

Appendix H1: Macroinvertebrate Report 2010

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
FEBRUARY 2011

STAFF REPORT

A BIOLOGICAL SURVEY OF SITES ON THE KALAMAZOO RIVER AND TALMADGE CREEK
NEAR THE ENBRIDGE OIL SPILL IN MARSHALL
CALHOUN COUNTY, MICHIGAN
SEPTEMBER 2010

INTRODUCTION

On July 26, 2010, a 30-inch diameter pipeline ruptured discharging heavy crude oil into a culvert that leads to Talmadge Creek, a tributary to the Kalamazoo River, which drains into Lake Michigan. The amount of oil discharged is estimated at 819,000 to 1,000,000 gallons. The Kalamazoo River is bordered by wetland, forest, residential properties, farmland, and commercial properties for the approximate 35-mile stretch of impacted river in Calhoun County between Marshall and Morrow Lake.

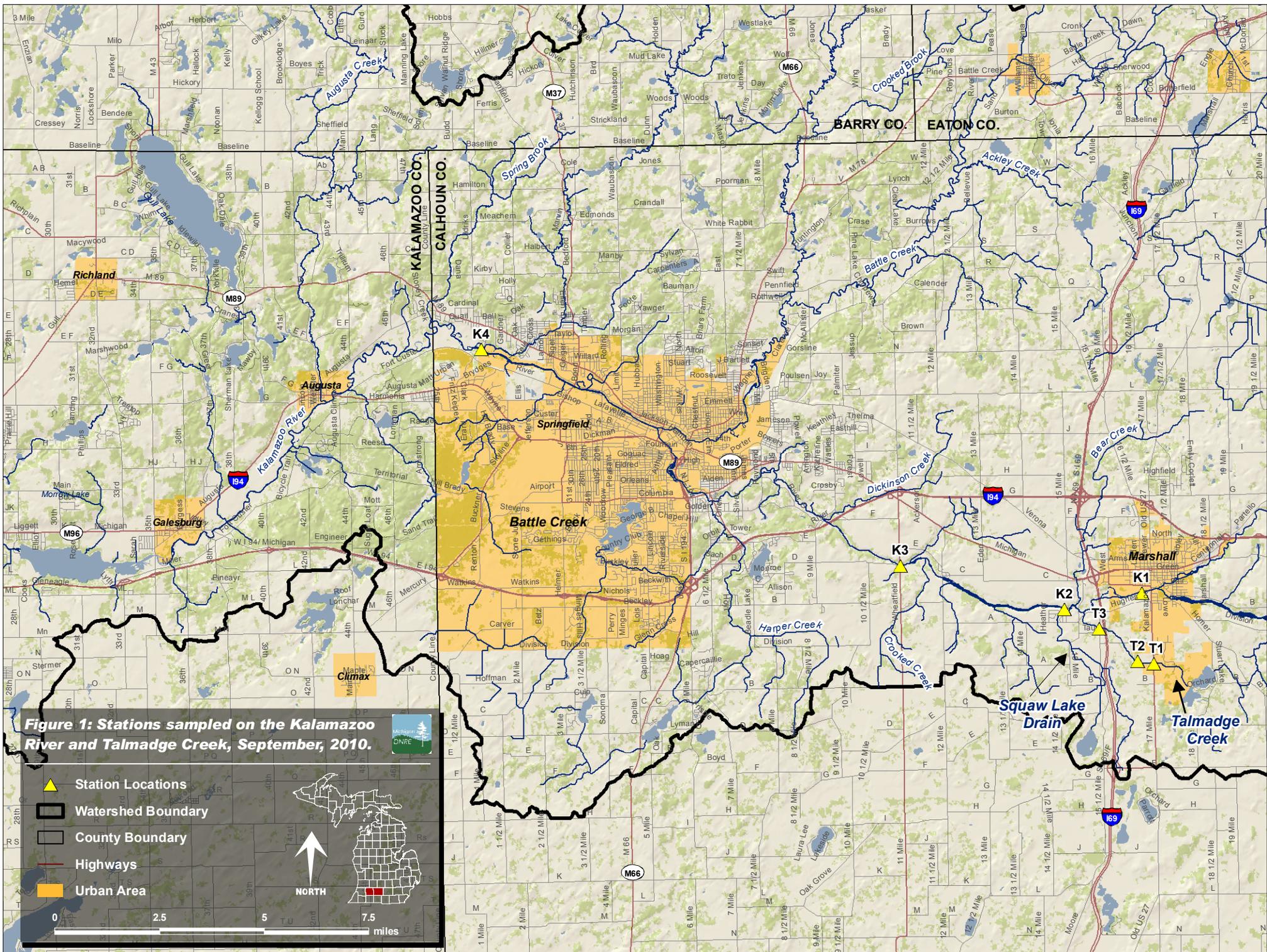
During September 2010, staff of the Surface Water Assessment Section (SWAS), Water Resources Division, conducted qualitative macroinvertebrate community and stream habitat surveys on the Kalamazoo River and Talmadge Creek. The objective of these surveys was to monitor the short-term effects of the oil spill and associated cleanup activities on macroinvertebrate communities and aquatic habitat. SWAS staff also assisted Fisheries Division staff with fish collection efforts and quantitative stream habitat assessments. The Fisheries Division is preparing a separate report, which details the fish and quantitative stream habitat sampling efforts. Additional surveys will be conducted in the future to monitor the short- and long-term effects of the oil spill and associated cleanup activities on the fish and macroinvertebrate communities and aquatic habitat (Wesley and Walterhouse, 2010).

METHODS

Most of the sites that were selected for this survey were specifically chosen because of historic (i.e., baseline) surveys that were conducted prior to the oil spill. An additional site on Talmadge Creek was added just upstream of the oil spill because stream flow at the historic control site further upstream at 17 Mile Road was minimal and the stream habitat had characteristics more typical of a wetland. A survey was also conducted at a site on the Kalamazoo River downstream of Talmadge Creek, where historical survey data was lacking, but the upstream proximity of Talmadge Creek warranted the addition of the site to determine impacts.

