MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
DECEMBER 2016

STAFF REPORT

Biological and Water Chemistry Surveys of Selected Stations in the Manistee River Watershed in Antrim, Crawford, Grand Traverse, Kalkaska, Missaukee, Lake, Manistee, Mason, Osceola, Otsego, and Wexford Counties, Michigan June-August 2014

Introduction

Staff of the Michigan Department of Environmental Quality (MDEQ), Surface Water Assessment Section (SWAS), assessed the biological and physical habitat conditions of selected water bodies in the Manistee River watershed in June-August 2014. Specific streams and rivers included the Little Manistee and Pine Rivers, Fife Lake outlet, and Black, Little Cannon, Anderson, Slagle, Peterson, Poplar, Coe, Stronach, Sickle, and Bear Creeks. These streams are in Antrim, Crawford, Grand Traverse, Kalkaska, Missaukee, Lake, Manistee, Mason, Osceola, Otsego, and/or Wexford Counties. 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. Address monitoring requests submitted by internal and external customers.
3. Identify nonpoint sources (NPS) of water quality impairment.
4. Gather water quality data needed for fiscal years 2013 and 2014 Total Maximum Daily Load (TMDL) development or delisting.
5. Evaluate biological integrity temporal trends.

Watershed Information

The Manistee River watershed is located in the northwestern portion of Michigan's Lower Peninsula. The watershed covers approximately 1,948 square miles with 1,938 miles of stream, of which 841 miles are perennial streams (USDA/NRCS, 2001). The headwaters of the Manistee River begin northwest of the city of Grayling in Antrim, Crawford, and Kalkaska Counties and flows south and west until the confluence with the drowned river mouth of Manistee Lake and finally Lake Michigan (Figure 1). The confluence of the main branch and one of its major tributaries, the North Branch Manistee River, is located west of Grayling. The main branch of the Manistee River then continues to flow southwest through Kalkaska, Missaukee, and Wexford Counties where it is joined by several smaller tributaries. There are two major impoundments on the main branch of the Manistee River. Hodenpyl Dam is located in Wexford County and Tippy Dam is in Manistee County. The Pine River is another major tributary of the Manistee River. The Pine River headwaters begin south of Cadillac. The Pine River flows generally west and then north until it reaches the Tippy Dam impoundment at the confluence with the Manistee River. Bear Creek is the third major tributary to the Manistee River. The headwaters of Bear Creek are near the village of Copemish. Bear Creek then flows south until its confluence with the Manistee River, east of the city of Manistee. The Little Manistee River headwaters begin near the village of Luther and its confluence with Manistee Lake is east of Manistee near Stronach.

The majority of the Manistee River watershed is designated as a coldwater stream. The exceptions can be found in Table 1, which has been adapted from the Michigan Department of Natural Resources (MDNR) Designated Trout Streams list (MDNR, 1997).

Table 1. Warmwater designated streams in Manistee River watershed (adapted [MDNR, 1997]).

Stream	Township, Range, Section	County
Manistee River between Tippy Dam and Redbridge and between Hodenpyle Dam and M-115.	several	Manistee and Wexford
Unnamed Creek	T22N,R16W, S31	Manistee
Unnamed Creek	T21N, R16W, S6	Manistee
Unnamed Creek	T21N, R16W, S5	Manistee
Claybank Bayou	T21N, R16W, S3	Manistee
Borski Bayou	T22N, R15W, S29	Manistee
Unnamed Creek	T23N, R13W, S24	Manistee
Walton Outlet Creek (upstream from railroad bridge)	T24N, R9W, S4	Manistee
Unnamed Creek	T22N, R14W, S20	Manistee
Unnamed Creek	T22N, R14W, S7	Manistee
Boswell Creek	T22N, R14W, S9	Manistee
Healy Lake Outlet	T24N, R14W, S33	Manistee
Little Beaver Creek	T19N, R10W, S19	Manistee
Wheeler Creek (upstream of dam)	T24N, R11W, S8	Manistee
Fife Lake Outlet upstream of dam	T25N, R9W, S26	Wexford, Grand Traverse
Fife Lake Outlet tributary	T24N, R9W, S1, 11	Wexford, Grand Traverse

The watershed is primarily within the Highplains District Ecosystem. The Highplains District consists of a large area of moraine and outwash terrain. Historically, pine and pine-oak forests covered the outwash plains and the moraines supported beech-sugar maple forests. Following logging and burning of this area, second-growth forest covers most of the area with little agriculture. The more downstream portion of the Manistee River watershed is within the Newaygo District Ecosystem (Albert, 1995). This district is a dry sandy outwash plain. The mouth of the watershed is within the Manistee District, which consists of a broad flat lake plain near the city of Manistee. Most stations sampled are located in the Northern Lakes and Forest Ecoregion, with a small portion of them (primarily those in the Pine River) in the Southern Michigan and Northern Indiana Till Plains Ecoregion, and another small portion (Bear Creek watershed) in the Northern Central Hardwoods Ecoregion (Omernik and Gallant, 2010).

Land use in the Manistee River watershed is presented in Tables 2 and 3. The amount of impervious area in the Manistee River watershed is between 1 and 26 percent (Table 3) (National Oceanic and Atmospheric Administration, 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 gravel roads, crushed stone driveways, parking areas, and sidewalks. Impervious area is closely linked to areas of development.

The amount of total wetlands lost since presettlement times in the Manistee River watershed (1-12 percent) is relatively low when compared to the entire state (40 percent) (Fizzell, 2014). The highest percent of wetlands lost in the watersheds presented in this report, is in

Slagle Creek near the village of Harrietta (Table 3). The high amount of land use that remains as wetlands and other natural areas is likely one factor leading to the high quality habitat and macroinvertebrate communities found in these watersheds.

Table 2. Land use summary for the Manistee River watersheds.

Watershed Name	Water	Natural Area	Cultivated Agriculture	Hay or Pasture	Development
North Branch Manistee River-Manistee River	2%	89%	2%	0%	6%
Silver Creek-Manistee River	1%	83%	8%	2%	6%
Peterson Creek-Manistee River	1%	80%	10%	3%	5%
Pine River	1%	80%	11%	3%	6%
Bear Creek	2%	78%	12%	2%	6%
Little Manistee River	1%	91%	3%	1%	5%
Manistee River	3%	84%	3%	1%	9%

Table 3. Detailed land use of the Manistee River watershed, broken down by watershed groups. The orange to green color variation is to help quickly interpret the table. Orange indicates a land use characteristic that is relatively more stressful on aquatic ecosystems, while shades of yellow are less stressful, and shades of green are more beneficial to aquatic ecosystems. The percent water is not an indicator of stress and thus is all one color of green.

12-digit HUC	Watershed HUC Name	Natural	Developed	Hay or Pasture	Cultivated	Water	Other	Impervious Cover	Lost wetlands
040601030101	Frenchman Creek-Manistee River	83%	9%	0%	7%	1%	0%	1%	1%
040601030102	Goose Creek	92%	5%	0%	0%	2%	0%	1%	2%
040601030103	Lost Lake-Manistee River	93%	7%	0%	0%	0%	0%	1%	3%
040601030104	Portage Creek-Manistee River	81%	10%	0%	0%	7%	2%	3%	4%
040601030105	Black Creek-Manistee River	92%	5%	0%	0%	2%	0%	1%	3%
040601030106	Manistee Lake-North Branch Manistee River	88%	5%	0%	2%	5%	0%	1%	4%
040601030107	Big Cannon Creek	92%	5%	0%	2%	1%	0%	1%	2%
040601030108	North Branch Manistee River	88%	4%	1%	6%	0%	0%	1%	7%
040601030109	Big Devil Creek-Manistee River	95%	5%	0%	0%	1%	0%	1%	8%
040601030201	Little Cannon Creek	94%	4%	0%	1%	0%	0%	1%	3%
040601030202	Maple Creek-Manistee River	80%	5%	4%	11%	1%	0%	1%	8%
040601030203	Ham Creek	93%	5%	0%	3%	0%	0%	3%	5%
040601030204	Hopkins Creek	84%	5%	1%	9%	0%	0%	3%	3%
040601030205	Hopkins Creek-Manistee River	87%	6%	1%	5%	1%	0%	1%	8%
040601030206	Fife Lake Outlet	79%	8%	1%	7%	5%	0%	4%	9%
040601030207	Chase Creek-Manistee River	80%	5%	3%	11%	0%	0%	3%	5%
040601030208	Manton Creek-Manistee River	82%	9%	1%	7%	0%	0%	3%	10%
040601030209	Silver Creek-Manistee River	76%	5%	5%	14%	0%	0%	1%	9%

Table 3 continued. Detailed land use of the Manistee River watershed, broken down by watershed groups. The orange to green color variation is to help quickly interpret the table. Orange indicates a land use characteristic that is relatively more stressful on aquatic ecosystems, while shades of yellow are less stressful, and shades of green are more beneficial to aquatic ecosystems. The percent water is not an indicator of stress and thus is all one color of green.

12-digit HUC	Watershed HUC Name	Natural	Development	Hay or Pasture	Cultivated	Water	Other	Impervious Cover	Lost wetlands
040601030301	Anderson Creek	57%	6%	10%	27%	0%	0%	2%	7%
040601030302	Soper Creek-Manistee River	87%	5%	1%	6%	1%	0%	1%	6%
040601030303	Cole Creek-Manistee River	86%	4%	1%	7%	1%	0%	1%	1%
040601030304	Fletcher Creek	68%	5%	7%	19%	0%	0%	2%	3%
040601030305	Burkett Creek-Manistee River	72%	10%	3%	13%	2%	0%	8%	8%
040601030306	Hodenpyl Dam Pond-Manistee River	82%	5%	1%	5%	6%	1%	2%	1%
040601030307	Slagle Creek	91%	4%	0%	4%	0%	0%	1%	12%
040601030308	Eddington Creek-Manistee River	85%	3%	1%	11%	0%	0%	2%	1%
040601030309	Peterson Creek	93%	5%	0%	2%	0%	0%	2%	7%
040601030310	Hinton Creek-Manistee River	92%	4%	1%	2%	0%	0%	2%	2%
040601030401	North Branch Pine River	74%	7%	4%	15%	0%	0%	2%	4%
040601030402	East Branch Pine River	69%	7%	5%	17%	2%	0%	2%	5%
040601030403	Coe Creek	87%	4%	1%	7%	1%	0%	1%	2%
040601030404	Beaver Creek-Pine River	74%	7%	5%	14%	0%	0%	3%	3%
040601030405	Poplar Creek-Pine River	93%	3%	0%	3%	0%	0%	1%	2%
040601030406	Pine River	93%	5%	0%	2%	0%	0%	1%	1%
040601030501	Dutchman Creek-Bear Creek	84%	6%	2%	8%	0%	0%	3%	0%
040601030502	Little Bear Creek	69%	7%	2%	15%	7%	0%	3%	2%
040601030503	Lemon Creek-Bear Creek	84%	5%	2%	9%	1%	0%	4%	2%
040601030504	Little Beaver Creek-Bear Creek	73%	7%	4%	15%	0%	0%	3%	6%
040601030505	Bear Creek	82%	5%	2%	11%	0%	0%	1%	2%
040601030601	Twin Creek	89%	4%	2%	5%	0%	0%	1%	3%
040601030602	Lincoln Creek-Little Manistee River	86%	5%	2%	7%	1%	0%	2%	0%
040601030603	Stronach Creek	89%	6%	1%	2%	1%	0%	2%	4%
040601030604	Elbow Lake-Little Manistee River	94%	5%	0%	1%	1%	0%	1%	1%
040601030605	Tank Creek-Little Manistee River	93%	5%	1%	1%	0%	0%	1%	8%
040601030606	Little Manistee River	93%	6%	0%	1%	0%	0%	3%	0%
040601030701	Tippy Dam Pond-Manistee River	89%	4%	0%	2%	4%	0%	1%	2%
040601030702	Pine Creek-Manistee River	92%	6%	0%	0%	1%	0%	1%	3%
040601030703	Larson Creek-Manistee River	76%	5%	6%	11%	2%	0%	3%	1%
040601030704	Claybank Creek-Manistee River	93%	5%	0%	1%	0%	0%	2%	3%
040601030705	Manistee River	62%	23%	2%	6%	5%	0%	26%	2%

Historical Sampling Efforts and Information

The most recent MDEQ survey of the Manistee River watershed was conducted in 2009 (Lipsey, 2010). Aquatic macroinvertebrate community and habitat assessments were conducted at 30 wadeable stations and 5 nonwadeable stations. The macroinvertebrate community was rated excellent at 19 of the wadeable stations and acceptable at 11 wadeable stations. For the nonwadeable stations, 1 scored excellent, 2 scored at the higher end of acceptable, and 2 scored at the lower end of acceptable. None of the stations scored poor. Habitat ratings ranged from good to excellent. The fish community was not sampled in 2009.

Prior surveys conducted in the Manistee River watershed include those conducted in 2004 (Walker, unpublished data) and in 1999 (Walker 2004a, 2004b, and 2004c; Walsh, 2001).

Methods

The macroinvertebrate community and/or physical habitat was qualitatively assessed at each of 26 stations (Figure 1 and Table 4) using the SWAS Procedure 51 (Creal et al., 1996; MDEQ, 1990) for wadeable streams. 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 to be at the lower end of acceptable, while positive scores in the acceptable range are considered to be at the higher end of acceptable. 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. Only the wadeable stream macroinvertebrate community scores are used to determine attainability of the Other Indigenous Aquatic Life and Wildlife (OIALW) designated use. Habitat scores and individual metrics are used to help better understand the macroinvertebrate scores (Creal et al., 1996; MDEQ, 1990).

The macroinvertebrate community and physical habitat was qualitatively assessed at 4 stations using the SWAS Procedure 22 (MDEQ, 2013), Qualitative Biological and Habitat Survey Protocols for Nonwadeable Rivers. Using Procedure 22, the range of scores possible for macroinvertebrate community metrics is 0-100 with scores from 26-100 typically representing communities meeting WQS. Only the macroinvertebrate community scores are used to determine attainability of the OIALW designated use.

Site Selection

Two site-selection methods were used to assess the Manistee River watershed in 2014: (1) stratified random; and (2) targeted. Twenty-two randomly selected sites were assigned to support the SWAS Status and Trend Program. These sites will be used to estimate the watershed attainment status for 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, and to facilitate a measurement of biointegrity temporal trends (MDEQ, 2015). Three stations within the Manistee River watershed were selected for targeted monitoring to support and answer concerns of stakeholders or SWAS staff. Five additional stations were targeted for sampling because they are fixed long-term targeted monitoring stations for the MDNR, Fisheries Division, and macroinvertebrate and habitat data will complement the information they have collected.

Table 4. Summary of the aquatic habitat and macroinvertebrate community evaluations for selected stations in the Manistee River watershed June-August 2014.

