dredged/Canopy Removal		Dredged		Dredged/Canopy Removal		Dredged/CR/Relocated
Nuisance Plants (Y/N):	N		Y		N		N		N
Report Number:									
STORET No.:	250502		790179		760210		760212		760211
Stream Name:	Dead Creek		Turtle Creek		Sanilac Huron Creek		White & Moffatt Drain		Sanilac Huron Creek
Road Crossing/Location:	Center Road		Wheeler Road		Downstream of Ritter Road		Dennis Road		Bay Forestville Road
County Code:	25		76		76		76		76
TRS:	09N07E09		12N13E20		14N12E16		11N12E08		14N12E09
Latitude (dd):	43.20586		43.4586		43.64738		43.3935		43.66222
Longitude (dd):	-83.64091		-82.9705		-83.07141		-83.0733		-83.06055
Ecoregion:	SMNITP		SMNITP		SMNITP		SMNITP		SMNITP
Stream Type:	Warmwater		Warmwater		Warmwater		Warmwater		Warmwater
USGS Basin Code:	4080205		4080205		4080205		4080205		4080205
* Applies only to Riffle/Run stream Surveys									
** Applies only to Glide/Pool stream Surveys									
<b>COMMENTS:</b>									

Table 3. Habitat evaluation for	North Branch White Creek	South Branch Cass River	South Branch Cass River	South Branch Cass River	Cass River
	McArthur Road	Montgomery Road	Shabonna Road	Kelly Road	Off Pinkerton Road
	RIFFLE/RUN	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN
<b>HABITAT METRIC</b>					
<b>Substrate and Instream Cover</b>					
Epifaunal Substrate/ Avail Cover (20)	7	5	5	6	14
Embeddedness (20)*	10				11
Velocity/Depth Regime (20)*	9				10
Pool Substrate Characterization (20)**		7	15	6	
Pool Variability (20)**		4	2	5	
<b>Channel Morphology</b>					
Sediment Deposition (20)	8	16	16	13	14
Flow Status - Maint. Flow Volume (10)	9	9	9	10	9
Flow Status - Flashiness (10)	6	4	5	8	5
Channel Alteration (20)	10	6	6	19	18
Frequency of Riffles/Bends (20)*	6				13
Channel Sinuosity (20)**		5	1	13	
<b>Riparian and Bank Structure</b>					
Bank Stability (L) (10)	5	4	1	8	8
Bank Stability (R) (10)	5	4	1	8	6
Vegetative Protection (L) (10)	5	6	2	8	8
Vegetative Protection (R) (10)	5	6	2	8	5
Riparian Veg. Zone Width (L) (10)	3	4	2	7	7
Riparian Veg. Zone Width (R) (10)	3	4	2	9	10
<b>TOTAL SCORE (200):</b>	<b>91</b>	<b>84</b>	<b>69</b>	<b>128</b>	<b>138</b>
<b>HABITAT RATING:</b>					
	MARGINAL	MARGINAL	MARGINAL	GOOD	GOOD
	(MODERATELY	(MODERATELY	(MODERATELY	(SLIGHTLY	(SLIGHTLY
	IMPAIRED)	IMPAIRED)	IMPAIRED)	IMPAIRED)	IMPAIRED)
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).					
Date:	7/15/2011	8/2/2011	7/14/2011	7/14/2011	7/13/2011
Weather:	Partly Cloudy	Cloudy	Sunny	Cloudy	Sunny
Air Temperature:	63 Deg. F.	78 Deg. F.	68 Deg. F.	74 Deg. F.	72 Deg. F.
Water Temperature:	68 Deg. F.	79 Deg. F.	74 Deg. F.	72 Deg. F.	81 Deg. F.