The surveys described in this report were conducted according to the guidelines of the SWAS Procedure 51 (MDEQ, 1990). Procedure 51 surveys conducted prior to 2008 and those conducted in 2010 were performed with nearly the same methodology except the macroinvertebrate sample size was increased from 100 to 300 with the 2008 revision to Procedure 51. The macroinvertebrate communities were scored with metrics that rate water bodies from excellent (+5 to +9) to poor (-5 to -9). Macroinvertebrate ratings from +4 to -4 are considered acceptable. Negative ratings that are acceptable are indicative of water bodies that are strongly tending toward poor, while positive ratings that are acceptable indicate slight impairment (Creal et al., 1996). Stream habitat was qualitatively evaluated at each station using a scoring system, which ranged in value from 0 (poor) to 200 (excellent).

Sampling locations are shown in Figure 1.



SUMMARY and OBSERVATIONS

Macroinvertebrate abundance and diversity were drastically reduced in Talmadge Creek and the Kalamazoo River downstream of the oil spill. Procedure 51 qualitative macroinvertebrate scores and ratings alone do not adequately measure the impact of the oil spill and associated cleanup activities.

Sampling efforts in depositional zones at all of the impacted sites on Talmadge Creek and the Kalamazoo River caused a disturbance that produced a surface oil sheen. The water and sediment at all of the impacted sites also had a notable petroleum odor.

The shallow riffle habitat at the impacted Kalamazoo River sites (stations K2 and K3) had obviously been heavily disturbed by the boat traffic associated with the cleanup operations. The cobble habitat in the riffles was abnormally clean and free of periphyton, loose (not embedded at all), and many of the boulders and cobbles were marked with material from boat hulls and propellers.

The waves associated with the abnormal boat traffic were creating turbidity and causing bank erosion. The wave action was also likely dislodging macroinvertebrates, especially in shallow habitats.

SAMPLING RESULTS

Talmadge Creek - Macroinvertebrates

The macroinvertebrate community sampling results for stations on Talmadge Creek are presented in Table 1a and the macroinvertebrate community metrics, scores, and ratings are presented in Table 1b. The stations are arranged in an upstream to downstream sequence. Two stations were surveyed as controls upstream of the oil spill. The control station at 17 Mile Road (station T1) was surveyed in 1999 allowing for comparisons with the current survey (Cooper, 2000). The control station downstream of 17 Mile Road (station T2) had never been surveyed but the stream habitat and greater flow volume were more similar to conditions downstream on the oil impacted segment of Talmadge Creek. Talmadge Creek was sampled in the oil impacted reach at 15½ Mile Road (station T3) where a survey was also conducted in 1999 (Cooper, 2000). Station T3 is one mile downstream (Mile Post 1.0) of where oil from the pipeline failure entered Talmadge Creek.

The macroinvertebrate community sampling results documented that of the 3 sites surveyed on Talmadge Creek, station T3 received the lowest score, supported the fewest taxa, and was dominated by Chironomidae (midge) larvae. The upstream site (station T2) that was comparable in terms of stream habitat and flow received an overall score of +1 compared to the score of -4 at station T3. The number of taxa decreased from 27 at station T2 to only 7 at station T3. Specific taxa that were present at both stations T1 and T2 that were absent at station T3 included Hirudinea, Amphipoda, Hydracarina, Caenidae, Limnephilidae, Physidae, Planorbidae, and Sphaeriidae.

The results of the current macroinvertebrate survey are presented along with the historic survey results from 1999 (Cooper, 2000) at stations T1 and T3 in Tables 2a and 2b. The upstream control site at station T1 consisted of taxa predominately associated with wetland habitat during both surveys. Some of the differences in macroinvertebrate community overall scores, number of taxa, and specific community attributes can likely be attributed to seasonal changes in abundance. The 1999 survey was conducted in July while the 2010 survey was conducted in September. At station T3 the overall macroinvertebrate score did not change significantly from 1999 to 2010; however, the overall macroinvertebrate community changed from a rather

balanced community where 19 total taxa were identified, to a community dominated by one taxa with only 7 total taxa present.

Kalamazoo River - Macroinvertebrates

The macroinvertebrate community sampling results for stations on the Kalamazoo River are presented in Table 3a and the macroinvertebrate community metrics, scores, and ratings are presented in Table 3b. The stations are arranged in an upstream to downstream sequence. The control station on the Kalamazoo River was upstream of the oil spill in Marshall at Kalamazoo Street (station K1). Three sites on the Kalamazoo River were surveyed in the reach that was impacted by the oil spill and the associated cleanup activities. Station K2 was located on the Kalamazoo River in the vicinity of the Squaw Lake Drain confluence at about Mile Post 2.75. Station K3 was downstream of the Ceresco Dam at 11 Mile Road approximately at Mile Post 7.25. Station K4 on the Kalamazoo River was located downstream of the city of Battle Creek at Custer Drive at about Mile Post 21.25.

The upstream control site on the Kalamazoo River (station K1) had an overall macroinvertebrate community score of +5 and a rating of excellent. The abundance of Simuliidae (black fly) larvae at the site impacted several metrics and lowered the overall score. The macroinvertebrate community at station K2 scored +6 and was rated as excellent. The site still harbored a diversity of taxa, many of which are considered intolerant of pollution. Downstream at station K3, the macroinvertebrate community scored +3 and was rated as acceptable. The site still supported a diversity of taxa, many of which are intolerant of pollution. The macroinvertebrate community further downstream at station K4 scored +2 and was also rated as acceptable. The 20 taxa collected at the site were reduced compared to the upstream sites where greater than 30 taxa were collected. The greater taxa diversity upstream at stations K1, K2, and K3, compared to downstream at station K4, is likely related to the greater diversity of in-stream substrates and cover at the upstream sites.

The results of the 2010 macroinvertebrate survey on the Kalamazoo River at Kalamazoo Street (station K1) are presented along with historic survey results from 1999 (Cooper, 2000) and 2004 (Walterhouse, 2005) in Tables 4a and 4 b. The macroinvertebrate community at K1 scored +4 to +6 during the current and previous sampling events and was rated as acceptable or excellent. The 34 taxa collected in September 2010 compares fairly well with 40 taxa collected in August 2004 and the 20 taxa collected in September 1999.