Station	Stream Name	Road Crossing	STORET	County	TRS	Latitude	Longitude	Date	Habitat Rating	Score	Bug Rating	Score	Station Type	AUID
1	Manistee River	Cameron Bridge	200155	Kalkaska	28N04W S19	44.79993	-84.84048	6/18/14	Good	151	Acceptable	4	T	040601030103-01
2	Manistee River	off King Rd. downstream of Black Creek	400167	Kalkaska	06N05W S29	44.61981	-84.93933	6/18/14	Excellent	159	Excellent	5	S	040601030105-01
3	Manistee River	off Weber Rd near Sunset Trail	400143	Kalkaska	26N06W S35	44.61100	-84.99744	7/15/14	Excellent	167	Excellent	7	Tr	040601030109-01
4	Manistee River	off end of Weber Rd	400144	Kalkaska	26N06W S34	44.60839	-85.01299	7/15/14	Excellent	171	Excellent	5	Tr	040601030109-01
5	Black Creek	End of Goose Creek Rd.	400168	Kalkaska	26N05W S29	49.62161	-84.94091	8/20/14	Good	152	Acceptable	-1	T	040601030105-03
6	North Branch Manistee	u/s Kniss Road	400123	Kalkaska	26N06W S02	44.67024	-85.00730	8/19/14	Good	153	Excellent	5	T	040601030108-01
7	North Branch Manistee	Mecum Road	400120	Kalkaska	26N06W S15	44.64104	-85.02687	8/19/14	Good	145	Excellent	7	T	040601030108-01
8	Little Cannon Creek	d/s Dutch John Rd	400111	Kalkaska	25N07W S27	44.53642	-85.13692	7/15/14	Excellent	169	Excellent	5	Tr	040601030201-01
9	Fife Lake Outlet	Number Two Road	280429	Grand Traverse	25N09W S35	44.51240	-85.37017	6/19/14	Excellent	159	Excellent	5	S	040601030206-01
10	Anderson Creek	County Line Rd	280411	Grand Traverse	25N11W S34	44.51235	-85.62202	7/15/14	Good	141	Acceptable	-1	Tr	040601030301-01
11	Manistee River	d/s Hodenpyl Dam	510229	Manistee	23N13W S26	44.35204	-85.83512	7/8/14	Excellent	162	Acceptable	0	S	040601030308-01
12	Slagle Creek	d/s S 1 Rd	830224	Wexford	22N12W S06	44.32746	-85.81930	7/16/14	Excellent	171	Excellent	5	Tr	040601030307-01
13	Peterson Creek	d/s S 7 Rd	830225	Wexford	21N12W S9	44.22769	-85.76011	7/16/14	Good	142	Excellent	7	Tr	040601030309-01

Habitat Scoring Wadeable Stations
Poor < 56 Marginal 56-104 Good 105-154 Excellent >154

Macroinvertebrate Scoring Wadeable Stations
Poor < -4 Acceptable -4 to +4 Excellent > +4

Table 4. Summary of the aquatic habitat and macroinvertebrate community evaluations for selected stations in the Manistee River watershed June-August 2014.

Station	Stream Name	Road Crossing	STORET	County	TRS	Latitude	Longitude	Date	Habitat Rating	Score	Bug Rating	Score	Station Type	AUID
14	Poplar Creek	S 15 Rd	830131	Wexford	21N11W S32	44.17384	-85.67823	7/16/14	Good	132	Acceptable	1	Tr	040601030405-02
15	Coe Creek	20 Mile Road	670252	Osceola	20N10W S19	44.10326	-85.55265	6/18/14	Good	135	Excellent	8	S	040601030403-01
16	Pine River	230th Ave.	670253	Osceola	19N10W S05	44.07101	-85.53928	8/20/14	Excellent	155	Acceptable	1	T	040601030404-03
17	Pine River	Skookum Road Canoe Launch	430630	Lake	20N11W S33	44.08235	-85.64801	8/20/14	Excellent	155	Acceptable	1	S	040601030405-04
18	Pine River	M37- upstream of Peterson Campground	830230	Wexford	21N12W S19	44.20418	-85.80094	8/21/14	Excellent	155	Acceptable	1	S	040601030406-02
19	Pine River	Stronach Dam (off Stronach Dam Rd)	510197	Manistee	21N13W S16	44.21344	-85.89504	8/21/14	Good	105	acceptable	1	S	040601030406-02
20	Bear Creek	Leffew	510233	Manistee	24N14W S29	44.45604	-86.03154	6/17/14	Excellent	173	Acceptable	2	T	040601030503-01
21	Bear Creek	13 Mile Rd	510237	Manistee	23N14W S06	44.42823	-86.04527	6/19/14	Good	140	Acceptable	-2	Tr	040601030504-01
22	Bear Creek	Coates Highway	510200	Manistee	22N14W S07	44.31392	-86.04810	6/16/14	Good	140	Excellent	6	S	040601030505-01
23	Little Manistee River	Johnson's Bridge (Brooks Rd. Johnson Rd.)	430629	Lake	20N14W S24	44.10889	-85.92728	8/21/14	NA	NA	Acceptable	2	T	040601030604-01
24	Little Manistee River	W 10.5 Mile Rd (W 11 Mile Road)	430597	Lake	20N14W S07	44.14583	-86.02502	8/5/14	Excellent	168	Excellent	6	Tr	040601030605-01
25	Stronach Creek	d/s Java Rd	430619	Lake	20N14W S01	44.14772	-85.93149	7/16/14	Excellent	157	Excellent	7	Tr	040601030603-01

Habitat Scoring Wadeable Stations
Poor < 56 Marginal 56-104 Good 105-154 Excellent >154

Macroinvertebrate Scoring Wadeable Stations
Poor < -4 Acceptable -4 to +4 Excellent > +4

Table 4. Summary of the aquatic habitat and macroinvertebrate community evaluations for selected stations in the Manistee River watershed June-August 2014.

Station	Stream Name	Road Crossing	STORET	County	TRS	Latitude	Longitude	Date	Habitat Rating	Score	Bug Rating	Score	Station Type	AUID
26	Sickle Creek	Forest Service Road Upstream of Rainbow Bend Boat Launch (8348)	510269	Manistee	22N15W S20	44.29630	-86.15378	6/16/14	Good	124	Acceptable	-1	T	040601030703-03
SV-1	Goose Creek	Goose Creek Road	400118	Kalkaska	27N05W S12	44.75114	-84.84909	8/20/14	NA	NA	NA	NA	SV	040601030102-01
SV-2	Black Creek	Riverview Road	400164	Kalkaska	26N05W S17	44.64 886	-84.94747	6/18/14	NA	NA	NA	NA	T	040601030105-03
SV-3	Little Devil Creek	Vallad Drive SE	NA	Kalkaska	25N06W S05	44.58614	-85.06386	8/20/14	NA	NA	NA	NA	T	040601030109-03
SV-4	Cedar Creek	Oravainen Road	510260	Manistee	23N14W S32	44.34603	-86.03072	7/16/15	NA	NA	NA	NA	SV	040601030505-01
SV-5	Little Manistee River	Six Mile Bridge Road	510262	Manistee	21N15W S31	44.18343	-86.16711	8/21/14	NA	NA	NA	NA	SV	040601030605-01
SV-6	Cool Creek	12 Mile Road	510265	Manistee	21N14W S34	44.16685	-85.98737	8/21/14	NA	NA	NA	NA	T	040601030603-01
SV-7	Chief Creek	Coates Highway	510266	Manistee	22N15W S09	44.31531	-86.13871	6/16/14	NA	NA	NA	NA	SV	040601030703-02
SV-8	Chief Creek	River Road	510235	Manistee	22N15W S16	44.30073	-86.13741	6/16/14	NA	NA	NA	NA	SV	040601030703-02

S/T/Tr = status, targeted, trend station
SV = site visit only station
NW = nonwadeable
NA = Not Applicable

Habitat Scoring Wadeable Stations
Poor < 56 Marginal 56-104 Good 105-154 Excellent >154

Macroinvertebrate Scoring Wadeable Stations
Poor < -4 Acceptable -4 to +4 Excellent > +4

Station	Stream Name	Road Crossing	STORET	County	TRS	Latitude	Longitude	Date	Habitat Rating	Score	Bug Rating	Score	Station Type	AUID
NW-1	Manistee River	Coster Road	400169	Kalkaska	25N08W S28	44.52728	-85.27585	7/10/14	NA	NA	Excellent	81	S	040601030205-01
NW-2	Manistee River	2.3 miles d/s 29 1/2 Mile Road	830231	Wexford	24N10W S09	44.48749	-85.53573	7/9/14	NA	NA	Good	73	S	040601030302-01
NW-3	Manistee River	6.8 miles d/s 29 1/2 Mile Road	830232	Wexford	24N10W S18	44.47813	-85.56178	7/9/14	NA	NA	Good	69	S	040601030302-01
NW-4	Manistee River	5.2 miles u/s Caberfae Highway	510270	Manistee	21N16W S03	44.25766	-86.22963	7/8/14	NA	NA	Excellent	77	S	040601030704-01

S/T/Tr = status, targeted, trend station
SV = site visit only station
NW = nonwadeable
NA = Not Applicable

Macroinvertebrate Scoring Nonwadeable Stations Poor < 26 Marginal 26-50 Good 51-74 Excellent 75-100

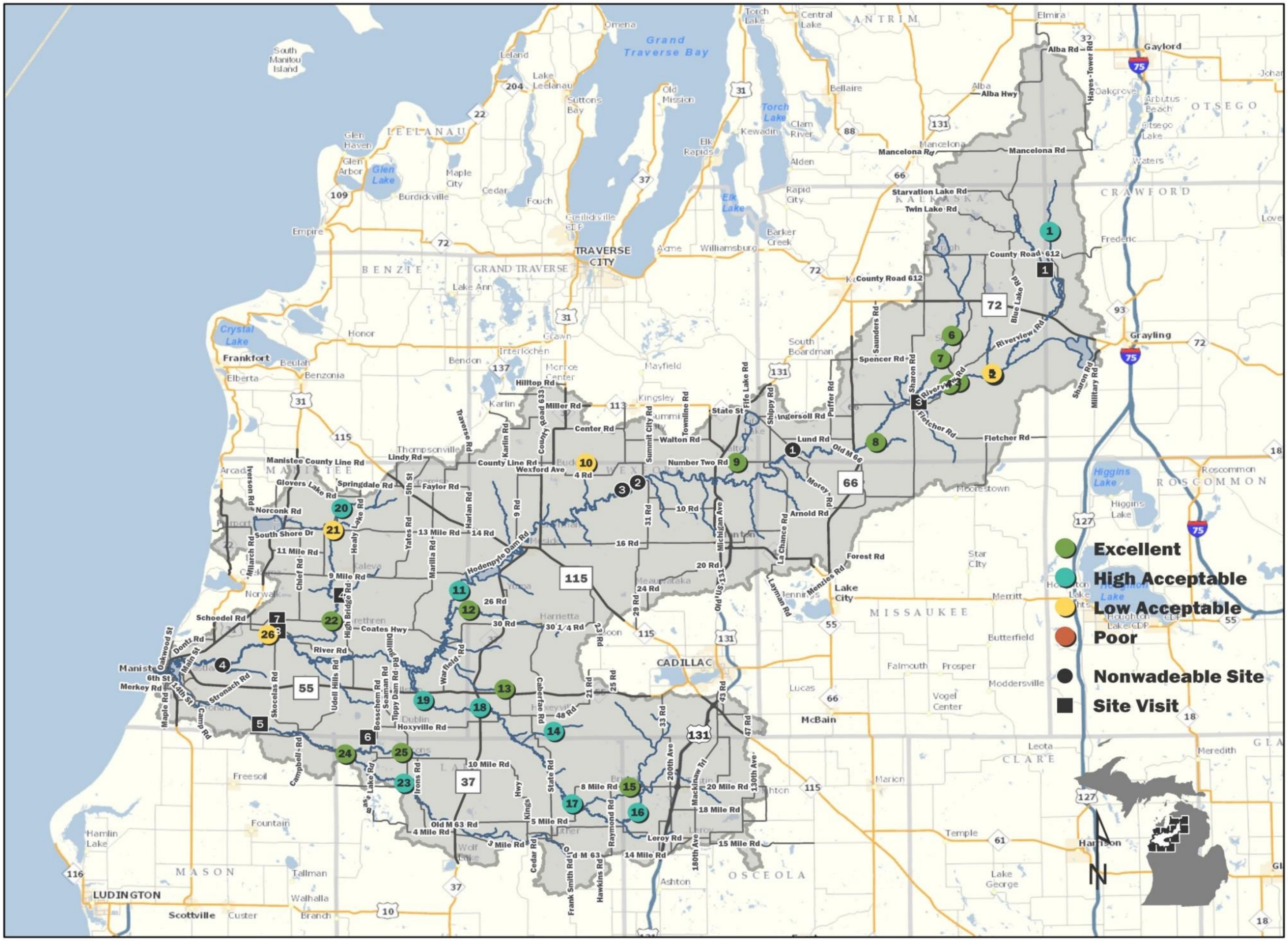

Figure 1. Map of the Manistee River watershed. Symbols represent Procedure 51 macroinvertebrate community survey scores or station types.

Summary of Findings

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

In 2014, aquatic macroinvertebrate community and habitat assessments were conducted at a total of 30 stations in the Manistee River watershed. The locations of these stations can be found in Table 4 and Figure 1. The OIALW designated use was being met at all stations.

In 2014, 12 randomly selected sites within the Manistee River watershed group (including two stations in the Lincoln River watershed that are discussed in a separate report) were sampled to support attainment status calculation. Based on the probabilistic monitoring aspect of this watershed group survey, 100 +/- 22 percent of the randomly selected sites supported the OIALW designated use using biological monitoring procedures. Percent attainment was calculated by dividing the number of random sites that met WQS by the total number of random locations ((12/12)/100 = 100 percent). This value is coupled with a 95 percent confidence interval to provide our estimation of certainty, meaning there is 95 percent certainty that the true proportion of attainment in the northwest Michigan watershed group is between 78 and 100 percent (MDEQ, 2015).

UPPER MANISTEE RIVER

The upper portion of the Manistee River (from headwaters to US-131) was sampled at four stations (1-4). Three of the 4 stations had excellent (non-impaired) habitat ratings (Table 5) and excellent macroinvertebrate scores (Table 6 and 7). Figure 2 was one of these excellent sites and is a good representation of the size of the river in this area. The Manistee River at Cameron Bridge (Figure 3) was the most upstream station sampled and both habitat and macroinvertebrate community was rated slightly lower but at the high end of acceptable. Shifting sand deposits was the dominant substrate at this station, which may limit where macroinvertebrates can colonize. The slightly lower macroinvertebrate score is caused by a lower percentage of mayfly individuals found and a dominance of *Leptoceridae* caddisflies and *Hydracarina* (water mites), neither of which are indicative of poor water quality.

Figure 2. Manistee River off King Road

Figure 3. Manistee River at Cameron Road

BLACK CREEK

Black Creek is a tributary to the Upper Manistee River. In 2009, the headwaters were observed to be wetland-dominated with a large amount of beaver activity. The road at Riverview Road was washed out and an extensive beaver dam was located at this station. This assessment unit is listed as having insufficient information for both the Coldwater Fisheries (CWF) and OIALW designated uses (Goodwin et al., 2014).

Figure 4. Black Creek at Riverview Road.

In 2014, the same location had a new culvert at Riverview Road (Figure 4). Black Creek was flowing well; however, upstream conditions were not suitable to Procedure 51 due to the natural wetland- like conditions. A macroinvertebrate community survey was not conducted but there was no indication that the macroinvertebrate community would not be meeting WQS. To confirm this assumption, Black Creek was sampled further downstream at the end of Goose Creek Road (Station 5). The glide/pool habitat was rated good (152; slightly impaired; Table 8). The substrate at this station was primarily deep deposits (greater than 2.5 feet, Figure 5) of shifting sand. The stream had a wetland-dominated riparian zone and a braided channel. Beaver activity was evident. Large woody material and overhanging vegetation were the primary epifaunal substrate. The macroinvertebrate community scored acceptable (-1; Tables 9 and 10), which is fairly low compared to the Manistee River, but is still meeting WQS. Therefore, this water body is now listed as attaining the OIALW designated use (Goodwin et al., 2016, in draft). We were not able to sample fish at this station and thus the CWF designated use remains as having insufficient information (Goodwin et al., 2016, in draft). If the CWF designated use is not being met, it is likely due to the beaver activity, lack of spawning habitat, and wetland nature of the stream, not due to a particular water quality issue.

Figure 5. Black Creek upstream of Manistee River confluence.

Figure 6. North Branch Manistee at Kniss Road.

NORTH BRANCH MANISTEE RIVER

Two stations (6 and 7) were sampled in the North Branch of the Manistee River watershed. The headwaters of the North Branch begin at the outlet of Manistee Lake. The confluence of the North Branch with the Manistee River is located along Sharon Road downstream of the confluence of Big Cannon Creek. Station 6 was located at Kniss Road (Figure 6) and Station 7 was located at Mecum Road. Station 6 is an MDNR status and trend station and was actually a replacement for the previous MDNR trend station at Mecum Road. More information about the Mecum Road station can be found below under Objective 3. The glide/pool habitat was rated good at both stations (153 and 145; slightly impaired; Table 8). A slight increase in sediment deposition was found at the Mecum Road station when the two are compared. The macroinvertebrate community scored excellent at both stations (Mecum (7) and Kniss (5), Tables 9 and 10). The coldwater fish community at Mecum Road included 4.6 percent salmonid species (Table 11) and is therefore meeting the CWF designated use. The road crossing at Kniss is very old and the bridge is in need of repair or replacement.

