Appendix H2: Macroinvertebrate Report 2011

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
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STAFF REPORT

A BIOLOGICAL SURVEY OF SITES ON THE KALAMAZOO RIVER AND TALMADGE CREEK NEAR THE ENBRIDGE OIL SPILL IN MARSHALL CALHOUN COUNTY, MICHIGAN AUGUST 2011

INTRODUCTION

On July 26, 2010, a 30-inch diameter pipeline ruptured and discharged heavy crude oil into 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 oil flowed down 2.2 miles of Talmadge Creek, a small designated warmwater stream, before entering the Kalamazoo River downstream of Marshall, Michigan. The Kalamazoo River is also a designated warmwater stream that is bordered by wetland, forest, residential properties, farm land, and commercial properties for the approximate 35-mile stretch of impacted river in Calhoun and Kalamazoo Counties between Marshall and Morrow Lake.

During September 2010, staff of the Surface Water Assessment Section (SWAS), Water Resources Division, Michigan Department of Environmental Quality (MDEQ), with assistance from Entrix, conducted qualitative macroinvertebrate community and stream habitat surveys on the Kalamazoo River and Talmadge Creek. The survey documented that macroinvertebrate abundance and diversity were drastically reduced in both water bodies because of the oil spill and associated cleanup activities (Walterhouse, 2011b). SWAS and Entrix staff also assisted staff of the Michigan Department of Natural Resources (MDNR), Fisheries Division, with fish collection efforts and quantitative stream habitat assessments. The MDNR, Fisheries Division, reported reduced fish abundance and diversity along with impacts to stream habitat in Talmadge Creek (Wesley, 2011 [draft]). Fish community diversity and catch also declined at two of the three sites on the Kalamazoo River, which were impacted by the oil spill and cleanup activities.

During August 2011, SWAS staff reconducted qualitative macroinvertebrate community and stream habitat surveys on the Kalamazoo River and Talmadge Creek. The objective of these surveys was to monitor the short- and long-term effects of the oil spill and associated cleanup activities on macroinvertebrate communities and aquatic habitat. SWAS staff also assisted the MDNR, Fisheries Division, staff with fish collection efforts and quantitative stream habitat assessments. The MDNR, 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 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 (Wesley and Walterhouse, 2010). 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 habitat had more wetland than stream characteristics. A survey was also conducted at a site on the Kalamazoo River downstream of Talmadge Creek and 15 Mile Road, where historical

survey data were lacking, but the proximity of Talmadge Creek upstream warranted the addition of the site to determine impacts.

The surveys described in this report were conducted according to the SWAS Procedure 51 (MDEQ, 1990). Procedure 51 surveys conducted prior to 2008 and those conducted in 2011 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 that ranged in value from 0 (poor) to 200 (excellent).

Sampling locations are shown in Figure 1.

SUMMARY AND OBSERVATIONS

Qualitative macroinvertebrate scores and ratings alone do not adequately measure the impact of the oil spill and associated cleanup activities.

In summary, macroinvertebrate abundance and diversity improved in Talmadge Creek, compared to 2010, downstream of the oil spill where cleanup operations have altered the instream and riparian habitat. The stream channel is now completely exposed to sunlight, which appears to have increased productivity at least in terms of taxa diversity. However, overall macroinvertebrate abundance in Talmadge Creek was still impacted compared to the sites upstream of the oil spill.

The abundance and diversity of macroinvertebrates at sites impacted by the oil spill on the Kalamazoo River were also improved compared to 2010, but abundance was still impacted compared to historic sampling efforts prior to the oil spill.

Oil sheen and odors were not noted on the segment of Talmadge Creek where sampling was conducted.

Sampling efforts in depositional zones at all of the impacted sites on the Kalamazoo River caused a disturbance that produced surface oil sheen. The sediments at the impacted sites on the Kalamazoo River also had a notable petroleum odor. Petroleum odors were detected in the water only at the site downstream of Battle Creek (station K4).

The shallow riffle habitat at the impacted Kalamazoo River sites (stations K2 and K3), which were obviously disturbed in 2010 by the abnormally heavy boat traffic associated with the cleanup operations, appeared to be recovering. The cobble habitat was beginning to be colonized by periphyton and macroinvertebrates in the riffles.

Limited observations of areas of Talmadge Creek and the Kalamazoo River where stream bank erosion problems developed during cleanup operations appeared to be stabilized with various stream bank stabilization techniques.

The amount of sediment in the depositional areas of the Kalamazoo River, particularly downstream of Battle Creek, appears to have increased in terms of both depth and aerial coverage.

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 2010 and 2011 surveys (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 15 ½ 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 2011 macroinvertebrate community sampling results documented that of the three sites surveyed on Talmadge Creek, station T3 received the highest score and supported a similar number taxa as the upstream control site (station T2). The upstream site (station T2) that was comparable in terms of stream flow received an overall score of +1 compared to the score of +4 at station T3. The number of taxa decreased slightly from 26 at station T2 to 24 at station T3. The higher macroinvertebrate community score at station T3 was a product of more mayflies and caddisflies in terms of both taxa and overall relative abundance. Specific taxa that were present at both stations T1 and T2 that were absent at station T3 included Hirudinea, Amphipoda, Caenidae, Coenagrionidae, and Sphaeriidae.

The results of the 2010 and 2011 macroinvertebrate surveys are presented along with the historic survey results from 1999 (Cooper, 2000) at station T1 in Tables 2a and 2b. The upstream control site at station T1 consisted of taxa predominately associated with wetland habitat during all of the surveys. The diversity and composition of taxa along with the overall scores at this wetland site has remained fairly constant.

The macroinvertebrate community sampling results from 2010 and 2011 at station T2 are presented in Tables 3a and 3b. The overall macroinvertebrate community score was +1 both years. The number of taxa identified was similar both years with the only major differences from 2010 to 2011 being a decline in the abundance of Simuliidae and mayflies, and an increase in the abundance of Amphipoda.

The results of the 1999 (Cooper, 2000), 2010, and 2011 macroinvertebrate surveys are presented in Tables 4a and 4b. At station T3 the overall macroinvertebrate score did not change significantly from 1999 (-3) to 2010 (-4); 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. The sampling in 2011 produced 24 taxa and a macroinvertebrate community score of +4. This is a dramatic change from both the 1999 and 2010 survey results and is likely a recovery phase response to cleanup and restoration efforts on Talmadge Creek. The removal of trees, shrubs, herbaceous plants, and grasses during the response phase of the oil cleanup has allowed more direct sunlight and an associated proliferation of filamentous algal growth on the stream substrate. This station showed large numerical increases in filter feeders (Hydropsychidae and Simulidae), collector gatherers (Baetidae), and filamentous algae piercers (Hydroptilidae). These four families accounted for 80 percent of the total macroinvertebrate assemblage, which is not uncommon in disturbed systems during early succession. Mackay (1992) reports, “In many instances, denuded channel areas are recolonized by successions of different invertebrate assemblages. First to appear are blackflies, chironomids, and baetid mayflies, which often reach high densities

early in the recolonization." This appears to be what has occurred at this site. Additional years of assessment will be needed to fully document short- and long-term impacts associated with the oil spill aftermath. Note that the stream banks and substrate of Talmadge Creek were disturbed once again after the 2011 survey by additional cleanup operations, so this recovery may be set back once again.