The results of the macroinvertebrate survey on the Kalamazoo River at 11 Mile Road (station K3) are presented along with historic sampling results from 2004 (Walterhouse, 2005) and 2008 (LeSage, 2009) in Tables 5a and 5b. In August 2004, 44 taxa were collected at the site and the macroinvertebrate community scored +6 and was rated as excellent. In late August 2008, the site was surveyed as part of a quality assurance evaluation of Procedure 51 (method and crew variance) by 2 crews who each sampled the site twice on one day (Lesage, 2009). The number of taxa collected during the four sampling efforts ranged from 44 to 56 and the macroinvertebrate community scores ranged from +2 to +4 with ratings of acceptable. The sampling effort in September 2010 produced only 31 taxa, but still resulted in a macroinvertebrate community score of + 3 and an acceptable rating. Many of the taxa, particularly filter feeding organisms, which were present in 2004 and 2008, were not collected in 2010.

The results of the macroinvertebrate survey on the Kalamazoo River at Custer Drive (station K4) are presented along with historic sampling results from 1994 (Kosek, 1994), 2004 (Walterhouse, 2005) and 2009 (Walterhouse, 2011) in Tables 6a and 6b. Ironically, this site was surveyed on September 15, 2009, and again exactly one year later. In 2009, 33 taxa were collected and the macroinvertebrate community scored +6 and was rated as excellent. In 2010,

20 taxa were collected and the macroinvertebrate community scored +2 and was rated as acceptable. Previous surveys in 1994 and 2004 were conducted in part because of the upstream proximity to the Battle Creek Wastewater Treatment Plant (NPDES #MI0022276) discharge. The previous surveys documented macroinvertebrate scores of +4 and +2 with acceptable ratings in 1994 and 2004, respectively.

Talmadge Creek – Stream Habitat

Qualitative stream habitat assessment results for sites on Talmadge Creek are presented in Table 7. The habitat at station T1 was rated as good primarily because of the wide natural wetland riparian corridor adjacent to the stream channel. The substrate was soft muck and flow was limited creating habitat that would be better classified as wetland habitat. Downstream at station T2 stream habitat was rated as excellent. Flow was slightly greater than at station T1. Riffle habitat was lacking and sand was the predominant substrate but some gravel and cobble were present along with an abundance of in-stream cover. The riparian corridor was a wide undisturbed scrub/shrub wetland.

The in-stream habitat, stream banks, and adjacent riparian corridor at station T3 were highly disturbed due to the cleanup activities and were rated as marginal. Riffle habitat was present but in-stream cover was extremely limited. The substrate was primarily sand with lesser amounts of gravel and limited cobble. A different habitat assessment technique was used in 1999; however, the average stream width was 18 feet this year compared to the width of 6 feet that was documented during the survey in 1999 (Cooper, 2000).

Kalamazoo River – Stream Habitat

The qualitative stream habitat evaluations for sites on the Kalamazoo River are presented in Table 8. Riffle habitat was lacking at the upstream control site (station K1) and glide/pool metrics were used to produce an overall stream habitat rating of good. In-stream habitat was abundant and included moderate amounts of large woody debris, aquatic vegetation, and root wads. The stream substrate was diverse with a nearly equal mixture of cobble, gravel, sand, and silt along with scattered boulders. The only significant detraction from the overall habitat score was the limited width of the riparian zone.

The riffle/run habitat on the Kalamazoo River at station K2 was rated as excellent. The dominant substrate was cobble with lesser amounts of gravel, sand, silt, and boulders. Additional forms of in-stream habitat such as undercut banks, large woody debris, aquatic vegetation, overhanging vegetation, and root wads had been reduced by activities associated with the cleanup activities.

The overall stream habitat at station K3 on the Kalamazoo River was rated as excellent using riffle/run metrics. Cobble and gravel were the dominant substrates along with scattered boulders and lesser amounts of sand and silt along the stream margins. Others forms of in-stream cover that were still moderately abundant included large woody debris, aquatic vegetation, and root wads. Cleanup operations had nearly eliminated all overhanging vegetation.

The Kalamazoo River at station K4 is much larger with an average width estimated at 360 feet and an estimated average depth of 2.5 feet. The overall stream habitat was rated as good using glide/pool metrics. The wide wooded floodplain at this site inflates the overall stream habitat score. In-stream habitat that is suitable for macroinvertebrate colonization was limited. Sand was the predominant form of substrate with scattered patches of gravel and occasional cobbles and boulders. Silt was the second most common form of substrate, but it was primarily

limited to the stream margins. Other in-stream cover present in sparse quantities were aquatic vegetation, large woody debris, root wads, and undercut banks.

Macroinvertebrate Abundance

Procedure 51 is a qualitative collection method that involves sampling all available in-stream habitats to produce a composite macroinvertebrate sample that is typically subsampled until 300 organisms have been identified and counted. After 300 organisms have been counted, the remainder of the composite sample is examined for large and/or rare organisms that were not identified in the initial subsamples. These organisms are added as one individual to the total taxa list. Typically, only a small volume of the composite sample is needed to yield the 300 organisms required by Procedure 51. This is especially true in streams such as the Kalamazoo River that have a diversity of in-stream habitat types, especially in riffle habitats that were present at stations K2 and K3. The majority of the sample is typically examined for large and/or rare taxa. Counting the entire composite sample is seldom necessary, except in streams that are either habitat-limited or have serious violations of Michigan's Water Quality Standards. Macroinvertebrate abundance in the composite samples at the upstream control sites on Talmadge Creek (stations T1 and T2) and the Kalamazoo River (station K1) was normal. The abundance of macroinvertebrates in the composite samples collected at all of the impacted sites on Talmadge Creek (station T3) and Kalamazoo River (stations K2, K3, and K4) was so low that the entire composite sample was counted at all of the sites and the goal of enumerating 300 organisms was not achieved at the site on Talmadge Creek and station K4 on the Kalamazoo River.