LITTLE CANNON CREEK

Little Cannon Creek was sampled downstream of Dutch John Road and is a trend station (Station 8), and therefore has been sampled in 2009 and 2014. The riffle/run habitat was rated excellent (169, non-impaired; Table 8). There was a variety of epifaunal substrate including cobble, gravel, large woody material, and extensive undercut banks. The macroinvertebrate community scored excellent (5, Tables 9 and 10). Over 48 percent of the individuals found were *Hydropsychidae.* A dominance of any one taxon may be an indicator of some type of environmental perturbation.

FIFE LAKE OUTLET

The outlet of Fife Lake was sampled at East County Line (Number 2) Road (Station 9). This road is 12 miles downstream of Fife Lake and seven miles downstream of another small lake. The glide/pool habitat was rated at the lower end of excellent (159, non-impaired; Table 12). Epifaunal substrate was lacking cobble and gravel. Shifting sand deposition was moderate in the pools. The riparian area consisted of a wetland floodplain with emergent grasses and cattail (Figure 7). The macroinvertebrate community scored excellent (5, Tables 13 and 14). The water was relatively warm at 62 degrees Fahrenheit. This would be expected for a lake outlet.

Figure 7. Upstream of Fife Lake outlet looking at East County Line Road crossing

ANDERSON CREEK

Anderson Creek was sampled at County Line Road and is a trend station (Station 10), and had been sampled in 2009. The glide/pool habitat was rated good in 2014 (141, slightly impaired; Table 12). There was a large amount of siltation at this station. It was common to sink to your knees in silt along the stream margins. Fine particulate organic matter was common and although snags and large woody material were present, it was often embedded in silt. The macroinvertebrate community scored acceptable (-1, Tables 13 and 14). Contributing to this relatively low score was that no stonefly taxa were found and *Chironomidae* were dominant at nearly 40 percent. The bridge crossing at this station looks to be extremely old and if there was a flood event, it seems a large amount of sediment could potentially enter the water body (Figure 8).

Figure 8. Road crossing over Anderson Creek at County Line Road.

MANISTEE RIVER

The Manistee River was sampled using Procedure 51 downstream of Hodenpyl Dam off of Upper River Road (Station 11). This station was initially planned as a nonwadeable station and was reached by boat (Figure 9). Upon arrival, SWAS biologists found that a majority of the reach was wadeable. The riffle/run habitat was rated excellent (162, non-impaired; Table 12) with relatively unstable banks, which is not uncommon in the middle and lower portions of the Manistee River. The current was extremely fast at this station and the estimated flow was determined to be 896 cubic feet per second. Large woody material, cobble, and gravel were the dominant epifaunal substrates. The amount of large woody material was fairly sparse and pushed against the river banks. The macroinvertebrate community scored acceptable (0, Tables 13 and 14). No stonefly taxa were found and only two mayfly families. Although it was not deep, sampling all habitats for a large length of river in the fast current was difficult. This station was a status station and if it is ever sampled again, it may be best to use the nonwadeable procedure or use a boat to travel to a variety of habitats over a longer reach of river.

Figure 9. Manistee River downstream of Hodenpyl Dam.

SLAGLE CREEK

Slagle Creek was sampled downstream of S 1 Road (Figure 10; Station 12). This is a trend station and thus was sampled in 2009 as well. The riffle/run habitat was rated as excellent (171; non-impaired; Table 12). Epifaunal substrate consisted of gravel mixed with sand and some cobble. There was a large amount of periphyton, filamentous algae, and macrophytes throughout the reach. Vegetation was not at nuisance levels, but was denser than what is typically found in a stream of this size in the Manistee River watershed. The macroinvertebrate community was rated excellent (5) in 2014 (Tables 13 and 14) and acceptable tending towards excellent (3) in 2009 (Lipsey, 2010). Based on the macroinvertebrate community, the OIALW designated use is being met.

Figure 10. Slagle Creek downstream of S 1 Road.

PETERSON CREEK

Peterson Creek was sampled downstream of S 7 Road (Figure 11; Station 13). This is a trend station and was sampled in 2009. The glide/pool habitat was rated as good (142; slightly impaired; Table 15). Substrate was dominated by sand with a large amount of large woody material. In an adjacent wetland floodplain area sand could be seen as far back as 30 feet, indicating there is a large amount of sand in this stream during high flow events. As noted in 2009, the road crossing culvert is undersized. The macroinvertebrate community was rated excellent (7) in 2014 (Tables 16 and 17) and in 2009 (Lipsey, 2010). This high excellent score is one of five (>7) that was found in the Manistee River watershed in 2014, indicating Peterson Creek is a comparatively high quality water body despite the amount of sedimentation observed. This water body may be one of interest to watershed groups seeking areas that may be in need of attention for protection.

Figure 11. Peterson Creek downstream of 7 Road.

POPLAR CREEK

Poplar Creek is a tributary to the Pine River and was sampled at 15 Road (Figure 12; Station 14). This is a trend station and was sampled in 2009. The glide/pool habitat was rated as good (132; slightly impaired; Table 15) in 2014. Substrate was entirely sand with an abundance of embedded large woody material. Undercut banks were extensively available for epifaunal substrate. The riparian area was wetland in nature and beaver activity was noticeable, but the beaver dam observed in 2009 was gone. The macroinvertebrate community was rated acceptable in both 2014 (Tables 16 and 17) and 2009 (Lipsey, 2010) (scores 1 and 3, respectively).

Figure 12. Poplar Creek at 15 Road.

COE CREEK

Coe Creek is a tributary to the Pine River and was sampled at 20 Mile Road (Figure 13; Station 15). The creek is in a fairly deep valley with a good size riparian zone on the left side when looking downstream. The right side riparian area was bordered by an agriculture field 50 feet from the edge of the stream. The riffle/run habitat was rated good (135, slightly impaired; Table 15). Epifaunal substrate included cobble, boulders, large woody material, and undercut banks. The macroinvertebrate community scored excellent (8, Tables 16 and 17). This was the highest score of the stations sampled in the Manistee River in 2014. A large variety (7 families) of caddisfly (Trichoptera) taxa were found, which is indicative of good water quality.

Figure 13. Coe Creek at 20 Mile Road.

PINE RIVER

Four stations were sampled on the Pine River (Stations 16-19). The most upstream station was located at 230th Avenue (Figure 14; Station 16). This station was targeted because it is a fixed, long-term trend station for the MDNR, Fisheries Division, and corresponding macroinvertebrate data will complement the Fisheries Division's fish community and habitat data.

Figure 14. Pine River at 230th Avenue, upstream of access site, looking downstream.

In the winter of 2010/2011 a fish cover project was completed in the reach. Large woody structures were placed along the stream edges and out into the channel to provide habitat for salmonids and concentrate flow in the middle of the channel to expose gravel substrate and develop deeper pools (Mark Tonello, MDNR, Fisheries Division;

personal communication). In 2014, the riffle/run habitat was rated excellent (155; non-impaired; Table 18). The river ran very fast at this station with many deep scour pools, which limited access for sampling. Sand, gravel, cobble, and boulders were available for epifaunal substrate and were approximately 40 percent embedded. Attached algae were present on the larger boulders and cobble, and the large piles of woody material were observed. The macroinvertebrate community scored acceptable (1, Tables 19 and 20). *Pteronarcyidae* and *Perlidae* stoneflies, which are indicative of good water quality, were collected. However, no caddisflies were collected, which is unusual for high quality water bodies.

Station 17 was located at the Skookum Bridge canoe launch (0.6 miles downstream of North Skookum Road; Figure 15). The riffle/run habitat was rated excellent (155; non-impaired; Table 18). The river ran very fast at this station with many deep scour pools at the bends, which limited access for sampling. The pools had sandy bottoms with gravel embedded in the riffles by 40 percent. Cobble and large wood provided epifaunal substrate. Some erosion was evident at the bends and sand deposits were evident on the elevated floodplain indicating that spring runoff or other high flows are a source of sediment to the stream banks. A large amount of attached algae and periphyton was observed on the cobble. The macroinvertebrate community scored acceptable (1, Tables 19 and 20).

Figure 15. Pine River at Skookum Road canoe launch.

Station 18 was located upstream of M-37 in the Peterson Bridge campground (Figure 16). The riffle/run habitat scored excellent (155, non-impaired; Table 18). The reach sampled was almost entirely a riffle area. On the left side of the stream the bank was eroding and sand formed a shallow pool area, which did not provide much epifaunal substrate. The cobble that made up the riffle was approximately 50 percent embedded in the sand. Attached algae were abundant on the rocks. Large woody structures, sticks, and leaf packs were fairly common. The macroinvertebrate community scored acceptable (1; Tables 19 and 20).

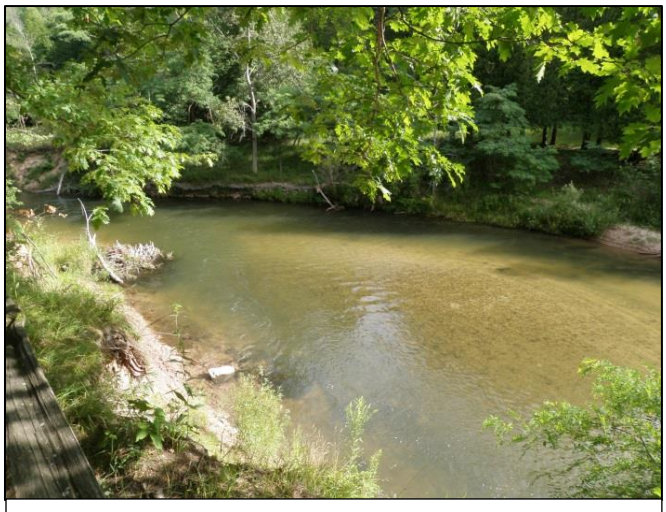

Figure 16. Pine River upstream of Peterson Bridge Campground.

The most downstream station sampled on the Pine River was Station 19 at the end of Stronach Dam Road (Figure 17). The glide/pool habitat scored Good (105; slightly impaired; Table 18). However, the habitat was much different than that observed at the upstream three stations. The river had much less habitat diversity with a very flat sandy area observed at the outside bend. Large woody structures were not abundant. Gravel was only available in the thalweg (fastest flowing and deepest part of the stream). The macroinvertebrate community scored acceptable (1; Tables 19 and 20), similar to the other reaches sampled on the Pine River.

Figure 17. Pine River at Stronach Dam Road.

BEAR CREEK

Bear Creek is a tributary to the Manistee River that flows from north to south. The headwaters begin near Bear Lake, located adjacent to US-31, and the confluence with the Manistee River is downstream of Pine Creek. Three stations were sampled in Bear Creek. The most upstream Station 20 was sampled at Leffew Road where a bridge is no longer in service (Figure 18). This is an MDNR, Fisheries Division, status and trend site and was targeted for sampling so that complementary macroinvertebrate data are available for this station. The riffle/run habitat scored excellent (173; non-impaired; Table 21). The creek was a bit high with a fast current due to a recent rain event, making it difficult to see the habitat well. Gravel and cobble were available for epifaunal substrate with some depositional area also evident. Alders and ferns made up the very natural and extensive riparian area. The macroinvertebrate community scored acceptable (2; Tables 22 and 23). Despite the fact that several, pollution-sensitive, *Ephemeroptera, Plecoptera, and Trichoptera* family taxa were found at this station, there were also several individuals found that are more tolerant to pollution including 38 percent *Amphipoda* and several (6 percent) *Isopoda.* This is not an indicator of poor water quality since the sensitive taxa were found, but is somewhat unique for the 2014 surveys.

Figure 18. Bear Creek at Leffew Road.

Station 21 was sampled in Bear Creek at 13 Mile Road (Figure 19). The glide/pool habitat scored good (140; slightly-impaired; Table 21). Shifting sand and silt dominated the substrate at this site. The aquatic macrophyte *Elodea* and overhanging brush were the dominant epifaunal substrates. The road bridge at this crossing had been recently replaced and vegetation had not yet established resulting in erosion of the bank adjacent to the bridge. The macroinvertebrate community scored at the lower end of acceptable (-2; Tables 22 and 23). A large number of amphipods (54 percent) and a low percentage of caddisfly and mayfly taxa (10 percent and 17 percent, respectively) were found at this station resulting in a lower score. This site should be revisited in future biosurveys to determine if this unusually low score for the Manistee River watershed persists.

Figure 19. Bear Creek at 13 Mile Road.

Station 22 was sampled at Coates Highway (Figure 20). The riffle/run habitat scored good (140; slightly-impaired; Table 21). Sand dominated the substrate at this station, especially near the road crossing, but more gravel was available upstream of the first bend. A large pile of woody material slows down the water at the inside of the bend and much of the sand settles out. There is a large amount of sediment deposition at the bend suggesting a large sediment load moving through the stream during high water events. A powerline right-of-way impacts the riparian zone at this site with the removal of trees. The macroinvertebrate community scored excellent (6; Tables 22 and 23) with 4 stonefly taxa found. This large number of stonefly families is somewhat uncommon and an indicator of high water quality.

Figure 20. Bear Creek at Coates Highway.

LITTLE MANISTEE RIVER

The Little Manistee River was sampled at two stations. Station 23 was sampled upstream of Johnson's bridge off of private property (Figure 21; Table 24). This station is an MDNR, Fisheries Division, status and trend site and was targeted for SWAS sampling so that complimentary macroinvertebrate data are available for this station. The habitat datasheet for this station was misplaced but it is likely to have scored at the high end of good or low end of excellent. Gravel was present but was very embedded by sand. Large woody structures were available as well as overhanging vegetation. The riparian area on the right bank was dominated

by mowed lawns and the left bank was more natural but very steep. The macroinvertebrate community scored acceptable (2; Tables 25 and 26) with *Chironomidae* dominating (47%) the taxa found. The domination of one family of macroinvertebrates can be an indicator of an environmental stress. However, two stonefly taxa and several caddisfly and mayfly taxa were also found, which are less tolerant of pollution and suggest good water quality.

Figure 21. Little Manistee River upstream of Johnson's Bridge.

The second station sampled on the Little Manistee River is a trend station and was also sampled in 2009. Station 24 is located at 11 Mile Road off of private property upstream of the confluence of Cool Creek. The glide/pool habitat scored excellent (168; non-impaired; Table 24). There are many large deep pools with gravel substrates at this station along with moving firm sand and some silt making up the dominant substrate types. The large woody structures were well colonized. The macroinvertebrate community scored excellent (6; Tables 25 and 26), which is consistent with what the macroinvertebrate community scored in 2009 and 2010 when the station was sampled as part of a quality assurance study (unpublished data from the SWAS biosurvey database).

STRONACH CREEK

Station 25 was sampled on Stronach Creek downstream of Java Road. This is a trend station and was sampled in 2009. The riffle/run habitat scored excellent (157; non-impaired; Table 24). This is a small stream with good perennial flow and a diversity of epifaunal substrate available for macroinvertebrate colonization. The macroinvertebrate community scored excellent (7; Tables 25 and 26), which is consistent with what the macroinvertebrate community scored in 2009. Thirty-two taxa were found, which is amazing considering the small size of the stream. The twin culverts at this crossing need to be replaced. They are not aligned properly and are both perched and therefore blocking fish passage and sediment transport.

SICKLE CREEK

Station 26 was sampled on Sickle Creek off of Forest Service Road 5777, which leads to a popular Manistee River access site, Rainbow Bend (Figure 22). This station was targeted for sampling because in 2011, the Little River Band of Ottawa Indians (LRBOI) sampled this station after the road crossing had been replaced (using the SWAS Procedure 51) and found the macroinvertebrates scored poor. When SWAS staff sampled this station in 2014 the riffle/run habitat was rated good (124; slightly impaired; Table 24) and the macroinvertebrate community scored at the lower end of acceptable (-1; Tables 25 and 26) and thus was meeting the OIALW designated use. The epifaunal substrate at this station available

Figure 22. Sickle Creek at Forest Service Road 5777.

for colonization was limited due to the degree it was embedded in the sand. Tree roots were exposed due to erosion nearly two feet above the surface of the water, and indicate the stream may be flashy.

MANISTEE RIVER NONWADEABLE STATIONS

Figure 23. Manistee River nonwadeable station upstream of Coster Road.

