

**MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
AUGUST 2018
STAFF REPORT**

Biological and water chemistry surveys of selected stations in the Maple River watershed in Clinton, Gratiot, Ionia, and Montcalm Counties, June-September 2017.

Introduction

Biological and physical habitat conditions of selected water bodies in the Maple River watershed, in Clinton, Gratiot, Ionia, and Montcalm Counties were assessed by staff of the Michigan Department of Environmental Quality (MDEQ), Water Resources Division, Surface Water Assessment Section (SWAS), in June-September 2017. Water bodies included Baker, Fish, Hayworth, Muskrat, and Pine Creeks, North Shade Drain, Little Maple River, and the main branch of the Maple River. The primary objectives of the assessments were to:

- 1) Assess the current status and condition of individual water bodies and determine if Michigan Water Quality Standards (WQS) are being met.
- 2) Satisfy monitoring requests submitted by internal and external customers.
- 3) Identify nonpoint sources (NPS) of water quality impairment.
- 4) Evaluate biological integrity temporal trends.

Watershed Information

The Maple River is a warmwater designated stream (Michigan Department of Natural Resources [MDNR], 1997) that originates in the central portion of Shiawassee County. The river then flows in a general northwesterly direction to the village of Bannister where it changes direction and flows in a southwesterly direction until it converges with the Grand River in Muir (Figure 1). Fish Creek and all tributaries to Fish Creek are the only water bodies designated as coldwater streams.

The Maple River watershed encompasses approximately 970 square miles of predominantly agricultural land (Hanshue, 2002). The majority of the watershed is contained within the Southern Michigan Northern Indiana Till Plains (SMNITP) ecoregion, while the northeast corner of the watershed is located within the Huron Erie Lake Plains ecoregion (Omernik and Gallant, 2010). The Maple River watershed lies within the Lansing subsection (VI.4.1) of the regional Landscape Ecosystem Classification of Michigan. This subsection consists of a broad till plain that has rich, loamy soils. The subsection has a low undulating topography of ground moraine, which has alternating well- and moderately well-drained rises and poorly- to very poorly-drained depressions resulting in wetlands (Albert, 1995). Many wetlands were largely converted to agriculture using field tiles as artificial drainage and drainage ditches. Most of the uplands have been converted to crop land, while most of the swamp forest has been converted to pasture.

Presettlement vegetation on uplands was largely beech-maple forests, with pockets of oak-hickory, which have been converted to crop production. Lowlands were formerly wet prairies or red maple swamps. Swamp forest and wet meadow persist locally on the landscape. One of the rarest plant communities in the state, an inland salt marsh, remains along a saline seepage near the Maple River (Albert, 1995).

Land use, the amount of impervious surfaces, and the loss of wetlands since presettlement times, in the Maple River watershed is presented in Table 2 using a subwatershed scale (12-digit hydrologic unit code [HUC]). Agriculture is the dominant land use, consisting of row crops (e.g., corn and beans) and hay or pasture lands. The developed portion includes urban areas that consist of small villages and cities throughout the watershed. The natural area percentage includes forests, wetlands, grassland, and shrub areas (United States Department of Agriculture [USDA]/Natural Resources Conservation Service [NRCS], 2001).

The amount of impervious area in the Maple River watershed is between 1 and 5% (Table 1; National Oceanic and Atmospheric Administration [NOAA], 2011). Impervious surfaces are those areas on the land that cannot effectively absorb water and pass it through to the groundwater table. Examples include: decks, patios, paved and gravel roads, crushed stone driveways, parking areas, and sidewalks. Impervious area is closely linked to areas of development. The higher amount of impervious cover is related to a higher amount of storm water runoff, impacting in-stream biological communities due to pollutants in the runoff and its contribution to flashy flows that scour the stream bottom. The subwatershed with the highest amount of impervious surface is the Spaulding Drain watershed, which includes the southern portion of the city of St. Johns.

The statewide average amount of total wetlands lost since presettlement times is 40% (Fizzell, 2014). In the Maple River subwatersheds, an average of 37% of the wetlands has been lost since presettlement. The highest percentage of wetlands lost at the 12-digit HUC watershed level is 84% in the Spaulding Drain watershed (Table 1). Wetlands retain water during precipitation events reducing runoff and preventing flooding and extreme fluctuations in stream flow, all of which are important to both people and in-stream biological communities. In areas where a large amount of wetland has been lost, there is more stress on in-stream biological communities.

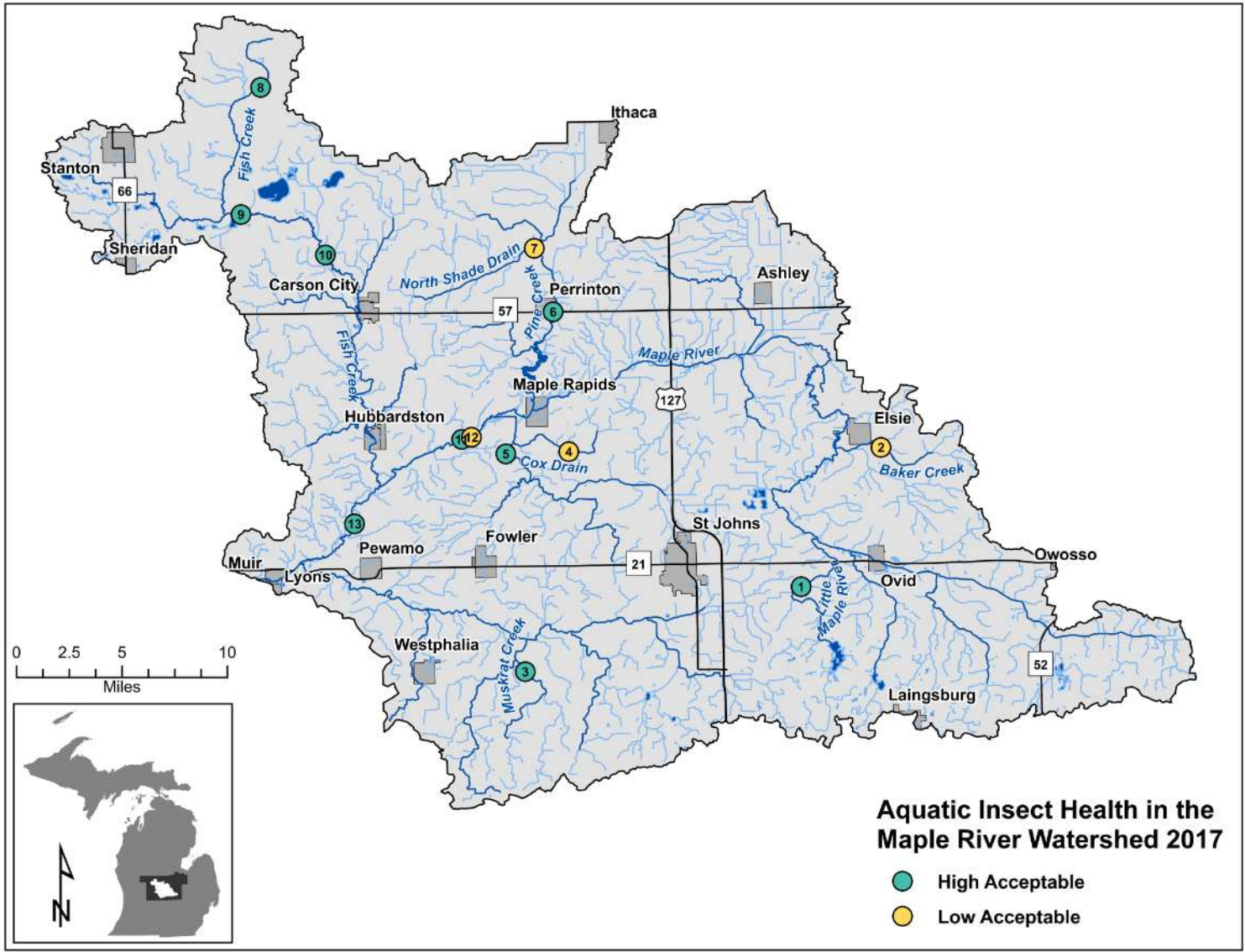


Figure 1. Maple River watershed. Dots represent 2017 aquatic macroinvertebrate community survey stations ratings. Numbers correlate to station numbers in Table 3.

Table 1. Detailed land use of the Maple River watershed, broken down by watershed groups. The dark to light blue color variation is to help quickly interpret the table. The lighter the blue the more beneficial it is for aquatic ecosystems.

12-Digit HUC	12-Digit HUC Watershed Name	Natural	Developed	Cultivated Agriculture	Hay or Pasture	Other Landuses	Lost Wetlands since Human Settlement	Impervious Surface
040500050101	Spring Brook-Maple River	23%	6%	49%	21%	1%	25%	1%
040500050102	Coon Creek-Bear Creek	22%	5%	52%	21%	0%	29%	1%
040500050103	Alder Creek	23%	7%	48%	20%	2%	22%	1%
040500050104	Little Maple River	26%	5%	47%	19%	2%	32%	1%
040500050105	Town of Ovid-Maple River	13%	9%	55%	22%	1%	62%	2%
040500050201	Baker Creek	10%	5%	66%	18%	0%	67%	1%
040500050202	Stevens Drain-Maple River	13%	6%	66%	13%	2%	63%	1%
040500050203	Nile Drain-Bear Creek	19%	6%	67%	7%	0%	50%	1%
040500050204	Ferdon Creek-Maple River	15%	7%	66%	12%	0%	61%	1%
040500050205	River Styx-Pine Creek	15%	6%	68%	11%	0%	64%	1%
040500050206	North Shade Drain	6%	5%	75%	14%	0%	64%	1%
040500050207	Pine Creek	11%	8%	70%	9%	2%	3%	2%
040500050208	Collier Creek-Maple River	26%	6%	55%	12%	2%	12%	1%
040500050301	West Branch Fish Creek	48%	10%	24%	14%	3%	3%	2%
040500050302	Upper Fish Creek	42%	5%	36%	17%	0%	11%	1%
040500050303	Country Ditch # One Hundred Thirty-One	27%	6%	48%	18%	1%	35%	1%
040500050304	Butternut Creek	16%	6%	65%	12%	0%	23%	1%
040500050305	Middle Fish Creek	28%	9%	42%	14%	7%	11%	2%
040500050306	Lower Fish Creek	18%	6%	60%	15%	0%	10%	1%
040500050401	Spaulding Drain	7%	15%	67%	10%	0%	84%	5%
040500050402	Bad Creek	12%	5%	75%	8%	0%	42%	1%
040500050403	Holden Drain-Stony Creek	17%	6%	62%	14%	0%	49%	1%
040500050404	Muskrat Creek	14%	5%	66%	15%	0%	61%	1%
040500050405	Kloeckner and Fuller Creek-Stony Creek	7%	6%	73%	14%	0%	59%	1%
040500050406	Ruel Drain-Stony Creek	12%	6%	66%	16%	0%	10%	1%
040500050501	South Fork Hayworth Creek	6%	4%	71%	18%	0%	65%	1%
040500050502	Doty Brook-Hayworth Creek	10%	12%	65%	13%	1%	74%	4%
040500050503	Hayworth Creek	12%	6%	59%	24%	0%	11%	1%
040500050504	Reynolds and Sessions Drain-Maple River	33%	5%	46%	16%	1%	6%	1%
040500050505	Bower Drain-Maple River	5%	48%	15%	32%	0%	4%	1%

Historical Sampling Efforts and Information

Historic reports from the past 2 decades are presented and summarized in Table 2. The most recent surveys of the Maple River watershed were conducted in 2012 (Holden, 2013). Aquatic macroinvertebrate community and habitat assessments were conducted at 16 stations.