Kalamazoo River - Macroinvertebrates

The macroinvertebrate community sampling results for stations on the Kalamazoo River are presented in Table 5a and the macroinvertebrate community metrics, scores, and ratings are presented in Table 5b. 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 +6 and a rating of excellent. The macroinvertebrate community at station K2 scored +6 and was rated as excellent. The site harbored the most taxa of any of the stations surveyed on the Kalamazoo River in 2011. Downstream at station K3, the macroinvertebrate community scored +5 and was rated as excellent. The site supported a diversity of taxa, many of which are considered intolerant of pollution. The macroinvertebrate community further downstream at station K4 scored +1 and was rated as acceptable. The 27 taxa collected at the site were reduced compared to the upstream sites where greater than 35 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 2011 macroinvertebrate survey on the Kalamazoo River at Kalamazoo Street (station K1) are presented along with historic survey results from 1999 (Cooper, 2000), 2004 (Walterhouse, 2005), and 2010 (Walterhouse, 2011b) in Tables 6a and 6b. The macroinvertebrate community at K1 has scored +4 to +6 during the current and previous sampling events and has rated acceptable or excellent. The 35 taxa collected in August 2011 compares well with the 34 taxa collected in 2010 and the 40 taxa collected in 2004.

The results of the 2010 (Walterhouse, 2011b) and 2011 macroinvertebrate surveys on the Kalamazoo River downstream of 15 Mile Road at the Squaw Lake Drain confluence (station K2) are presented in Tables 7a and 7b. The macroinvertebrate community scored +6 and was rated as excellent during both investigations. The taxa that were present along with the overall composition of the community were fairly consistent between years.

Macroinvertebrate survey results from 2011 on the Kalamazoo River at 11 Mile Road (station K3) are presented along with historic sampling results from 2004 (Walterhouse, 2005), 2008 (LeSage, 2009), and 2010 (Walterhouse, 2011b) in Tables 8a and 8b. 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 two 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. In 2011,

the number of macroinvertebrate taxa collected increased to 36 and the community scored +5 and was rated excellent. Several taxa of filter feeding macroinvertebrates that were absent in 2010 were collected once again in 2011.

The results of the macroinvertebrate survey in 2011 on the Kalamazoo River at Custer Drive (station K4) are presented along with historic sampling results from 1994 (Kosek, 1994), 2004 (Walterhouse, 2005), 2009 (Walterhouse, 2011a) and 2010 (Walterhouse, 2011b) in Tables 9a and 9b. Previous surveys in 1994 and 2004 were conducted in part because of the upstream proximity to the Battle Creek Wastewater Treatment Plant (National Pollutant Discharge Elimination System Permit #MI0022276) discharge. The previous surveys documented macroinvertebrate scores of +4 and +2 with acceptable ratings in 1994 and 2004, respectively. 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. The sampling effort in 2011 produced 27 taxa that resulted in a score of +1 and an acceptable rating. The percentage of surface air breathers relative to the overall macroinvertebrate community in 2011 was abnormally high.

Talmadge Creek – Stream Habitat

Qualitative stream habitat assessment results for sites on Talmadge Creek are presented in Table 10. The habitat at station T1 was rated as good primarily because of the wide, natural wetland riparian corridor adjacent to 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 good. 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.

In 2010, 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. In 2011, the overall stream habitat was rated at the lower range of good. The stream banks and riparian zone were stabilized with vegetative cover and various structures. The stream channel was narrower than in 2010 and riffle habitat was present, but in-stream cover was still extremely limited. The substrate was primarily sand and gravel with a limited amount of cobble still present. The disturbance from cleanup activities has effectively created a clean channel that is silt free.

It is important to note that after the August 2011 survey, additional cleanup operations were conducted on Talmadge Creek that involved dredging the stream banks and channel. Restoration activities are expected to be completed prior to sampling again in 2012.

Kalamazoo River – Stream Habitat

The qualitative stream habitat evaluations for sites on the Kalamazoo River are presented in Table 11. 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 at the upper end of good. The dominant substrates were cobble and gravel with lesser amounts of 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 operations. Submergent aquatic vegetation is beginning to become established once again and was present in about 15 percent of the reach.

The overall stream habitat at station K3 on the Kalamazoo River was rated as good 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 have nearly eliminated all overhanging vegetation. It was observed that the size of the depositional areas had increased, compared to 2010, and the depth of the soft sediments in these areas was also much greater.

The Kalamazoo River at station K4 is much larger with an average width estimated at 360 feet and an estimated average depth of 2.9 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 at this site in 2010. Sampling in 2011 found that the predominant form of substrate in this wide, deep segment of the Kalamazoo River is now silt with sand being the second most common form of substrate. Only scattered patches of gravel are present and cobbles and boulders are rare. The amount of large woody debris along the margins of the stream channel has increased due to the severe wind storms, which impacted the Battle Creek area in the spring of 2011. Other in-stream cover present in sparse quantities were aquatic vegetation, 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 sub-sampled 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 sub-samples. 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 like those 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 in 2010 and 2011. 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) in 2010 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. In 2011, the abundance of macroinvertebrates was greater than in 2010 at all of the impacted sites on Talmadge Creek and the Kalamazoo River. It was still necessary to count the entire macroinvertebrate composite sample at the impacted site (station T3) on Talmadge Creek and two (stations K2 and K4) of the three impacted sites on the Kalamazoo River. The abundance of macroinvertebrates at station K4 is still extremely limited.