Four additional stations on the main branch of the Manistee River were assessed using the SWAS Procedure 22 (MDEQ, 2013). These four stations are labeled NW-1, NW-2, NW-3, and NW-4, (Table 4 and Figure 1). The most upstream station NW-1 was sampled at Coster Road (Figure 23) and was accessed via the boat launch at this crossing. NW-2 and NW-3 were accessed via private property off of River Road. NW-5 was the most downstream station, located approximately 5.2 miles upstream of Caberfae Highway. It was accessed via private property off Peterson Road. Macroinvertebrate community scores were good or excellent (Appendix A).

Objective 2: Satisfy monitoring requests submitted by internal and external customers

SLAGLE CREEK

Water quality, macroinvertebrate community, and habitat sampling of Slagle Creek upstream and downstream of a private fish hatchery was conducted by staff of the MDEQ, Permits Section, in 2014. Results of this sampling can be found in a separate report (Schmitt, 2015). Permits Section staff requested any additional information the SWAS may collect regarding Slagle Creek in 2014. One of the trend stations is on Slagle Creek downstream of S 1 Road. The macroinvertebrate community was rated excellent (5) in 2014 (Tables 13 and 14) compared with the acceptable tending towards excellent rating (3) found in 2009 (Lipsey, 2010).

Fish waste and resultant nutrients are the primary concerns for potential impacts to Slagle Creek from the private hatchery and a State of Michigan Hatchery discharge that is located further upstream of the private hatchery on Slagle Creek.

Schmitt (2015) indicates that habitat in Slagle Creek may be impacted downstream of the hatchery due to bank sloughing while the water quality samples did not indicate any water quality exceedances. Slagle Creek is currently meeting designated uses (Goodwin et al., 2014; Schmitt, 2015). To determine if the hatcheries are impacting nutrient loads and water quality, continuous water quality monitoring for nutrients and more rigorous biological assessment would be necessary.

MDNR FIXED TARGETED MONITORING STATIONS

Macroinvertebrate community and habitat sampling occurred at five stations (1, 6, 16, 20, and 23) in the Manistee River watershed that are MDNR, Fisheries Division, fixed, long-term targeted monitoring stations. Macroinvertebrate community and habitat data will complement the fish community information collected on a regular basis at these stations. The macroinvertebrate community scored at the high end of acceptable or excellent at all five stations. The habitat rating was good or excellent at all stations (Table 4).

SICKLE CREEK

The targeted stations submitted by SWAS staff included Sickle Creek at Forest Service Road 8348, which leads to the Manistee River-Rainbow Bend boat launch (Station 26). In 2011, the LRBOI found that the macroinvertebrate community scored poor (using Procedure 51 metrics) at this station. It is also one of the LRBOI's long-term monitoring stations. In 2014, SWAS staff found that the macroinvertebrate community was rated as acceptable (-1; Tables 25 and 26). Habitat was rated as good (124; Table 24); but had a large amount of sand deposition that embedded the large woody material. It also appeared that the stream may be somewhat flashy as was evident by the exposed tree roots. The road crossing had been recently replaced with a bridge. Perhaps the poor score found in 2011 was prior to the bridge being installed. It may be useful to look more closely at the land use upstream of this road crossing and see if there are opportunities to minimize the impact of high flows.

INSUFFICIENT INFORMATION STATIONS

Three additional stations were noted to have insufficient information for one or more designated uses in our assessment database and thus were targeted for sampling. Black Creek at Riverview Road (Station SV-2) is listed for insufficient information for both the CWF and OIALW designated uses (Goodwin et al., 2014). This site was visited in 2009 and the road crossing had been washed out due to beaver activity. In 2014, this station was visited and was nearly stagnant upstream of Riverview Road due to beaver activity and is not suitable for Procedure 51. Downstream of Riverview Road, the stream was flowing, but was likely to be impacted by the ponded area upstream of the road and thus would still not be suitable for Procedure 51. We sampled Black Creek further downstream at the end of Goose Creek Road (Station 5). The macroinvertebrate community was rated as acceptable (-1, Tables 9 and 10) and the habitat was rated at the high end of good (154, Table 8). Fish sampling was attempted, but could not be completed due to the backpack electrofishing unit malfunctioning. The CWF designated use will remain as insufficient information and the OIALW designated use is being met (Goodwin et al., 2016, in draft).

Big Cannon Creek at Naples Road has been listed as having insufficient information for CWF. Less than 1% of *Salmonidae* species were found in 2004 and it was noted by SWAS staff (Bruce Walker, unpublished notes) that upstream impoundments may be causing increased temperatures at this site that may be impacting the CWF. Fish sampling was not attempted due to the backpack electrofishing unit malfunctioning. The CWF designated use in Big Cannon Creek will remain as having insufficient information.

Little Devil Creek (SV-3) is currently listed as having insufficient information for the OIALW designated use because it has very little flow and may be intermittent (Goodwin et al., 2014). The macroinvertebrate community was not sampled at Vallad Drive SE (SV-3) because conditions indicated that the stream is intermittent and not suitable for Procedure 51. This stream will be changed to attaining designated uses in the next integrated report since there is no information suggesting it would not meet them.

Objective 3: Identify NPS of water quality impairment.

The following NPS issues were observed or investigated in the 2012 sampling season. Locations are noted in Figure 1 and Table 1.

NORTH BRANCH MANISTEE RIVER AT MECUM ROAD

The road crossing at Mecum Road over the North Branch of the Manistee River was replaced in 2012. This crossing previously included five separate culverts placed side by side that restricted the flow of the river and prevented sediment transport. The five culverts were replaced with a timber bridge. Previous to the culvert replacement the MDNR, Fisheries Division, had sampled the North Branch Manistee River at Mecum Road from 2002-2004 and again in 2008 (Tonello, 2015). During the 2008 survey, only two brook trout were caught. It was noted that the habitat within the reach had changed dramatically since the 2004 survey. Silt and sand had filled deeper holes that formerly provided habitat for trout. The river resembled more of an impoundment than a stream due to numerous kinds of aquatic vegetation and northern pike that were present within the reach (Tonello, 2010). In 2014, SWAS staff conducted fish and macroinvertebrate community and habitat sampling using Procedure 51 at this station (Figure 24). Macroinvertebrates were rated as excellent (7; Table 10), habitat was rated as good (145; Table 8), and salmonid species were 4.6 percent of the fish captured (Table 11). This meets the 1 percent ratio needed to meet the CWF designated use.

Figure 24. North Branch Manistee River at Mecum Road.

The MDNR also sampled fish in 2014 and captured 19 brook trout and 1 brown trout (Tonello, 2015). These data suggest that the Mecum Road crossing improvement is a successful application of a best management practice to improve salmonid fisheries population numbers.

GOOSE CREEK AT GOOSE CREEK ROAD, BEAR LAKE TOWNSHIP, KALKASKA COUNTY

The culvert at this road crossing is undersized for the stream size and is causing the stream to pool, similar to what we found in 2009 (Lipsey, 2010). The macroinvertebrate community was not assessed in 2014.

CHIEF CREEK AT RIVER ROAD AND AT COATES HIGHWAY

These two stations were observed for NPS of pollution. The culvert at the River Road crossing may be undersized. Chief Creek seems to widen upstream of the culvert and woodchips and sediment deposits were evident (Figure 25), which indicates water likely gets backed up during high flows. A plunge pool is present at the Coates Highway road crossing and the culvert should be replaced to allow for fish passage. The macroinvertebrate community was not assessed at these stations in 2014.

Figure 25. Chief Creek at River Road. Sedimentation upstream of road.

CEDAR CREEK AT ORAVAINEN ROAD

Cedar Creek at Oravainen Road was visited in 2009 and revisited in 2014 due to bank stabilization issues that are the result of construction of a pond that periodically discharges to Cedar Creek via an overflow pipe connection. Erosion issues continue at this site (Figures 26, 27, and 28) and efforts to work with the landowner to remediate the impacts would be beneficial to reduce sediment input to the stream.

Figure 26. Cedar Creek at Oravainen Road.

Figure 27. Cedar Creek at Oravainen Road.

Figure 28. Cedar Creek at Oravainen Road.

COOL CREEK AT 12 MILE ROAD

Figure 29. Cool Creek upstream (north) of 12-Mile Road. Cattle access causing erosion and sedimentation.

Cattle have direct access to approximately 300 feet of Cool Creak at 12 Mile Road and banks are being trampled causing erosion (Figure 29). Access is limited to north of 12-Mile Road. Water and macroinvertebrate community samples were not collected due to time constraints. In the future, if landowner access is granted, Cool Creek could be assessed upstream and downstream of the cattle access, south of 12-Mile Road. Cool Creek flows from south to north and then south again across 12-Mile Road. It is the MDEQ's understanding that Right to Farm personnel has been alerted to the issue. Staff of the MDEQ, NPS Unit, and Michigan Department of Agriculture and Rural Development should be consulted prior to 2019 watershed sampling to determine if actions have been taken to rectify the problem, thereby necessitating additional monitoring to document impairment or improvement.

Objective 4: Gather water quality data needed for fiscal years 2013 and 2014 TMDL development or delisting.

Portions of the Manistee River watersheds are on the nonattainment list due to PCB concentrations in the water column or in fish tissue (Goodwin et al., 2016, in draft). A draft statewide PCB TMDL has been developed and includes these water bodies. No additional data were collected to support TMDL development.

Objective 5: Evaluate biological integrity temporal trends.

Ten sites (3, 4, 8, 10, 12, 13, 14, 21, 24, and 35) were selected as trend stations in the Manistee River watershed. They were sampled in 2009 and 2014, and will be sampled once every five years in the future. Stations 3, 10, 12, 14, and 20 will be used to analyze watershed trends, while the remaining stations will be used to analyze statewide trends (MDEQ, 2015). This information will be presented in a future statewide status and trend report.

Conclusions and Future Monitoring Recommendations

In 2014, aquatic macroinvertebrate community and habitat assessments were conducted at a total of 30 stations in the Manistee River watershed (Table 4, Figure 1). The OIALW designated use was being met at all stations. The macroinvertebrate community in Coe Creek, Peterson Creek, Stronach Creek, upper Manistee River off of Weber Road, and the North Branch of the Manistee River all had a high score of 7 or 8 (excellent). Peterson Creek had an excellent macroinvertebrate community despite the amount of sedimentation observed. This water body may be one of interest to watershed groups seeking areas that may be in need of attention for protection.

The macroinvertebrate community in Black Creek, Anderson Creek, and Sickle Creek scored in the lower end of acceptable (-1). Sickle Creek (Station 26) had a large amount of sand deposition, large woody material was embedded, and the stream appeared to be flashy. In 2011, the LRBOI used Procedure 51 following a bridge replacement and found a poor score at this station (LRBOI, 2013). The score may have been a result of the recent bridge construction; yet it may be useful to look more closely at the land use upstream of this road crossing to see if there may be best management practices that could be implemented to minimize the impact of high flows.

The macroinvertebrate community in Bear Creek at 13 Mile Road had a relatively low score (-2) and should be revisited in future biosurveys to determine if this unusually low score for the Manistee River watershed persists.

The relatively low score (0) found in the Manistee River downstream of Hodenpyl Dam (Station 11) may be artificially low. Although the reach was wadeable, the current was very quick, and it was difficult to sample all available habitats using the wadeable Procedure 51. If this reach of stream is sampled in the future, the nonwadeable Procedure 22 could be considered for use or alternatively, a boat could be used to get to various habitat types since parts of the reach was nonwadeable.

Slagle Creek has been of interest to the SWAS due to the potential environmental impact of both private- and state-run fish hatcheries that discharge to the stream. Slagle Creek is meeting designated uses according to current listing methodologies (Goodwin et al., 2014; Schmitt, 2015). To determine if the hatcheries are impacting nutrient loads and water quality, continuous water quality monitoring for nutrients and more rigorous biological assessments would be necessary. A quantitative sampling method with repetitive sampling over a longer time period may be more informative, but may not necessarily change designated use attainment determination.

The CWF designated use in Black Creek at the end of Goose Creek Road will remain as insufficient information, while the OIALW designated use is being met. The CWF designated use in Big Cannon Creek will remain as having insufficient information. The CWF designated use of the North Branch of the Manistee River upstream of Mecum Road should be listed as being met. The OIALW designated use in Little Devil Creek will be changed from insufficient information to meeting designated uses, since there is no information suggesting it would not meet designated uses and is simply an intermittent stream.

There were several road crossings that should be considered for repair or replacement. These include the North Branch Manistee River at Kniss Road (age of structure), Goose Creek at Goose Creek Road (undersized), Chief Creek at River Road (undersized), Chief Creek at Coates Highway (plunge pool), and Stronach Creek at Java Road (misaligned).

Bank erosion issues in Cedar Creek at Oravainen Road due to the outfall of a constructed pond adjacent to the creek and in Cool Creek at 12-Mile Road due to cattle access were observed in both 2009 and 2014. Efforts to work with the landowners at each of these stations to remediate impacts would be beneficial to reduce sediment input to the stream. Staff of the Department of Agriculture and Rural Development should be consulted prior to 2019 watershed sampling to determine if actions have been taken to rectify the cattle access issue in Cool Creek, thereby necessitating additional monitoring to document impairment or improvement.

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Table 5. Habitat evaluation for selected stations in the Manistee River watershed, July 2014.

	Manistee River @ Cameron Road GLIDE/POOL	Manistee River off King Road GLIDE/POOL	Manistee River @ Weber Rd./ Sunset Trail GLIDE/POOL	Manistee River @ Weber Road GLIDE/POOL
	Station 1	**Station 2**	**Station 3**	**Station 4**
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	13	10	14	16
Embeddedness (20)*				
Velocity/Depth Regime (20)*				
Pool Substrate Characterization (20)**	12	12	16	17
Pool Variability (20)**	14	15	14	15
Channel Morphology				
Sediment Deposition (20)	5	8	12	15
Flow Status - Maintenance Flow Volume (10)	10	10	10	10
Flow Status - Flashiness (10)	10	10	10	10
Channel Alteration (20)	16	20	20	19
Frequency of Riffles/Bends (20)*				
Channel Sinuosity (20)**	16	18	18	18
Riparian and Bank Structure				
Bank Stability (L) (10)	10	10	10	10
Bank Stability (R) (10)	10	10	10	8
Vegetative Protection (L) (10)	10	8	8	9
Vegetative Protection (R) (10)	8	10	8	6
Riparian Vegetative Zone Width (L) (10)	10	8	10	10
Riparian Vegetative Zone Width (R) (10)	7	10	7	8
TOTAL SCORE (200):	**151**	**159**	**167**	**171**
HABITAT RATING:	**GOOD (SLIGHTLY IMPAIRED)**	**EXCELLENT (NON-IMPAIRED)**	**EXCELLENT (NON-IMPAIRED)**	**EXCELLENT (NON-IMPAIRED)**
Date:	6/18/2014	6/18/2014	7/15/2014	7/15/2014
Weather:	Cloudy	Partly Cloudy	Cloudy	Rainy
Air Temperature: °F		73	62	62
Water Temperature: °F	51	59	60	60
Average Stream Width: Feet	41	79	81	71.07
Average Stream Depth: Feet	2	3	2.59	2.27
Surface Velocity: Feet/Second	1.96	1.6	3.14	3.42
Estimated Flow: Cubic Feet/Second	160.72	379.2	658.7406	551.744838
Stream Modifications:	Habitat Improvement	None	None	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	200155	400167	400143	400144
County Code:	20	40	40	40
TRS:	28N04W19	06N05W29	26N06W35	26N06W34
Latitude (dd):	44.79993	44.61981	44.611	44.60839
Longitude (dd):	-84.84048	-84.93933	-84.99744	-85.01299
Ecoregion:	NLAF	NLAF	NLAF	NLAF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060103	4060103	4060103	4060103

*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 6. Qualitative macroinvertebrate community sampling results at selected stations in the Manistee River watershed, Crawford and Kalkaska County, June-July 2014.