The sampling effort at the impacted sites on Talmadge Creek and the Kalamazoo River was more intensive than normal. Each macroinvertebrate sample from the different habitat types was inspected before it was added to the composite sample in an effort to identify habitat that was not impacted. It was apparent during the sampling effort that the abundance of macroinvertebrates associated with all of the different habitat types was extremely low and extra effort was expended sampling all forms of habitat at all depths and flow velocities in order to obtain a sample of 300 organisms.

Report by: Mike Waltherhouse, Aquatic Biologist
Surface Water Assessment Section
Water Resources Division

Fieldwork by: Mike Alexander, Aquatic Biologist
Bill Taft, Aquatic Biologist
Mike Waltherhouse, Aquatic Biologist
Surface Water Assessment Section
Water Resources Division

Fieldwork Assistance by:
John Matousek, Entrix
Mike Nadeau, Entrix
Dusty Tazelaar, Entrix

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Table 1A. Qualitative macroinvertebrate sampling results for sites on Talmadge Creek in the vicinity of the Enbridge oil spill, Calhoun County, September, 2010

TAXA	Talmadge Creek	Talmadge Creek	Talmadge Creek
	17 Mile Road 9/16/2010 STATION T1	downstream 17 Mile Road 9/16/2010 STATION T2	15 1/2 Mile Road 9/16/2010 STATION T3
ANNELIDA (segmented worms)			
Hirudinea (leeches)	31	3	
Oligochaeta (worms)	8		8
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	34	107	
Decapoda (crayfish)		2	
Arachnoidea			
Hydracarina	1	1	
Insecta			
Ephemeroptera (mayflies)			
Baetidae		12	21
Caenidae	37	14	
Odonata			
Anisoptera (dragonflies)			
Libellulidae	7		
Zygoptera (damselflies)			
Calopterygidae	1	27	1
Coenagrionidae		1	
Hemiptera (true bugs)			
Belostomatidae	1	1	1
Corixidae		1	
Gerridae		1	
Notonectidae		1	
Megaloptera			
Sialidae (alder flies)		3	
Trichoptera (caddisflies)			
Hydropsychidae		6	
Leptoceridae		1	
Limnephilidae	1	1	
Uenoidae		1	
Coleoptera (beetles)			
Dytiscidae (total)		1	
Haliplidae (adults)		8	
Hydrophilidae (total)		1	
Diptera (flies)			
Chironomidae	79	38	150
Culicidae		1	
Simuliidae		60	15
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)	1	28	1
Physidae	4	1	
Planorbidae	5	6	
Pelecypoda (bivalves)			
Sphaeriidae (clams)	81	22	
TOTAL INDIVIDUALS	291	349	197

Table 1B. Macroinvertebrate metric evaluation of sites on Talmadge Creek in the vicinity of the Enbridge oil spill, Calhoun County, September, 2010.

METRIC	Talmadge Creek		Talmadge Creek		Talmadge Creek	
	17 Mile Road		downstream 17 Mile Road		15 1/2 Mile Road	
	9/16/2010		9/16/2010		9/16/2010	
	STATION T1		STATION T2		STATION T3	
	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	14	1	27	1	7	-1
NUMBER OF MAYFLY TAXA	1	0	2	1	1	-1
NUMBER OF CADDISFLY TAXA	1	0	4	1	0	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	12.71	0	7.45	0	10.66	0
PERCENT CADDISFLY COMP.	0.34	-1	2.58	-1	0.00	-1
PERCENT DOMINANT TAXON	27.84	0	30.66	0	76.14	-1
PERCENT ISOPOD, SNAIL, LEECH	14.09	-1	10.89	-1	0.51	1
PERCENT SURF. AIR BREATHERS	0.34	1	4.30	1	0.51	1
TOTAL SCORE		-1		1		-4
MACROINV. COMMUNITY RATING		ACCEPT.		ACCEPT.		ACCEPT.

Table 2a. Qualitative macroinvertebrate sampling results at sites on Talmadge Creek, Calhoun County, 1999 and 2010.

TAXA	Talmadge Creek 17 Mile Road 7/12/1999 STATION T1		Talmadge Creek 17 Mile Road 9/16/2010 STATION T1		Talmadge Creek 15 1/2 Mile Road 7/12/1999 STATION T3		Talmadge Creek 15 1/2 Mile Road 9/16/2010 STATION T3	
	Value	Score	Value	Score	Value	Score	Value	Score
ANNELIDA (segmented worms)								
Hirudinea (leeches)			31					
Oligochaeta (worms)			8		1		8	
ARTHROPODA								
Crustacea								
Amphipoda (scuds)	30		34		10			
Decapoda (crayfish)	2				3			
Arachnoidea								
Hydracarina	3		1		15			
Insecta								
Ephemeroptera (mayflies)								
Baetidae	2				7		21	
Caenidae	6		37					
Odonata								
Anisoptera (dragonflies)								
Aeshnidae	4				1			
Gomphidae	1							
Libellulidae			7					
Zygoptera (damselflies)								
Calopterygidae	10		1		3		1	
Coenagrionidae	10							
Hemiptera (true bugs)								
Belostomatidae			1				1	
Corixidae	1				5			
Gerridae	1				1			
Veliidae					1			
Megaloptera								
Sialidae (alder flies)					1			
Trichoptera (caddisflies)								
Hydropsychidae					1			
Limnephilidae	1		1					
Coleoptera (beetles)								
Elmidae					2			
Diptera (flies)								
Ceratopogonidae	1							
Chironomidae	25		79		30		150	
Simuliidae					6		15	
Tabanidae					1			
MOLLUSCA								
Gastropoda (snails)								
Ancylidae (limpets)			1		1		1	
Physidae	1		4		2			
Planorbidae	3		5		1			
Pelecypoda (bivalves)								
Sphaeriidae (clams)	5		81					
TOTAL INDIVIDUALS	106		291		92		197	

Table 2b. Macroinvertebrate metric evaluation at sites on Talmadge Creek, Calhoun County, 1999 and 2010.