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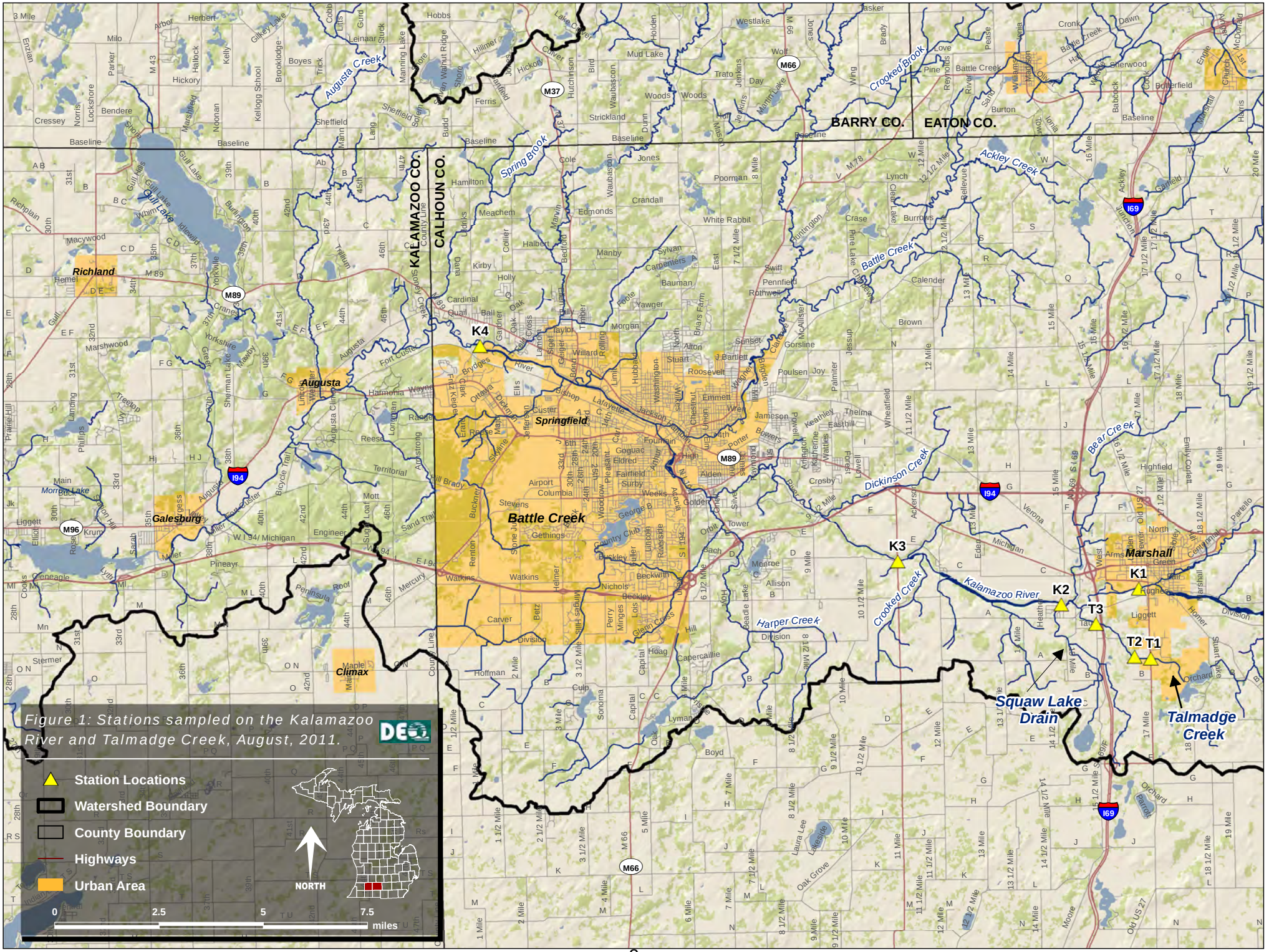

Figure 1: Stations sampled on the Kalamazoo River and Talmadge Creek, August, 2011.

Table 1A. Qualitative macroinvertebrate sampling results for sites on Talmadge Creek in the vicinity of the Enbridge oil spill, Calhoun County, August 2011.

TAXA	Talmadge Creek 17 Mile Road 8/29/2011 STATION T1	Talmadge Creek downstream 17 Mile Road 8/29/2011 STATION T2	Talmadge Creek 15 1/2 Mile Road 8/29/2011 STATION T3
ANNELIDA (segmented worms)			
Hirudinea (leeches)	18	5	
Oligochaeta (worms)	11	1	1
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	3	184	1
Decapoda (crayfish)		2	
Isopoda (sowbugs)	5		
Arachnoidea			
Hydracarina			5
Insecta			
Ephemeroptera (mayflies)			
Baetidae		1	105
Caenidae	65	2	
Heptageniidae			1
Isonychiidae			2
Tricorythidae			8
Odonata			
Anisoptera (dragonflies)			
Aeshnidae		3	1
Libellulidae	2		
Zygoptera (damselflies)			
Calopterygidae		37	15
Coenagrionidae	2	2	
Hemiptera (true bugs)			
Belostomatidae		1	
Gerridae	1	1	1
Notonectidae		5	
Pleidae			1
Veliidae		1	
Megaloptera			
Sialidae (alder flies)		5	
Trichoptera (caddisflies)			
Hydropsychidae		14	48
Hydroptilidae		8	55
Leptoceridae		3	1
Uenoidae			1
Coleoptera (beetles)			
Dytiscidae (total)		1	1
Haliplidae (adults)		2	
Hydrophilidae (total)	1		1
Elmidae		3	
Diptera (flies)			
Chironomidae	7	14	21
Ephydridae			1
Ptychopteridae	1		
Simuliidae		2	57
Tabanidae			1
Tipulidae			1
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)		1	
Physidae	2	2	1
Planorbidae	1	1	1
Pelecypoda (bivalves)			
Sphaeriidae (clams)	171	4	
TOTAL INDIVIDUALS	290	305	331

Table 1B. Macroinvertebrate metric evaluation of sites on Talmadge Creek in the vicinity of the Enbridge oil spill, Calhoun County, August, 2011.

METRIC	Talmadge Creek 17 Mile Road 8/29/2011 STATION T1 Value	Score	Talmadge Creek downstream 17 Mile Road 8/29/2011 STATION T2 Value	Score	Talmadge Creek 15 1/2 Mile Road 8/29/2011 STATION T3 Value	Score
TOTAL NUMBER OF TAXA	14	1	26	1	24	0
NUMBER OF MAYFLY TAXA	1	1	2	1	4	1
NUMBER OF CADDISFLY TAXA	0	-1	3	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	22.41	1	0.98	-1	35.05	1
PERCENT CADDISFLY COMP.	0.00	-1	8.20	0	31.72	1
PERCENT DOMINANT TAXON	58.97	-1	60.33	-1	31.72	0
PERCENT ISOPOD, SNAIL, LEECH	8.97	0	2.95	1	0.60	1
PERCENT SURF. AIR BREATHERS	1.03	1	3.61	1	1.21	1
TOTAL SCORE	0		1		4	
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		ACCEPT.	

Table 2A. Qualitative macroinvertebrate sampling results at 17 Mile Road, Talmadge Creek, Calhoun County.