	Manistee River @ Cameron Road 6/18/2014	Manistee River off King Road 6/18/2014	Manistee River @ Weber Road/ Sunset Trail 7/15/2014	Manistee River @ Weber Road 7/15/2014
TAXA	**Station 1**	**Station 2**	**Station 3**	**Station 4**
PORIFERA (sponges)				
PLATYHELMINTHES (flatworms)				
Turbellaria				
ANNELIDA (segmented worms)				
Hirudinea (leeches)	1	1		
Oligochaeta (worms)	10	1	4	4
ARTHROPODA				
Crustacea				
Amphipoda (scuds)		1	6	9
Decapoda (crayfish)		1		1
Isopoda (sowbugs)	13	7	16	16
Arachnoidea				
Hydracarina	41	18	17	2
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae		24	1	1
Baetidae	15	10	40	34
Caenidae			16	9
Ephemerellidae	26	9	21	56
Ephemeridae		6	3	6
Heptageniidae	1	3	7	2
Isonychiidae		1	7	7
Leptophlebiidae				
Tricorythidae				1
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		3	1	1
Gomphidae		1	6	3
Zygoptera (damselflies)				
Calopterygidae		13	2	7
Coenagrionidae				
Plecoptera (stoneflies)				
Leuctridae	1			
Nemouridae				
Perlidae		2	4	5
Perlodidae	2	13		
Pteronarcyidae		1	2	
Hemiptera (true bugs)				
Belostomatidae				
Corixidae		34	3	
Gelastocoridae				1
Gerridae			1	
Megaloptera				
Corydalidae (dobson flies)				
Sialidae (alder flies)				
Trichoptera (caddisflies)				
Brachycentridae	13	3	11	5
Glossosomatidae	2			1
Helicopsychidae			3	4

	Manistee River @ Cameron Road 6/18/2014	Manistee River off King Road 6/18/2014	Manistee River @ Weber Road/ Sunset Trail 7/15/2014	Manistee River @ Weber Road 7/15/2014
TAXA	**Station 1**	**Station 2**	**Station 3**	**Station 4**
Hydropsychidae	4	11	14	27
Hydroptilidae				
Lepidostomatidae	37	3	3	1
Leptoceridae	16	5	1	5
Limnephilidae	50	14	1	5
Molannidae	1	1		
Philopotamidae				
Polycentropodidae		2		
Uenoidae	3		1	
Coleoptera (beetles)				
Haliplidae (adults)				
Hydrophilidae (total)				
Elmidae	1	1	13	21
Gyrinidae (larvae)		1		
Diptera (flies)				
Athericidae	3		14	18
Ceratopogonidae		1	1	1
Chironomidae	12	20	47	31
Culicidae			1	
Dixidae	1			
Simuliidae	25	1	4	7
Stratiomyidae		1		
Tabanidae	25	1	4	7
Tipulidae	1		1	
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		1		
Bithyniidae				
Hydrobiidae		17		1
Lymnaeidae			1	1
Physidae	1	2		1
Planorbidae				
Pomatiopsidae	3			
Viviparidae			3	
Pelecypoda (bivalves)				
Dreissenidae				
Sphaeriidae (clams)		47	1	1
Unionidae (mussels)				
TOTAL INDIVIDUALS	309	287	282	306

Table 7. Macroinvertebrate metric evaluation of selected stations in the Manistee River watershed, Crawford and Kalkaska Counties June-July 2014.

	Manistee River @ Cameron Road 6/18/2014		**Manistee River off King Road 6/18/2014**		**Manistee River @ Weber Road/ Sunset Trail 7/15/2014**		**Manistee River @ Weber Road 7/15/2014**	
	Station 1		**Station 2**		**Station 3**		**Station 4**	
METRIC	Value	Score	Value	Score	Score	Value	Score	Value
TOTAL NUMBER OF TAXA	27	0	37	1	36	1	37	1
NUMBER OF MAYFLY TAXA	3	0	6	1	7	1	8	1
NUMBER OF CADDISFLY TAXA	8	1	7	1	7	1	7	1
NUMBER OF STONEFLY TAXA	2	1	3	1	2	1	1	0
PERCENT MAYFLY COMPOSITION	14.74	0	18.60	0	34.17	1	38.54	1
PERCENT CADDISFLY COMPOSTITION	44.21	1	13.68	0	12.23	0	15.95	0
PERCENT DOMINANT TAXON	17.54	0	16.49	1	16.91	1	18.60	0
PERCENT ISOPOD, SNAIL, LEECH	6.32	0	9.82	0	7.19	0	6.31	0
PERCENT SURFACE AIR BREATHERS	0.00	1	12.28	0	1.80	1	0.33	1
TOTAL SCORE		4		5		7		5
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		EXCELLENT		EXCELLENT		EXCELLENT	

Table 8. Habitat evaluation for selected stations in the Manistee River watershed, July-August, 2014.

	Black Creek @ Goose Creek Road GLIDE/POOL	North Branch Manistee River @ Kniss Rd GLIDE/POOL	North Branch Manistee River @ Mecum Rd GLIDE/POOL	Little Cannon Creek @ Dutch John Rd RIFFLE/RUN
	Station 5	**Station 6**	**Station 7**	**Station 8**
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	11	13	8	18
Embeddedness (20)*				11
Velocity/Depth Regime (20)*				14
Pool Substrate Characterization (20)**	11	12	8	
Pool Variability (20)**	14	10	13	
Channel Morphology				
Sediment Deposition (20)	4	10	5	14
Flow Status - Maintenance Flow Volume (10)	10	10	10	10
Flow Status - Flashiness (10)	10	10	10	10
Channel Alteration (20)	20	18	18	19
Frequency of Riffles/Bends (20)*				17
Channel Sinuosity (20)**	18	10	13	
Riparian and Bank Structure				
Bank Stability (L) (10)	10	10	10	10
Bank Stability (R) (10)	10	10	10	9
Vegetative Protection (L) (10)	8	10	10	9
Vegetative Protection (R) (10)	8	10	10	9
Riparian Vegetative Zone Width (L) (10)	8	10	10	9
Riparian Vegetative Zone Width (R) (10)	10	10	10	10
TOTAL SCORE (200):	152	153	145	169
HABITAT RATING:	**GOOD (SLIGHTLY IMPAIRED)**	**GOOD (SLIGHTLY IMPAIRED)**	**GOOD (SLIGHTLY IMPAIRED)**	**EXCELLENT (NON-IMPAIRED)**
Date:	8/20/2014	8/19/2014	8/19/2014	7/15/2014
Weather:	Cloudy	Cloudy	Partly Cloudy	Cloudy
Air Temperature: °F	70	65	65	64
Water Temperature: °F	67	64	62	62
Average Stream Width: Feet	13.5	34.43	27.5	87.5
Average Stream Depth: Feet	0.99	0.95	1.84	1.01
Surface Velocity: Feet/Second	1.13	0.88	1.07	1.5
Estimated Flow: Cubic Feet/Second	15.10245	28.78348	54.142	132.5625
Stream Modifications:	None	None	None	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	400168	400123	400120	400111
County Code:	40	40	40	40
TRS:	26N05W29	26N06W02	26N06W15	25N07W27
Latitude (dd):	44.62161	44.67024	44.64104	44.53646
Longitude (dd):	-84.94091	-85.0073	-85.02687	-85.13686
Ecoregion:	NLAF	NLAF	NLAF	NLAF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060103	4060103	4060103	4060103

*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 9. Qualitative macroinvertebrate community sampling results at selected stations in the Manistee River watershed, Kalkaska County, July-August, 2014.

	Black Creek @ Goose Creek Road 8/20/2014	North Branch Manistee River @ Kniss Rd 8/19/14	North Branch Manistee River @ Mecum Rd 8/19/14	Little Cannon Creek @ Dutch John Rd 7/15/2014
TAXA	**Station 5**	**Station 6**	**Station 7**	**Station 8**
ANNELIDA (segmented worms)				
Hirudinea (leeches)		1		
Oligochaeta (worms)		5	2	6
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	45	71	17	6
Decapoda (crayfish)	1	1	1	1
Isopoda (sowbugs)	4	2		
Arachnoidea				
Hydracarina			6	3
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae		33	2	
Baetidae	12	26	47	19
Ephemerellidae		1	1	8
Ephemeridae				12
Heptageniidae			13	2
Isonychiidae	4	6	1	3
Leptophlebiidae				
Tricorythidae		4		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	13	2	4	2
Cordulegastridae	1	1		
Gomphidae	11		1	9
Macromiidae				
Zygoptera (damselflies)				
Calopterygidae	11	1	4	1
Coenagrionidae				
Plecoptera (stoneflies)				
Nemouridae		6		
Perlidae		1	2	4
Perlodidae				
Pteronarcyidae			4	
Hemiptera (true bugs)				
Corixidae	13	1	11	
Gerridae				
Mesoveliidae		1		1
Megaloptera				
Corydalidae (dobson flies)		1		4
Sialidae (alder flies)			1	
Trichoptera (caddisflies)				
Brachycentridae		35	15	6
Glossosomatidae		1		1
Helicopsychidae				1
Hydropsychidae	10	29	58	166

	Black Creek @ Goose Creek Road 8/20/2014	North Branch Manistee River @ Kniss Rd 8/19/14	North Branch Manistee River @ Mecum Rd 8/19/14	Little Cannon Creek @ Dutch John Rd 7/15/2014
TAXA	**Station 5**	**Station 6**	**Station 7**	**Station 8**
Hydroptilidae			2	1
Lepidostomatidae				1
Leptoceridae				2
Limnephilidae	3		3	1
Philopotamidae		1		3
Phryganeidae	6	1	2	
Polycentropodidae		5	1	
Psychomyiidae				
Uenoidae				2
Coleoptera (beetles)				
Dytiscidae (total)	2		2	
Gyrinidae (adults)	3			
Haliplidae (adults)				
Hydrophilidae (total)				
Elmidae	2	10		15
Diptera (flies)				
Athericidae		6		
Ceratopogonidae		2	2	1
Chironomidae	5	47	25	49
Ptychopteridae				
Simuliidae		28	18	5
Tabanidae				
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		10	3	1
Bithyniidae				
Hydrobiidae			5	
Physidae		1	9	
Pelecypoda (bivalves)				
Dreissenidae				
Sphaeriidae (clams)			3	1
Unionidae (mussels)				
TOTAL INDIVIDUALS	148	344	265	346

Table 10. Macroinvertebrate metric evaluation of selected stations in the Manistee River watershed, Grand Traverse, Manistee, and Wexford Counties, July 2014.

	Black Creek @ Goose Creek Road 8/20/2014		North Branch Manistee River @ Kniss Rd 8/19/14		North Branch Manistee River @ Mecum Rd 8/19/14		Little Cannon Creek @ Dutch John Rd 7/15/2014	
	Station5		Station 6		Station 7		Station 8	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	18	0	33	1	30	1	33	1
NUMBER OF MAYFLY TAXA	3	0	6	1	5	1	6	1
NUMBER OF CADDISFLY TAXA	3	0	6	1	6	1	10	1
NUMBER OF STONEFLY TAXA	0	-1	2	1	2	1	1	0
PERCENT MAYFLY COMPOSITION	12.16	0	21.22	0	24.15	1	15.03	0
PERCENT CADDISFLY COMPOSTITION	12.84	0	20.93	0	30.57	1	53.18	1
PERCENT DOMINANT TAXON	30.41	-1	20.64	0	21.89	0	47.98	-1
PERCENT ISOPOD, SNAIL, LEECH	2.70	1	4.07	0	6.42	0	0.58	1
PERCENT SURFACE AIR BREATHERS	12.16	0	0.87	1	4.91	1	0.29	1
TOTAL SCORE		-1		5		7		5
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		EXCELLENT		EXCELLENT		EXCELLENT	

Table 11. Qualitative fish community sampling results from the North Branch Manistee River at Mecum Road August, 2014.

TAXA	North Branch Manistee River @ Mecum Rd 8/19/2014 STATION 7
Petromyzontidae (lampreys)	
Ichthyomyzon castaneus (Chestnut lamprey)	5
Salmonidae (trouts)	
Salmo trutta (Brown trout)	5
Umbridae (mudminnows)	
Umbra limi (Central mudminnow)	16
Esocidae (pikes)	
Esox lucius (Northern Pike)	2
Cyprinidae (minnows and carps)	
Semotilus atromaculatus (Creek chub)	12
Luxilus cornutus (Common shiner)	1
Rhinichthys atratulus (Blacknose dace)	7
Cottidae (sculpins)	
Cottus bairdii (Mottled sculpin)	6
Catostomidae (suckers)	
Catostomus commersoni (White sucker)	30
Percidae (perch)	
Etheostoma caeruleum (Rainbow darter)	2
Etheostoma nigrum (Johnny darter)	20
Percina caprodes (Logperch)	1
Lotidae (codfishes)	
Lota lota (Burbot)	1
TOTAL INDIVIDUALS	**108**
Number of hybrid sunfish	0
Number of anomalies	0
Percent anomalies	0.000
Percent salmonids	4.630
Reach sampled (ft)	500
Area sampled (sq ft)	13,750
Density (# fish/sq ft)	0.008
Gear	stream shocker

Table 12. Habitat evaluation for selected stations in the Manistee River watershed, July 2014.

	Fife Lake Outlet @ East County Line Road GLIDE/POOL	Anderson Creek @ County Line Road GLIDE/POOL	Manistee River @ downstream Hodenpyle Dam RIFFLE/RUN	Slagle Creek @ d/s S1 Road RIFFLE/RUN
	Station 9	**Station 10**	**Station 11**	**Station 12**
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	13	9	15	17
Embeddedness (20)*			13	16
Velocity/Depth Regime (20)*			15	14
Pool Substrate Characterization (20)**	13	10		
Pool Variability (20)**	17	11		
Channel Morphology				
Sediment Deposition (20)	8	6	16	13
Flow Status - Maintenance Flow Volume (10)	10	10	10	10
Flow Status - Flashiness (10)	10	10	9	8
Channel Alteration (20)	13	17	18	19
Frequency of Riffles/Bends (20)*			20	16
Channel Sinuosity (20)**	19	8		
Riparian and Bank Structure				
Bank Stability (L) (10)	10	10	5	10
Bank Stability (R) (10)	10	10	5	10
Vegetative Protection (L) (10)	8	10	8	9
Vegetative Protection (R) (10)	8	10	8	9
Riparian Vegetative Zone Width (L) (10)	10	10	10	10
Riparian Vegetative Zone Width (R) (10)	10	10	10	10
TOTAL SCORE (200):	159	141	162	171
HABITAT RATING:	**EXCELLENT (NON-IMPAIRED)**	**GOOD (SLIGHTLY IMPAIRED)**	**EXCELLENT (NON-IMPAIRED)**	**EXCELLENT (NON-IMPAIRED)**
Date:	6/19/2014	7/15/2014	7/8/2014	7/16/2014
Weather:	Sunny	Cloudy	Cloudy	Partly Cloudy
Air Temperature: °F	65	64	68	69
Water Temperature: °F	62	70	67	55
Average Stream Width: Feet	31.6	21	121	23.6
Average Stream Depth: Feet	1.2	1.2	3.5	0.89
Surface Velocity: Feet/Second	2.17	0.73	2.11	3.9
Estimated Flow: Cubic Feet/Second	82.2864	18.396	893.585	81.9156
Stream Modifications:	None	None	Impounded	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	280429	280411	510229	830224
County Code:	28	28	51	83
TRS:	25N09W35	25N11W34	23N13W36	22N12W06
Latitude (dd):	44.5124	44.51235	44.35204	44.327457
Longitude (dd):	-85.37017	-85.62202	-85.83512	-85.819301
Ecoregion:	NLAF	NCHF	NLAF	NLAF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060103	4060103	4060103	4060103

*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 13. Qualitative macroinvertebrate community sampling results at selected stations in the Manistee River watershed , Grand Traverse, Manistee, and Wexford Counties, July 2014.