Macroinvertebrate community ratings were all acceptable with the exception of Fish Creek downstream of Washington Street in the town of Hubbardston and Stoney Creek at the end of Stoney Creek Road, which scored excellent; and Pine Creek at Hayes Road, which scored poor due to cattle access to the stream and likely habitat destruction and sedimentation.

Table 2. Surveys conducted in the Maple River watershed 1997-2016.

Survey Year	Report Citation and Number	Finding/Comments
1997	Hanshue, S. 2002 MI/DEQ/SWQ-02/003	<ul style="list-style-type: none"> • Fish community samples collected at 11 stations, ratings ranged from poor to acceptable. Poor fish community rating found in Alder Creek. • Macroinvertebrate community assessed at 22 stations, ratings ranged from poor to excellent. Poor communities found in the Maple River at Morrice Road, South Fork of Hayworth Creek. • Habitat ratings ranged from fair to excellent. Primary causes of habitat impairment are associated with drainage maintenance projects and dense growths of cladophora indicating nutrient enrichment. • Water chemistry collected from 28 locations. Concentrations of nutrients were higher than average for the ecoregion.
2002	Rockafellow, D. 2003 MI/DEQ/WD-03/017	<ul style="list-style-type: none"> • Macroinvertebrate community and habitat conditions assessed at 14 stations. Communities were rated acceptable or excellent at all but Peet Creek at Wacousta Road. Habitat was rated good or excellent at all but the Maple River at Shepardsville Road. • Fish community and habitat conditions assessed at 4 stations. The fish community was acceptable at all stations but Butternut Creek at Miner Road. Butternut Creek is a coldwater designated tributary to Fish Creek. It scored poor due to no salmonids being found. It is a highly maintained drain. • Water samples collected at 26 stations including 2 illegal dairy discharges and Crystal Lake. Concentrations of nutrients were higher (at some stations) than average for the ecoregion.
2007	Holden, S. 2008 MI/DEQ/WB-08/087	<ul style="list-style-type: none"> • Macroinvertebrate community and habitat conditions assessed at 41 stations. Communities were rated acceptable, with the exception of poor ratings found at M-52 and the River Styx. Habitat was generally rated as marginal or good. • Fish community assessed at 7 stations and was rated acceptable to excellent. • Water samples collected at 18 stations. Michigan WQS were being met at all stations. Nutrient concentrations were very high and nuisance levels of filamentous algae in St. Johns Big Ditch, downstream of water treatment plant were observed.
2010	Clinton County Conservation District (CCCD, 2013) MI/DEQ/CMIGRT-10/500	<ul style="list-style-type: none"> • Mid-Michigan Streambank Erosion Study.
2012	Holden, S. 2013 MI/DEQ/WRD-13/022	<ul style="list-style-type: none"> • Lake Ovid water chemistry samples; hypereutrophic. • Macroinvertebrate community and habitat conditions assessed at 16 stations. Most communities were rated acceptable or excellent with the exception of Pine Creek upstream of the confluence with North Shade Drain. Habitat rated marginal or good. • Dissolved Oxygen Monitoring in Hayworth Creek, WQS not met. • <i>E. coli</i> monitoring at 6 stations, WQS not met.

Methods

The macroinvertebrate community and physical habitat was qualitatively assessed at 16 stations using the SWAS Procedure 51 (Creal et al., 1996; MDEQ, 1990) for wadeable streams (Table 3). If a station is at a road crossing, it is sampled upstream unless otherwise noted. The macroinvertebrate and fish communities were assessed and scored with metrics that rate water bodies from excellent (+5 to +9 [macroinvertebrates], +5 to +10 [fish]) to poor (-5 to -9 [macroinvertebrates], -5 to -10 [fish]). Scores from +4 to -4 are rated acceptable. Negative scores in the acceptable range are considered tending towards a poor rating, while positive scores in the acceptable range are tending towards an excellent rating. Habitat evaluations are based on 10 metrics, with a maximum total score of 200. A station habitat score of >154 is characterized as having excellent habitat, 105-154 is good, 56-104 is marginal, and <56 is poor. Where available, macroinvertebrate community scores are used to determine attainment of the Other Indigenous Aquatic Life and Wildlife (OIALW) designated use and fish community scores are used to assess attainment of the relevant fish designated use. Habitat scores and individual metrics are used to help better understand the biological community scores.

Site Selection

Two site-selection methods are used in watershed surveys: (1) stratified random; and (2) targeted. Stratified random sites support the Status and Trend Program, which is designed to statistically assess the biological conditions of macroinvertebrate communities in Michigan's rivers and streams and determine whether changes are occurring over time (MDEQ, 2015). Targeted sites are chosen through the "Targeted Monitoring Request" process, which involves stakeholders from across Michigan submitting monitoring requests. All survey types are considered when determining support of the OIALW designated use component of Rule 100 ([R 323.1100\(e\)](#)) of the Part 4 Rules, WQS, promulgated under Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

2017 Sampling Results

Table 3. Summary of the aquatic habitat and macroinvertebrate community evaluations for selected stations in the Maple River watershed, June-September 2017.

Station #	Stream Name	Road Crossing	STORET #	Township	County	Latitude	Longitude	Habitat Evaluation Rating and Score		Macroinvertebrate Community Rating and Score		S/T/Tr	AUID#
								Rating	Score	Rating	Score		
1	Little Maple River	Saint Clair Road	190205	Ovid	Clinton	42.98445	-84.44491	Marginal	71	Acceptable	3	S	040500050104-01
2	Baker Creek	Meridian Road	190117	Duplain	Clinton	43.07902	-84.36763	Marginal	92	Acceptable	-3	S	040500050201-01
3	Muskrat Creek	Price Road	190101	Riley	Clinton	42.92938	-84.70436	Good	114	Acceptable	3	S	040500050404-01
4	Cox Drain	Essex Center Road	190206	Essex	Clinton	43.07995	-84.66039	Marginal	104	Acceptable	-4	S	040500050503-03
5	Hayworth Creek	Bauer Road	190118	Lebanon	Clinton	43.07917	-84.71944	Good	114	Acceptable	1	T	040500050503-01
6	Pine Creek	Cleveland Road (M-57)	290209	Fulton	Clinton	43.17614	-84.67303	Good	140	Acceptable	0	T & S	040500050207-01
7	North Shade Drain	Ennis Road	290211	Newark	Gratiot	43.21992	-84.68969	Marginal	84	Acceptable	-3	T	040500050206-01
8	Fish Creek	Pine Grove Road	590323	Ferris	Montcalm	43.33310	-84.94480	Marginal	99	Acceptable	1	Tr	040500050302-01
9	Fish Creek	Vickeryville Road	590271	Day	Montcalm	43.24599	-84.96481	Good	137	Acceptable	3	S	040500050305-03
10	Fish Creek	Bollinger Road	590365	Crystal	Montcalm	43.21749	-84.88592	Good	144	Acceptable	2	S	040500050305-03
11	Maple River	Tallman Road	190164	Lebanon	Clinton	43.08952	-84.76057	Good	122	Acceptable	0	Tr	040500050504-01
12	Maple River	Tallman Road (downstream)	190204	Lebanon	Clinton	43.08950	-84.75960	Excellent	156	Acceptable	-1	T	040500050504-01
13	Maple River	Nickel Plate Road	340228	North Plains	Ionia	43.03266	-84.86210	Good	144	Acceptable	2	S	040500050505-01

S/T/Tr = status, targeted, trend station NA = Not Applicable

Habitat Scoring

Poor <56 Marginal 56-104 Good 105-154 Excellent >154

Macroinvertebrate Scoring

Poor < -4 Acceptable -4 to +4 Excellent > +4

Summary of Findings by Monitoring Objective

Objective 1: Assess the current status and condition of individual waters of the state and determine whether Michigan WQS are being met.

In 2017, 13 sites within the Maple River watershed were sampled to assess the designated use support status of their associated individual assessment units (Figure 1; Table 3). Aquatic macroinvertebrate community and habitat assessments were conducted and it was determined that the OIALW designated use was being met at all stations.

LITTLE MAPLE RIVER

The Little Maple River was sampled at Saint Clair Road (Station 1). The glide/pool habitat was rated at the lower end of marginal (71; slightly impaired, Table 4). The river at this station is a maintained drain with steep banks and it runs right along the road. As a result, there is very little riparian area between the river and the road and the river and cultivated fields (Figure 2). The substrate at this station consisted primarily of sand and small gravel with no overhanging vegetation or large woody debris (LWD). The water was very clear until the fine layer of silt covering the substrate was kicked up. The macroinvertebrate community scored at the higher end of acceptable (3; Tables 5 and 6) due to a large number of caddisfly and mayfly taxa, which are more sensitive to pollution and a high number of total taxa found (30). It is likely the biological community would score excellent if there was cleaner substrate, pool variability, and LWD available for colonization.



Figure 2. Little Maple River upstream of St. Clair Road, Clinton County, Michigan, July 2017.

BAKER CREEK

Baker Creek was sampled at Meridian Road (Station 2). It is a small tributary that has been historically maintained as a drain. The bridge at this crossing was creosote timber with an open bottom. The glide/run habitat was rated marginal (92; Table 4). Grass was the dominant riparian vegetation (Figure 3). There was a large amount of Elodea and overhanging grass limiting flow and habitat diversity (Figure 4). Vegetation was the only colonizable substrate. Banks had sloughed in the past and the substrate consisted of a mix of silt, sand, and clay. The macroinvertebrate community scored at the lower end of acceptable (-3; Tables 5 and 6). Only 1 mayfly taxa and 2 caddisfly taxa were found and more than 60% of the individuals found were *Physidae* snails, which are very tolerant of environmental stressors.



Figure 3. Baker Creek upstream of Meridian Road, Clinton County, Michigan, July 2017.



Figure 4. Thick *Elodea sp.* in Baker Creek upstream of Meridian Road, Clinton County, Michigan, July 2017.

MUSKRAT CREEK

Muskrat Creek was sampled at Price Road (Station 3). It is a moderately sized stream that has been maintained as a drain. The riffle/run habitat at this station is somewhat unique for the Maple River watershed and habitat was rated at the low end of good (114; Table 4). There was a large amount of cobble available as epifaunal substrate; however, it was heavily embedded with cladophora (Figures 5-7). Muskrat Creek is part of the watershed that is listed as impaired due to excessive nutrients, which likely explains the nuisance-level cladophora conditions observed throughout this stream reach that had very little riparian vegetation available for shade. The macroinvertebrate community scored at the higher end of acceptable (3; Tables 5 and 6). This is attributed to a large number of taxa (34) found including several caddisfly and mayfly.



Figure 5. Cladophora in Muskrat Creek upstream of Price Road, looking upstream.



Figure 6. Close-up of nuisance conditions observed in Muskrat Creek.



Figure 7. Muskrat Creek upstream of Price Road. Note the straight channel indicative of a maintained drain.

COX DRAIN

Cox Drain was sampled at Essex Center Road (Station 4). It is a small, historically maintained drain with sloughing banks and a large amount of sediment deposition allowing for islands of emergent grass. The deposition was so prevalent that the stream was a series of very shallow constricted areas and shallow pools. It also appeared to be somewhat flashy, with debris piled up on the banks. The glide/pool habitat was rated at the high end of marginal (104; Table 4). There was a substantial amount of LWD in the channel but very little other epifaunal substrate. About 50% of the habitat in the reach consisted of floating and attached algae (Figures 8-11). The macroinvertebrate community scored at the low end of acceptable (-4; Tables 5 and 6), which is just 1 point away from scoring poor. Isopods and chironomids dominated the taxa found and both are tolerant to environmental stress.



Figures 8-11. Cox Drain upstream of Essex Center Road, Clinton County, Michigan, June 2017.