TAXA	Talmadge Creek 17 Mile Road 7/12/1999 STATION T1	Talmadge Creek 17 Mile Road 9/16/2010 STATION T1	Talmadge Creek 17 Mile Road 8/29/2011 STATION T1
ANNELIDA (segmented worms)			
Hirudinea (leeches)		31	18
Oligochaeta (worms)		8	11
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	30	34	3
Decapoda (crayfish)	2		
Isopoda (sowbugs)			5
Arachnoidea			
Hydracarina	3	1	
Insecta			
Ephemeroptera (mayflies)			
Baetidae	2		
Caenidae	6	37	65
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	4		
Gomphidae	1		
Libellulidae		7	2
Zygoptera (damselflies)			
Calopterygidae	10	1	
Coenagrionidae	10		2
Hemiptera (true bugs)			
Belostomatidae		1	
Corixidae	1		
Gerridae	1		1
Trichoptera (caddisflies)			
Limnephilidae	1	1	
Coleoptera (beetles)			
Hydrophilidae (total)			1
Diptera (flies)			
Ceratopogonidae	1		
Chironomidae	25	79	7
Ptychopteridae			1
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)		1	
Physidae	1	4	2
Planorbidae	3	5	1
Pelecypoda (bivalves)			
Sphaeriidae (clams)	5	81	171
TOTAL INDIVIDUALS	106	291	290

Table 2B. Macroinvertebrate metric evaluation at 17 Mile Road, Talmadge Creek, Calhoun County

METRIC	Talmadge Creek 17 Mile Road 7/12/1999 STATION T1 Value	Score	Talmadge Creek 17 Mile Road 9/16/2010 STATION T1 Value	Score	Talmadge Creek 17 Mile Road 8/29/2011 STATION T1 Value	Score
TOTAL NUMBER OF TAXA	17	1	14	1	14	1
NUMBER OF MAYFLY TAXA	2	1	1	0	1	1
NUMBER OF CADDISFLY TAXA	1	0	1	0	0	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	7.55	0	12.71	0	22.41	1
PERCENT CADDISFLY COMP.	0.94	-1	0.34	-1	0.00	-1
PERCENT DOMINANT TAXON	28.30	0	27.84	0	58.97	-1
PERCENT ISOPOD, SNAIL, LEECH	3.77	1	14.09	-1	8.97	0
PERCENT SURF. AIR BREATHERS	1.89	1	0.34	1	1.03	1
TOTAL SCORE	2		-1		0	
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		ACCEPT.	

Table 3A. Qualitative macroinvertebrate sampling results downstream of 17 Mile Road, Talmadge Creek, Calhoun County.

TAXA	Talmadge Creek downstream 17 Mile Road 9/16/2010 STATION T2	Talmadge Creek downstream 17 Mile Road 8/29/2011 STATION T2
ANNELIDA (segmented worms)		
Hirudinea (leeches)	3	5
Oligochaeta (worms)		1
ARTHROPODA		
Crustacea		
Amphipoda (scuds)	107	184
Decapoda (crayfish)	2	2
Arachnoidea		
Hydracarina	1	
Insecta		
Ephemeroptera (mayflies)		
Baetidae	12	1
Caenidae	14	2
Odonata		
Anisoptera (dragonflies)		
Aeshnidae		3
Zygoptera (damselflies)		
Calopterygidae	27	37
Coenagrionidae	1	2
Hemiptera (true bugs)		
Belostomatidae	1	1
Corixidae	1	
Gerridae	1	1
Notonectidae	1	5
Veliidae		1
Megaloptera		
Sialidae (alder flies)	3	5
Trichoptera (caddisflies)		
Hydropsychidae	6	14
Hydroptilidae		8
Leptoceridae	1	3
Limnephilidae	1	
Uenoidae	1	
Coleoptera (beetles)		
Dytiscidae (total)	1	1
Haliplidae (adults)	8	2
Hydrophilidae (total)	1	
Elmidae		3
Diptera (flies)		
Chironomidae	38	14
Culicidae	1	
Simuliidae	60	2
MOLLUSCA		
Gastropoda (snails)		
Ancylidae (limpets)	28	1
Physidae	1	2
Planorbidae	6	1
Pelecypoda (bivalves)		
Sphaeriidae (clams)	22	4
TOTAL INDIVIDUALS	349	305

Table 3B. Macroinvertebrate metric evaluation downstream of 17 Mile Road, Talmadge Creek, Calhoun County.

METRIC	Talmadge Creek downstream 17 Mile Road 9/16/2010 STATION T2 Value	Score	Talmadge Creek downstream 17 Mile Road 8/29/2011 STATION T2 Value	Score
TOTAL NUMBER OF TAXA	27	1	26	1
NUMBER OF MAYFLY TAXA	2	1	2	1
NUMBER OF CADDISFLY TAXA	4	1	3	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1
PERCENT MAYFLY COMP.	7.45	0	0.98	-1
PERCENT CADDISFLY COMP.	2.58	-1	8.20	0
PERCENT DOMINANT TAXON	30.66	0	60.33	-1
PERCENT ISOPOD, SNAIL, LEECH	10.89	-1	2.95	1
PERCENT SURF. AIR BREATHERS	4.30	1	3.61	1
TOTAL SCORE	1		1	
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.	

Table 4A. Qualitative macroinvertebrate sampling results at 15 1/2 Mile Road, Talmadge Creek, Calhoun County.

TAXA	Talmadge Creek 15 1/2 Mile Road 7/12/1999 STATION T3	Talmadge Creek 15 1/2 Mile Road 9/16/2010 STATION T3	Talmadge Creek 15 1/2 Mile Road 8/29/2011 STATION T3
ANNELIDA (segmented worms)			
Oligochaeta (worms)	1	8	1
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	10		1
Decapoda (crayfish)	3		
Arachnoidea			
Hydracarina	15		5
Insecta			
Ephemeroptera (mayflies)			
Baetidae	7	21	105
Heptageniidae			1
Isonychiidae			2
Tricorythidae			8
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	1		1
Zygoptera (damselflies)			
Calopterygidae	3	1	15
Hemiptera (true bugs)			
Belostomatidae		1	
Corixidae	5		
Gerridae	1		1
Pleidae			1
Veliidae	1		
Megaloptera			
Sialidae (alder flies)	1		
Trichoptera (caddisflies)			
Hydropsychidae	1		48
Hydroptilidae			55
Leptoceridae			1
Uenoidae			1
Coleoptera (beetles)			
Dytiscidae (total)			1
Hydrophilidae (total)			1
Elmidae	2		
Diptera (flies)			
Chironomidae	30	150	21
Ephydridae			1
Simuliidae	6	15	57
Tabanidae	1		1
Tipulidae			1
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)	1	1	
Physidae	2		1
Planorbidae	1		1
TOTAL INDIVIDUALS	92	197	331

Table 4B. Macroinvertebrate metric evaluation at 15 1/2 Mile Road, Talmadge Creek, Calhoun County.

METRIC	Talmadge Creek 15 1/2 Mile Road 7/12/1999 STATION T3 Value	Score	Talmadge Creek 15 1/2 Mile Road 9/16/2010 STATION T3 Value	Score	Talmadge Creek 15 1/2 Mile Road 8/29/2011 STATION T3 Value	Score
TOTAL NUMBER OF TAXA	19	0	7	-1	24	0
NUMBER OF MAYFLY TAXA	1	0	1	-1	4	1
NUMBER OF CADDISFLY TAXA	1	-1	0	-1	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMP.	7.61	0	10.66	0	35.05	1
PERCENT CADDISFLY COMP.	1.09	-1	0.00	-1	31.72	1
PERCENT DOMINANT TAXON	32.61	0	76.14	-1	31.72	0
PERCENT ISOPOD, SNAIL, LEECH	4.35	0	0.51	1	0.60	1
PERCENT SURF. AIR BREATHERS	7.61	0	0.51	1	1.21	1
TOTAL SCORE	-3		-4		4	
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		ACCEPT.	