	Fife Lake Outlet @ East County Line Road 6/19/2014	Anderson Creek @ County Line Road 7/15/2014	Manistee River @ downstream Hodenpyle Dam 7/8/2014	Slagle Creek @ d/s S1 Road 7/16/2014
TAXA	**Station 9**	**Station 10**	**Station 11**	**Station 12**
PLATYHELMINTHES (flatworms)				
Turbellaria				3
ANNELIDA (segmented worms)				
Hirudinea (leeches)			1	1
Oligochaeta (worms)	1	3		16
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	60	15	214	12
Decapoda (crayfish)	3	1	2	
Isopoda (sowbugs)			1	1
Arachnoidea				
Hydracarina	3	6	1	21
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae	1			
Baetidae	16	1	23	81
Caenidae		10		
Ephemerellidae	26		3	70
Ephemeridae		6		
Heptageniidae	1	1		
Isonychiidae				
Leptophlebiidae		1		2
Tricorythidae	3	22		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	17	6		
Gomphidae	3	1		
Libellulidae	1			
Zygoptera (damselflies)				
Calopterygidae	2	13		
Coenagrionidae			1	
Plecoptera (stoneflies)				
Nemouridae	2			6
Perlidae	12			
Pteronarcyidae				1
Hemiptera (true bugs)				
Gerridae		2		
Corixidae	4		1	
Mesoveliidae		5	1	
Veliidae		1		
Megaloptera				
Corydalidae (dobson flies)	1	2		
Sialidae (alder flies)		3		
Trichoptera (caddisflies)				
Brachycentridae	6		1	27
Glossosomatidae			4	4
Helicopsychidae			1	
Hydropsychidae	13	2	132	13
Hydroptilidae		8		

	Fife Lake Outlet @ East County Line Road 6/19/2014	Anderson Creek @ County Line Road 7/15/2014	Manistee River @ downstream Hodenpyle Dam 7/8/2014	Slagle Creek @ d/s S1 Road 7/16/2014
TAXA	**Station 9**	**Station 10**	**Station 11**	**Station 12**
Lepidostomatidae				8
Leptoceridae	1	3	2	5
Limnephilidae	14	3		1
Philopotamidae	11			34
Phryganeidae		4		
Polycentropodidae		21		
Psychomyiidae				
Uenoidae				
Coleoptera (beetles)				
Gyrinidae (adults)				
Hydrophilidae (total)				
Elmidae	13	3		18
Psephenidae (larvae)			1	
Diptera (flies)				
Athericidae				
Ceratopogonidae	23			3
Chironomidae	8	101	24	49
Dixidae	1	2		
Simuliidae	4		9	130
Tabanidae		2		1
Tipulidae	1			
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)		1	2	
Bithyniidae				
Hydrobiidae	4	3		
Lymnaeidae			1	
Physidae	1		9	2
Pleuroceridae			1	
Pomatiopsidae	1			
Viviparidae	1			
Pelecypoda (bivalves)				
Sphaeriidae (clams)	1	3		
Unionidae (mussels)	1			
TOTAL INDIVIDUALS	260	255	436	509

Table 14. Macroinvertebrate metric evaluation of selected stations in the Manistee River watershed, Grand Traverse, Manistee, and Wexford Counties, July 2014.

	Fife Lake Outlet @ East County Line Road 6/19/2014		Anderson Creek @ County Line Road 7/15/2014		Manistee River @ downstream Hodenpyle Dam 7/8/2014		Slagle Creek @ d/s S1 Road 7/16/2014	
	Station 9		Station 10		Station 11		Station 12	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	34	1	31	1	23	0	24	0
NUMBER OF MAYFLY TAXA	5	1	6	1	2	-1	3	0
NUMBER OF CADDISFLY TAXA	5	0	6	1	5	0	7	1
NUMBER OF STONEFLY TAXA	2	1	0	-1	0	-1	2	1
PERCENT MAYFLY COMPOSITION	18.08	0	16.08	0	5.96	0	30.06	1
PERCENT CADDISFLY COMPOSTITION	17.31	0	16.08	-1	32.11	1	18.07	0
PERCENT DOMINANT TAXON	23.08	0	39.61	-1	49.08	-1	25.54	0
PERCENT ISOPOD, SNAIL, LEECH	2.69	1	1.57	0	3.44	1	0.79	1
PERCENT SURFACE AIR BREATHERS	1.54	1	3.14	-1	0.46	1	0.00	1
TOTAL SCORE		5		-1		0		5
MACROINVERTEBRATE COMMUNITY RATING	EXCELLENT		ACCEPTABLE		ACCEPTABLE		EXCELLENT	

Table 15. Habitat evaluation for selected stations in the Manistee River watershed, June-July 2014.

	Peterson Creek downstream of S 7 Road GLIDE/POOL	Poplar Creek @ 15 Road GLIDE/POOL	Coe Creek @ 20 Mile Road RIFFLE/RUN
	Station 13	**Station 14**	**Station 15**
HABITAT METRIC			
Substrate and Instream Cover			
Epifaunal Substrate/ Available Cover (20)	11	8	16
Embeddedness (20)*			14
Velocity/Depth Regime (20)*			14
Pool Substrate Characterization (20)**	6	6	
Pool Variability (20)**	15	13	
Channel Morphology			
Sediment Deposition (20)	5	4	11
Flow Status - Maintenance Flow Volume (10)	10	10	9
Flow Status - Flashiness (10)	7	10	6
Channel Alteration (20)	18	18	13
Frequency of Riffles/Bends (20)*			10
Channel Sinuosity (20)**	16	9	
Riparian and Bank Structure			
Bank Stability (L) (10)	9	9	9
Bank Stability (R) (10)	9	9	6
Vegetative Protection (L) (10)	8	8	8
Vegetative Protection (R) (10)	8	8	6
Riparian Vegetative Zone Width (L) (10)	10	10	8
Riparian Vegetative Zone Width (R) (10)	10	10	5
TOTAL SCORE (200):	142	132	135
HABITAT RATING:	**GOOD (SLIGHTLY IMPAIRED)**	**GOOD (SLIGHTLY IMPAIRED)**	**GOOD (SLIGHTLY IMPAIRED)**
Date:	7/16/2014	7/16/2014	6/18/2014
Weather:	Partly Cloudy	Cloudy	Sunny
Air Temperature: ^{o}F	66	59	75
Water Temperature: ^{o}F	56	58	68
Average Stream Width: Feet	7.3	12	15.9
Average Stream Depth: Feet	0.48	0.95	1.1
Surface Velocity: Feet/Second	1.7	2	1.19
Estimated Flow: Cubic Feet/Second	5.9568	22.8	20.8131
Stream Modifications:	None	None	Dredged
Nuisance Plants (Y/N):	N	N	N
STORET No.:	830225	830131	670252
County Code:	83	83	67
TRS:	21N12W10	21N11W32	20N10W19
Latitude (dd):	44.22769	44.17384	44.10326
Longitude (dd):	-85.76011	-85.67823	-85.55265
Ecoregion:	NLAF	NLAF	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060103	4060103	4060103

*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 16. Qualitative macroinvertebrate community sampling results at selected stations in the Manistee River watershed, Osceola and Wexford Counties, June-July 2014.

	Peterson Creek downstream of S 7 Road 7/16/2014	Poplar Creek @ 15 Road 7/16/2014	Coe Creek @ 20 Mile Road 6/18/2014
TAXA	**Station 13**	**Station 14**	**Station 15**
ANNELIDA (segmented worms)			
Hirudinea (leeches)		1	
Oligochaeta (worms)	4	3	
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	3	20	3
Decapoda (crayfish)			
Isopoda (sowbugs)			
Arachnoidea			
Hydracarina	1	63	1
Insecta			
Ephemeroptera (mayflies)			
Baetidae	60	58	21
Caenidae		1	
Ephemerellidae	13		
Ephemeridae	1	1	
Heptageniidae	4		
Leptophlebiidae			13
Tricorythidae			1
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	3		7
Cordulegastridae	1		
Gomphidae			3
Zygoptera (damselflies)			
Calopterygidae			2
Plecoptera (stoneflies)			
Leuctridae			
Nemouridae	9	18	
Perlidae			3
Perlodidiae	12		
Hemiptera (true bugs)			
Corixidae			3
Gerridae			5
Mesoveliidae		1	
Megaloptera			
Corydalidae (dobson flies)	2		6
Sialidae (alder flies)	1		
Trichoptera (caddisflies)			
Brachycentridae	51		3
Helicopsychidae			
Hydropsychidae	2	14	10
Lepidostomatidae	17	22	
Leptoceridae	1		3
Limnephilidae	1	17	50
Odontoceridae			
Philopotamidae	18		11
Phryganeidae	1		
Polycentropodidae		2	1
Rhyacophilidae			

	Peterson Creek downstream of S 7 Road 7/16/2014	Poplar Creek @ 15 Road 7/16/2014	Coe Creek @ 20 Mile Road 6/18/2014
TAXA	**Station 13**	**Station 14**	**Station 15**
Uenoidae			1
Coleoptera (beetles)			
Dytiscidae (total)		1	
Gyrinidae (adults)	3	1	
Haliplidae (adults)			
Hydrophilidae (total)	1	1	
Dryopidae	7	1	
Elmidae	2	5	56
Diptera (flies)			
Athericidae	2		
Ceratopogonidae	2	3	2
Chironomidae	47	323	16
Dixidae			3
Empididae			2
Simuliidae	65	45	3
Stratiomyidae			
Tabanidae		1	1
Tipulidae	2	2	1
MOLLUSCA			
Gastropoda (snails)			
Bithyniidae			
Physidae			
Planorbidae	1		
Pelecypoda (bivalves)			
Sphaeriidae (clams)			4
TOTAL INDIVIDUALS	337	604	247

Table 17. Macroinvertebrate metric evaluation of selected stations in the Manistee River watershed, Lake, Osceola, Manistee, and Wexford Counties, August 2014.

	Peterson Creek downstream of S 7 Road 7/16/2014		Poplar Creek @ 15 Road 7/16/2014		Coe Creek @ 20 Mile Road 6/18/2014	
	Station 13		Station 14		Station 15	
METRIC	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	30	1	23	0	29	1
NUMBER OF MAYFLY TAXA	4	1	3	0	4	1
NUMBER OF CADDISFLY TAXA	7	1	4	0	7	1
NUMBER OF STONEFLY TAXA	2	1	1	0	1	1
PERCENT MAYFLY COMPOSITION	23.15	1	9.93	0	19.03	1
PERCENT CADDISFLY COMPOSTITION	27.00	0	9.11	0	31.98	1
PERCENT DOMINANT TAXON	19.29	0	53.48	-1	22.67	0
PERCENT ISOPOD, SNAIL, LEECH	0.30	1	0.17	1	0.00	1
PERCENT SURFACE AIR BREATHERS	1.19	1	0.66	1	3.24	1
TOTAL SCORE		7		1		8
MACROINVERTEBRATE COMMUNITY RATING	EXCELLENT		ACCEPTABLE		EXCELLENT	

Table 18. Habitat evaluation for selected stations in the Manistee River watershed, August 2014.

	Pine River @ 230th Avenue RIFFLE/RUN	Pine River @ Skookum Bridge canoe launch RIFFLE/RUN	Pine River @ M37, Peterson Bridge campground RIFFLE/RUN	Pine River @ Stronach Dam GLIDE/POOL
	Station 16	**Station 17**	**Station 18**	**Station 19**
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	17	16	19	7
Embeddedness (20)*	13	13	11	
Velocity/Depth Regime (20)*	14	15	15	
Pool Substrate Characterization (20)**				6
Pool Variability (20)**				7
Channel Morphology				
Sediment Deposition (20)	10	10	14	5
Flow Status - Maintenance Flow Volume (10)	10	10	10	9
Flow Status - Flashiness (10)	8	8	9	9
Channel Alteration (20)	19	18	18	15
Frequency of Riffles/Bends (20)*	12	18	19	
Channel Sinuosity (20)**				16
Riparian and Bank Structure				
Bank Stability (L) (10)	8	6	5	7
Bank Stability (R) (10)	9	7	6	4
Vegetative Protection (L) (10)	9	9	6	6
Vegetative Protection (R) (10)	9	9	8	6
Riparian Vegetative Zone Width (L) (10)	9	9	6	4
Riparian Vegetative Zone Width (R) (10)	8	7	9	4
TOTAL SCORE (200):	**155**	**155**	**155**	**105**
HABITAT RATING:	**EXCELLENT (NON-IMPAIRED)**	**EXCELLENT (NON-IMPAIRED)**	**EXCELLENT (NON-IMPAIRED)**	**GOOD (SLIGHTLY IMPAIRED)**
Date:	8/20/2014	8/20/2014	8/21/2014	8/21/2014
Weather:	Cloudy	Partly Cloudy	Partly Cloudy	Partly Cloudy
Air Temperature: °F	69	73	62	75
Water Temperature: °F	60	58	56	58
Average Stream Width: Feet	35.5	39.37	54.67	95.67
Average Stream Depth: Feet	1.79	2.29	2.09	1.72
Surface Velocity: Feet/Second	2.01	2.32	3.49	2.5
Estimated Flow: Cubic Feet/Second	127.72545	209.164936	398.768447	411.381
Stream Modifications:	None	None	None	Bank Stabilization
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	670253	430630	830230	510197
County Code:	67	43	83	51
TRS:	19N10W5	20N11W33	21N12W19	21N13W16
Latitude (dd):	44.07101	44.08235	44.202288	44.213056
Longitude (dd):	-85.53928	-85.64801	-85.795058	-85.895
Ecoregion:	SMNITP	NLAF	NLAF	NLAF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060103	4060103	4060103	4060103

*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 19. Qualitative macroinvertebrate community sampling results at selected stations in the Manistee River watershed, Lake, Osceola, Manistee, and Wexford Counties, August 2014.

	Pine River @ 230th Avenue 8/20/2014	Pine River @ Skookum Bridge canoe launch 8/20/2014	Pine River @ upstream M37, Peterson Bridge campground 8/21/2014	Pine River @ Stronach Dam 8/21/2014
TAXA	**Station 16**	**Station 17**	**Station 18**	**Station 19**
PLATYHELMINTHES (flatworms)				
Turbellaria				
ANNELIDA (segmented worms)				
Hirudinea (leeches)				
Oligochaeta (worms)	1	1	10	1
ARTHROPODA				
Crustacea				
Amphipoda (scuds)				24
Decapoda (crayfish)				1
Isopoda (sowbugs)				7
Arachnoidea				
Hydracarina	4	9	8	7
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae	19	1		1
Baetidae	32	58	25	75
Caenidae				
Ephemerellidae				1
Ephemeridae				
Heptageniidae	3	1		1
Isonychiidae	2	1	1	1
Leptophlebiidae				
Tricorythidae	17	15	6	5
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	1			
Gomphidae				
Libellulidae				
Zygoptera (damselflies)				
Calopterygidae	1	2		2
Coenagrionidae				
Plecoptera (stoneflies)				
Nemouridae				
Perlidae	23		2	
Pteronarcyidae	8	1	1	1
Hemiptera (true bugs)				
Corixidae	72	5	6	16
Gerridae	2			4
Mesoveliidae	1	1		
Veliidae				
Megaloptera				
Corydalidae (dobson flies)				
Sialidae (alder flies)				
Trichoptera (caddisflies)				
Brachycentridae				
Glossosomatidae				
Helicopsychidae				
Hydropsychidae		3	6	18
Hydroptilidae		1	4	1

	Pine River @ 230th Avenue 8/20/2014	Pine River @ Skookum Bridge canoe launch 8/20/2014	Pine River @ upstream M37, Peterson Bridge campground 8/21/2014	Pine River @ Stronach Dam 8/21/2014
TAXA	**Station 16**	**Station 17**	**Station 18**	**Station 19**
Lepidostomatidae				
Leptoceridae				
Limnephilidae		1		
Philopotamidae				
Phryganeidae				
Polycentropodidae				
Psychomyiidae				
Uenoidae				
Coleoptera (beetles)				
Dytiscidae (total)	2	2		
Gyrinidae (adults)				
Hydrophilidae (total)		2		
Elmidae	2	5	3	
Psephenidae (larvae)				
Diptera (flies)				
Athericidae	38	11	18	1
Ceratopogonidae	4	1	4	
Chironomidae	26	202	110	56
Dixidae				
Empididae				1
Simuliidae	17	148	65	113
Tabanidae	1	1		
Tipulidae		1	3	9
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				
Bithyniidae				
Hydrobiidae				
Lymnaeidae				
Physidae	2		3	1
Pleuroceridae				
Pomatiopsidae				
Viviparidae				
Pelecypoda (bivalves)				
Sphaeriidae (clams)				
Unionidae (mussels)				
TOTAL INDIVIDUALS	278	473	275	347

Table 20. Macroinvertebrate metric evaluation of selected stations in the Manistee River watershed, Lake, Osceola, Manistee, and Wexford Counties, August 2014.