Ave. Stream Width:	30 Feet	22 Feet	45 Feet	100 Feet	110 Feet
Ave. Stream Depth:	1 Feet	0.75 Feet	1.5 Feet	2 Feet	1 Feet
Surface Velocity:	0.2 Ft./Sec.	0.1 Ft./Sec.	0.3 Ft./Sec.	0.1 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	6 CFS	1.65 CFS	20.25 CFS	20 CFS	110 CFS
Stream Modifications:	Dredged	Dredged/Canopy Removal	CR/Dredged	None	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	790171	440241	760217	790176	790182
Stream Name:	North Branch White Creek	South Branch Cass River	South Branch Cass River	South Branch Cass River	Cass River
Road Crossing/Location:	McArthur Road	Montgomery Road	Shabonna Road	Kelly Road	Off Pinkerton Road
County Code:	79	44	76	79	79
TRS:	13N11E20	10N12E24	13N12E27	13N11E12	11N07E24
Latitude (dd):	43.5321	43.2849	43.5317	43.57295	43.3492
Longitude (dd):	-83.19996	-83.00239	-83.0434	-83.11758	-83.60207
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080205	4080205	4080205	4080205	4080205
* Applies only to Riffle/Run stream Surveys					
** Applies only to Glide/Pool stream Surveys					
<b>COMMENTS:</b>					

Table 3. Habitat evaluation for	South Branch White Creek		South Branch White Creek		South Branch White Creek		North Branch Cass River		Evergreen Creek	
	Mushroom Road		Phillips Road		Arthur Road		Stanbaugh Road		Waterman Rd	
	RIFPLE/RUN		RIFPLE/RUN		RIFPLE/RUN		GLIDE/POOL		RIFPLE/RUN	
<b>HABITAT METRIC</b>										
<b>Substrate and Instream Cover</b>										
Epifaunal Substrate/ Avail Cover (20)	9		7		11		8		16	
Embeddedness (20)*	16		13		10				16	
Velocity/Depth Regime (20)*	15		11		11				10	
Pool Substrate Characterization (20)**							6			
Pool Variability (20)**							5			
<b>Channel Morphology</b>										
Sediment Deposition (20)	11		10		6		7		15	
Flow Status - Maint. Flow Volume (10)	9		9		4		9		9	
Flow Status - Flashiness (10)	6		8		2		4		9	
Channel Alteration (20)	18		16		16		5		16	
Frequency of Riffles/Bends (20)*	11		10		11				18	
Channel Sinuosity (20)**							6			
<b>Riparian and Bank Structure</b>										
Bank Stability (L) (10)	3		7		4		8		9	
Bank Stability (R) (10)	5		7		4		8		9	
Vegetative Protection (L) (10)	9		8		8		7		7	
Vegetative Protection (R) (10)	9		8		8		7		7	
Riparian Veg. Zone Width (L) (10)	9		8		9		4		9	
Riparian Veg. Zone Width (R) (10)	9		8		9		3		9	
<b>TOTAL SCORE (200):</b>	<b>139</b>		<b>130</b>		<b>113</b>		<b>87</b>		<b>159</b>	
<b>HABITAT RATING:</b>	<b>GOOD</b>		<b>GOOD</b>		<b>GOOD</b>		<b>MARGINAL</b>		<b>EXCELLENT</b>	
	(SLIGHTLY IMPAIRED)		(SLIGHTLY IMPAIRED)		(SLIGHTLY IMPAIRED)		(MODERATELY IMPAIRED)		(NON-IMPAIRED)	
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).										
Date:	7/15/2011		7/15/2011		9/14/2011		8/1/2011		8/24/2011	
Weather:	Sunny		Sunny		Sunny		Sunny		Sunny	
Air Temperature:	76 Deg. F.		72 Deg. F.		67 Deg. F.		80 Deg. F.		75 Deg. F.	
Water Temperature:	72 Deg. F.		73 Deg. F.		56 Deg. F.		83 Deg. F.		64 Deg. F.	
Ave. Stream Width:	17 Feet		26 Feet		15 Feet		12 Feet		14 Feet	
Ave. Stream Depth:	1 Feet		1.25 Feet		0.75 Feet		0.75 Feet		0.5 Feet	
Surface Velocity:	0.3 Ft./Sec.		0.15 Ft./Sec.		0.2 Ft./Sec.		0.8 Ft./Sec.		1.1 Ft./Sec.	