Table 5A. Qualitative macroinvertebrate sampling results for sites on the Kalamazoo River in the vicinity of the Enbridge oil spill, Calhoun County, August 2011.

TAXA	Kalamazoo River Kalamazoo St. 8/31/2011 STATION K1	Kalamazoo River Squaw Lake Drain confluence 8/31/2011 STATION K2	Kalamazoo River 11-Mile Road 8/31/2011 STATION K3	Kalamazoo River Custer Drive 8/29/2011 STATION K4
PLATYHELMINTHES (flatworms)				
Turbellaria			2	
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	
Oligochaeta (worms)	1	1	19	2
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	27	11	15	29
Decapoda (crayfish)		1	1	
Isopoda (sowbugs)	3	1		1
Arachnoidea				
Hydracarina	1	5		1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	35	69	71	13
Caenidae		2		1
Ephemerellidae		3	1	
Heptageniidae	21	23	7	5
Isonychiidae	10	21	1	
Potamanthidae				2
Tricorythidae	10	18	9	8
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1		1	
Gomphidae	3		2	3
Zygoptera (damselflies)				
Calopterygidae	2	5	1	
Coenagrionidae	24	1	11	24
Plecoptera (stoneflies)				
Perlidae	1	2	1	
Pteronarcyidae	1		1	
Hemiptera (true bugs)				
Corixidae	2			
Gerridae	7	8	1	14
Pleidae	1	2		1
Veliidae		1		
Megaloptera				
Corydalidae (dobson flies)			1	
Trichoptera (caddisflies)				
Brachycentridae	20	5	2	1
Helicopsychidae	1	5		
Hydropsychidae	56	22	35	11
Hydroptilidae	1	3	1	5
Leptoceridae	5	9	5	1
Limnephilidae			1	
Philopotamidae	5	5		
Polycentropodidae	1	1	1	
Uenoidae		2	4	
Coleoptera (beetles)				
Dytiscidae (total)		1		
Gyrinidae (adults)	38			63
Haliplidae (adults)		1		
Hydrophilidae (total)		1		1
Elmidae	8	11	32	72
Psephenidae (larvae)		2		
Diptera (flies)				
Athericidae		1		
Chironomidae	9	19	9	4
Culicidae		1		
Simuliidae	30	30	3	1
Tabanidae	2	1	1	
Tipulidae		1		1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1			1
Hydrobiidae			6	
Physidae	1	4	4	1
Planorbidae	2	2	5	
Pleuroceridae	7	9	27	
Pelecypoda (bivalves)				
Corbiculidae	1	2	1	
Pisidiidae				1
Sphaeriidae (clams)	4	1	54	1
Unionidae (mussels)		1	1	
TOTAL INDIVIDUALS	342	314	338	268

Table 5B. Macroinvertebrate metric evaluation of sites on the Kalamazoo River in the vicinity of the Enbridge oil spill, Calhoun County, August, 2011.

METRIC	Kalamazoo River Kalamazoo St. 8/31/2011 STATION K1 Value	Score	Kalamazoo River Squaw Lake Drain confluence 8/31/2011 STATION K2 Value	Score	Kalamazoo River 11-Mile Road 8/31/2011 STATION K3 Value	Score	Kalamazoo River Custer Drive 8/29/2011 STATION K4 Value	Score
TOTAL NUMBER OF TAXA	35	1	42	1	36	1	27	1
NUMBER OF MAYFLY TAXA	4	1	6	1	5	1	5	1
NUMBER OF CADDISFLY TAXA	7	1	8	1	7	1	4	0
NUMBER OF STONEFLY TAXA	2	1	1	1	2	1	0	-1
PERCENT MAYFLY COMP.	22.22	1	43.31	1	26.33	1	10.82	0
PERCENT CADDISFLY COMP.	26.02	0	16.56	0	14.50	0	6.72	0
PERCENT DOMINANT TAXON	16.37	1	21.97	0	21.01	0	26.87	0
PERCENT ISOPOD, SNAIL, LEECH	4.09	0	5.10	0	12.72	-1	1.12	1
PERCENT SURF. AIR BREATHERS	14.04	0	4.78	1	0.30	1	29.48	-1
TOTAL SCORE	6		6		5		1	
MACROINV. COMMUNITY RATING	EXCELLENT		EXCELLENT		EXCELLENT		ACCEPT.	

Table 6A. Qualitative macroinvertebrate sampling results at Kalamazoo Street, Kalamazoo River, Calhoun County.

TAXA	Kalamazoo River Kalamazoo St. 9/18/1999 STATION K1	Kalamazoo River Kalamazoo St. 8/16/2004 STATION K1	Kalamazoo River Kalamazoo St. 9/9/2010 STATION K1	Kalamazoo River Kalamazoo St. 8/31/2011 STATION K1
PORIFERA (sponges)		1	1	
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	
Oligochaeta (worms)		1	1	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	30	5	8	27
Decapoda (crayfish)		1	1	
Isopoda (sowbugs)		2	1	3
Arachnoidea				
Hydracarina	2	1	1	1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	15	5	26	35
Caenidae		2	1	
Ephemerellidae		2		
Heptageniidae	4	5	22	21
Isonychiidae		1	3	10
Tricorythidae			3	10
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	2	1		1
Gomphidae		1		3
Zygoptera (damselflies)				
Calopterygidae		1	1	2
Coenagrionidae	2	3	1	24
Plecoptera (stoneflies)				
Perlidae	6			1
Pteronarcyidae		1	2	1
Hemiptera (true bugs)				
Corixidae		5	1	2
Gerridae	2	1	1	7
Mesoveliidae		1		
Nepidae		1		
Pleidae			1	1
Megaloptera				
Sialidae (alder flies)		1		
Trichoptera (caddisflies)				
Brachycentridae	2	5	5	20
Glossosomatidae	2			
Helicopsychidae	4			1
Hydropsychidae	8	15	18	56
Hydroptilidae				1
Lepidostomatidae		1		
Leptoceridae		2	6	5
Limnephilidae	10	3		
Philopotamidae	4	1	2	5
Phryganeidae		1		
Polycentropodidae		2	1	1
Uenoidae		1		
Coleoptera (beetles)				
Gyrinidae (adults)		1	1	38
Elmidae	3	3	2	8
Gyrinidae (larvae)		1		
Psephenidae (larvae)			1	
Diptera (flies)				
Chironomidae	4	15	6	9
Simuliidae		5	196	30
Tabanidae		1	1	2
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	1	1	1	1
Physidae	2		1	1
Planorbidae		1		2
Pleuroceridae			2	7
Viviparidae		1		
Pelecypoda (bivalves)				
Corbiculidae		1	1	1
Pisidiidae	2			
Sphaeriidae (clams)	2	1	1	4
TOTAL INDIVIDUALS	107	104	321	342

Table 6B. Macroinvertebrate metric evaluation at Kalamazoo Street, Kalamazoo River, Calhoun County.