HAYWORTH CREEK

Hayworth Creek was sampled at Bauer Road (Station 5). It is a fairly large drain that has had some in-stream habitat improvement work, including the periodic placement of several j-hooks. These habitat improvements are increasing flow in the thalweg of the channel and exposing clean gravels. The drain has been historically maintained and is deeply incised (>50 feet; Figure 12). Although there are areas of clean gravel, there is a fine layer of silt covering most of the substrate and the backwater areas near the j-hooks are very black due to the silt deposition. Upstream of the j-hooks, floating algae collects. The riffle/run habitat was rated at the lower end of good (114; Table 7). No LWD was available for colonization and there were few larger trees in the riparian area that would provide for future woody structure. The macroinvertebrate community scored acceptable (1; Tables 8 and 9). Thirty-eight taxa were found at this station. However, there were no stoneflies found, and the percentage of isopods and snails found was high enough to deduct points for these metrics indicating that there may be some type of environmental stressor impacting the biological community.



Figure 12. Hayworth Creek upstream of Bauer Road looking downstream, Clinton County, Michigan, September 2017.

PINE CREEK

Pine Creek was sampled at Cleveland Road (M-57; Station 6). It is a relatively large stream that was in a relatively natural state when compared to other stations sampled in 2017. The riparian area was wide with many large trees and dead ash. There was a lot of LWD in the channel as well as cobble and gravel for colonization (Figures 13 and 14); however, the substrate had a fine layer of silt and attached algae on it, which may prevent the most sensitive species from colonizing it. The stream appeared flashy due to the substantial number of very large LWD jams and debris located as high as 5 feet above the surface of the water, which was less than 1-foot deep on average. The riffle/run habitat was rated as good (140; Table 7). The macroinvertebrate community scored at acceptable (0; Tables 8 and 9). Although there was a large diversity of macroinvertebrates found, many of them were from taxa orders that are more tolerant of pollution. No stonefly taxa were found and of the 36 taxa found, 8 were from the most sensitive groups.



Figure 13. Pine Creek upstream of M-57, Clinton County, Michigan, September 2017.



Figure 14. Woody structure in Pine Creek upstream of M-57.

NORTH SHADE DRAIN

North Shade Drain was sampled at Ennis Road (Station 7). It is a small stream that has current and historic direct livestock access, although current access is limited to horses (Figure 15). More details regarding this can be found in the nonpoint source targeted monitoring section below. The glide/pool habitat was rated as marginal (84; Table 7). The pool substrate was gravel and cobble, but was covered with silt, and the pools were almost nonexistent. There was very little LWD and the riparian zone was very narrow with steep eroding banks on the right side. The macroinvertebrate community scored at the low end of acceptable with flatworms comprising nearly 50% of the total individuals collected (-3; Tables 8 and 9). Less than 1% of the individuals were mayflies or caddisflies indicating an environmental stressor is impacting the macroinvertebrate community.



Figure 15. North Shade Drain upstream of Ennis Road, Gratiot County, Michigan, September 2017.

FISH CREEK

Fish Creek is a coldwater tributary located in the lower portion of the Maple River watershed and was sampled at 3 locations. The upstream station (Station 8) was sampled at Pine Grove Road. The glide/pool habitat was rated as marginal (99; Table 10). Firm sand was the prevalent substrate with a large amount of siltation and sediment deposition, especially along the edges. There was only 1 pool, very little LWD, and the only colonizable substrate was aquatic vegetation (Figure 16). The water level seemed a bit low. The macroinvertebrate community scored acceptable (1; Tables 11 and 12) with midges dominating (47%) the macroinvertebrate community. Caddisflies and mayflies were not abundant and no stonefly taxa were found, all indicating some amount of environmental stress. The water temperature was the coldest measured in the Maple River watershed at 59 degrees Fahrenheit.



Figure 16. Fish Creek upstream of Pine Grove Road, Clinton County, Michigan, July 2017.

The second station to be sampled in Fish Creek was 1 mile downstream at Vickeryville Road (Station 9). The glide/pool habitat was rated good (137; Table 10). Although sand was the prevalent substrate there was less sediment deposition, more LWD, and a little bit of gravel (Figure 17). Banks were fairly stable except for 1 area that had a lot of erosion; however, tree roots were stabilizing the bank. The macroinvertebrate community scored acceptable (3; Tables 11 and 12) with 9 species of pollution-sensitive mayflies, caddisflies, and stoneflies found and no one taxa dominating the community. Local fishermen have been reported to catch brown trout at this station also indicating a healthy stream. There is an additional tributary that joins Fish Creek approximately a half mile upstream of this station that provides additional flow.



Figure 17. Fish Creek upstream of Vickeryville Road, Clinton County, Michigan, July 2017.

The third and most downstream station (Station 10) in Fish Creek was sampled at Bollinger Road. The glide/pool habitat was rated good (144; Table 10). There was a mix of cobble, gravel, sand, and silt. Clay was also exposed at 1 undercut bank. There was only 1 pool and a very LWD jam, indicating the stream may be flashy at times. Dead ash trees were also present in the riparian zone, which may be contributing to woody debris jams, and also impacted the amount of shade provided by taller trees (Figure 18). The macroinvertebrate community scored acceptable (2; **Error! Reference source not found.** with 10 species of pollution sensitive mayflies, caddisflies, and stoneflies found and 33 total taxa, indicating a large amount of diversity. There was a large number of water boatman (family: Corixidae) found, which are considered air breathers and therefore more tolerant to degraded conditions.



Figure 18. Fish Creek upstream of Bollinger Road, Clinton County, Michigan, July 2017.

MAPLE RIVER

The Maple River was sampled at 3 stations. The Maple River upstream of Tallman Road (Station 11) is a trend station that was sampled in 2007, 2012, and 2017. The Maple River was also sampled downstream of Tallman Road (Station 12) in early August due to the inability to get in to the river safely upstream of the road. In the future this trend station should be sampled at very low water levels in the last week of August or September. The original trend sampling time frame was late July

to early August, but that may not be possible during years where the river is at a similar or higher water level than that observed in mid-summer of 2017.



Figure 19. Maple River upstream of Tallman Road, Clinton County, Michigan, August 2017.

The glide/pool habitat was rated good (122; Table 13) upstream at the trend station (Figure 19), and excellent (156) downstream of Tallman Road (Figure 20). The Maple River is very large at this point in the watershed being 60- to 100-feet wide and averaging more than 3 feet deep with much of the thalweg and pools nonwadeable. Silt and sand are the dominant substrate with little LWD. Aquatic vegetation provides some additional epifaunal substrate. The river is very slow moving and is slow to rise and fall and remains fairly turbid throughout the monitoring season. The macroinvertebrate community scored acceptable (-1 and 0; Tables 14 and 15). Both upstream and downstream communities were diverse with 34-35 taxa found. No stoneflies were found and the percentage of mayfly and caddisfly taxa was somewhat low.



Figure 20. Maple River downstream of Tallman Road, Clinton County, Michigan, August 2017.

The most downstream station sampled in the Maple River was at Nickel Plate Road (Station 13). The water level at this station remained high throughout most of the sampling season. It was wadeable at the end of September (Figure 21). The sampling station began just upstream of the confluence of the tributary that comes from the northeast. The glide/pool habitat was rated good (144; Table 13). There was a large depositional area of sand near the tributary confluence. Rootwads were abundant. The riparian area was a large intact floodplain with naturally little understory. One small area was

maintained on the right bank for river access. Several species of mussel shells were found. The banks were steep due to down cutting of the clay banks. The water was very turbid and slow moving with sand, silt, and clay dominating. There were very few macrophytes but a fair amount of large woody structure but all substrate was covered by a thin layer of silt. The macroinvertebrate community scored acceptable (2; Tables 14 and 15). The community continued to be diverse with 36 taxa found. No stoneflies were found and the percentage of caddisfly taxa found was somewhat low. Amphipods were nearly a third of the taxa found, indicating some amount of environmental stressor is impacting the biological community.



Figure 21. Maple River upstream of Nickel Plate Road, Clinton County, Michigan, September 2017.

Objectives 2 and 3: Satisfy monitoring requests submitted by internal and external customers and identify NPS of water quality impairment.

LITTLE MAPLE RIVER

The glide/pool habitat in the Little Maple River at Saint Clair Road (Station 1) was rated at the lower end of marginal (71; Table 4), but the macroinvertebrate community scored at the higher end of acceptable (3; Tables 5 and 6). It is possible the biological community health has the potential to improve if there was more clean substrate, pool variability, and LWD available for colonization. Currently, the river is a maintained drain that runs right along Saint Clair Road with very little riparian area between the river and the road and the river and the crop fields (Figure 2). It has very steep banks and little to no sinuosity. This site would be a good candidate for NPS best management practices (BMP) that would allow for reduced siltation and increased riparian vegetation, LWD, and pool variability in the channel.

FISH CREEK

The road crossing at Pine Grove Road is a dirt road with twin 2-foot culverts that appear undersized for the channel width (Figure 22). This site would be a good candidate for road crossing replacement if funds are available. The macroinvertebrate community scored acceptable (1; Tables 11 and 12).



Figure 22. Undersized culverts for Fish Creek at Pine Grove Road, Clinton County, Michigan, July 2017.



Figure 23. Culverts for Fish Creek crossing at Vickeryville Road, Clinton County, Michigan, July 2017.

The road crossing of Fish Creek at Vickeryville Road consists of 2 large culverts and a paved approach (Figure 23). However, the alignment of the culverts at this station may not be appropriate for the stream's geomorphology, and causing siltation on one side of the channel and erosion on the other. Pool variability was good. The macroinvertebrate community scored acceptable (3; Tables 11 and 12).

HAYWORTH CREEK AND PINE CREEK

Procedure 51 macroinvertebrate community and habitat surveys were requested by NPS staff for Hayworth Creek at Bauer Road and Pine Creek at M-57 (Cleveland Road). This sampling is to support the USDA/NRCS National Water Quality Initiative funding that was awarded to landowners in the Hayworth Creek watershed. Annual sampling of Hayworth Creek began in 2014 to document conditions prior to any implementation and is expected to continue for a total of 10 years per United States Environmental Protection Agency (USEPA) requirements. Pine Creek at M-57 serves as a control site because it is covered by the same approved phosphorus Total Maximum Daily Load (TMDL) and Upper Maple River Watershed Management Plan (UMWMP) as Hayworth Creek but is not a recipient of the National Water Quality Initiative funding. MDEQ NPS staff plan to request that these sites be sampled annually as long as required by the USEPA.

Hayworth Creek's habitat and macroinvertebrate scores in 1997 and 2014-2017 can be found in Tables 16-18. Habitat scores have always rated good (Table 16, note 1997 habitat scores cannot be compared due to different methodologies). Macroinvertebrates scored acceptable every year with the most noteworthy change being the reduction in score from 4 in 2016 to 1 in 2017 (Tables 17 and 18). This change was due to a reduction of caddisfly families found, a reduction in the percentage of mayfly individuals found, and an increase in the number of chironomidae family found.

Pine Creek's habitat and macroinvertebrate scores in 2012, and 2014-2017 can be found in Tables 19-21. Habitat scores have scored good with the exception of the excellent score in 2014. The macroinvertebrate community has scored acceptable each year with little variability in scores.

NORTH SHADE DRAIN AND THE PINE RIVER NEAR SOUTH ENNIS ROAD

Problems with cattle access at in North Shade Drain and the Pine River near South Ennis Road have been noted since 2006 (Holden, 2013). Through an NPS Program Section 319 implementation grant, in September 2015, the CCCD worked with the landowner upstream of the road crossing to add a section of fence and an alternate water source to keep cattle out of most of the stream and prevent continued bank erosion and substrate disturbance. The same station scored acceptable (0) in 2012 (Holden, 2013).