Estimated Flow:	5.1 CFS		4.875 CFS		2.25 CFS		7.2 CFS		7.7 CFS	
Stream Modifications:	None		None		None		Dredged/Canopy Removal		None	
Nuisance Plants (Y/N):	N		N		N		N		N	
Report Number:										
STORET No.:	790204		790206		790210		320051		790155	
Stream Name:	th Branch White Creek		South Branch White Creek		South Branch White Creek		North Branch Cass River		Evergreen Creek	
Road Crossing/Location:	Mushroom Road		Phillips Road		Arthur Road		Stanbaugh Road		Waterman Rd	
County Code:	79		79		79		32		79	
TRS:	12N11E07		12N11E07		12N11E17		15N13E32		11N08E01	
Latitude (dd):	43.48452		43.47473		43.460507		43.687505		43.3943	
Longitude (dd):	-83.22045		-83.21312		-83.19778		-82.958892		-83.476	
Ecoregion:	SMNITP		SMNITP		SMNITP		SMNITP		SMNITP	
Stream Type:	Warmwater		Warmwater		Warmwater		Warmwater		Warmwater	
USGS Basin Code:	4080205		4080205		4080205		4080205		4080205	
* Applies only to Riffle/Run stream Surveys										
** Applies only to Glide/Pool stream Surveys										
COMMENTS:										

Table 3. Habitat evaluation for	Evergreen Creek		Turtle Creek		Goodings Creek		Goodings Creek		Butternut Drain
	M-46		Snover Road		Caine Road		M-15 @ Park		Conklin Road
	RIFFLE/RUN		GLIDE/POOL		RIFFLE/RUN		RIFFLE/RUN		RIFFLE/RUN
<b>HABITAT METRIC</b>									
<b>Substrate and Instream Cover</b>									
Epifaunal Substrate/ Avail Cover (20)	10		3		15		16		11
Embeddedness (20)*	11				11		17		14
Velocity/Depth Regime (20)*	12				15		11		10
Pool Substrate Characterization (20)**			6						
Pool Variability (20)**			4						
<b>Channel Morphology</b>									
Sediment Deposition (20)	8		16		10		11		14
Flow Status - Maint. Flow Volume (10)	7		8		9		9		9
Flow Status - Flashiness (10)	3		4		3		1		1
Channel Alteration (20)	14		8		15		15		12
Frequency of Riffles/Bends (20)*	16				16		16		5
Channel Sinuosity (20)**			6						
<b>Riparian and Bank Structure</b>									
Bank Stability (L) (10)	4		7		6		9		4
Bank Stability (R) (10)	4		7		6		9		6
Vegetative Protection (L) (10)	3		7		7		8		4
Vegetative Protection (R) (10)	3		7		7		8		5
Riparian Veg. Zone Width (L) (10)	8		3		9		7		6
Riparian Veg. Zone Width (R) (10)	8		3		9		3		3
TOTAL SCORE (200):	111		89		138		140		104
HABITAT RATING:	GOOD		MARGINAL		GOOD		GOOD		MARGINAL
	(SLIGHTLY		(MODERATELY		(SLIGHTLY		(SLIGHTLY		(MODERATELY
	IMPAIRED)		IMPAIRED)		IMPAIRED)		IMPAIRED)		IMPAIRED)
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).									
Date:	8/24/2011		8/2/2011		8/24/2011		9/14/2011		8/25/2011
Weather:	Cloudy		Cloudy		Partly Cloudy		Rainy		Partly Cloudy
Air Temperature:	74 Deg. F.		74 Deg. F.		75 Deg. F.		55 Deg. F.		68 Deg. F.
Water Temperature:	68 Deg. F.		75 Deg. F.		68 Deg. F.		64 Deg. F.		64 Deg. F.
Ave. Stream Width:	8 Feet		4 Feet		18 Feet		12 Feet		10 Feet
Ave. Stream Depth:	0.7 Feet		0.5 Feet		0.6 Feet		0.5 Feet		0.8 Feet
Surface Velocity:	0.8 Ft./Sec.		0.1 Ft./Sec.		0.7 Ft./Sec.		0.8 Ft./Sec.		0.2 Ft./Sec.