METRIC	Kalamazoo River Kalamazoo St. 9/18/1999 STATION K1 Value	Score	Kalamazoo River Kalamazoo St. 8/16/2004 STATION K1 Value	Score	Kalamazoo River Kalamazoo St. 9/9/2010 STATION K1 Value	Score	Kalamazoo River Kalamazoo St. 8/31/2011 STATION K1 Value	Score
TOTAL NUMBER OF TAXA	20	0	40	1	34	1	35	1
NUMBER OF MAYFLY TAXA	2	0	5	1	5	1	4	1
NUMBER OF CADDISFLY TAXA	6	1	9	1	5	1	7	1
NUMBER OF STONEFLY TAXA	1	1	1	1	1	1	2	1
PERCENT MAYFLY COMP.	17.76	0	14.42	0	17.13	0	22.22	1
PERCENT CADDISFLY COMP.	28.04	0	29.81	1	9.97	0	26.02	0
PERCENT DOMINANT TAXON	28.04	0	14.42	1	61.06	-1	16.37	1
PERCENT ISOPOD, SNAIL, LEECH	2.80	1	4.81	0	1.87	1	4.09	0
PERCENT SURF. AIR BREATHERS	1.87	1	8.65	0	1.25	1	14.04	0
TOTAL SCORE	4		6		5		6	
MACROINV. COMMUNITY RATING	ACCEPT.		EXCELLENT		EXCELLENT		EXCELLENT	

Table 7A. Qualitative macroinvertebrate sampling results downstream of 15 Mile Raod, Kalamazoo River, Calhoun County.

TAXA	Kalamazoo River Squaw Lake Drain confluence 9/15/2010 STATION K2	Kalamazoo River Squaw Lake Drain confluence 8/31/2011 STATION K2
PORIFERA (sponges)	1	
ANNELIDA (segmented worms)		
Oligochaeta (worms)	2	1
ARTHROPODA		
Crustacea		
Amphipoda (scuds)	43	11
Decapoda (crayfish)	2	1
Isopoda (sowbugs)	2	1
Arachnoidea		
Hydracarina		5
Insecta		
Ephemeroptera (mayflies)		
Baetidae	67	69
Caenidae		2
Ephemerellidae	1	3
Heptageniidae	22	23
Isonychiidae	11	21
Tricorythidae	10	18
Odonata		
Anisoptera (dragonflies)		
Aeshnidae	2	
Gomphidae	1	
Zygoptera (damselflies)		
Calopterygidae	13	5
Coenagrionidae	2	1
Plecoptera (stoneflies)		
Perlidae	1	2
Pteronarcyidae	1	
Hemiptera (true bugs)		
Belostomatidae	4	
Corixidae	3	
Gerridae		8
Nepidae	1	
Pleidae		2
Veliidae		1
Megaloptera		
Sialidae (alder flies)	2	
Trichoptera (caddisflies)		
Brachycentridae		5
Helicopsychidae	5	5
Hydropsychidae	10	22
Hydroptilidae	1	3
Leptoceridae	1	9
Limnephilidae	2	
Philopotamidae		5
Polycentropodidae		1
Uenoidae	6	2
Coleoptera (beetles)		
Dytiscidae (total)		1
Haliplidae (adults)		1
Hydrophilidae (total)		1
Elmidae	5	11
Psephenidae (larvae)		2
Diptera (flies)		
Athericidae		1
Ceratopogonidae	1	
Chironomidae	20	19
Culicidae		1
Simuliidae	27	30
Tabanidae	1	1
Tipulidae	3	1
MOLLUSCA		
Gastropoda (snails)		
Ancylidae (limpets)	1	
Hydrobiidae	6	
Lymnaeidae	17	
Physidae		4
Planorbidae		2
Pleuroceridae	1	9
Pelecypoda (bivalves)		
Corbiculidae	9	2
Sphaeriidae (clams)		1
Unionidae (mussels)	1	1
TOTAL INDIVIDUALS	308	314

Table 7B. Macroinvertebrate metric evaluation downstream of 15 Mile Road, Kalamazoo River, Calhoun County.

METRIC	Kalamazoo River Squaw Lake Drain confluence 9/15/2010 STATION K2 Value	Score	Kalamazoo River Squaw Lake Drain confluence 8/31/2011 STATION K2 Value	Score
TOTAL NUMBER OF TAXA	38	1	42	1
NUMBER OF MAYFLY TAXA	5	1	6	1
NUMBER OF CADDISFLY TAXA	6	1	8	1
NUMBER OF STONEFLY TAXA	2	1	1	1
PERCENT MAYFLY COMP.	36.04	1	43.31	1
PERCENT CADDISFLY COMP.	8.12	0	16.56	0
PERCENT DOMINANT TAXON	21.75	0	21.97	0
PERCENT ISOPOD, SNAIL, LEECH	8.77	0	5.10	0
PERCENT SURF. AIR BREATHERS	2.60	1	4.78	1
TOTAL SCORE	6		6	
MACROINV. COMMUNITY RATING	EXCELLENT		EXCELLENT	

Table 8a. Qualitative macroinvertebrate sampling results at 11 Mile Road, Kalamazoo River, Calhoun County.

TAXA	Kalamazoo River 11-Mile Rd 8/16/2004 STATION K3	Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3	Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3	Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3	Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3	Kalamazoo River 11-Mile Rd 9/9/2010 STATION K3	Kalamazoo River 11-Mile Road 8/31/2011 STATION K3
PORIFERA (sponges)	1						
PLATYHELMINTHES (flatworms)							
Turbellaria		4					2
BRYOZOA (moss animals)	1						
ANNELIDA (segmented worms)							
Hirudinea (leeches)		1	1	1	3	3	1
Oligochaeta (worms)	1	13	18	20	19	4	19
ARTHROPODA							
Crustacea							
Amphipoda (scuds)	5	3	8	54	12		15
Decapoda (crayfish)	1	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	71
Caenidae	2	2	1	2	5		
Ephemerellidae		1	1				1
Ephemeridae				1			
Heptageniidae	5	6	4	3	2	17	7
Isonychiidae	3	1	1	4	1	3	1
Tricorythidae	2	8	8	5	4	3	9
Odonata							
Anisoptera (dragonflies)							
Aeshnidae	1	1	1	1		1	1
Gomphidae	1	1	1	1	1	2	2
Libellulidae	1		1				
Macromiidae			1				
Zygoptera (damselflies)							
Calopterygidae	2	2	13	1	11	3	1
Coenagrionidae	2	4	3	16	2	7	11
Plecoptera (stoneflies)							
Perlidae	2						1
Pteronarcyidae			1			1	1
Hemiptera (true bugs)							
Belostomatidae		1		1			
Corixidae	5	3	15	8	7		
Gerridae	1	1	1	2	2		1
Mesoveliidae	1	1	2	5	1		
Naucoridae				1			
Notonectidae			1				
Pleidae	1		1	2	1		
Saldidae					1		
Veliidae					1		
Megaloptera							
Corydalidae (dobson flies)	1		1		1	2	1
Sialidae (alder flies)	1	1	1	3			
Neuroptera (spongilla flies)							
Sisyridae	1						
Trichoptera (caddisflies)							
Brachycentridae		2	3	10	1		2
Glossosomatidae			1				
Helicopsychidae	1	8	9	8	4		
Hydropsychidae	12	45	48	19	29		35
Hydroptilidae		4	17	6	8	1	1
Lepidostomatidae			1				
Leptoceridae	1	1	3	1	1	2	5
Limnephilidae	3	1	1				1
Philopotamidae	1	1					
Phryganeidae	1						