On August 23, 2017, MDEQ staff visited North Shade Drain at South Ennis Road (Station 7) to repeat the macroinvertebrate/habitat sampling using Procedure 51. The glide/pool habitat was rated as marginal (84; Table 7) and the macroinvertebrate community scored at low end of acceptable (-3; Tables 8 and 9) suggesting the quality of the macroinvertebrate community had not improved, but rather may have gotten worse. While conducting the survey, residents of the cooperating property stopped by and spoke with MDEQ staff. They reported they do not keep cattle near the stream, but do occasionally pasture horses there. More details regarding the macroinvertebrate community and habitat measurements collected during this 2017 survey can be found under Objective 1 above.

Downstream of South Ennis Road several cows were observed with unrestricted access to both North Shade Drain (~240 feet; Figure 24) and the Pine River upstream and downstream of the confluence with North Shade Drain (~1100 feet; Figure 25). Trampled banks due to cattle frequently crossing the stream and animals defecating in the stream were both obvious sources of sedimentation and pathogen contamination.

The South Ennis Road location is just upstream of the confluence of North Shade Drain with the Pine River. The macroinvertebrate community in the Pine River was sampled upstream of the North Shade Drain confluence in 2012 (Holden, 2013) and was rated as poor (-5). Cattle access has been noted at this station from at least 2007, and is likely the cause of nonattainment.



Figure 24. North Shade Drain downstream of Ennis Road, Gratiot County, Michigan, September 2017. Confluence of Pine Creek is located at the tree line at upper portion of photo.



Figure 25. Pine Creek along South Ennis Road, Gratiot County, Michigan, looking north, September 2017.

While driving west on West Hayes Road from Ennis Road, we observed several additional cattle in North Shade Drain downstream of West Hayes Road. Conversations with the property residents at the South Ennis Road station, revealed that these cows belonged to a third property owner. The cattle access observances and available pictures were sent to staff of the MDEQ, Lansing District Office, who forwarded the information to Gratiot County Right-to-Farm staff. They indicated the landowner with cows in the stream downstream of West Hayes Road would build an exclusion fence. The property owner of the cows in North Shade Drain and Pine Creek downstream of Ennis Road, could not be reached, but staff were going to try again.

MDEQ staff will return to these stations during the next cycle year in North Shade Drain and Pine Creek to determine if Right-to-Farm staff were successful in working with the landowners to install appropriate livestock exclusion BMPs. Additional water chemistry, habitat, and macroinvertebrate community monitoring may be conducted.

Objective 4: Evaluate Biological Integrity Temporal Trends

Two stations (8 and 11) within the Maple River watershed were randomly selected as trend stations and have been sampled every 5 years since 2007. Station 8 is Fish Creek at Pine Grove Road. The habitat at this station has been rated fair each year without much change in score. The macroinvertebrate community has been in the acceptable range but has varied from a 3 to a -1 (Tables 22-24) with a rise in the dominant taxa percentage and reduction in the number of mayfly taxa or percentage of individual mayfly being the cause of lower scores. The Maple River at Tallman Road (Station 11) is the second trend station. The habitat at this station has been rated as good each year and macroinvertebrate community has been rated acceptable without much change in metric scores (Tables 25-27). Trend information will be summarized in a separate report.

Conclusions and Future Monitoring Recommendations

In 2017 aquatic macroinvertebrate community and habitat assessments were conducted at a total of 13 stations in the Maple River watershed (Figure 1, Table 1). The OIALW designated use was being met at all stations. The macroinvertebrate community most often scored at the higher end of acceptable (0 to 4) with Cox Drain at Essex Center Road scoring near poor (-4).

The CCCD received funding to develop the UMWMP (Fishbeck et al., 2010). The Upper Maple River watershed includes the river and all tributaries upstream of Maple Rapids. The purpose of the UMWMP is to identify impairments to the watershed and restore the qualities necessary for a healthy ecosystem. Sediment, nutrients, and pathogens were the top three pollutants of concern noted in the plan and the surveys conducted in 2017 indicate that these priority pollutants are appropriate. Sediment impacts aquatic life by covering up natural substrates needed for survival or spawning, damages gills needed to breath, and carries other pollutants such as nutrients to the stream. Nutrients can cause aquatic vegetation, including algae, to grow excessively. The nuisance algal and plant growth impairs the ability of native aquatic life to inhabit the stream due to habitat loss and low dissolved oxygen levels and reduces the recreational potential of the stream.

Sedimentation is often caused by runoff and soil erosion from crop lands, storm water runoff from urban areas, and construction in developing areas. Sediment deposits and sedimentation impacts have been observed throughout the watershed in the past and continued to be observed in 2017. Efforts to reduce sedimentation through protection, restoration, and conservation practices should continue in the Maple River watershed. Nutrient pollution sources include overuse or improper application of manure/fertilizers, lack of riparian buffers at livestock holding facilities adjacent to channels, uncontrolled livestock access, and aging septic systems and/or improper septic system maintenance, and stormwater runoff.

The UMWMP indicates that the highest priority goal of the watershed stakeholders was to preserve agricultural use, even though the plan identifies that the same use is the greatest contributor of NPS pollution to the watershed (Fishbeck et al., 2010). The UMWMP notes that in order to preserve agricultural lands and concurrently maintain water quality, the BMPs selected should include structural and vegetative BMPs, as well as management and policy BMPs. Information and education practices were noted as also being a priority to raise awareness, educate stakeholders, and inspire action to improve water quality in the Upper Maple River watershed.

NORTH SHADE DRAIN AND PINE RIVER *E. COLI* SAMPLING

In the 2020 Integrated Report, North Shade Drain at Ennis Road (040500050206-01) and Pine Creek upstream of Hayes Road (040500050207-02) should remain on the nonattainment list for the *E. coli* WQS for partial body contact recreation not being met. These particular sites have not been sampled for *E. coli* but a downstream location in Pine Creek at Luce Road was sampled in 2012 and found to be in nonattainment (MDEQ, 2016) and likely continues to exceed WQS. *E. coli* sampling should be considered in 2022 if livestock access is not remediated.

Pine Creek at Hayes Road should also remain on the nonattainment list for macroinvertebrates not meeting WQS as it appears habitat conditions have not changed since cattle were observed in the stream in 2012. If the conservation district office or Right-to-Farm staff are successful in finding a way to get compliance with getting the livestock out of the stream, repeated sampling at this station should be considered in 2022. North Shade Drain is currently meeting the OIALW designated use but repeated sampling upstream of Ennis Road should also be considered in 2022.

In 2021, the following recommendations should be considered as resources allow:

- 1) North Shade Drain and Pine Creek at South Ennis Road can be revisited to determine if improvements have been made in restricting livestock access to the drain, and if not, report conditions to district staff and/or the Michigan Department of Agricultural and Rural Development. In addition, *E.coli* samples could be taken to better document if the partial body contact recreation designated use is being met.
- 2) BMPs that reduce sediment and increase habitat diversity and epifaunal substrate should be encouraged. If BMPs including road crossing replacements are planned for these watersheds, and it is a priority for NPS staff to show success, before and/or after surveys can be conducted.
- 3) There are several water bodies in the Maple River watershed that are on the Section 303(d) list of impaired and threatened waters (Table 28), but not all were sampled in 2017. These water bodies as well as those that have not been assessed for one or more designated use should be considered when developing monitoring plans in the future. More information regarding water bodies that are impaired can be found in the 2016 Integrated Report (MDEQ, 2016).

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Table 4. Habitat evaluation for selected stations in the Maple River watershed, Michigan, June and July 2017.

	Station 1 Little Maple River @ Saint Clair Road 7/6/2017	Station 2 Baker Creek @ Meridian Rd 7/6/2017	Station 3 Muskrat Creek @ Price Rd 7/6/2017	Station 4 Cox Drain @ Essex Center Road 6/9/2017
HABITAT METRIC	GLIDE/POOL	GLIDE/POOL	RIFFLE/RUN	GLIDE/POOL
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	6	10	8	9
Embeddedness (20)*			11	
Velocity/Depth Regime (20)*			13	
Pool Substrate Characterization (20)**	11	11		10
Pool Variability (20)**	8	3		8
Channel Morphology				
Sediment Deposition (20)	6	10	14	6
Flow Status - Maintenance Flow Volume (10)	6	9	8	10
Flow Status - Flashiness (10)	3	3	6	3
Channel Alteration (20)	6	8	7	14
Frequency of Riffles/Bends (20)*			6	
Channel Sinuosity (20)**	1	8		7
Riparian and Bank Structure				
Bank Stability (L) (10)	5	5	8	5
Bank Stability (R) (10)	5	5	8	5
Vegetative Protection (L) (10)	4	6	6	8
Vegetative Protection (R) (10)	5	6	6	7
Riparian Vegetative Zone Width (L) (10)	2	4	5	8
Riparian Vegetative Zone Width (R) (10)	3	4	8	4
TOTAL SCORE (200):	71	92	114	104
HABITAT RATING:	MARGINAL	MARGINAL	GOOD	MARGINAL
Weather:		Sunny	Sunny	Partly Cloudy
Air Temperature: °F	85		90	68
Water Temperature: °F	72	66	76	58
Average Stream Width: Feet	10	6	18	10
Average Stream Depth: Feet	0.6	0.1	0.1	1
Surface Velocity: Feet/Second	1.20	0.30	0.27	0.26
Estimated Flow: Cubic Feet/Second	6.66	1.29	0.57	7.75
Stream Modifications:	Relocated		Canopy Removal	Canopy Removal
Nuisance Plants (Y/N):	N	N	Y	N
STORET No.:	190205	190117	190101	190206
County Code:	19	19	19	19
TRS:	07N01W20	08N01W24	07N03W07	08N03W15
Latitude (dd):	42.98444	43.06000137	42.9293	43.07955
Longitude (dd):	-84.444913	-84.36777496	-84.7044	-84.660391
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050005	4050005	4050005	4050005
*Applies only to Riffle/Run stream Surveys **Applies only to Glide/Pool stream Surveys				
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).				

Table 5. Qualitative macroinvertebrate community sampling results at selected stations in the Maple River watershed, Michigan, June and July 2017.

TAXA	STATION 1 Little Maple River @ Saint Clair Road 7/6/2017	STATION 2 Baker Creek @ Meridian Road 7/6/2017	STATION 3 Muskrat Creek @ Price Road 7/6/2017	STATION 4 Cox Drain @ Essex Center Road 6/9/2017
PLATYHELMINTHES (flatworms)				
Turbellaria			11	3
ANNELIDA (segmented worms)				
Hirudinea (leeches)	26	2	2	1
Oligochaeta (worms)	1	4	7	
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	12	13	7	31
Decapoda (crayfish)	2	2	11	1
Isopoda (sowbugs)				100
Arachnoidea				
Hydracarina	12		6	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	49	1	10	
Caenidae	83		4	1
Tricorythidae	2		1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	3	1	1	1
Zygoptera (damselflies)				
Calopterygidae		2	1	4
Coenagrionidae	12		14	
Hemiptera (true bugs)				
Belostomatidae				1
Corixidae	2	2	7	2
Gerridae			7	
Mesoveliidae		2		
Veliidae			1	
Megaloptera				
Sialidae (alder flies)	4			
Trichoptera (caddisflies)				
Helicopsychidae	1		2	
Hydropsychidae	2	1	40	1
Hydroptilidae			3	
Lepidostomatidae			6	
Leptoceridae	12	4		
Limnephilidae				1
Polycentropodidae	3			
Uenoidae	1		1	
Coleoptera (beetles)				
Dytiscidae (total)	2			
Haliplidae (adults)		0	1	
Hydrophilidae (total)	2		1	5
Elmidae	39	26	91	1
Gyrinidae (larvae)		2		
Haliplidae (larvae)		1		3

TAXA	STATION 1 Little Maple River @ Saint Clair Road 7/6/2017	STATION 2 Baker Creek @ Meridian Road 7/6/2017	STATION 3 Muskrat Creek @ Price Road 7/6/2017	STATION 4 Cox Drain @ Essex Center Road 6/9/2017
Diptera (flies)				
Ceratopogonidae			1	
Chironomidae	41	38	42	90
Culicidae	2	1		2
Dixidae			1	2
Simuliidae	1		2	
Tabanidae		2		
Tipulidae	1		2	
MOLLUSCA				
Gastropoda (snails)				
Hydrobiidae	1		7	
Lymnaeidae			1	
Physidae	11	221		3
Planorbidae	12			
Pleuroceridae			1	
Viviparidae	1		1	
Pelecypoda (bivalves)				
Sphaeriidae (clams)	4	1	9	5
TOTAL INDIVIDUALS	346	326	303	263

Table 6. Macroinvertebrate metric evaluation of selected stations in the Maple River watershed, Michigan, June and July 2017.