METRIC	Talmadge Creek 17 Mile Road 7/12/1999 STATION T1		Talmadge Creek 17 Mile Road 9/16/2010 STATION T1		Talmadge Creek 15 1/2 Mile Road 7/12/1999 STATION T3		Talmadge Creek 15 1/2 Mile Road 9/16/2010 STATION T3	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	17	1	14	1	19	0	7	-1
NUMBER OF MAYFLY TAXA	2	1	1	0	1	0	1	-1
NUMBER OF CADDISFLY TAXA	1	0	1	0	1	-1	0	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	7.55	0	12.71	0	7.61	0	10.66	0
PERCENT CADDISFLY COMP.	0.94	-1	0.34	-1	1.09	-1	0.00	-1
PERCENT DOMINANT TAXON	28.30	0	27.84	0	32.61	0	76.14	-1
PERCENT ISOPOD, SNAIL, LEECH	3.77	1	14.09	-1	4.35	0	0.51	1
PERCENT SURF. AIR BREATHERS	1.89	1	0.34	1	7.61	0	0.51	1
TOTAL SCORE	2		-1		-3		-4	
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.	

Table 3A. Qualitative macroinvertebrate sampling results for sites on the Kalamazoo River in the vicinity of the Enbridge oil spill, Calhoun County, September 2010.

TAXA	Kalamazoo River	Kalamazoo River	Kalamazoo River	Kalamazoo River
	Kalamazoo St. 9/9/2010	Squaw Lk Drain confluence 9/15/2010	11-Mile Rd 9/9/2010	Custer Drive 9/15/2010
	STATION K1	STATION K2	STATION K3	STATION K4
PORIFERA (sponges)	1	1		1
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1		3	
Oligochaeta (worms)	1	2	4	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	8	43		13
Decapoda (crayfish)	1	2	1	
Isopoda (sowbugs)	1	2		3
Arachnoidea				
Hydracarina	1		2	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	26	67	54	12
Caenidae	1			1
Ephemerellidae		1		
Heptageniidae	22	22	17	4
Isonychiidae	3	11	3	
Tricorythidae	3	10	3	2
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		2	1	1
Gomphidae		1	2	7
Zygoptera (damselflies)				
Calopterygidae	1	13	3	2
Coenagrionidae	1	2	7	34
Plecoptera (stoneflies)				
Perlidae		1		
Pteronarcyidae	2	1	1	
Hemiptera (true bugs)				
Belostomatidae		4		
Corixidae	1	3		
Gerridae	1			1
Nepidae		1		
Pleidae	1			
Megaloptera				
Corydalidae (dobson flies)			2	
Sialidae (alder flies)		2		
Trichoptera (caddisflies)				
Brachycentridae	5			6
Helicopsychidae		5		
Hydropsychidae	18	10		54
Hydroptilidae		1	1	
Leptoceridae	6	1	2	
Limnephilidae		2		
Philopotamidae	2			
Polycentropodidae	1			
Uenoidae		6	3	
Coleoptera (beetles)				
Dytiscidae (total)			1	
Gyrinidae (adults)	1		1	
Halplidae (adults)			15	
Elmidae	2	5	7	
Psephenidae (larvae)	1		1	
Diptera (flies)				
Ceratopogonidae		1		
Chironomidae	6	20	18	21
Simuliidae	196	27		
Tabanidae	1	1		
Tipulidae		3		
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1	1	1	12
Hydrobiidae		6	3	
Lymnaeidae		17	5	
Physidae	1			2
Planorbidae			1	1
Pleuroceridae	2	1	86	
Pelecypoda (bivalves)				
Corbiculidae	1	9	2	7
Sphaeriidae (clams)	1		49	
Unionidae (mussels)		1	1	
TOTAL INDIVIDUALS	321	308	300	185

Table 3B. Macroinvertebrate metric evaluation of sites on the Kalamazoo River in the vicinity of the Enbridge oil spill, Calhoun County, September 2010.

METRIC	Kalamazoo River		Kalamazoo River		Kalamazoo River		Kalamazoo River	
	Kalamazoo St. 9/9/2010		Squaw Lk Drain confluence 9/15/2010		11-Mile Rd 9/9/2010		Custer Drive 9/15/2010	
	STATION K1	STATION K2	STATION K2	STATION K3	STATION K3	STATION K4	STATION K4	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	34	1	38	1	31	1	20	0
NUMBER OF MAYFLY TAXA	5	1	5	1	4	1	4	1
NUMBER OF CADDISFLY TAXA	5	1	6	1	3	0	2	0
NUMBER OF STONEFLY TAXA	1	1	2	1	1	1	0	-1
PERCENT MAYFLY COMP.	17.13	0	36.04	1	25.67	1	10.27	0
PERCENT CADDISFLY COMP.	9.97	0	8.12	0	2.00	-1	32.43	1
PERCENT DOMINANT TAXON	61.06	-1	21.75	0	28.67	0	29.19	0
PERCENT ISOPOD, SNAIL, LEECH	1.87	1	8.77	0	33.00	-1	9.73	0
PERCENT SURF. AIR BREATHERS	1.25	1	2.60	1	5.67	1	0.54	1
TOTAL SCORE	5		6		3		2	
MACROINV. COMMUNITY RATING	EXCELLENT		EXCELLENT		ACCEPT.		ACCEPT.	

Table 4A. Qualitative macroinvertebrate sampling results at Kalamazoo Street (17 Mile Rd), Kalamazoo River, Calhoun County, 1999, 2004 and 2010.