Table 8a. Qualitative macroinvertebrate sampling results at 11 Mile Road, Kalamazoo River, Calhoun County.

TAXA	Kalamazoo River 11-Mile Rd 8/16/2004 STATION K3	Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3	Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3	Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3	Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3	Kalamazoo River 11-Mile Rd 9/9/2010 STATION K3	Kalamazoo River 11-Mile Road 8/31/2011 STATION K3
Polycentropodidae	2	2	1	1	1		1
Uenoidae	2	2	1	1	1	3	4
Lepidoptera (moths)							
Pyralidae			1	1	1		
Coleoptera (beetles)							
Dytiscidae						1	
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	32
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	9
Culicidae				4			
Ptychopteridae			1				
Simuliidae	5	22	21	2	9		3
Tabanidae		3	1	1	2		1
Tipulidae		1	1	1			
MOLLUSCA							
Gastropoda (snails)							
Ancylidae (limpets)	1	1	1		2	1	
Hydrobiidae		29	10	73	87	3	6
Lymnaeidae						5	
Physidae		3	1	4	3		4
Planorbidae	1	4	6	7	11	1	5
Pleuroceridae		100	90	21	17	86	27
Valvatidae	1						
Viviparidae		1	2	1	2		
Pelecypoda (bivalves)							
Corbiculidae	1	1	1	1	1	2	1
Sphaeriidae (clams)	1	22	10	20	9	49	54
Unionidae (mussels)	1	1	1	1	1	1	1
TOTAL INDIVIDUALS	98	389	398	407	346	300	338

Table 8b. Macroinvertebrate metric evaluation at 11 Mile Road, Kalamazoo River, Calhoun County.

METRIC	Kalamazoo River 11-Mile Rd 8/16/2004 STATION K3		Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3		Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3		Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3		Kalamazoo River 11-Mile Rd 8/27/2008 STATION K3		Kalamazoo River 11-Mile Rd 9/9/2010 STATION K3		Kalamazoo River 11-Mile Road 8/31/2011 STATION K3	
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	44	1	48	1	56	1	48	1	44	1	31	1	36	1
NUMBER OF MAYFLY TAXA	5	1	6	1	6	1	6	1	5	1	4	1	5	1
NUMBER OF CADDISFLY TAXA	8	1	9	1	10	1	7	1	7	1	3	0	7	1
NUMBER OF STONEFLY TAXA	1	1	0	-1	1	1	0	-1	0	-1	1	1	2	1
PERCENT MAYFLY COMP.	17.35	0	15.42	0	15.33	0	10.07	0	17.34	0	25.67	1	26.33	1
PERCENT CADDISFLY COMP.	23.47	0	16.97	0	21.36	0	11.30	0	13.01	0	2.00	-1	14.50	0
PERCENT DOMINANT TAXON	12.24	1	25.71	0	22.61	0	17.94	1	25.14	0	28.67	0	21.01	0
PERCENT ISOPOD, SNAIL, LEECH	3.06	1	35.73	-1	28.39	-1	26.54	-1	36.71	-1	33.00	-1	12.72	-1
PERCENT SURF. AIR BREATHERS	10.20	0	2.31	1	6.03	1	6.63	1	4.05	1	5.67	1	0.30	1
TOTAL SCORE	6		2		4		3		2		3		5	
MACROINV. COMMUNITY RATING	EXCELLENT		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.		ACCEPT.		EXCELLENT	

Table 9a. Qualitative macroinvertebrate sampling results at Custer Drive, Kalamazoo River, Calhoun County.

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	Kalamazoo River Custer Drive 8/29/2011 STATION K4
PORIFERA (sponges)				1	
PLATYHELMINTHES (flatworms)					
Turbellaria	2				
BRYOZOA (moss animals)		1			
ANNELIDA (segmented worms)					
Oligochaeta (worms)				1	2
ARTHROPODA					
Crustacea					
Amphipoda (scuds)	20	20	56	13	29
Decapoda (crayfish)		1	1		
Isopoda (sowbugs)	1	1	2	3	1
Arachnoidea					
Hydracarina					1
Insecta					
Ephemeroptera (mayflies)					
Baetiscidae			1		
Baetidae		5	16	12	13
Caenidae	2			1	1
Ephemerellidae	25	1			
Heptageniidae	2	5	1	4	5
Potamanthidae					2
Tricorythidae		5	3	2	8
Odonata					
Anisoptera (dragonflies)					
Aeshnidae	2	1	1	1	
Gomphidae			2	7	3
Libellulidae			3		
Zygoptera (damselflies)					
Calopterygidae	2	2		2	
Coenagrionidae	8	1	12	34	24
Plecoptera (stoneflies)					
Perlidae			1		
Perlodidae	1				
Pteronarcyidae			1		
Hemiptera (true bugs)					
Belostomatidae	2		1		
Corixidae		3			
Gerridae		1	2	1	14
Mesoveliidae	3	1			
Naucoridae	1				
Pleidae	1	1	1		1
Veliidae			2		
Megaloptera					
Corydalidae (dobson flies)			1		
Sialidae (alder flies)	1				
Trichoptera (caddisflies)					
Brachycentridae		5	5	6	1
Hydropsychidae	4	5	103	54	11
Hydroptilidae					5
Leptoceridae			3		1
Limnephilidae		2			
Molannidae			2		
Philopotamidae	1		2		
Phryganeidae			1		
Polycentropodidae		1			
Coleoptera (beetles)					
Dytiscidae (total)			1		
Gyrinidae (adults)		1	1		63
Hydrophilidae (total)					1
Elmidae	2	2	16		72
Diptera (flies)					
Chironomidae	16	35	54	21	4
Culicidae		1			
Simuliidae	4	3	2		1
Tipulidae					1
MOLLUSCA					
Gastropoda (snails)					
Ancylidae (limpets)	1		6	12	1
Physidae		1	4	2	1
Planorbidae				1	
Pleuroceridae			1		
Viviparidae		1			
Pelecypoda (bivalves)					
Corbiculidae		1		7	
Pisidiidae					1
Sphaeriidae (clams)	1	1			1
Unionidae (mussels)		1	1		
TOTAL INDIVIDUALS	102	109	309	185	268

Table 9b. Macroinvertebrate metric evaluation at Custer Drive, Kalamazoo River, Calhoun County.