	Little Maple River @ Saint Clair Road 12/7/2017 Station 1		Baker Creek @ Meridian Rd 7/6/2017 Station 2		Muskrat Creek @ Price Rd 7/6/2017 Station 3		Cox Drain @ Essex Center Road 6/9/2017 Station 4	
MACROINVERTEBRATE COMMUNITY METRIC	Value	Score	Value	Score	Score	Value	Score	Value
TOTAL NUMBER OF TAXA	30	1	20	1	34	1	21	0
NUMBER OF MAYFLY TAXA	3	1	1	0	3	0	1	0
NUMBER OF CADDISFLY TAXA	5	1	2	0	5	1	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	38.73	1	0.31	-1	4.95	0	0.38	-1
PERCENT CADDISFLY COMPOSTITION	5.49	0	1.53	-1	17.16	0	0.76	-1
PERCENT DOMINANT TAXON	23.99	0	67.79	-1	30.03	0	38.02	-1
PERCENT ISOPOD, SNAIL, LEECH	14.74	-1	68.40	-1	3.96	1	39.54	-1
PERCENT SURFACE AIR BREATHERS	2.31	1	1.53	1	5.94	1	3.80	1
TOTAL SCORE		3		-3		3		-4
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 7. Habitat evaluation for selected stations in the Maple River watershed, Michigan, August and September 2017.

	STATION 5 Hayworth Creek @ Bauer Road 8/23/2017	STATION 6 Pine Creek @ Cleveland Road (M-57) 9/23/2017	STATION 7 North Shade Drain @ Ennis Road 8/25/2017
HABITAT METRIC	RIFFLE/RUN	RIFFLE/RUN	RIFFLE/RUN
Substrate and Instream Cover			
Epifaunal Substrate/ Available Cover (20)	11	15	10
Embeddedness (20)*	12	16	10
Velocity/Depth Regime (20)*	10	10	2
Pool Substrate Characterization (20)**			
Pool Variability (20)**			
Channel Morphology			
Sediment Deposition (20)	11	7	8
Flow Status - Maintenance Flow Volume (10)	7	8	7
Flow Status - Flashiness (10)	6	3	3
Channel Alteration (20)	10	14	11
Frequency of Riffles/Bends (20)*	6	19	3
Channel Sinuosity (20)**			
Riparian and Bank Structure			
Bank Stability (L) (10)	7	8	7
Bank Stability (R) (10)	7	8	5
Vegetative Protection (L) (10)	6	7	5
Vegetative Protection (R) (10)	7	7	5
Riparian Vegetative Zone Width (L) (10)	5	9	4
Riparian Vegetative Zone Width (R) (10)	9	9	4
TOTAL SCORE (200):	114	140	84
HABITAT RATING:	GOOD	GOOD	MARGINAL
Weather:	Partly Cloudy	Sunny	Partly Cloudy
Air Temperature: °F	74	70	74
Water Temperature: °F	72	68	72
Average Stream Width: Feet	25	30	15.3
Average Stream Depth: Feet	1	0.5	0.4
Surface Velocity: Feet/Second	0.421832359	1.057454295	0.187405712
Estimated Flow: Cubic Feet/Second	0.793747888	1.44301388	1.14080104
Stream Modifications:	Canopy Removal	None	Snaggin
Nuisance Plants (Y/N):	N	N	N
STORET No.:	190118	290209	290211
County Code:	19	29	29
TRS:	08N04W13	09N03W09	10N03W29
Latitude (dd):	43.079166	43.17611	43.21992
Longitude (dd):	-84.719444	-84.67304	-84.690342
Ecoregion:	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050005	4050005	4050005

Table 8. Qualitative macroinvertebrate community sampling results at selected stations in the Maple River watershed, Michigan, August and September 2017.

TAXA	STATION 5 Hayworth Creek @ Bauer Road 8/23/2017	STATION 6 Pine Creek @ Cleveland Road (M-57) 9/23/2017	STATION 7 North Shade Drain @ Ennis Road 8/25/2017
PLATYHELMINTHES (flatworms)			
Turbellaria	41	2	176
ANNELIDA (segmented worms)			
Hirudinea (leeches)	2		2
Oligochaeta (worms)	2	1	36
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	6	6	
Decapoda (crayfish)	1	1	1
Isopoda (sowbugs)	14	3	1
Arachnoidea			
Hydracarina	3		29
Insecta			
Ephemeroptera (mayflies)			
Baetidae	1	21	
Caenidae	8		1
Ephemerellidae		1	
Ephemeridae	2		
Heptageniidae	1	12	
Tricorythidae	11		
Odonata			
Anisoptera (dragonflies)			
Aeshnidae		1	
Gomphidae	1		
Libellulidae	1	1	1
Zygoptera (damselflies)			
Calopterygidae	3	3	
Coenagrionidae	20	2	3
Hemiptera (true bugs)			
Belostomatidae		1	
Corixidae	1	2	3
Gerridae	2	1	
Mesoveliidae		6	
Naucoridae		1	
Nepidae	1	1	
Notonectidae	2	1	1
Trichoptera (caddisflies)			
Hydropsychidae	10	73	1
Hydroptilidae	2	11	1
Leptoceridae	1	1	
Phryganeidae		1	
Coleoptera (beetles)			
Gyrinidae (adults)	6		
Halplidae (adults)		5	4
Hydrophilidae (total)	7	2	1
Elmidae	7	20	7

TAXA	STATION 5 Hayworth Creek @ Bauer Road 8/23/2017	STATION 6 Pine Creek @ Cleveland Road (M-57) 9/23/2017	STATION 7 North Shade Drain @ Ennis Road 8/25/2017
Gyrinidae (larvae)	14	1	24
Psephenidae (larvae)		1	
Diptera (flies)			
Ceratopogonidae	4		1
Chironomidae	99	75	55
Simuliidae	1	1	
Tabanidae	3		1
Tipulidae	2	2	
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)	2		1
Physidae	24	26	2
Planorbidae	2	1	
Pleuroceridae		4	
Pelecypoda (bivalves)			
Sphaeriidae (clams)	1	2	8
Unionidae (mussels)	1		
TOTAL INDIVIDUALS	316	295	361

Table 9. Macroinvertebrate metric evaluation of selected stations in the Maple River watershed, Michigan, August and September 2017.

	Hayworth Creek @ Bauer Road 8/23/17 STATION 5		Pine Creek @ M-57 9/23/17 STATION 6		North Shade Drain @ Ennis Road 8/25/17 STATION 7	
MACROINVERTEBRATE COMMUNITY METRIC	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	38	1	36	1	24	0
NUMBER OF MAYFLY TAXA	5	1	3	0	1	-1
NUMBER OF CADDISFLY TAXA	3	0	5	1	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	7.28	0	9.24	0	0.28	-1
PERCENT CADDISFLY COMPOSITION	4.11	0	43.21	1	0.56	-1
PERCENT DOMINANT TAXON	31.33	0	20.38	0	48.89	-1
PERCENT ISOPOD, SNAIL, LEECH	13.92	-1	9.24	0	1.67	1
PERCENT SURFACE AIR BREATHERS	6.01	1	6.79	1	3.61	1
TOTAL SCORE		1		0		-3
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 10. Habitat evaluation for selected stations in the Maple River watershed, Michigan, July and August 2017.

HABITAT METRIC	STATION 8 Fish Creek @ Pine Grove Road 8/8/2017	STATION 9 Fish Creek @ Vickeryville Rd 7/5/2017	STATION 10 Fish Creek @ Bollinger Road 7/5/2017
	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL
Substrate and Instream Cover			
Epifaunal Substrate/ Available Cover (20)	6	11	13
Embeddedness (20)*			
Velocity/Depth Regime (20)*			
Pool Substrate Characterization (20)**	10	15	15
Pool Variability (20)**	5	13	11
Channel Morphology			
Sediment Deposition (20)	6	12	14
Flow Status - Maintenance Flow Volume (10)	8	9	9
Flow Status - Flashiness (10)	4	5	6
Channel Alteration (20)	14	16	16
Frequency of Riffles/Bends (20)*			
Channel Sinuosity (20)**	5	13	14
Riparian and Bank Structure			
Bank Stability (L) (10)	7	8	6
Bank Stability (R) (10)	7	5	9
Vegetative Protection (L) (10)	7	8	7
Vegetative Protection (R) (10)	6	9	7
Riparian Vegetative Zone Width (L) (10)	8	9	8
Riparian Vegetative Zone Width (R) (10)	6	4	9
TOTAL SCORE (200):	99	137	144
HABITAT RATING:	MARGINAL	GOOD	GOOD
Weather:	Sunny	Sunny	Sunny
Air Temperature: °F	70	75	83
Water Temperature: °F	55		71
Average Stream Width: Feet	12	34	35
Average Stream Depth: Feet	0.1	0.2	2
Surface Velocity: Feet/Second	1.259259259	1.263227513	1.381993007
Estimated Flow: Cubic Feet/Second	1.288676955	6.630470679	103.8318986
Stream Modifications:	Snagging	None	None
Nuisance Plants (Y/N):	N	N	N
STORET No.:	590323	590271	590365
County Code:	59	59	19
TRS:	11N05N20	11N06W36	10N05W34
Latitude (dd):	43.3331	43.29333496	43.21748
Longitude (dd):	-84.9448	-84.96527863	-84.885919
Ecoregion:	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4050005	4050005	4050005

Table 11. Qualitative macroinvertebrate community sampling results at selected stations in the Maple River watershed, Michigan, July and August 2017.

TAXA	STATION 8 Fish Creek @ Pine Grove Road 8/8/2017	STATION 9 Fish Creek @ Vickeryville Road 7/5/2017	STATION 10 Fish Creek @ Bollinger Road 7/5/2017
ANNELIDA (segmented worms)			
Oligochaeta (worms)	1	2	1
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	9	85	40
Decapoda (crayfish)	3	8	6
Arachnoidea			
Hydracarina	3	1	1
Insecta			
Ephemeroptera (mayflies)			
Baetidae	19	2	4
Ephemeridae		2	
Heptageniidae	2	6	9
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	1	1	1
Gomphidae		1	1
Zygoptera (damselflies)			
Calopterygidae	12	2	
Plecoptera (stoneflies)			
Perlidae		6	3
Hemiptera (true bugs)			
Belostomatidae	1	1	
Corixidae		32	98
Gerridae		1	1
Mesoveliidae	4		
Megaloptera			
Corydalidae (dobson flies)	1	2	
Trichoptera (caddisflies)			
Brachycentridae	18	8	9
Helicopsychidae			1
Hydropsychidae	8	49	10
Hydroptilidae	1	1	
Leptoceridae	1	13	50
Limnephilidae		1	1
Polycentropodidae			2
Uenoidae			1
Coleoptera (beetles)			
Gyrinidae (adults)	2		
Hydrophilidae (total)	2		1
Elmidae	7	18	9
Haliplidae (larvae)			1
Psephenidae (larvae)			2
Diptera (flies)			
Athericidae			1
Ceratopogonidae	4		
Chironomidae	118	18	7

TAXA	STATION 8 Fish Creek @ Pine Grove Road 8/8/2017	STATION 9 Fish Creek @ Vickeryville Road 7/5/2017	STATION 10 Fish Creek @ Bollinger Road 7/5/2017
Simuliidae	23	1	1
Tabanidae	2		
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)		2	1
Bithyniidae		4	1
Physidae	3	6	8
Planorbidae	1	1	2
Pleuroceridae			1
Viviparidae		1	1
Pelecypoda (bivalves)			
Sphaeriidae (clams)	4	3	1
TOTAL INDIVIDUALS	252	278	277

Table 12. Macroinvertebrate metric evaluation of selected stations in the Maple River watershed, Michigan, July and August 2017.