TAXA	Kalamazoo River	Kalamazoo River	Kalamazoo River
	Kalamazoo St. 9/18/1999 STATION K1	Kalamazoo St. 8/16/2004 STATION K1	Kalamazoo St. 9/9/2010 STATION K1
PORIFERA (sponges)		1	1
ANNELIDA (segmented worms)			
Hirudinea (leeches)			1
Oligochaeta (worms)		1	1
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	30	5	8
Decapoda (crayfish)		1	1
Isopoda (sowbugs)		2	1
Arachnoidea			
Hydracarina	2	1	1
Insecta			
Ephemeroptera (mayflies)			
Baetidae	15	5	26
Caenidae		2	1
Ephemerellidae		2	
Heptageniidae	4	5	22
Isonychiidae		1	3
Tricorythidae			3
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	2	1	
Gomphidae		1	
Zygotera (damselflies)			
Calopterygidae		1	1
Coenagrionidae	2	3	1
Plecoptera (stoneflies)			
Perlidae	6		
Pteronarcyidae		1	2
Hemiptera (true bugs)			
Corixidae		5	1
Gerridae	2	1	1
Mesoveliidae		1	
Nepidae		1	
Pleidae			1
Megaloptera			
Sialidae (alder flies)		1	
Trichoptera (caddisflies)			
Brachycentridae	2	5	5
Glossosomatidae	2		
Helicopsychidae	4		
Hydropsychidae	8	15	18
Lepidostomatidae		1	
Leptoceridae		2	6
Limnephilidae	10	3	
Philopotamidae	4	1	2
Phryganeidae		1	
Polycentropodidae		2	1
Uenoidae		1	
Coleoptera (beetles)			
Gyrinidae (adults)		1	1
Elmidae	3	3	2
Gyrinidae (larvae)		1	
Psephenidae (larvae)			1
Diptera (flies)			
Chironomidae	4	15	6
Simuliidae		5	196
Tabanidae		1	1
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)	1	1	1
Physidae	2		1
Planorbidae		1	
Pleuroceridae			2
Viviparidae		1	
Pelecypoda (bivalves)			
Corbiculidae		1	1
Pisidiidae	2		
Sphaeriidae (clams)	2	1	1
TOTAL INDIVIDUALS	107	104	321

Table 4B. Macroinvertebrate metric evaluation at Kalamazoo Street (17 Mile Rd), Kalamazoo River, Calhoun County, 1999, 2004 and 2010.

METRIC	Kalamazoo River		Kalamazoo River		Kalamazoo River	
	9/18/1999	Score	8/16/2004	Score	9/9/2010	Score
	STATION K1		STATION K1		STATION K1	
TOTAL NUMBER OF TAXA	20	0	40	1	34	1
NUMBER OF MAYFLY TAXA	2	0	5	1	5	1
NUMBER OF CADDISFLY TAXA	6	1	9	1	5	1
NUMBER OF STONEFLY TAXA	1	1	1	1	1	1
PERCENT MAYFLY COMP.	17.76	0	14.42	0	17.13	0
PERCENT CADDISFLY COMP.	28.04	0	29.81	1	9.97	0
PERCENT DOMINANT TAXON	28.04	0	14.42	1	61.06	-1
PERCENT ISOPOD, SNAIL, LEECH	2.80	1	4.81	0	1.87	1
PERCENT SURF. AIR BREATHERS	1.87	1	8.65	0	1.25	1
TOTAL SCORE		4		6		5
MACROINV. COMMUNITY RATING		ACCEPT.		EXCELLENT		EXCELLENT

Table 5a. Qualitative macroinvertebrate sampling results at 11 Mile Road, Calhoun County, 2004, 2008 and 2010.

TAXA	Kalamazoo River	Kalamazoo River				
	11-Mile Rd 8/16/2004 STATION K3	11-Mile Rd 8/27/2008 STATION K3	11-Mile Rd 8/27/2008 STATION K3	11-Mile Rd 8/27/2008 STATION K3	11-Mile Rd 8/27/2008 STATION K3	11-Mile Rd 9/9/2010 STATION K3
PORIFERA (sponges)	1					
PLATYHELMINTHES (flatworms)						
Turbellaria		4				
BRYOZOA (moss animals)	1					
ANNELIDA (segmented worms)						
Hirudinea (leeches)		1	1	1	3	3
Oligochaeta (worms)	1	13	18	20	19	4
ARTHROPODA						
Crustacea						
Amphipoda (scuds)	5	3	8	54	12	
Decapoda (crayfish)	1	1	1	1	1	1
Isopoda (sowbugs)			2	1	2	
Arachnoidea						
Hydracarina	1	4	2			2
Insecta						
Ephemeroptera (mayflies)						
Baetidae	5	42	46	26	48	54
Caenidae	2	2	1	2	5	
Ephemerellidae		1	1			
Ephemeridae				1		
Heptageniidae	5	6	4	3	2	17
Isonychiidae	3	1	1	4	1	3
Tricorythidae	2	8	8	5	4	3
Odonata						
Anisoptera (dragonflies)						
Aeshnidae	1	1	1	1		1
Gomphidae	1	1	1	1	1	2
Libellulidae	1		1			
Macromiidae			1			
Zygoptera (damselflies)						
Calopterygidae	2	2	13	1	11	3
Coenagrionidae	2	4	3	16	2	7
Plecoptera (stoneflies)						
Perlidae	2					
Pteronarcyidae			1			1
Hemiptera (true bugs)						
Belostomatidae		1		1		
Corixidae	5	3	15	8	7	
Gerridae	1	1	1	2	2	
Mesoveliidae	1	1	2	5	1	
Naucoridae				1		
Notonectidae			1			
Pleidae	1		1	2	1	
Megaloptera						
Corydalidae (dobson flies)	1		1		1	2
Sialidae (alder flies)	1	1	1	3		
Neuroptera (spongilla flies)						
Sisyridae	1					
Trichoptera (caddisflies)						
Brachycentridae		2	3	10	1	
Glossosomatidae			1			
Helicopsychidae	1	8	9	8	4	
Hydropsychidae	12	45	48	19	29	
Hydroptilidae		4	17	6	8	1
Lepidostomatidae			1			
Leptoceridae	1	1	3	1	1	2
Limnephilidae	3	1	1			
Phlipopotamidae	1	1				
Phryganeidae	1					
Polycentropodidae	2	2	1	1	1	
Uenoidae	2	2	1	1	1	3
Lepidoptera (moths)						
Pyralidae			1	1	1	
Coleoptera (beetles)						
Gyrinidae (adults)	1	1	1			1
Haliplidae (adults)		1	1	4	1	15
Hydrophilidae (total)	1	1	1			
Elmidae	2	9	6	6	5	7
Gyrinidae (larvae)				1	1	
Psephenidae (larvae)			1	1		1
Scirtidae (larvae)		1				
Diptera (flies)						
Ceratopogonidae	1			2	1	
Chironomidae	12	21	20	51	23	18
Culicidae				4		
Ptychopteridae			1			
Simuliidae	5	22	21	2	9	
Tabanidae		3	1	1	2	
Tipulidae		1	1	1		
MOLLUSCA						
Gastropoda (snails)						
Ancylidae (limpets)	1	1	1		2	1
Hydrobiidae		29	10	73	87	3
Physidae		3	1	4	3	
Planorbidae	1	4	6	7	11	1
Pleuroceridae		100	90	21	17	86
Valvatidae	1					
Viviparidae		1	2	1	2	
Pelecypoda (bivalves)						
Corbiculidae	1	1	1	1	1	2
Sphaeriidae (clams)	1	22	10	20	9	49
Unionidae (mussels)	1	1	1	1	1	1
TOTAL INDIVIDUALS	98	389	398	407	346	300

Table 5b. Macroinvertebrate metric evaluation at 11 Mile Road, Calhoun County, 2004, 2008 and 2010.