	Pine River @ 230th Avenue 8/20/2014		Pine River @ Skookum Bridge canoe launch 8/20/2014		Pine River @ upstream M37, Peterson Bridge campground 8/21/2014		Pine River @ Stronach Dam 8/21/2014	
	Station 16		Station 17		Station 18		Station 19	
METRIC	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	Value	Score
TOTAL NUMBER OF TAXA	22	0	23	0	17	0	23	0
NUMBER OF MAYFLY TAXA	5	1	5	1	3	0	6	1
NUMBER OF CADDISFLY TAXA	0	-1	3	0	2	-1	2	-1
NUMBER OF STONEFLY TAXA	2	1	1	0	2	1	1	0
PERCENT MAYFLY COMPOSITION	26.26	1	16.07	0	11.64	0	24.21	1
PERCENT CADDISFLY COMPOSTITION	0.00	-1	1.06	-1	3.64	0	5.48	0
PERCENT DOMINANT TAXON	25.90	0	42.71	-1	40.00	-1	32.56	-1
PERCENT ISOPOD, SNAIL, LEECH	0.72	1	0.00	1	1.09	1	2.31	1
PERCENT SURFACE AIR BREATHERS	27.70	-1	2.11	1	2.18	1	5.76	0
TOTAL SCORE		1		1		1		1
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	

Table 21. Habitat evaluation for selected stations in the Manistee River watershed, Lake and Manistee Counties, June 2014.

	Bear Creek @ downstream of Leffew Road RIFFLE/RUN	Bear Creek @ 13 Mile Road GLIDE/POOL	Bear Creek @ Coates Highway RIFFLE/RUN
	Station 20	**Station 21**	**Station 22**
HABITAT METRIC			
Substrate and Instream Cover			
Epifaunal Substrate/ Available Cover (20)	19	11	16
Embeddedness (20)*	10		10
Velocity/Depth Regime (20)*	15		15
Pool Substrate Characterization (20)**		14	
Pool Variability (20)**		13	
Channel Morphology			
Sediment Deposition (20)	12	7	5
Flow Status - Maintenance Flow Volume (10)	10	10	10
Flow Status - Flashiness (10)	9	9	8
Channel Alteration (20)	19	13	18
Frequency of Riffles/Bends (20)*	19		18
Channel Sinuosity (20)**		14	
Riparian and Bank Structure			
Bank Stability (L) (10)	10	9	9
Bank Stability (R) (10)	10	9	7
Vegetative Protection (L) (10)	10	8	6
Vegetative Protection (R) (10)	10	8	6
Riparian Vegetative Zone Width (L) (10)	10	6	6
Riparian Vegetative Zone Width (R) (10)	10	9	6
TOTAL SCORE (200):	173	140	140
HABITAT RATING:	**EXCELLENT (NON-IMPAIRED)**	**GOOD (SLIGHTLY-IMPAIRED)**	**GOOD (SLIGHTLY-IMPAIRED)**
Date:	6/17/2014	6/19/2014	6/16/2014
Weather:	Partly Cloudy	Sunny	
Air Temperature: ºF	75	75	80
Water Temperature: ºF	58		64
Average Stream Width: Feet	44	65	51
Average Stream Depth: Feet	1.5	2.2	2
Surface Velocity: Feet/Second	1.8	1.46	2.45
Estimated Flow: Cubic Feet/Second	118.8	208.78	249.9
Stream Modifications:	None	Bank Stabilization	Canopy Removal
Nuisance Plants (Y/N):	N	N	N
STORET No.:	510233	510237	510200
County Code:	51	51	51
TRS:	24N14W29	24N14W31	22N14W07
Latitude (dd):	44.45604	44.42838	44.31216
Longitude (dd):	-86.03154	-86.04512	-86.05002
Ecoregion:	NCHF	NCHF	NCHF
Stream Type:	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060103	4060103	4060103

*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 22. Qualitative macroinvertebrate community sampling results at selected stations in the Manistee River watershed. Lake and Manistee Counties, June 2014.

	Bear Creek @ downstream of Leffew Road 6/17/2014	Bear Creek @ 13 Mile Road 6/19/2014	Bear Creek @ Coates Highway 6/16/2014
TAXA	**Station 20**	**Station 21**	**Station 22**
PLATYHELMINTHES (flatworms)			
Turbellaria			1
ANNELIDA (segmented worms)			
Hirudinea (leeches)			
Oligochaeta (worms)	4	4	6
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	114	150	10
Decapoda (crayfish)			5
Isopoda (sowbugs)	19	14	3
Arachnoidea			
Hydracarina	4	3	15
Insecta			
Ephemeroptera (mayflies)			
Baetiscidae		12	
Baetidae	28	16	7
Caenidae			
Ephemerellidae	6	10	25
Ephemeridae			
Heptageniidae	2		13
Isonychiidae			
Leptophlebiidae			1
Siphlonuridae	1	6	
Tricorythidae		2	3
Odonata			
Anisoptera (dragonflies)			
Aeshnidae			2
Corduliidae	1		
Gomphidae	1		1
Libellulidae			
Zygoptera (damselflies)			
Calopterygidae	1	1	
Coenagrionidae			
Plecoptera (stoneflies)			
Leuctridae	1		1
Nemouridae			
Perlidae	2	5	1
Perlodidae			1
Pteronarcyidae			2
Hemiptera (true bugs)			
Corixidae		4	
Gerridae			
Mesoveliidae			
Veliidae			
Megaloptera			
Corydalidae (dobson flies)	4		
Sialidae (alder flies)	1		

	Bear Creek @ downstream of Leffew Road 6/17/2014	Bear Creek @ 13 Mile Road 6/19/2014	Bear Creek @ Coates Highway 6/16/2014
TAXA	**Station 20**	**Station 21**	**Station 22**
Trichoptera (caddisflies)			
Brachycentridae	3		1
Glossosomatidae			
Helicopsychidae	12		
Hydropsychidae	42	4	27
Hydroptilidae			
Lepidostomatidae	7	1	3
Leptoceridae	5	5	8
Limnephilidae	1	17	6
Molannidae	1		
Philopotamidae			1
Phryganeidae			
Polycentropodidae			
Psychomyiidae			
Uenoidae			
Coleoptera (beetles)			
Dytiscidae (total)			
Gyrinidae (adults)			
Hydrophilidae (total)		1	
Elmidae	15		2
Psephenidae (larvae)			
Diptera (flies)			
Athericidae	4		7
Ceratopogonidae	4		
Chironomidae	4	6	43
Dixidae			
Empididae			
Simuliidae	3	9	33
Stratiomyidae			1
Tabanidae	2		1
Tipulidae	1	1	
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)			
Bithyniidae		1	
Hydrobiidae			
Lymnaeidae			
Physidae		4	1
Pleuroceridae			
Pomatiopsidae			
Viviparidae			
Pelecypoda (bivalves)			
Sphaeriidae (clams)	2		
Unionidae (mussels)			
TOTAL INDIVIDUALS	295	276	231

Table 23. Macroinvertebrate metric evaluation of selected stations in the Manistee River watershed, Lake and Manistee Counties, June 2014.

	Bear Creek @ downstream of Leffew Road 6/17/2014		Bear Creek @ 13 Mile Road 6/19/2014		Bear Creek @ Coates Highway 6/16/2014	
	Station 20		Station 21		Station 22	
METRIC	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
TOTAL NUMBER OF TAXA	30	1	22	0	30	1
NUMBER OF MAYFLY TAXA	4	0	5	1	5	1
NUMBER OF CADDISFLY TAXA	7	1	4	0	6	1
NUMBER OF STONEFLY TAXA	2	1	1	0	4	1
PERCENT MAYFLY COMPOSITION	12.54	0	16.67	0	21.21	0
PERCENT CADDISFLY COMPOSTITION	24.07	0	9.78	-1	19.91	0
PERCENT DOMINANT TAXON	38.64	-1	54.35	-1	18.61	1
PERCENT ISOPOD, SNAIL, LEECH	6.44	-1	6.88	-1	1.73	0
PERCENT SURFACE AIR BREATHERS	0.00	1	1.81	0	0.43	1
TOTAL SCORE		2		-2		6
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		EXCELLENT	

Table 24. Habitat evaluation for selected stations in the Manistee River watershed, Lake County, July-August 2014.

	Little Manistee River @ Johnson's Bridge RIFFLE/RUN	Little Manistee River @ 11 Mile Bridge RIFFLE/RUN	Stronach Creek downstream Java Road RIFFLE/RUN	Sickle Creek @ Forest Service Road 5777 RIFFLE/RUN
	Station 23	**Station 24**	**Station 25**	**Station 26**
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)		14	18	9
Embeddedness (20)*			16	5
Velocity/Depth Regime (20)*			18	9
Pool Substrate Characterization (20)**		17		
Pool Variability (20)**		14		
Channel Morphology				
Sediment Deposition (20)		10	12	4
Flow Status - Maintenance Flow Volume (10)		10	8	8
Flow Status - Flashiness (10)		9	8	6
Channel Alteration (20)		19	17	19
Frequency of Riffles/Bends (20)*			18	16
Channel Sinuosity (20)**		16		
Riparian and Bank Structure				
Bank Stability (L) (10)		10	9	6
Bank Stability (R) (10)		9	9	6
Vegetative Protection (L) (10)		10	6	8
Vegetative Protection (R) (10)		10	8	8
Riparian Vegetative Zone Width (L) (10)		10	4	10
Riparian Vegetative Zone Width (R) (10)		10	6	9
TOTAL SCORE (200):	**NA**	168	157	124
HABITAT RATING:	**Habitat Data Not Available**	**EXCELLENT (NON-IMPAIRED**	**EXCELLENT (NON-IMPAIRED**	**GOOD SLIGHTLY IMPAIRED**
Date:	8/21/2014	8/5/2014	7/16/2014	6/16/2014
Weather:	Cloudy	Sunny	Partly Cloudy	Sunny
Air Temperature: °F	77	74	68	75
Water Temperature: °F	58	64	65	59
Average Stream Width: Feet	33	37.33	5.4	7.7
Average Stream Depth: Feet	1.84	1.94	0.3	0.43
Surface Velocity: Feet/Second	1.75	1.83	2.36	1.6
Estimated Flow: Cubic Feet/Second	107.1	132.528966	3.8232	5.2976
Stream Modifications:	None	None	None	None
Nuisance Plants (Y/N):	N	N	N	N
STORET No.:	430629	430597	430619	510269
County Code:	43	43	43	51
TRS:	20N14W24	20N14W07	20N14W01	22N15W20
Latitude (dd):	49.10408	44.14515	44.14772	44.2963
Longitude (dd):	-85.92625	-86.0238	-85.93149	-86.15378
Ecoregion:	NLAF	NLAF	NLAF	NCHF
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4060103	4060103	4060103	4060103

*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 25. Qualitative macroinvertebrate community sampling results at selected stations in the Manistee River watershed. Lake County, July-August 2014.

	Little Manistee River @ Johnson's Bridge 8/21/2014	Little Manistee River @ 11 Mile Bridge 8/5/2014	Stronach Creek downstream Java Road 7/16/2014	Sickle Creek @ Forest Service Road 5777 6/16/14
TAXA	**Station 23**	**Station 24**	**Station 25**	**Station 26**
PLATYHELMINTHES (flatworms)				
Turbellaria				
NEMATOMORPHA (roundworms)			5	
ANNELIDA (segmented worms)				
Hirudinea (leeches)				
Oligochaeta (worms)	2	11	12	5
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	22	9	5	162
Decapoda (crayfish)		1	1	
Isopoda (sowbugs)				24
Arachnoidea				
Hydracarina	10	5	6	3
Insecta				
Ephemeroptera (mayflies)				
Baetiscidae	3	1		
Baetidae	11	54	48	16
Caenidae		1		
Ephemerellidae		1	7	
Ephemeridae	3	1		
Heptageniidae		6	1	2
Isonychiidae		5		
Leptophlebiidae			1	
Tricorythidae	21	23		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae				
Cordulegastridae			1	
Corduliidae			2	1
Zygoptera (damselflies)				
Calopterygidae	1	9		
Coenagrionidae				
Plecoptera (stoneflies)				
Nemouridae			2	18
Perlidae	4	2	4	
Perlodidiae		1	10	
Pteronarcyidae	6	8		
Hemiptera (true bugs)				
Corixidae				
Gerridae			1	
Mesoveliidae			1	
Pleidae	1			
Megaloptera				
Corydalidae (dobson flies)		1	3	
Sialidae (alder flies)	2			
Trichoptera (caddisflies)				
Brachycentridae			5	1
Glossosomatidae			8	
Helicopsychidae				
Hydropsychidae	19	27	39	1

	Little Manistee River @ Johnson's Bridge 8/21/2014	Little Manistee River @ 11 Mile Bridge 8/5/2014	Stronach Creek downstream Java Road 7/16/2014	Sickle Creek @ Forest Service Road 5777 6/16/14
TAXA	**Station 23**	**Station 24**	**Station 25**	**Station 26**
Hydroptilidae	3	1	4	
Lepidostomatidae				9
Leptoceridae	1	9		1
Limnephilidae	1	2	31	21
Philopotamidae			6	
Phryganeidae			1	
Polycentropodidae	2	1		
Psychomyiidae				
Uenoidae				2
Coleoptera (beetles)				
Dytiscidae (total)	1		1	
Dryopidae				2
Gyrinidae (adults)		1		
Hydrophilidae (total)		1	2	
Elmidae	3	2	6	
Gyrinidae (larvae)		1		
Diptera (flies)				
Athericidae	5	13		
Ceratopogonidae	3		2	
Chironomidae	147	29	38	20
Dixidae				
Empididae				
Simuliidae	35	65	14	10
Tabanidae	2	2		
Tipulidae	1	2		3
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)				
Bithyniidae				
Hydrobiidae				
Lymnaeidae				
Physidae	1		2	
Pleuroceridae				
Pomatiopsidae				
Viviparidae				
Pelecypoda (bivalves)				
Sphaeriidae (clams)	2			
Unionidae (mussels)				
TOTAL INDIVIDUALS	312	295	270	301

Table 26. Macroinvertebrate metric evaluation of selected stations in the Manistee River watershed, Lake and Manistee Counties, July-August 2014.

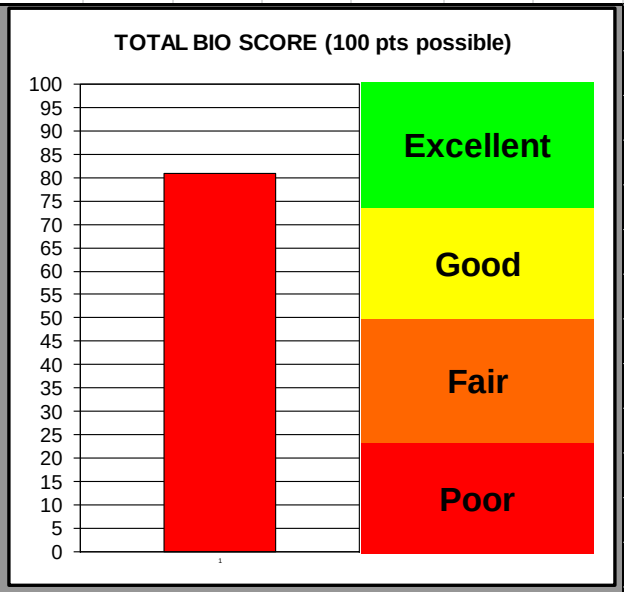
	Little Manistee River @ Johnson's Bridge 8/21/2014		Little Manistee River @ 11 Mile Bridge 8/5/2014		Stronach Creek downstream Java Road 7/16/2014		Sickle Creek @ Forest Service Road 5777 6/16/14	
	Station 23		Station 24		Station 25		Station 26	
METRIC	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**	**Value**	**Score**
TOTAL NUMBER OF TAXA	27	0	30	1	32	1	18	1
NUMBER OF MAYFLY TAXA	4	0	8	1	4	1	2	0
NUMBER OF CADDISFLY TAXA	5	0	5	0	7	1	6	1
NUMBER OF STONEFLY TAXA	2	1	3	1	3	1	1	0
PERCENT MAYFLY COMPOSITION	12.18	0	31.19	1	21.11	0	5.98	-1
PERCENT CADDISFLY COMPOSTITION	8.33	0	13.56	0	34.81	1	11.63	-1
PERCENT DOMINANT TAXON	47.12	-1	22.03	0	17.78	0	53.82	-1
PERCENT ISOPOD, SNAIL, LEECH	0.32	1	0.00	1	0.74	1	7.97	-1
PERCENT SURFACE AIR BREATHERS	0.64	1	0.68	1	1.85	1	0.00	1
TOTAL SCORE		2		6		7		-1
MACROINVERTEBRATE COMMUNITY RATING	ACCEPTABLE		EXCELLENT		EXCELLENT		ACCEPTABLE	

Appendix A. Nonwadeable Procedure 22, Results for four stations in the Manistee River watershed July 8-10, 2014.