MACROINVERTEBRATE COMMUNITY METRIC	Fish Creek @ Pine Grove Road 8/8/2017 STATION 8		Fish Creek @ Vickeryville Road 7/5/17 STATION 9		Fish Creek @ Bollinger Road 12/7/2017 STATION 10	
	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	26	1	29	1	33	1
NUMBER OF MAYFLY TAXA	2	0	3	0	2	0
NUMBER OF CADDISFLY TAXA	4	0	5	1	7	1
NUMBER OF STONEFLY TAXA	0	-1	1	1	1	1
PERCENT MAYFLY COMPOSITION	8.33	0	3.60	0	4.69	0
PERCENT CADDISFLY COMPOSITION	11.11	0	25.90	0	26.71	0
PERCENT DOMINANT TAXON	46.83	-1	30.58	0	35.38	0
PERCENT ISOPOD, SNAIL, LEECH	1.59	1	5.04	0	5.05	0
PERCENT SURFACE AIR BREATHERS	3.57	1	12.23	0	36.10	-1
TOTAL SCORE		1		3		2
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 13. Habitat evaluation for selected stations in the Maple River watershed, Michigan, August and September 2017.

	STATION 11 Maple River Tallman Road 8/30/2017	STATION 12 Maple River Downstream of Tallman Road 8/8/2017	STATION 13 Maple River Nickel Plate Road 9/21/2017
HABITAT METRIC	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL
Substrate and Instream Cover			
Epifaunal Substrate/ Available Cover (20)	9	11	10
Embeddedness (20)*			
Velocity/Depth Regime (20)*			
Pool Substrate Characterization (20)**	9	13	13
Pool Variability (20)**	10	15	13
Channel Morphology			
Sediment Deposition (20)	10	11	11
Flow Status - Maintenance Flow Volume (10)	10	10	8
Flow Status - Flashiness (10)	3	9	10
Channel Alteration (20)	15	18	16
Frequency of Riffles/Bends (20)*			
Channel Sinuosity (20)**	12	18	13
Riparian and Bank Structure			
Bank Stability (L) (10)	6	9	8
Bank Stability (R) (10)	9	9	8
Vegetative Protection (L) (10)	5	7	8
Vegetative Protection (R) (10)	8	8	7
Riparian Vegetative Zone Width (L) (10)	6	8	10
Riparian Vegetative Zone Width (R) (10)	10	10	9
TOTAL SCORE (200):	122	156	144
HABITAT RATING:	GOOD	EXCELLENT	GOOD
Weather:		Sunny	Sunny
Air Temperature: °F	73	84	75
Water Temperature: °F	65	75	71
Average Stream Width: Feet	60	98	28
Average Stream Depth: Feet	3		0.2
Surface Velocity: Feet/Second	0.301070821		0.698412698
Estimated Flow: Cubic Feet/Second	4.625200495		3.950687831
Stream Modifications:	Bank Stabilization		None
Nuisance Plants (Y/N):	N	N	N
STORET No.:	190164	190204	340228
County Code:	19	19	34
TRS:	05N04W15	05N04W15	08N05W35
Latitude (dd):	43.0895	43.08952	43.03287
Longitude (dd):	-84.7596	-84.76057	-84.8629
Ecoregion:	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050005	4050005	4050005

Table 14. Qualitative macroinvertebrate community sampling results at selected stations in the Maple River watershed, Michigan, August and September 2017.

	STATION 11 Maple River upstream of Tallman Road 8/30/2017	STATION 12 Maple River downstream of Tallman Road 8/8/2017	STATION 13 Maple River @ Nickel Plate Road 9/21/2017
PLATYHELMINTHES (flatworms)			
Turbellaria		2	
ANNELIDA (segmented worms)			
Hirudinea (leeches)			3
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	13	51	110
Isopoda (sowbugs)	4	9	7
Arachnoidea			
Hydracarina	1	8	3
Insecta			
Ephemeroptera (mayflies)			
Baetiscidae	1		1
Baetidae	31	15	3
Caenidae	2		3
Ephemerellidae			4
Ephemeridae	5	1	6
Heptageniidae	10	1	1
Isonychiidae			1
Tricorythidae			2
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	1	1	1
Gomphidae	1		2
Macromiidae	1	1	1
Zygoptera (damselflies)			
Calopterygidae	1		1
Coenagrionidae	103	43	70
Hemiptera (true bugs)			
Belostomatidae	2	2	1
Corixidae	78	30	7
Gerridae	2	1	1
Mesoveliidae	1		
Naucoridae		1	
Nepidae		1	1
Notonectidae	1	3	4
Pleidae	2		
Veliidae	1		
Megaloptera			
Sialidae (alder flies)		3	
Trichoptera (caddisflies)			
Brachycentridae			19
Hydropsychidae			4
Hydroptilidae		2	
Leptoceridae	2	2	26
Limnephilidae	1	2	
Polycentropodidae			1

	STATION 11 Maple River upstream of Tallman Road 8/30/2017	STATION 12 Maple River downstream of Tallman Road 8/8/2017	STATION 13 Maple River @ Nickel Plate Road 9/21/2017
Lepidoptera (moths)			
Pyrilidae			1
Coleoptera (beetles)			
Gyrinidae (adults)		1	1
Haliplidae (adults)	7	2	
Hydrophilidae (total)	1	2	1
Elmidae	31	20	13
Gyrinidae (larvae)	1		1
Diptera (flies)			
Ceratopogonidae		1	
Chironomidae	78	25	27
Culicidae	2	1	
Tabanidae	1		
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)	2	1	
Hydrobiidae		9	
Physidae	3	1	16
Pleuroceridae	1	1	1
Pomatiopsidae		1	
Pelecypoda (bivalves)			
Sphaeriidae (clams)	1	1	9
Unionidae (mussels)	1		
TOTAL INDIVIDUALS	394	247	354

Table 15. Macroinvertebrate metric evaluation of selected stations in the Maple River watershed, Michigan, August and September 2017.

	Maple River @ Tallman Road 8/30/17 STATION 11		Maple River downstream Tallman Road 8/8/17 STATION 12		Maple River @ Nickel Plate Road 9/21/17 STATION 13	
	Value	Score	Value	Score	Value	Score
MACROINVERTEBRATE COMMUNITY METRIC						
TOTAL NUMBER OF TAXA	35	1	34	1	36	1
NUMBER OF MAYFLY TAXA	5	1	3	0	8	1
NUMBER OF CADDISFLY TAXA	2	0	3	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	12.44	0	6.88	0	5.93	0
PERCENT CADDISFLY COMPOSITION	0.76	-1	2.43	-1	14.12	0
PERCENT DOMINANT TAXON	26.14	0	20.65	0	31.07	0
PERCENT ISOPOD, SNAIL, LEECH	2.54	1	8.91	0	7.63	0
PERCENT SURFACE AIR BREATHERS	26.40	-1	18.62	0	4.52	1
TOTAL SCORE		0		-1		2
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 16. Habitat evaluation for Hayworth Creek at Bauer Road, Clinton County, Michigan, 2014-2017.

HABITAT METRIC	Hayworth Creek at Bauer Road			
	8/21/2014	9/16/2015	9/26/2016	8/23/2017
	RIFFLE/RUN	RIFFLE/RUN	RIFFLE/RUN	RIFFLE/RUN
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	12	7	9	11
Embeddedness (20)*	10	7	9	12
Velocity/Depth Regime (20)*	8	10	11	10
Pool Substrate Characterization (20)**				
Pool Variability (20)**				
Channel Morphology				
Sediment Deposition (20)	12	9	8	11
Flow Status - Maintenance Flow Volume (10)	9	8	8	7
Flow Status - Flashiness (10)	5	6	4	6
Channel Alteration (20)	12	11	15	10
Frequency of Riffles/Bends (20)*	11	11	13	6
Channel Sinuosity (20)**				
Riparian and Bank Structure				
Bank Stability (L) (10)	7	5	5	7
Bank Stability (R) (10)	7	5	5	7
Vegetative Protection (L) (10)	7	6	5	6
Vegetative Protection (R) (10)	7	6	5	7
Riparian Vegetative Zone Width (L) (10)	7	8	9	5
Riparian Vegetative Zone Width (R) (10)	9	9	9	9
TOTAL SCORE (200):	123	108	115	114
HABITAT RATING:	GOOD	GOOD	GOOD	GOOD
Weather:	Cloudy	Sunny	Sunny	Partly Cloudy
Air Temperature: °F	72	65	85	74
Water Temperature: °F	68	64	73	72
Average Stream Width: Feet	32	28	25	25
Average Stream Depth: Feet	1	0.7	0.8	1
Surface Velocity: Feet/Second			0.42	0.42
Estimated Flow: Cubic Feet/Second			5.89	0.79
Stream Modifications:	Dredged	Dredged	Bank Stabilization	Canopy Removal
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	190118			
County Code:	19			
TRS:	08N04W13			
Latitude (dd):	43.079166			
Longitude (dd):	-84.719444			
Ecoregion:	SMNITP			
Stream Type:	Warmwater			
USGS Basin Code:	4050005			

Table 17. Qualitative macroinvertebrate community sampling results in Hayworth Creek at Bauer Road, Clinton County, Michigan, 1994 and 2014-2017.

	Hayworth Creek at Bauer Road				
	7/11/1994	8/21/2014	9/16/2015	7/26/2016	8/23/2017
PLATYHELMINTHES (flatworms)					
Turbellaria		4	12		41
ANNELIDA (segmented worms)					
Hirudinea (leeches)		1	1	5	2
Oligochaeta (worms)		4	15	2	2
ARTHROPODA					
Crustacea					
Amphipoda (scuds)	4	4	23	10	6
Decapoda (crayfish)	3	1		1	1
Isopoda (sowbugs)	15	1	18	18	14
Arachnoidea					
Hydracarina		22	1	8	3
Insecta					
Ephemeroptera (mayflies)					
Baetidae	3	51	12	9	1
Caenidae		1	8	57	8
Ephemeridae				2	2
Heptageniidae	5	5	6	10	1
Isonychiidae	2				
Siphonuridae		1			
Tricorythidae	2	81	49	6	11
Odonata					
Anisoptera (dragonflies)				7	
Aeshnidae	5	1	1		
Gomphidae		1	1		1
Libellulidae		1			1
Zygoptera (damselflies)				28	
Calopterygidae		7	21	7	3
Coenagrionidae		9	4		20
Plecoptera (stoneflies)					
Perlodidae	5				
Hemiptera (true bugs)					
Belostomatidae				1	
Corixidae	4	14	1	3	1
Gerridae	3	1	1	1	2
Mesoveliidae			1		
Nepidae				1	1
Notonectidae		1	1		2
Pleidae			2		
Veliidae			1		
Trichoptera (caddisflies)					
Hydropsychidae	25	12	40	5	10
Hydroptilidae		3			2
Lepidostomatidae		1		1	
Leptoceridae		4	2	9	1
Limnephilidae				1	
Polycentropodidae		1			
Uenoidae		3	1	1	
Coleoptera (beetles)					

	Hayworth Creek at Bauer Road				
	7/11/1994	8/21/2014	9/16/2015	7/26/2016	8/23/2017
Dytiscidae (total)	2				
Gyrinidae (adults)	1				6
Haliplidae (adults)	3	10	15	3	
Hydrophilidae (total)			4	9	7
Elmidae	8	14	23	18	7
Gyrinidae (larvae)					14
Haliplidae (larvae)			2		
Diptera (flies)					
Ceratopogonidae			2	2	4
Chironomidae	6	91	55	49	99
Simuliidae		25	1	3	1
Tabanidae		1	3		3
Tipulidae			2	6	2
MOLLUSCA					
Gastropoda (snails)					
Ancylidae (limpets)				2	2
Lymnaeidae		3			
Physidae	2	19	13	15	24
Planorbidae	1		1	1	2
Pelecypoda (bivalves)					
Corbiculidae		1			
Sphaeriidae (clams)	3	1	1	8	1
Unionidae (mussels)	1	1		1	1
TOTAL INDIVIDUALS	103	401	348	319	316

Table 18. Macroinvertebrate metric evaluation of Hayworth Creek at Bauer Road Michigan, 1997 and 2014-2017.