Estimated Flow:	4.48 CFS		0.2 CFS		7.56 CFS		4.8 CFS		1.6 CFS
Stream Modifications:	at Improvement		Dredged/Canopy Removal		None		Canopy Removal		Dredged
Nuisance Plants (Y/N):	N		N		N		N		N
Report Number:									
STORET No.:	790081		760260		790205		790153		790169
Stream Name:	Evergreen Creek		Turtle Creek		Goodings Creek		Goodings Creek		Butternut Drain
Road Crossing/Location:	M-46		Snover Road		Caine Road		M-15 @ Park		Conklin Road
County Code:	79		76		79		79		79
TRS:	12N08E35		12N13E19		11N08E22		11N08E19		13N10E34
Latitude (dd):	43.40892		43.46098		43.33988		43.35		43.50414
Longitude (dd):	-83.48317		-82.97781		-83.52145		-83.5792		-83.28435
Ecoregion:	SMNITP		SMNITP		SMNITP		SMNITP		SMNITP
Stream Type:	Warmwater		Warmwater		Warmwater		Warmwater		Warmwater
USGS Basin Code:	4080205		4080205		4080205		4080205		4080205
* Applies only to Riffle/Run stream Surveys									
** Applies only to Glide/Pool stream Surveys									
COMMENTS:									

Table 3. Habitat evaluation for	Cass River	Cass River	Cass River	White Creek	North Branch White Creek
	M-53 (Van Dyke)	M-15 (Huron Avenue)	Frankenmuth Rd @ Cemetery	Hurds Corner	Crawford Road
	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN
<b>HABITAT METRIC</b>					
<b>Substrate and Instream Cover</b>					
Epifaunal Substrate/ Avail Cover (20)	13	10	7	11	13
Embeddedness (20)*					13
Velocity/Depth Regime (20)*					11
Pool Substrate Characterization (20)**	9	10	8	10	
Pool Variability (20)**	10	5	4	6	
<b>Channel Morphology</b>					
Sediment Deposition (20)	18	16	12	12	14
Flow Status - Maint. Flow Volume (10)	9	9	9	9	9
Flow Status - Flashiness (10)	5	5	2	4	1
Channel Alteration (20)	16	13	11	18	11
Frequency of Riffles/Bends (20)*					8
Channel Sinuosity (20)**	12	6	5	13	
<b>Riparian and Bank Structure</b>					
Bank Stability (L) (10)	8	8	8	3	5
Bank Stability (R) (10)	8	8	8	3	5
Vegetative Protection (L) (10)	9	7	8	10	9
Vegetative Protection (R) (10)	9	7	8	10	8
Riparian Veg. Zone Width (L) (10)	10	4	8	9	9
Riparian Veg. Zone Width (R) (10)	10	4	4	9	6
<b>TOTAL SCORE (200):</b>	<b>146</b>	<b>112</b>	<b>102</b>	<b>127</b>	<b>122</b>
<b>HABITAT RATING:</b>					
	GOOD	GOOD	MARGINAL	GOOD	GOOD
	(SLIGHTLY	(SLIGHTLY	(MODERATELY	(SLIGHTLY	(SLIGHTLY
	IMPAIRED)	IMPAIRED)	IMPAIRED)	IMPAIRED)	IMPAIRED)
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).					
Date:	8/2/2011	9/14/2011	9/14/2011	8/1/2011	9/14/2011
Weather:	Cloudy	Cloudy	Rainy	Sunny	Sunny
Air Temperature:	73 Deg. F.	65 Deg. F.	63 Deg. F.	80 Deg. F.	65 Deg. F.
Water Temperature:	79 Deg. F.	61 Deg. F.	61 Deg. F.	80 Deg. F.	56 Deg. F.