METRIC	Kalamazoo River Custer Drive 9/9/1994 STATION K4 Value	Score	Kalamazoo River Custer Drive 8/17/2004 STATION K4 Value	Score	Kalamazoo River Custer Drive 9/15/2009 STATION K4 Value	Score	Kalamazoo River Custer Drive 9/15/2010 STATION K4 Value	Score	Kalamazoo River Custer Drive 8/29/2011 STATION K4 Value	Score
TOTAL NUMBER OF TAXA	22	0	29	1	33	1	20	0	27	1
NUMBER OF MAYFLY TAXA	3	0	4	1	4	1	4	1	5	1
NUMBER OF CADDISFLY TAXA	2	0	4	0	6	1	2	0	4	0
NUMBER OF STONEFLY TAXA	1	1	0	-1	2	1	0	-1	0	-1
PERCENT MAYFLY COMP.	28.43	1	14.68	0	6.80	0	10.27	0	10.82	0
PERCENT CADDISFLY COMP.	4.90	0	11.93	0	37.54	1	32.43	1	6.72	0
PERCENT DOMINANT TAXON	24.51	0	32.11	0	33.33	0	29.19	0	26.87	0
PERCENT ISOPOD, SNAIL, LEECH	1.96	1	2.75	1	4.21	0	9.73	0	1.12	1
PERCENT SURF. AIR BREATHERS	6.86	1	7.34	0	2.59	1	0.54	1	29.48	-1
TOTAL SCORE	4		2		6		2		1	
MACROINV. COMMUNITY RATING	ACCEPT.		ACCEPT.		EXCELLENT		ACCEPT.		ACCEPT.	

Table 10. Habitat evaluation for sites in the vicinity of the Enbridge oil spill, Talmadge Creek, Calhoun County, August 2011.

HABITAT METRIC	Station T1 Talmadge Creek 17 Mile Road GLIDE/POOL	Station T2 Talmadge Creek downstream 17 Mile Road GLIDE/POOL	Station T3 Talmadge Creek 15 1/2 Mile Road RIFFLE/RUN
Substrate and Instream Cover			
Epifaunal Substrate/ Avail Cover (20)	3	11	8
Embeddedness (20)*			8
Velocity/Depth Regime (20)*			10
Pool Substrate Characterization (20)**	6	13	
Pool Variability (20)**	6	8	
Channel Morphology			
Sediment Deposition (20)	6	8	15
Flow Status - Maint. Flow Volume (10)	9	9	9
Flow Status - Flashiness (10)	9	9	8
Channel Alteration (20)	11	15	10
Frequency of Riffles/Bends (20)*			13
Channel Sinuosity (20)**	6	11	
Riparian and Bank Structure			
Bank Stability (L) (10)	9	9	9
Bank Stability (R) (10)	9	9	9
Vegetative Protection (L) (10)	9	10	3
Vegetative Protection (R) (10)	9	10	3
Riparian Veg. Zone Width (L) (10)	9	10	7
Riparian Veg. Zone Width (R) (10)	9	10	7
TOTAL SCORE (200):	110	142	119
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)

Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Ratin describes the general riverine environment at the site(s).
* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

Date:	8/29/2011	8/29/2011	8/29/2011
Weather:	Sunny	Sunny	Partly Cloudy
Air Temperature:	60 Deg. F.	72 Deg. F.	80 Deg. F.
Water Temperature:	60 Deg. F.	68 Deg. F.	75 Deg. F.
Ave. Stream Width:	3 Feet	6 Feet	12 Feet
Ave. Stream Depth:	0.3 Feet	0.3 Feet	0.2 Feet
Surface Velocity:	0.5 Ft./Sec.	0.5 Ft./Sec.	0.9 Ft./Sec.
Estimated Flow:	0.45 CFS	0.9 CFS	2.16 CFS
Stream Modifications:	Dredged	None	Bank Stabilization
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
COMMENTS:	Wetland habitat		The riparian zone and the stream channel have been subjected to major alterations during clean up operations

Table 11. Habitat evaluation for sites in the vicinity of the Enbridge oil spill, Kalamazoo River, Calhoun County, August 2011.

HABITAT METRIC	Station K1 Kalamazoo River Kalamazoo St. GLIDE/POOL	Station K2 Kalamazoo River Squaw Lake Drain confluence GLIDE/POOL	Station K3 Kalamazoo River 11-Mile Road RIFFLE/RUN	Station K4 Kalamazoo River Custer Drive GLIDE/POOL
Substrate and Instream Cover				
Epifaunal Substrate/ Avail Cover (20)	16	13	13	6
Embeddedness (20)*			16	
Velocity/Depth Regime (20)*			16	
Pool Substrate Characterization (20)**	16	16		10
Pool Variability (20)**	16	11		8
Channel Morphology				
Sediment Deposition (20)	14	16	10	11
Flow Status - Maint. Flow Volume (10)	9	9	9	8
Flow Status - Flashiness (10)	7	8	6	4
Channel Alteration (20)	16	18	18	13
Frequency of Riffles/Bends (20)*			11	
Channel Sinuosity (20)**	15	11		6
Riparian and Bank Structure				
Bank Stability (L) (10)	8	9	8	7
Bank Stability (R) (10)	8	9	8	7
Vegetative Protection (L) (10)	7	9	5	9
Vegetative Protection (R) (10)	7	6	9	9
Riparian Veg. Zone Width (L) (10)	3	10	5	9
Riparian Veg. Zone Width (R) (10)	4	3	9	9
TOTAL SCORE (200):	146	148	143	116
HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY 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).
* Applies only to Riffle/Run stream Surveys
** Applies only to Glide/Pool stream Surveys

Date:	8/31/2011	8/31/2011	8/31/2011	8/29/2011
Weather:	Cloudy	Partly Cloudy	Partly Cloudy	Sunny
Air Temperature:	72 Deg. F.	76 Deg. F.	83 Deg. F.	82 Deg. F.
Water Temperature:	70 Deg. F.	69 Deg. F.	72 Deg. F.	72 Deg. F.
Ave. Stream Width:	120 Feet	200 Feet	150 Feet	360 Feet
Ave. Stream Depth:	3 Feet	1.5 Feet	1.5 Feet	2.9 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	626.4 CFS
Stream Modifications:	None	None	None	Dredged
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 Road	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
COMMENTS:		Impacted by oil spill clean up operations	Impacted by oil spill clean up operations	Impacted by oil spill clean up operations