	Hayworth Creek at Bauer Road									
	7/11/1997		8/21/2014		9/16/2015		7/26/2016		8/23/2017	
MACROINVERTEBRATE COMMUNITY METRIC	Value	Score	Value	Score	Score	Value	Score	Value	Score	Value
TOTAL NUMBER OF TAXA	21	0	36	1	36	1	36	1	38	1
NUMBER OF MAYFLY TAXA	4	1	5	1	4	1	5	1	5	1
NUMBER OF CADDISFLY TAXA	1	-1	6	1	3	0	5	1	3	0
NUMBER OF STONEFLY TAXA	1	1	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	11.65	0	34.66	1	21.55	1	26.33	1	7.28	0
PERCENT CADDISFLY COMPOSITION	24.27	0	5.99	0	12.36	0	5.33	0	4.11	0
PERCENT DOMINANT TAXON	24.27	0	22.69	0	15.80	1	17.87	1	31.33	0
PERCENT ISOPOD, SNAIL, LEECH	17.48	-1	5.99	0	9.48	0	12.85	-1	13.92	-1
PERCENT SURFACE AIR BREATHERS	15.53	0	8.98	0	11.78	0	6.58	1	6.01	1
TOTAL SCORE		0		3		3		4		1
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 19. Habitat evaluation for Pine Creek at M-53, Michigan, Clinton County, Michigan, 2012 and 2014-2017.

	Pine Creek at M-53				
	7/10/2012	8/21/2014	9/16/2015	7/26/2016	9/23/2017
HABITAT METRIC	RIFFLE/RUN	RIFFLE/RUN	RIFFLE/RUN	RIFFLE/RUN	RIFFLE/RUN
Substrate and Instream Cover					
Epifaunal Substrate/ Available Cover (20)	9	15	11	11	15
Embeddedness (20)*	8	15	13	13	16
Velocity/Depth Regime (20)*	13	16	15	10	10
Pool Substrate Characterization (20)**					
Pool Variability (20)**					
Channel Morphology					
Sediment Deposition (20)	13	13	12	12	7
Flow Status - Maintenance Flow Volume (10)	6	8	8	7	8
Flow Status - Flashiness (10)	4	8	5	4	3
Channel Alteration (20)	15	15	11	15	14
Frequency of Riffles/Bends (20)*	13	18	15	16	19
Channel Sinuosity (20)**					
Riparian and Bank Structure					
Bank Stability (L) (10)	5	7	5	3	8
Bank Stability (R) (10)	5	7	7	5	8
Vegetative Protection (L) (10)	8	8	6	7	7
Vegetative Protection (R) (10)	8	8	6	7	7
Riparian Vegetative Zone Width (L) (10)	7	10	9	9	9
Riparian Vegetative Zone Width (R) (10)	8	10	9	9	9
TOTAL SCORE (200):	122	158	132	128	140
HABITAT RATING:	GOOD	EXCELLENT	GOOD	GOOD	GOOD
Weather:	Sunny	Partly Cloudy	Sunny	Sunny	Sunny
Air Temperature: °F	65	78	75	78	70
Water Temperature: °F	68	70	65	72	68
Average Stream Width: Feet	20	25	30	28	30
Average Stream Depth: Feet	0.8	0.9	1	0.5	0.5
Surface Velocity: Feet/Second				0.21	1.06
Estimated Flow: Cubic Feet/Second				3.73	1.44
Stream Modifications:	None	None		Canopy Removal	None
Nuisance Plants (Y/N):	N	N	N	N	N
STORET No.:	290209				
County Code:	29				
TRS:	09N03W09				
Latitude (dd):	43.17611				
Longitude (dd):	-84.67304				
Ecoregion:	SMNITP				

Table 20. Qualitative macroinvertebrate community sampling results for Pine Creek at M-53, Clinton County, Michigan, Michigan, 2012 and 2014-2017.

	Pine Creek at M-53				
	7/10/2012	8/21/2014	9/16/2015	7/26/2016	9/23/2017
PLATYHELMINTHES (flatworms)					
Turbellaria	1			4	2
ANNELIDA (segmented worms)					
Hirudinea (leeches)	1	1	2		
Oligochaeta (worms)	3	6	24		1
ARTHROPODA				3	
Crustacea				3	
Amphipoda (scuds)	17	4	9		6
Decapoda (crayfish)	1	1	1		1
Isopoda (sowbugs)	3	2	30	8	3
Arachnoidea				5	
Hydracarina		3	1	29	
Insecta					
Ephemeroptera (mayflies)					
Baetidae	13	30	3	13	21
Caenidae				3	
Ephemerellidae					1
Heptageniidae	7	7	31	10	12
Odonata					
Anisoptera (dragonflies)					
Aeshnidae	4	1	3	2	1
Gomphidae		1	1	1	
Libellulidae					1
Zygoptera (damselflies)					
Calopterygidae	4	2	18	5	3
Coenagrionidae		4	3		2
Hemiptera (true bugs)					
Belostomatidae		1	1		1
Corixidae	13	1	14	1	2
Gerridae	2	1		2	1
Mesoveliidae					6
Naucoridae					1
Nepidae		1			1
Notonectidae		1	1	1	1
Pleidae		1			
Veliidae			2		
Megaloptera					
Sialidae (alder flies)	1				
Trichoptera (caddisflies)					
Brachycentridae			1		
Helicopsychidae	11	8	6	2	
Hydropsychidae	125	78	42	89	73
Hydroptilidae		37			11
Leptoceridae	36	3	11	37	1
Limnephilidae	1			1	
Molannidae				1	
Philopotamidae	1			4	
Phryganeidae			1		1
Polycentropodidae		2		1	
Uenoidae			1		

	Pine Creek at M-53				
	7/10/2012	8/21/2014	9/16/2015	7/26/2016	9/23/2017
Lepidoptera (moths)					
Pyrilidae		1	2	1	
Coleoptera (beetles)					
Haliplidae (adults)		2	1	3	5
Hydrophilidae (total)					2
Psephenidae (adults)			1		
Dryopidae	1				
Elmidae	42	17	25	68	20
Gyrinidae (larvae)					1
Psephenidae (larvae)	1	1			1
Diptera (flies)					
Chironomidae	48	70	19	68	75
Dixidae		1			
Simuliidae	1	39		4	1
Stratiomyidae		1			
Tabanidae			3	3	
Tipulidae	3	1	2	9	2
MOLLUSCA					
Gastropoda (snails)					
Ancylidae (limpets)		1	1		
Bithyniidae				1	
Physidae	24	9	20	6	26
Planorbidae		2			1
Pleuroceridae	1	1	1	2	4
Pelecypoda (bivalves)					
Sphaeriidae (clams)	2	3	8	2	2
TOTAL INDIVIDUALS	367	345	289	392	295

Table 21. Macroinvertebrate metric evaluation for Pine Creek at M-53, Clinton County, Michigan, 2012, 2014, 2015, and 2017.

	Pine Creek at M-53									
	7/10/2012		8/21/2014		9/16/2015		7/26/2016		9/23/2017	
MACROINVERTEBRATE COMMUNITY METRIC	Value	Score	Value	Score	Score	Value	Score	Value	Score	Value
TOTAL NUMBER OF TAXA	27	1	37	1	33	1	33	1	36	1
NUMBER OF MAYFLY TAXA	2	0	2	0	2	0	3	0	3	0
NUMBER OF CADDISFLY TAXA	5	1	5	1	6	1	7	1	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	5.45	0	10.72	0	11.76	0	6.63	0	11.53	0
PERCENT CADDISFLY COMPOSITION	47.41	1	37.10	1	21.45	0	34.44	1	29.15	1
PERCENT DOMINANT TAXON	34.06	0	22.61	0	14.53	1	22.70	0	25.42	0
PERCENT ISOPOD, SNAIL, LEECH	7.90	0	4.64	0	18.69	-1	10.46	-1	11.53	-1
PERCENT SURFACE AIR BREATHERS	4.09	1	3.19	1	7.27	0	2.55	1	8.47	0
TOTAL SCORE		3		3		1		2		0
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 22. Habitat evaluation for Fish Creek at Pine Grove Road, Montcalm County, Michigan, 2007, 2008, 2012, and 2017.

HABITAT METRIC	Fish Creek at Pine Grove Road			
	7/19/2007	7/15/2008	7/31/2012	8/8/2017
	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)				
Embeddedness (20)*	6	10	7	6
Velocity/Depth Regime (20)*				
Pool Substrate Characterization (20)**	11	13	7	10
Pool Variability (20)**	6	8	7	5
Channel Morphology				
Sediment Deposition (20)	10	10	6	6
Flow Status - Maintenance Flow Volume (10)	9	8	9	8
Flow Status - Flashiness (10)	8	8	7	4
Channel Alteration (20)	3	6	10	14
Frequency of Riffles/Bends (20)*				
Channel Sinuosity (20)**	3	5	5	5
Riparian and Bank Structure				
Bank Stability (L) (10)	7	7	7	7
Bank Stability (R) (10)	9	7	9	7
Vegetative Protection (L) (10)	5	6	8	7
Vegetative Protection (R) (10)	5	6	8	6
Riparian Vegetative Zone Width (L) (10)	10	9	9	8
Riparian Vegetative Zone Width (R) (10)	10	9	5	6
TOTAL SCORE (200):	102	112	104	99
HABITAT RATING:	MARGINAL	GOOD	MARGINAL	MARGINAL
Weather:	Cloudy	Sunny	Sunny	Sunny
Air Temperature: °F	65	85	70	70
Water Temperature: °F	58	76	58	55
Average Stream Width: Feet	12	14	11	12
Average Stream Depth: Feet	0.68	0.67	0.8	0.1
Surface Velocity: Feet/Second				1.26
Estimated Flow: Cubic Feet/Second				1.29
Stream Modifications:	Dredged, Canopy Removal	Dredged, Canopy Removal	Dredged	Snagging
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	590323	590323	590323	590323
County Code:	59	59	59	59
TRS:	11N05N20	11N05N20	11N05N20	11N05N20
Latitude (dd):	43.3331	43.3331	43.3331	43.3331
Longitude (dd):	-84.9448	-84.9448	-84.9448	-84.9448
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4050005	4050005	4050005	4050005

Table 23. Qualitative macroinvertebrate community sampling results for Fish Creek at Pine Grove Road, Montcalm County, Michigan, 2007, 2008, 2012, and 2017.