Ave. Stream Width:	60 Feet	120 Feet	100 Feet	40 Feet	20 Feet
Ave. Stream Depth:	2 Feet	1.75 Feet	2 Feet	1 Feet	8 Feet
Surface Velocity:	0.1 Ft./Sec.	0.1 Ft./Sec.	0.2 Ft./Sec.	0.1 Ft./Sec.	0.1 Ft./Sec.
Estimated Flow:	12 CFS	21 CFS	40 CFS	4 CFS	16 CFS
Stream Modifications:	at Improvement	Canopy Removal	BS/CR/Dredged	None	Dredged
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	760012	790043	790160	790157	790211
Stream Name:	Cass River	Cass River	Cass River	White Creek	North Branch White Creek
Road Crossing/Location:	M-53 (Van Dyke)	M-15 (Huron Avenue)	Frankenmuth Rd @ Cemetery	Hurds Corner	Crawford Road
County Code:	76	79	79	79	79
TRS:	13N12E17	11N08E07	11N07E13	13N10E27	13N11E24
Latitude (dd):	43.552226	43.37087	43.361	43.5157	43.53854
Longitude (dd):	-83.095003	-83.581116	-83.5961	-83.2896	-83.13145
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080205	4080205	4080205	4080205	4080205
* Applies only to Riffle/Run stream Surveys					
** Applies only to Glide/Pool stream Surveys					
<b>COMMENTS:</b>					

Table 3. Habitat evaluation for	Columbus Drain	Sucker Creek	Sucker Creek	Butternut Creek	Unnamed Tributary to Cass River
	Index Road	Weeden Rd	Rossman Road	Orr Road	Obrien Road
	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN
<b>HABITAT METRIC</b>					
<b>Substrate and Instream Cover</b>					
Epifaunal Substrate/ Avail Cover (20)	10	9	15	12	11
Embeddedness (20)*					11
Velocity/Depth Regime (20)*					13
Pool Substrate Characterization (20)**	7	7	8	6	
Pool Variability (20)**	4	13	1	8	
<b>Channel Morphology</b>					
Sediment Deposition (20)	9	10	16	8	9
Flow Status - Maint. Flow Volume (10)	9	9	9	7	9
Flow Status - Flashiness (10)	3	7	6	5	2
Channel Alteration (20)	6	14	6	19	16
Frequency of Riffles/Bends (20)*					15
Channel Sinuosity (20)**	3	7	1	15	
<b>Riparian and Bank Structure</b>					
Bank Stability (L) (10)	8	8	4	3	5
Bank Stability (R) (10)	8	8	4	3	5
Vegetative Protection (L) (10)	6	9	5	5	6
Vegetative Protection (R) (10)	6	9	5	7	6
Riparian Veg. Zone Width (L) (10)	3	9	3	5	6
Riparian Veg. Zone Width (R) (10)	4	9	4	10	8
<b>TOTAL SCORE (200):</b>	<b>86</b>	<b>128</b>	<b>87</b>	<b>113</b>	<b>122</b>
<b>HABITAT RATING:</b>	<b>MARGINAL</b>	<b>GOOD</b>	<b>MARGINAL</b>	<b>GOOD</b>	<b>GOOD</b>
	(MODERATELY	(SLIGHTLY	(MODERATELY	(SLIGHTLY	(SLIGHTLY
	IMPAIRED)	IMPAIRED)	IMPAIRED)	IMPAIRED)	IMPAIRED)
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).					
Date:	8/2/2011	8/25/2011	9/29/2011	8/25/2011	8/24/2011
Weather:	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Air Temperature:	78 Deg. F.	72 Deg. F.	64 Deg. F.	65 Deg. F.	73 Deg. F.
Water Temperature:	75 Deg. F.	67 Deg. F.	54 Deg. F.	64 Deg. F.	68 Deg. F.
Ave. Stream Width:	18 Feet	35 Feet	10 Feet	8 Feet	6 Feet
Ave. Stream Depth:	1.5 Feet	2 Feet	0.75 Feet	0.9 Feet	0.6 Feet
Surface Velocity:	0.1 Ft./Sec.	0.1 Ft./Sec.	0.5 Ft./Sec.	0.2 Ft./Sec.	0.3 Ft./Sec.