METRIC	Kalamazoo River		Kalamazoo River		Kalamazoo River		Kalamazoo River		Kalamazoo River		Kalamazoo River	
	11-Mile Rd 8/16/2004 STATION K3	Value	Score	11-Mile Rd 8/27/2008 STATION K3	Value	Score	11-Mile Rd 8/27/2008 STATION K3	Value	Score	11-Mile Rd 8/27/2008 STATION K3	Value	Score
TOTAL NUMBER OF TAXA	44	1	48	1	56	1	48	1	43	1	30	1
NUMBER OF MAYFLY TAXA	5	1	6	1	6	1	6	1	5	1	4	1
NUMBER OF CADDISFLY TAXA	8	1	9	1	10	1	7	1	7	1	3	0
NUMBER OF STONEFLY TAXA	1	1	0	-1	1	1	0	-1	0	-1	1	1
PERCENT MAYFLY COMP.	17.35	0	15.42	0	15.33	0	10.07	0	17.34	0	25.67	1
PERCENT CADDISFLY COMP.	23.47	0	16.97	0	21.36	0	11.30	0	13.01	0	2.00	-1
PERCENT DOMINANT TAXON	12.24	1	25.71	0	22.61	0	17.94	1	25.14	0	28.67	0
PERCENT ISOPOD, SNAIL, LEECH	3.06	1	35.73	-1	28.39	-1	26.54	-1	36.71	-1	33.00	-1
PERCENT SURF AIR BREATHERS	10.20	0	2.31	1	6.03	1	6.63	1	4.05	1	5.67	1
TOTAL SCORE		6		2		4		3		2		3
MACROINV. COMMUNITY RATING		EXCELLENT		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.

Table 6a. Qualitative macroinvertebrate sampling results at Custer Drive, Calhoun County, 1994, 2004, 2009 and 2010.

TAXA	Kalamazoo River Custer Drive 9/9/1994 STATION K4	Kalamazoo River Custer Drive 8/17/2004 STATION K4	Kalamazoo River Custer Drive 9/15/2009 STATION K4	Kalamazoo River Custer Drive 9/15/2010 STATION K4
PORIFERA (sponges)				1
PLATYHELMINTHES (flatworms)				
Turbellaria	2			
BRYOZOA (moss animals)		1		
ANNELIDA (segmented worms)				
Oligochaeta (worms)				1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	20	20	56	13
Decapoda (crayfish)		1	1	
Isopoda (sowbugs)	1	1	2	3
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae			1	
Baetidae		5	16	12
Caenidae	2			1
Ephemerellidae	25	1		
Heptageniidae	2	5	1	4
Tricorythidae		5	3	2
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1	1	1
Gomphidae			2	7
Libellulidae			3	
Zygoptera (damselflies)				
Calopterygidae	2	2		2
Coenagrionidae	8	1	12	34
Plecoptera (stoneflies)				
Perlidae			1	
Perlodidae	1			
Pteronarcyidae			1	
Hemiptera (true bugs)				
Belostomatidae	2		1	
Corixidae		3		
Gerridae		1	2	1
Mesoveliidae	3	1		
Naucoridae	1			
Pleidae	1	1	1	
Veliidae			2	
Megaloptera				
Corydalidae (dobson flies)			1	
Sialidae (alder flies)	1			
Trichoptera (caddisflies)				
Brachycentridae		5	5	6
Hydropsychidae	4	5	103	54
Leptoceridae			3	
Limnephilidae		2		
Molannidae			2	
Philopotamidae	1		2	
Phryganeidae			1	
Polycentropodidae		1		
Coleoptera (beetles)				
Dytiscidae (total)			1	
Gyrinidae (adults)		1	1	
Elmidae	2	2	16	
Diptera (flies)				
Chironomidae	16	35	54	21
Culicidae		1		
Simuliidae	4	3	2	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1		6	12
Physidae		1	4	2
Planorbidae				1
Pleuroceridae			1	
Viviparidae		1		
Pelecypoda (bivalves)				
Corbiculidae		1		7
Sphaeriidae (clams)	1	1		
Unionidae (mussels)		1	1	
TOTAL INDIVIDUALS	102	109	309	185

Table 6b. Macroinvertebrate metric evaluation at Custer Drive, Calhoun County, 1994, 2004, 2009 and 2010.

METRIC	Kalamazoo River Custer Drive 9/9/1994 STATION K4		Kalamazoo River Custer Drive 8/17/2004 STATION K4		Kalamazoo River Custer Drive 9/15/2009 STATION K4		Kalamazoo River Custer Drive 9/15/2010 STATION K4	
	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	22	0	29	1	33	1	20	0
NUMBER OF MAYFLY TAXA	3	0	4	1	4	1	4	1
NUMBER OF CADDISFLY TAXA	2	0	4	0	6	1	2	0
NUMBER OF STONEFLY TAXA	1	1	0	-1	2	1	0	-1
PERCENT MAYFLY COMP.	28.43	1	14.68	0	6.80	0	10.27	0
PERCENT CADDISFLY COMP.	4.90	0	11.93	0	37.54	1	32.43	1
PERCENT DOMINANT TAXON	24.51	0	32.11	0	33.33	0	29.19	0
PERCENT ISOPOD, SNAIL, LEECH	1.96	1	2.75	1	4.21	0	9.73	0
PERCENT SURF. AIR BREATHERS	6.86	1	7.34	0	2.59	1	0.54	1
TOTAL SCORE	4		2		6		2	
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		EXCELLENT		ACCEPT.	