	Fish Creek at Pine Grove Road			
	7/19/2007	7/15/2008	7/31/2012	8/8/2017
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1		1	
Oligochaeta (worms)	17	3	2	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	37	30	73	9
Decapoda (crayfish)	2	4	2	3
Isopoda (sowbugs)		1		
Arachnoidea				
Hydracarina	3	7	1	3
Insecta				
Ephemeroptera (mayflies)				
Baetidae	34	48	4	19
Ephemerellidae	1		1	
Ephemeridae	5	4	1	
Heptageniidae		1		2
Tricorythidae	8	1	1	
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	3	2	1	1
Zygoptera (damselflies)				
Calopterygidae	3	9	8	12
Coenagrionidae	1		8	
Hemiptera (true bugs)				
Belostomatidae	1	1	1	1
Corixidae	9	100	1	
Gerridae		1	1	
Mesoveliidae			2	4
Nepidae			1	
Veliidae	2			
Megaloptera				
Corydalidae (dobson flies)	2			1
Sialidae (alder flies)	8		14	
Trichoptera (caddisflies)				
Brachycentridae	9	4	5	18
Hydropsychidae	8		12	8
Hydroptilidae			2	1
Leptoceridae	11	14	8	1
Limnephilidae	1			
Phryganeidae		13		
Coleoptera (beetles)				
Gyrinidae (adults)			1	2
Halipidae (adults)	1	5	1	
Hydrophilidae (total)	1		1	2
Elmidae	4		19	7
Diptera (flies)				
Ceratopogonidae		2	1	4
Chironomidae	46	16	55	118
Dixidae			1	

	Fish Creek at Pine Grove Road			
	7/19/2007	7/15/2008	7/31/2012	8/8/2017
Simuliidae		4		23
Tabanidae	5	2	2	2
Tipulidae	4			
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)			1	
Physidae	16	19	15	3
Planorbidae			2	1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	30	13	15	4
TOTAL INDIVIDUALS	274	304	265	252

Table 24. Macroinvertebrate metric evaluation for Fish Creek at Pine Grove Road, Montcalm County, Michigan, 2007, 2008, 2012, and 2017.

	Fish Creek at Pine Grove Road							
	7/19/2007		7/15/2008		7/31/2012		8/8/2017	
MACROINVERTEBRATE COMMUNITY METRIC	Value	Score	Value	Score	Score	Value	Score	Value
TOTAL NUMBER OF TAXA	30	1	24	0	35	1	26	1
NUMBER OF MAYFLY TAXA	4	1	4	1	4	1	2	0
NUMBER OF CADDISFLY TAXA	4	0	3	0	4	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	17.52	0	17.76	0	2.64	-1	8.33	0
PERCENT CADDISFLY COMPOSITION	10.58	0	10.20	0	10.19	0	11.11	0
PERCENT DOMINANT TAXON	16.79	1	32.89	0	27.55	0	46.83	-1
PERCENT ISOPOD, SNAIL, LEECH	6.20	0	6.58	0	7.17	0	1.59	1
PERCENT SURFACE AIR BREATHERS	5.47	1	36.84	-1	3.77	1	3.57	1
TOTAL SCORE		3		-1		1		1
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 25. Habitat evaluation for the Maple River at Tallman Road, Clinton County, Michigan, 2007, 2012, and 2017.

	Maple River at Tallman Road			
	7/26/2007	7/30/2007	7/31/2012	8/30/2017
HABITAT METRIC	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	11	8	5	9
Embeddedness (20)*				
Velocity/Depth Regime (20)*				
Pool Substrate Characterization (20)**	15	7	9	9
Pool Variability (20)**	10	11	11	10
Channel Morphology				
Sediment Deposition (20)	11	7	7	10
Flow Status - Maintenance Flow Volume (10)	6	8	9	10
Flow Status - Flashiness (10)	5	5	6	3
Channel Alteration (20)	15	15	14	15
Frequency of Riffles/Bends (20)*				
Channel Sinuosity (20)**	13	10	13	12
Riparian and Bank Structure				
Bank Stability (L) (10)	9	5	5	6
Bank Stability (R) (10)	9	9	5	9
Vegetative Protection (L) (10)	9	5	8	5
Vegetative Protection (R) (10)	9	9	8	8
Riparian Vegetative Zone Width (L) (10)	9	5	10	6
Riparian Vegetative Zone Width (R) (10)	9	9	10	10
TOTAL SCORE (200):	140	113	120	122
HABITAT RATING:	GOOD	GOOD	GOOD	GOOD
Weather:	Rainy	Sunny	Cloudy	
Air Temperature: °F	72	75	76	73
Water Temperature: °F	74	74	74	65
Average Stream Width: Feet	75	75	100	60
Average Stream Depth: Feet	2	3	3	3
Surface Velocity: Feet/Second				.3
Estimated Flow: Cubic Feet/Second				4.6
Stream Modifications:	Snagged?	None	None	Bank Stabilization
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	190164	190164	190164	190164
County Code:	19	19	19	19
TRS:	05N04W15	05N04W15	05N04W15	05N04W15
Latitude (dd):	43.0895	43.0895	43.0895	43.0895
Longitude (dd):	-84.7596	-84.7596	-84.7596	-84.7596
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Warmwater
USGS Basin Code:	4050005	4050005	4050005	4050005

Table 26. Qualitative macroinvertebrate community sampling results from the Maple River at Tallman Road, Clinton County, Michigan, 2007, 2012, and 2017.

	Maple River at Tallman Road			
	7/26/2007	7/30/2007	7/31/2012	8/30/2017
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1		
Oligochaeta (worms)	2	4	1	
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	13	15	14	13
Decapoda (crayfish)	2	1		
Isopoda (sowbugs)		2		4
Arachnoidea				
Hydracarina	1	2	1	1
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae				1
Baetidae	14	10	7	31
Caenidae	8	15	11	2
Ephemerellidae	1			
Ephemeridae	4	8	1	5
Heptageniidae	17	18	12	10
Tricorythidae		3		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	4	1	1	1
Gomphidae				1
Macromiidae				1
Zygoptera (damselflies)				
Calopterygidae	5	6	12	1
Coenagrionidae	21	39	49	103
Hemiptera (true bugs)				
Belostomatidae		1	2	2
Corixidae	65	37	120	78
Gerridae	2	6	8	2
Mesoveliidae	1			1
Nepidae	1			
Notonectidae			3	1
Pleidae	2			2
Veliidae				1
Megaloptera				
Corydalidae (dobson flies)		1	1	
Trichoptera (caddisflies)				
Hydropsychidae	27	9	2	
Hydroptilidae			3	
Leptoceridae	22	14	3	2
Limnephilidae				1
Polycentropodidae	1	7	8	
Coleoptera (beetles)				
Dytiscidae (total)	4	2		
Gyrinidae (adults)	7	1		
Haliplidae (adults)		3	1	7
Hydrophilidae (total)				1

	Maple River at Tallman Road			
	7/26/2007	7/30/2007	7/31/2012	8/30/2017
Scirtidae (adults)			1	
Dryopidae	11			
Elmidae	11	10	23	31
Gyrinidae (larvae)			2	1
Diptera (flies)				
Ceratopogonidae	2	1	3	
Chironomidae	19	76	48	78
Culicidae				2
Simuliidae	4	7		
Tabanidae			2	1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		5		2
Physidae		3	2	3
Planorbidae		5	2	
Pleuroceridae	1	1		1
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	8	1	1
Unionidae (mussels)				1
TOTAL INDIVIDUALS	274	322	344	394

Table 27. Macroinvertebrate metric evaluation results from the Maple River at Tallman Road, Clinton County, Michigan, 2007, 2012, and 2017.

	Maple River at Tallman Road							
	7/26/2007		7/30/2007		7/31/2012		8/30/2017	
MACROINVERTEBRATE COMMUNITY METRIC	Value	Score	Value	Score	Score	Value	Score	Value
TOTAL NUMBER OF TAXA	30	1	33	1	29	1	35	1
NUMBER OF MAYFLY TAXA	5	1	5	1	4	1	5	1
NUMBER OF CADDISFLY TAXA	3	0	3	0	4	0	2	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	16.06	0	16.77	0	9.01	0	12.44	0
PERCENT CADDISFLY COMPOSITION	18.25	0	9.32	0	4.65	0	0.76	-1
PERCENT DOMINANT TAXON	23.72	0	23.60	0	34.88	0	26.14	0
PERCENT ISOPOD, SNAIL, LEECH	0.73	1	5.28	0	1.16	1	2.54	1
PERCENT SURFACE AIR BREATHERS	29.93	-1	16.46	0	39.53	-1	26.40	-1
TOTAL SCORE		1		1		1		0
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 28. Water bodies in the Maple River watershed that are not meeting one or more designated uses and are therefore considered impaired (MDEQ, 2016).

AUID	Waterbody Description	Designated Use Not Met	Pollutant	Status
040500050101-01	Maple River and Spring Brook	OIALW	Habitat	4c
040500050103-02	Alder Creek Drain	OIALW	Phosphorus	4a
040500050202-02	Maple River	OIALW	Phosphorus	4a
040500050204-02	Ferdon Creek and Maple River	OIALW	Phosphorus	4a
040500050205-01	Unnamed Tributaries to Pine Creek	PBC	<i>E. coli</i>	5
040500050205-02	Newark Drain	PBC	<i>E. coli</i>	5
040500050205-03	River Styx	OIALW, PBC	habitat, <i>E. coli</i>	4c
040500050205-04	Pine Creek	PBC	<i>E. coli</i>	5
040500050206-01	Knowels and Northshade Drain	PBC	<i>E. coli</i>	5
040500050207-01	Pine Creek	PBC	<i>E. coli</i>	5
040500050207-02	Pine Creek	OIALW, PBC	<i>E. coli</i>	5
040500050207-03	Otter Creek	PBC	<i>E. coli</i>	5
040500050208-02	Collier Creek and Maple River	OIALW	Phosphorus	4a
040500050301-01	Holland Lake Outlet and Unnamed Tributaries to Lampman Lake, Mitchell Lake, Rosa Lake, Twin Lakes, and Twin Stone Lakes	PBC	<i>E. coli</i>	5
040500050301-04	West Branch Fish Creek	PBC	<i>E. coli</i>	5
040500050302-01	Fish Creek	PBC	<i>E. coli</i>	5
040500050303-01	Unnamed Tributary to Fish Creek	PBC	<i>E. coli</i>	5
040500050304-01	Butternut Creek	CWW, PBC	habitat, <i>E. coli</i>	4c, 5
040500050305-02	Fish Creek	PBC	<i>E. coli</i>	5
040500050305-03	Fish Creek	PBC	<i>E. coli</i>	5
040500050306-02	Fish Creek and Stroughton Creek	PBC	<i>E. coli</i>	5
040500050403-02	Lost Creek	OIALW, WWF	Phosphorus	4a
040500050502-02	Hayworth Creek	OIALW	Phosphorus	5
040500050503-02	Peet Creek	OIALW	Phosphorus	4a
040500050505-01	Maple River and Spring Brook	PBC	<i>E. coli</i>	5
*With a few exceptions the waterbodies above and most other waterbodies in the Maple River watershed are also not attaining the total body contact water quality standard due to pathogens and fish consumption advisories due to PCB levels in the fish and in the water column.				
PBC = Partial Body Contact				
CWW = Coldwater fishery, WWF = Warmwater Fishery				
OIALW = Other Indigenous Aquatic Life and Wildlife				
5 = not attaining one or more designated use				
4c = not attaining designated use but the impairment is not caused by a pollutant				
4a = designated uses not being met, but a USEPA approved TMDL has been written				