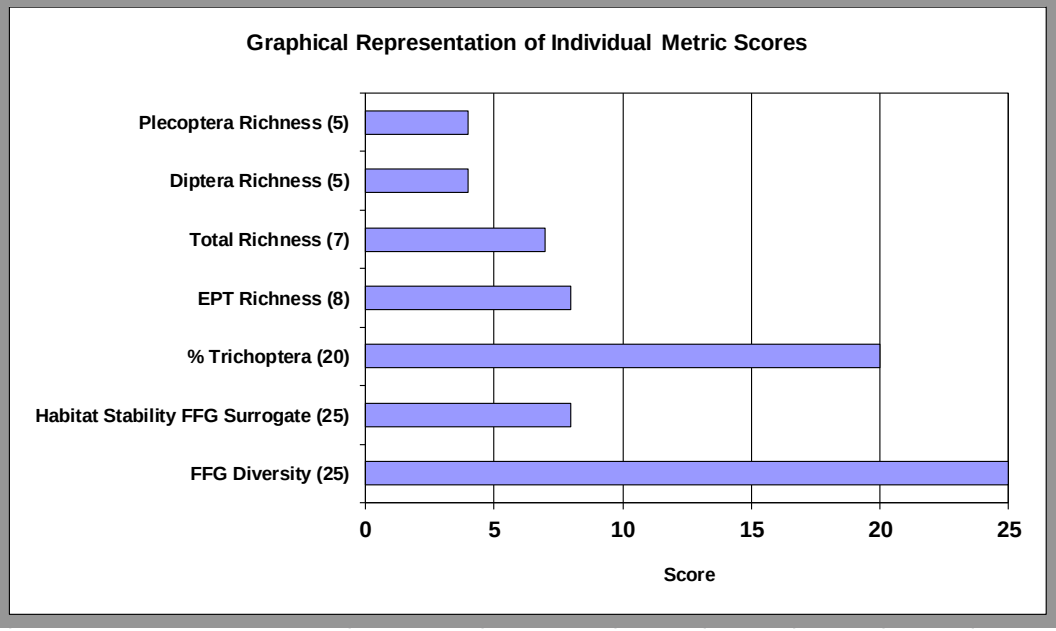
DATE: 7/10/14
RIVER: Manistee
STATION NUMBER: NW-1 (Coster Road)

Attribute	Value
Total Abundance	434
Total Richness	36
Number of Ephemeroptera Families	7
Number of Plecoptera Families	2
Number of Trichoptera Families	6
Number of Diptera Taxa	4
Trichoptera Abundance	81
Abundance of Dominant Taxon	50
Shredder Abundance	70
Scraper Abundance	100
Coll-Filterer Abundance	75
Coll-Gath Abundance	121
Predator Abundance	68

Metric Calculations	Value	Metric Score
FFG Diversity (25)	2.28	25
Habitat Stability FFG Surrogate (25)	0.92	8
% Trichoptera (20)	18.66	20
EPT Richness (8)	15.00	8
Total Richness (7)	36.00	7
Diptera Richness (5)	4.00	4
Plecoptera Richness (5)	2.00	4
% Dominance (5)	11.52	5
	Total Score=	81



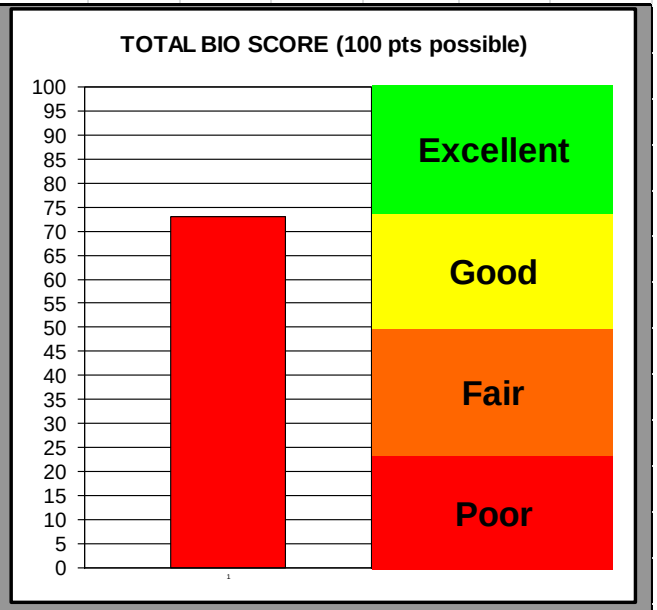
FFG Diversity Workbook	
Numbers calculated automatically	0.42
based on FFG abundance above.	0.49
	0.44
	0.51
	0.42
FFG Diversity =	2.28



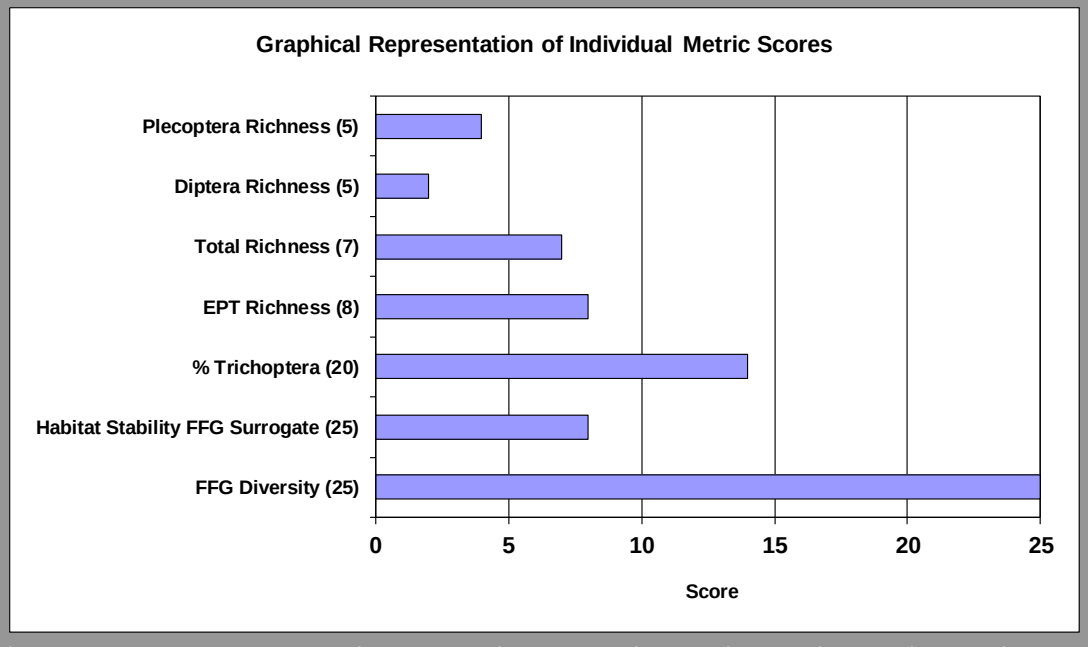
DATE:	7/9/14
RIVER:	Manistee
STATION NUMBER:	NW-2 (2.3 Miles downstream of 29 1/2 Road)

Attribute	Value
Total Abundance	371
Total Richness	27
Number of Ephemeroptera Families	6
Number of Plecoptera Families	2
Number of Trichoptera Families	3
Number of Diptera Taxa	2
Trichoptera Abundance	19
Abundance of Dominant Taxon	82
Shredder Abundance	62
Scraper Abundance	30
Coll-Filterer Abundance	29
Coll-Gath Abundance	212
Predator Abundance	38

Metric Calculations	Value	Metric Score
FFG Diversity (25)	1.81	25
Habitat Stability FFG Surrogate (25)	0.22	8
% Trichoptera (20)	5.12	14
EPT Richness (8)	11.00	8
Total Richness (7)	27.00	7
Diptera Richness (5)	2.00	2
Plecoptera Richness (5)	2.00	4
% Dominance (5)	22.10	5
	Total Score=	73



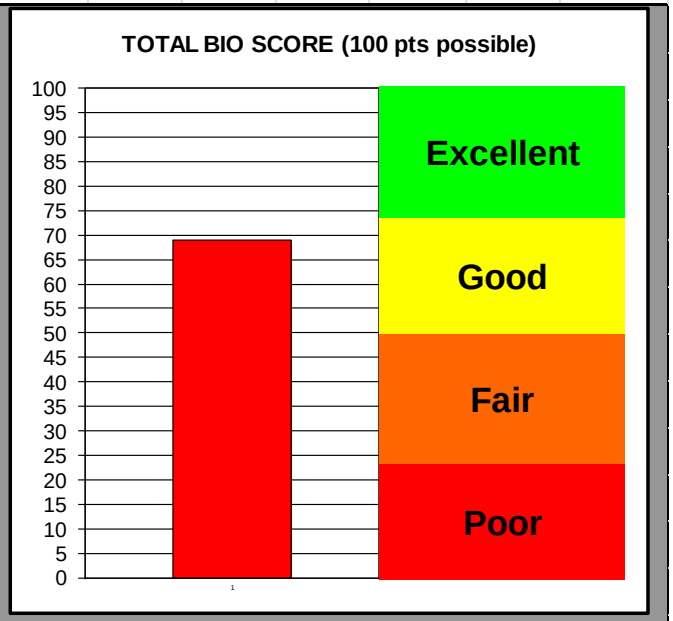
FFG Diversity Workbook	0.43
Numbers calculated automatically	0.29
based on FFG abundance above.	0.29
	0.46
	0.34
FFG Diversity =	**1.81**



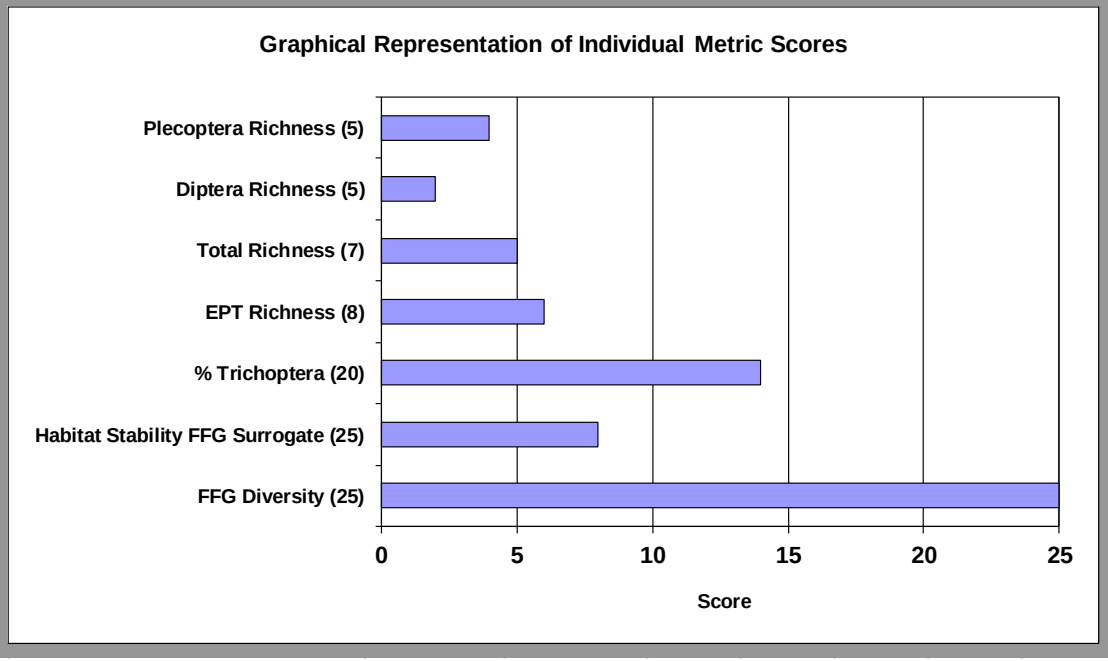
DATE: 7/9/14
RIVER: Manistee
STATION: NW-3 (6.8 miles d/s 29 1/2 Mile Road)

Attribute	Value
Total Abundance	168
Total Richness	24
Number of Ephemeroptera Families	5
Number of Plecoptera Families	2
Number of Trichoptera Families	2
Number of Diptera Taxa	3
Trichoptera Abundance	11
Abundance of Dominant Taxon	48
Shredder Abundance	18
Scraper Abundance	24
Coll-Filterer Abundance	19
Coll-Gath Abundance	87
Predator Abundance	20

Metric Calculations	Value	Metric Score
FFG Diversity (25)	1.96	25
Habitat Stability FFG Surrogate (25)	0.41	8
% Trichoptera (20)	6.55	14
EPT Richness (8)	9.00	6
Total Richness (7)	24.00	5
Diptera Richness (5)	3.00	2
Plecoptera Richness (5)	2.00	4
% Dominance (5)	28.57	5
	Total Score=	69



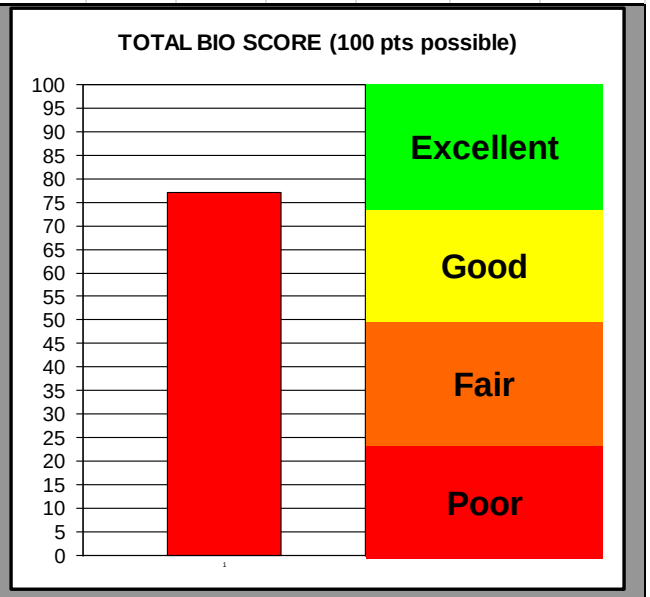
FFG Diversity Workbook	0.35
Numbers calculated automatically	0.40
based on FFG abundance above.	0.36
	0.49
	0.37
FFG Diversity =	1.96



DATE: 7/8/14
RIVER: Manistee
STATION: NW-4 (5.2 Miles upstream of Caberfae Highway)

Attribute	Value
Total Abundance	501
Total Richness	26
Number of Ephemeroptera Families	5
Number of Plecoptera Families	2
Number of Trichoptera Families	4
Number of Diptera Taxa	1
Trichoptera Abundance	82
Abundance of Dominant Taxon	172
Shredder Abundance	262
Scraper Abundance	40
Coll-Filterer Abundance	28
Coll-Gath Abundance	83
Predator Abundance	88

Metric Calculations	Value	Metric Score
FFG Diversity (25)	1.88	25
Habitat Stability FFG Surrogate (25)	0.20	8
% Trichoptera (20)	16.37	20
EPT Richness (8)	11.00	8
Total Richness (7)	26.00	7
Diptera Richness (5)	1.00	0
Plecoptera Richness (5)	2.00	4
% Dominance (5)	34.33	5
	Total Score=	77



FFG Diversity Workbook	0.49
Numbers calculated automatically	0.29
based on FFG abundance above.	0.23
	0.43
	0.44
FFG Diversity =	1.88