Estimated Flow:	2.7 CFS	7 CFS	3.75 CFS	1.44 CFS	1.08 CFS
Stream Modifications:	Canopy Removal	Dredged	Dredged/Canopy Removal	None	None
Nuisance Plants (Y/N):	N	N	N	N	N
Report Number:					
STORET No.:	440221	790145	790209	790207	790208
Stream Name:	Columbus Drain	Sucker Creek	Sucker Creek	Butternut Creek	Unnamed Tributary to Cass River
Road Crossing/Location:	Index Road	Weeden Rd	Rossman Road	Orr Road	Obrien Road
County Code:	44	79	79	79	79
TRS:	10N12E26	12N09E02	12N10E28	13N10E31	11N08E10
Latitude (dd):	43.2704	43.49019	43.42513	43.50292	43.38159
Longitude (dd):	-83.0251	-83.37468	-83.30128	-83.33882	-83.52061
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4080205	4080205	4080205	4080205	4080205
* Applies only to Riffle/Run stream Surveys					
** Applies only to Glide/Pool stream Surveys					
<b>COMMENTS:</b>					

Table 3. Habitat evaluation for	Dead Creek		Main Branch Cass River						
	Townline Road		Leslie						
	RIFFLE/RUN		GLIDE/POOL						
<b>HABITAT METRIC</b>									
<b>Substrate and Instream Cover</b>									
Epifaunal Substrate/ Avail Cover (20)		15		12					
Embeddedness (20)*		14							
Velocity/Depth Regime (20)*		10							
Pool Substrate Characterization (20)**				11					
Pool Variability (20)**				8					
<b>Channel Morphology</b>									
Sediment Deposition (20)		18		10					
Flow Status - Maint. Flow Volume (10)		8		9					
Flow Status - Flashiness (10)		5		2					
Channel Alteration (20)		11		18					
Frequency of Riffles/Bends (20)*		14							
Channel Sinuosity (20)**				10					
<b>Riparian and Bank Structure</b>									
Bank Stability (L) (10)		8		8					
Bank Stability (R) (10)		8		8					
Vegetative Protection (L) (10)		8		9					
Vegetative Protection (R) (10)		8		9					
Riparian Veg. Zone Width (L) (10)		5		10					
Riparian Veg. Zone Width (R) (10)		8		10					
TOTAL SCORE (200):		140		134		0		0	
HABITAT RATING:		GOOD		GOOD		POOR		POOR	
		(SLIGHTLY IMPAIRED)		(SLIGHTLY IMPAIRED)		(SEVERELY IMPAIRED)		(SEVERELY IMPAIRED)	
Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).									
Date:		7/13/2011		8/1/2011					
Weather:		Partly Cloudy		Sunny					
Air Temperature:		68 Deg. F.		80 Deg. F.		Deg. F.		Deg. F.	
Water Temperature:		72 Deg. F.		78 Deg. F.		Deg. F.		Deg. F.	
Ave. Stream Width:		14 Feet		22 Feet		Feet		Feet	
Ave. Stream Depth:		0.5 Feet		1 Feet		Feet		Feet	
Surface Velocity:		0.4 Ft./Sec.		0.1 Ft./Sec.		Ft./Sec.		Ft./Sec.	
Estimated Flow:		2.8 CFS		2.2 CFS		CFS		CFS	
Stream Modifications:		Dredged		None					
Nuisance Plants (Y/N):		N		N					
Report Number:									
STORET No.:		730338		760188					
Stream Name:		Dead Creek		Main Branch Cass River					
Road Crossing/Location:		Townline Road		Leslie					
County Code:		73		76					
TRS:		10N06E02		13N12E14					
Latitude (dd):		43.30684		43.548					
Longitude (dd):		-83.72575		-83.0348					
Ecoregion:		HELP		SMNITP					
Stream Type:		Coldwater		Warmwater					
USGS Basin Code:		4080205		4080205					
* Applies only to Riffle/Run stream Surveys									
** Applies only to Glide/Pool stream Surveys									
COMMENTS:									