Table 7. Habitat evaluation for sites on Talmadge Creek in the vicinity of the Enbridge oil spill, Calhoun County, September 2010.

HABITAT METRIC	Station T1	Station T2	Station T3
	Talmadge Creek 17 Mile Road GLIDE/POOL	Talmadge Creek downstream 17 Mile Road GLIDE/POOL	Talmadge Creek 15 1/2 Mile Road RIFFLE/RUN
Substrate and Instream Cover			
Epifaunal Substrate/ Avail Cover (20)	10	13	6
Embeddedness (20)*			13
Velocity/Depth Regime (20)*			8
Pool Substrate Characterization (20)**	11	13	
Pool Variability (20)**	10	10	
Channel Morphology			
Sediment Deposition (20)	8	10	13
Flow Status - Maint. Flow Volume (10)	9	9	3
Flow Status - Flashiness (10)	9	10	0
Channel Alteration (20)	13	16	1
Frequency of Riffles/Bends (20)*			18
Channel Sinuosity (20)**	10	15	
Riparian and Bank Structure			
Bank Stability (L) (10)	9	10	0
Bank Stability (R) (10)	9	10	0
Vegetative Protection (L) (10)	10	10	0
Vegetative Protection (R) (10)	10	10	0
Riparian Veg. Zone Width (L) (10)	10	10	5
Riparian Veg. Zone Width (R) (10)	10	10	1
TOTAL SCORE (200):	138	156	68

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON- IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)
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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).

	9/16/2010	9/16/2010	9/16/2010
Date:	9/16/2010	9/16/2010	9/16/2010
Weather:	Cloudy	Rainy	Cloudy
Air Temperature:	70 Deg. F.	70 Deg. F.	70 Deg. F.
Water Temperature:	62 Deg. F.	62 Deg. F.	58 Deg. F.
Ave. Stream Width:	4 Feet	5 Feet	18 Feet
Ave. Stream Depth:	0.4 Feet	0.3 Feet	0.3 Feet
Surface Velocity:	0.5 Ft./Sec.	0.75 Ft./Sec.	1 Ft./Sec.
Estimated Flow:	0.8 CFS	1.125 CFS	5.4 CFS
Stream Modifications:	Dredged	None	Dredged
Nuisance Plants (Y/N):	N	N	N
STORET No.:	130336	130405	130335
Stream Name:	Talmadge Creek	Talmadge Creek	Talmadge Creek
Road Crossing/Location:	17 Mile Road	downstream 17 Mile Road	15 1/2 Mile Road
County Code:	13	13	13
TRS:	03S06W01	03S06W02	02S06W34
Latitude (dd):	42.2394598	42.2402	42.251717
Longitude (dd):	-84.9632235	-84.97066	-84.9885712
Ecoregion:	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050003	4050003	4050003

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS:

Table 8. Habitat evaluation for sites on the Kalamazoo River in the vicinity of the the Enbridge oil spill, Calhoun County, September 2010.

HABITAT METRIC	Station K1 Kalamazoo River Kalamazoo St. GLIDE/POOL	Station K2 Kalamazoo River Squaw Lk Drain confluence RIFFLE/RUN	Station K3 Kalamazoo River 11-Mile Rd RIFFLE/RUN	Station K4 Kalamazoo River Custer Drive GLIDE/POOL
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	18	16	15	10
Embeddedness (20)*		18	18	
Velocity/Depth Regime (20)*		18	15	
Pool Substrate Characterization (20)**	18			11
Pool Variability (20)**	16			8
Channel Morphology				
Sediment Deposition (20)	13	16	15	6
Flow Status - Maint. Flow Volume (10)	9	9	9	9
Flow Status - Flashiness (10)	7	7	8	8
Channel Alteration (20)	18	18	18	16
Frequency of Riffles/Bends (20)*		15	15	
Channel Sinuosity (20)**	15			13
Riparian and Bank Structure				
Bank Stability (L) (10)	9	7	9	8
Bank Stability (R) (10)	9	9	9	8
Vegetative Protection (L) (10)	4	6	8	9
Vegetative Protection (R) (10)	8	9	10	9
Riparian Veg. Zone Width (L) (10)	3	6	7	9
Riparian Veg. Zone Width (R) (10)	4	9	10	9
TOTAL SCORE (200):	151	163	166	133
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	EXCELLENT (NON- IMPAIRED)	EXCELLENT (NON- IMPAIRED)	GOOD (SLIGHTLY 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:	9/9/2010	9/15/2010	9/9/2010	9/15/2010
Weather:	Sunny	Sunny	Sunny	Sunny
Air Temperature:	71 Deg. F.	55 Deg. F.	72 Deg. F.	64 Deg. F.
Water Temperature:	70 Deg. F.	64 Deg. F.	58 Deg. F.	65 Deg. F.
Ave. Stream Width:	120 Feet	200 Feet	150 Feet	360 Feet
Ave. Stream Depth:	3 Feet	1.5 Feet	1.5 Feet	2.5 Feet
Surface Velocity:	1 Ft./Sec.	1.25 Ft./Sec.	1.25 Ft./Sec.	0.6 Ft./Sec.
Estimated Flow:	360 CFS	375 CFS	281.25 CFS	540 CFS
Stream Modifications:	None	None	None	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	130211	130406	130048	130052
Stream Name:	Kalamazoo River	Kalamazoo River	Kalamazoo River	Kalamazoo River
Road Crossing/Location:	Kalamazoo St.	Squaw Lake Drain confluence	11-Mile Rd	Custer Drive
County Code:	13	13	13	13
TRS:	02S06W26	02S06W33	02S07W25	01S08W29
Latitude (dd):	42.26391	42.25852	42.27429	42.35074
Longitude (dd):	-84.96836	-85.00469	-85.08097	-85.27561
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050003	4050003	4050003	4050003

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

COMMENTS: