

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
MAY 2017

STAFF REPORT

Biological and Water Chemistry Surveys of Selected Stations in the Paw Paw River Watershed in Berrien and Van Buren Counties, Michigan, August 2016.

Introduction

Biological and physical habitat conditions of selected water bodies in the Paw Paw River watershed in Berrien and Van Buren Counties, were assessed by staff of the Michigan Department of Environmental Quality (MDEQ), Surface Water Assessment Section (SWAS), in August 2016. 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) Evaluate biological community temporal trends.**

Watershed Information

The Paw Paw River is a warmwater designated stream (MDNR, 1997) that originates approximately 60 miles upstream from its confluence with the St. Joseph River in Benton Harbor. The United States Geological Survey, Hydrologic Unit Code (HUC) for the St. Joseph River is 04050001. There are a limited number of listed coldwater tributaries in the Paw Paw River watershed (Table 1). The watershed has an area of approximately 466 square miles with 211 miles of perennial streams (USDA/NRCS, 2001) and has three main branches: the North Branch, South Branch, and East Branch that meet near the city of Paw Paw to form the Main Branch.

The soils in the Paw Paw River basin consist primarily of sandy loams with numerous gravel deposits. The watershed is located in the Allegan and Kalamazoo District Ecosystems (Albert, 1995). The Allegan District is primarily the downstream portion of the Paw Paw River watershed, and consists of a sand lake plain on the western edge and sandy end-moraine ridges. Due to the mild, lake-moderated climate, orchards and vineyards are common. The Kalamazoo District is the ecosystem district of the upstream portion of the watershed. It consists of primarily an outwash plain with small ground-moraine ridges. Most of the well-drained parts of the outwash are used for agriculture (Albert, 1995). All stations are located in the Southern Michigan and Northern Indiana Till Plains Ecoregion (Omernik and Gallant, 2010).

Table 1. Coldwater designated streams in the Paw Paw River watershed (adapted [MDNR, 1997]).

Stream	Township, Range, Section	Latitude	Longitude	County
Sand Creek	T4S,R18W,S7	42.135547	-86.434224	Berrien
Blue Creek	T4S,R18W,S4	42.148912	-86.408625	Berrien
Mill Creek (Except: Ryno Drain)	T3S,R17W,S23	42.193743	-86.252284	Berrien & Van Buren
Pine Creek	T3S,R16W,S17	42.215569	-86.201280	Van Buren
Brush Creek (Except: Reynolds Lake Drain)	T3S,R15W,S10	42.224055	-86.048813	Van Buren
North Branch Paw Paw River upstream of M-40	T2S,R14W,S30	42.271143	-85.878878	Van Buren
South (West Branch) Paw Paw River	T3S,R14W,S14	42.211819	-85.898620	Van Buren
East Branch Paw Paw River upstream of M-40	T3S,R14W,S13	42.212947	-85.891367	Van Buren

Land use in the Paw Paw River watershed is presented in Tables 2 and 3. Table 2 is a more general summary of land use in the Paw Paw River watershed. Agriculture is the dominant land use, consisting of row crops like corn and cucumbers; orchards and vineyards; and hay or pasture lands. The developed portion of the watershed is located primarily at the lower end of the watershed in Benton Harbor and a smaller amount in the upper portion in and around the city of Paw Paw. The natural area percentage includes forests, grassland, and shrub areas.

Table 2. Land use summary for the Paw Paw River watershed in southwest Michigan.

Watershed	Natural	Developed	Cultivated Agriculture	Hay or Pasture	Wetlands	Barren Land	Open Water
Paw Paw River	23%	13%	40%	7%	15%	<1%	1%

Table 3 is a more detailed summary of land use using a smaller watershed scale (12-digit HUC). The darker blue to light blue spectrum indicates a larger to smaller amount of stressful impact to the biological community. For example, the amount of impervious area in the Paw Paw River watershed is between 2 and 14% (Table 3; NOAA, 2011). Impervious surfaces are those areas on the land that cannot effectively absorb water and pass it through to the groundwater table. Examples include: decks, patios, paved gravel roads, crushed stone driveways, parking areas, and sidewalks. Impervious area is closely linked to areas of development. The higher amount of impervious cover is related to a higher amount of storm water runoff, impacting in-stream biological communities due to pollutants in the runoff and its contribution to flashy flows that scour the stream bottom. The largest proportion of impervious surface (14%) is located at the confluence of the Paw Paw River with the St. Joseph River, where the city of Benton Harbor is located. In Table 3, the 14% cell has a relatively darker color of blue compared to watersheds that have 1 or 2% impervious cover.

On average, the amount of total wetlands lost since presettlement times in the State of Michigan is 40% (Fizzell, 2014). In the Paw Paw River watershed, 57% of the wetlands had been lost by 1998 (SWMPC, 2008). The highest percentage of wetlands lost in the Paw Paw River 12-Digit HUC watersheds is in the South Branch of the Paw Paw River at 62% (Table 3). This large amount of wetland loss is due to drainage for settlement and agriculture. Wetlands are important to retain water during precipitation events to reduce runoff and prevent flooding and

extreme fluctuations in stream flow, all of which are important to both people and in-stream biological communities. In areas where a large amount of wetland has been lost, there is a larger amount of stress put on in-stream biological communities.

Historical Sampling

The most recent surveys of the Paw Paw River watershed was conducted in 2011 (Lipse, 2012). Aquatic macroinvertebrate community and habitat assessments were conducted at 17 stations. Macroinvertebrate community ratings ranged from acceptable to excellent with most stations scoring acceptable. Eagle Lake Drain and Pine Creek both scored a -4, which is 1 point from poor. Pine Creek and Eagle Lake Drain are designated as 4C streams (impaired by a cause that cannot be addressed through a total maximum daily load (TMDL), in this case because they are drains maintained by the country drain commission). Habitat ratings ranged from marginal to good. Previous surveys of the Paw Paw River watershed were conducted in 2005 and 2006 (Lipse, 2006; Walterhouse, 2006).

Methods

The macroinvertebrate community and/or physical habitat was qualitatively assessed at each of eight 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 communities were assessed and scored with metrics that rate water bodies from excellent (+5 to +9) to poor (-5 to -9). 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 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).

Site Selection

Two site-selection methods were used to assess the Paw Paw River watershed in 2016: (1) stratified random; and (2) targeted. Five randomly selected sites were assigned to support the SWAS Status (4 sites) and Trend (1 site) Program. These sites will be used to estimate the statewide 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 will be used as baseline data to facilitate a measurement of biological community temporal trends (MDEQ, 2015a). Statewide status and trend conditions will be available in separate reports in the future. Three stations within the Paw Paw River watershed were selected for targeted monitoring to answer concerns of stakeholders or staff.

Table 3. Detailed land use of the Paw Paw River watershed, broken down by watershed groups. The dark to light blue color variation is to help quickly interpret the table. For stressor indicators, dark blue indicates a land use characteristic that is more stressful on aquatic ecosystems, while shades of light blue are less stressful. In the case of land use, the lighter the blue, the more beneficial it is to aquatic ecosystems.

		Landcover Low Stress to Higher Stress				Stressor Indicators	
12 digit HUC	12 Digit HUC Watershed Name	% Total Wetland	% Total Forests	% Total Agriculture	% Total Developed Landcover	% Lost Wetlands	% Impervious Cover
040500012401	Lawton Drain-South Branch Paw Paw River	11.915	20.120	54.611	10.744	62.344	2.460
040500012402	East Branch Paw Paw River	9.744	34.563	32.491	18.337	10.514	4.598
040500012403	Campbell Creek-North Branch Paw Paw River	26.236	30.736	31.637	6.560	21.141	1.033
040500012404	Chase Lake-Brandywine Creek	15.350	17.992	56.884	7.016	18.191	1.594
040500012405	South Branch Paw Paw River	12.553	16.414	51.034	13.960	24.006	3.341
040500012406	North Branch Paw Paw River	13.546	32.838	35.094	13.996	20.028	2.464
040500012501	Brush Creek	14.994	17.163	57.582	6.842	3.884	1.346
040500012502	Headwaters Paw Paw River	23.519	19.870	47.964	5.089	24.251	0.669
040500012503	Mud Lake Drain	14.610	18.150	55.471	6.031	28.259	1.067
040500012504	Paw Paw River above Mud Lake Drain	16.861	21.946	48.856	9.247	6.210	2.046
040500012505	Paw Paw Lake	14.370	17.919	37.269	16.778	15.917	2.954
040500012506	Mill Creek	12.072	10.897	66.568	7.653	11.393	1.707
040500012507	Ryno Drain-Paw Paw River	16.143	12.967	48.582	18.292	8.953	4.520
040500012508	Blue Creek-Paw Paw River	10.907	17.772	54.158	11.780	4.011	2.292
040500012509	Paw Paw River near St. Joseph River confluence	8.031	13.307	25.701	46.975	12.358	14.084

2016 Sampling Results

Table 4. Summary of the aquatic habitat and macroinvertebrate community evaluations for selected stations in the Paw Paw River watershed, August 2016.

Station #	Stream Name	Road Crossing	STORET #	County	TRS	Township	Latitude	Longitude	Date	Habitat Evaluation		Macroinvertebrate Community		S/T/Tr	AUID#
										Score	Rating	Score	Rating		
1	North Branch Paw Paw River	Stevens Rd	800497	Van Buren	02S13W10	Almena	42.307251	-85.805393	8/3/2016	108	Good	-2	Acceptable	S	040500012403-01
2	Brandywine Creek	Downstream at M40	800594	Van Buren	2S14W1	Almena	42.3317	-85.879	8/2/2016	135	Good	0	Acceptable	S	040500012209-01
3	Unnamed Tributary to Mud Lake	County Rd 372/52nd	800596	Van Buren	3S16W4	Hartford	42.22951	-86.18587	8/3/2016	91	Fair	-4	Acceptable	S	040500012503-03
4	Paw Paw River	45th St	800595	Van Buren	2S14W31	Paw Paw	42.25273	-85.987925	8/3/2016	139	Good	-1	Acceptable	S	040500012502-01
5	Paw Paw River	Downstream off M-140	110719	Berrien	3S17W14	Watervliet	42.20604	-86.24354	8/3/2016	141	Good	5	Excellent	Tr	040500012507-01
6	Eagle Lake Drain	42nd	800551	Van Buren	4S14W4	Decatur	42.153.18	-85.95566	8/2/2016	93	Fair	-4	Acceptable	T	040500012405-09
7	Eagle Lake Drain	40th	800491	Van Buren	3S14W33	Paw Paw	42.1605	-85.93638	8/2/2016	91	Fair	-3	Acceptable	T	040500012405-09
8	Eagle Lake Drain	39th	800503	Van Buren	3S14W34	Paw Paw	42.1625	-85.92664	8/2/2016	107	Good	-2	Acceptable	T	040500012405-09

S/T/Tr = status, targeted, trend station

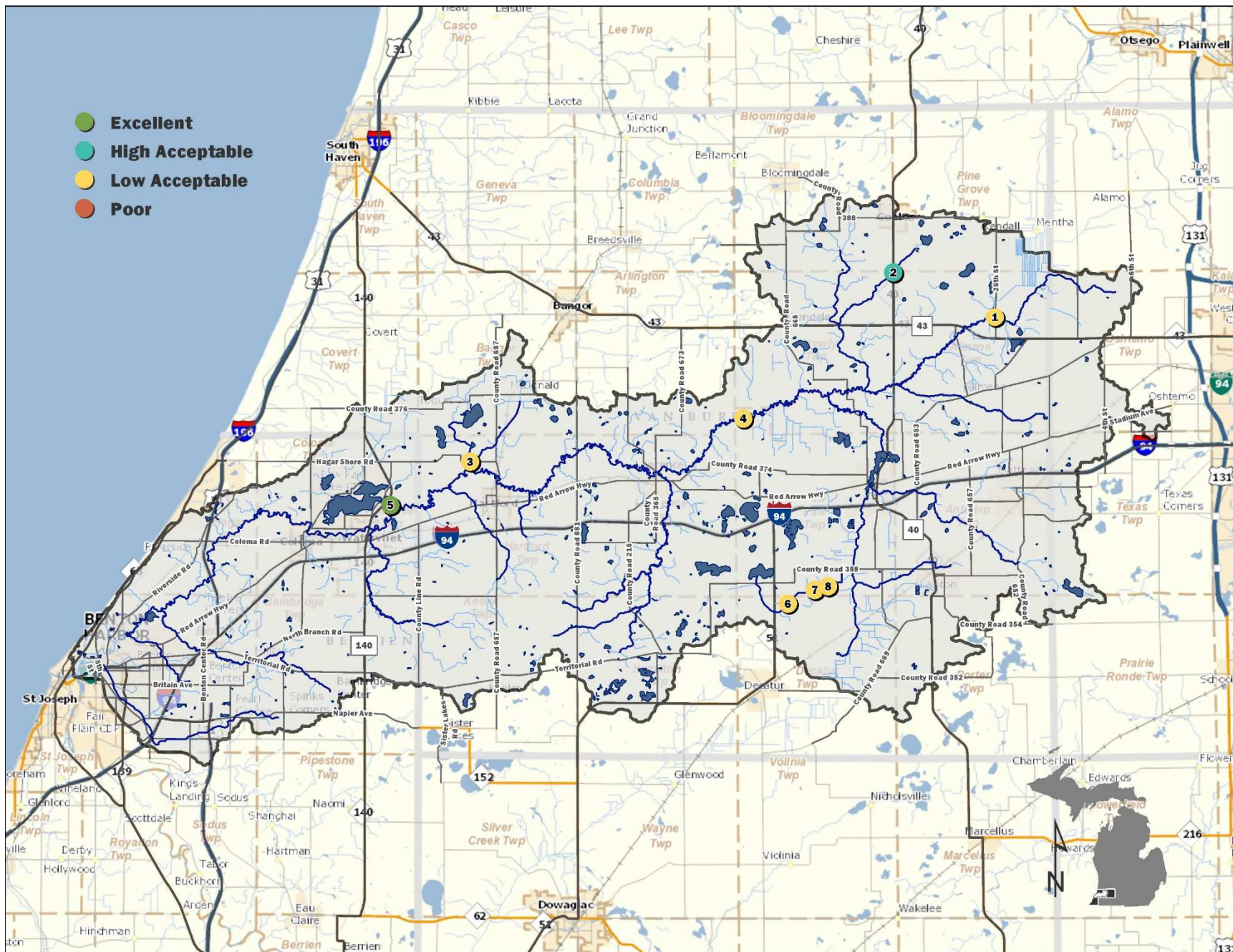
Habitat Scoring Wadeable Stations

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

Macroinvertebrate Scoring Wadeable Stations

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

Figure 1. Paw Paw River watershed. Dots represent 2016 aquatic macroinvertebrate community survey ratings.



Summary of Findings by Monitoring Objective

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

In 2016, aquatic macroinvertebrate community and habitat assessments were conducted at a total of eight stations in the Paw Paw River watershed. The OIALW designated use was met at all stations.

NORTH BRANCH PAW PAW RIVER

The North Branch Paw Paw River is designated as a coldwater stream and was sampled downstream of Stevens Road (Station 1; Table 4; Figure 2) because the stream is ponded and very deep upstream. The glide/pool habitat scored at the low end of good (108; Table 5). The entire left bank of this reach is a yard that is mowed to the edge and includes an area where the residents access the stream to swim. Shifting silt and some sand were the dominant substrate types. In-stream and overhanging vegetation were the only epifaunal substrates. The property owner indicated erosion of the property is frequent. The macroinvertebrate community was rated acceptable (-2; Tables 6 and 7). There was a large number of taxa. However, air breathers and amphipods were fairly abundant leading to negative scores for those metrics.



Figure 2. North Branch Paw Paw River downstream of Stevens Road.

BRANDYWINE CREEK

Brandywine Creek was sampled downstream of M-40 (Station 2; Table 4; Figure 3), and is designated as a warmwater stream. The riffle/run habitat was rated good (135; Table 5). The stream banks were incised approximately two feet, indicating some flashy flows, but were moderately stable. Large woody debris and some gravel was available for epifaunal substrate, but the dominant substrate was sand. The macroinvertebrate community was rated acceptable (0; Tables 6 and 7). There were no stonefly taxa and only two individual mayflies found. Both of these families are sensitive to pollution.

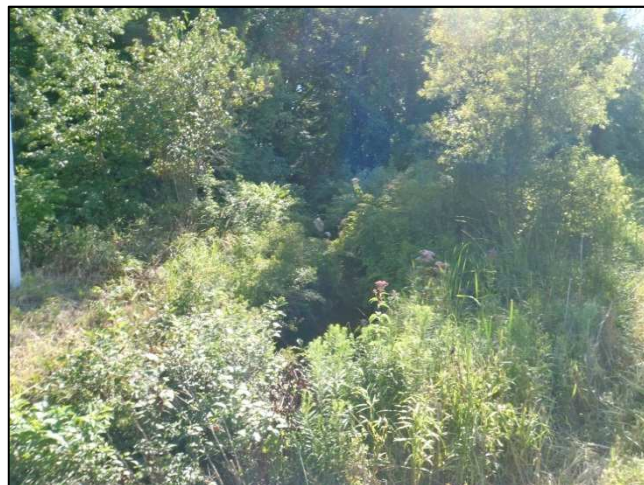


Figure 3. Brandywine Creek downstream of M-40.

Amphipods were very dominant at 70% of the macroinvertebrate community. A dominance of any one taxon may be an indicator of some type of environmental perturbation.

UNNAMED TRIBUTARY TO MUD LAKE

The Unnamed Tributary to Mud Lake was sampled at County Road 372/52nd (Station 3; Table 4; Figure 4), and is designated as a warmwater stream. The glide/pool habitat was rated as fair (91; Table 5). This station had no pool diversity and was uniform in depth. The substrate consisted of nearly three feet of silt/muck that was very unstable and anoxic. Large woody structures and some aquatic vegetation were present, but covered in silt and not suitable for epifaunal substrate. The straight channel is obviously maintained as a county drain, but the floodplain and riparian area were intact. The macroinvertebrate community was rated as acceptable and scored 1 point away from poor (-4; Tables 6 and 7). Only two families and seven individuals from the Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) orders were found. These orders are sensitive to pollution, including sedimentation, and a lack of these families in a stream indicate stressed environmental conditions.



Figure 4. Unnamed Tributary to Mud Lake at County Road 372/52nd.

PAW PAW RIVER 45TH STREET

The Paw Paw River was sampled at 45th Street (Station 4; Table 4; Figure 5), and is designated as a warmwater stream. The glide/pool habitat was rated as good (139; Table 8). The river is wadeable at this site, but is fairly deep and much of the mid-portion of the river is more than five feet deep. Small numbers of large woody structures were present, but were covered with silt and not suitable as epifaunal substrate. The stream bottom substrate was dominated by shifting sand. There was an intact floodplain and you could see where silt would settle during high water events. The macroinvertebrate community was rated acceptable (-1; Tables 9 and 10). No stonefly were found and there was a fairly high percentage (35%) of surface air breathers. These two metrics contributed to the low acceptable score.

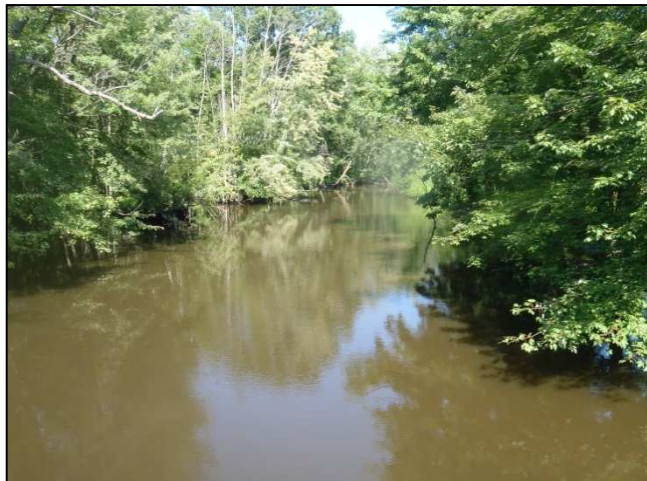


Figure 5. Paw Paw River at 45th Street.

PAW PAW RIVER M-140

The Paw Paw River was sampled at M-140 (Station 5; Table 4; Figure 6), and is designated as a warmwater stream. The glide/pool habitat was rated good (141; Table 8). This station is within a campground area and at the inside portion of a large bend in the river. The mid-portion and outside of the bend cannot be reached in most places due to the depth of the river. Large woody material and overhanging vegetation are the only available substrates. The macroinvertebrate community was rated excellent (5; Tables 9 and 10). This relatively high score is despite the low numbers of individuals and high

percentage (35%) of air breathing taxa that were collected. Eight taxa in the EPT families were found, and no one taxa was dominant, both of which indicate good water quality.



Figure 6. Paw Paw River off of M-140.

EAGLE LAKE DRAIN 42ND STREET

The Eagle Lake Drain is a coldwater stream that was sampled at three stations. The most upstream station was 42nd Street (Station 6; Table 4; Figure 7). The glide/pool habitat was rated fair (93; Table 11). Silt was the dominant substrate in the area sampled. Further upstream the stream narrows and has more sand substrate. This appears to be the area where any dredging done at the road stops. Submergent vegetation was the only epifaunal substrate available. Woody structures were covered by silt.

The macroinvertebrate community was rated acceptable, one point away from poor (-4; Tables 12 and 13). Of the EPT families, only one caddisfly family was found. There was a relatively large percentage (35%) of snails that dominated the macroinvertebrate community. The large percentage and dominance of snails both indicate a likely environmental perturbation is impacting the macroinvertebrate community at this station.

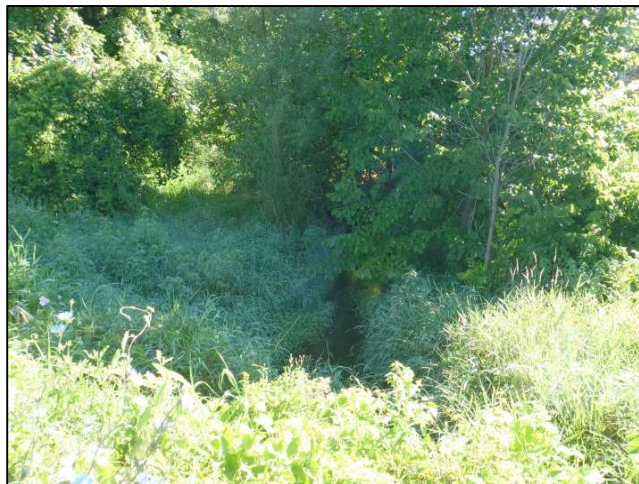


Figure 7. Eagle Lake Drain at 42nd Street.

EAGLE LAKE DRAIN 40TH STREET

Eagle Lake was also sampled at 40th Street (Station 7; Table 4; Figure 8), and was relatively cold for this watershed at 62 degrees Fahrenheit. The glide/pool habitat was rated fair (91; Table 11). There was a large amount of shifting silt along the stream bottom. Pools were present, but were partially filled with silt and the water level was very low. Aquatic vegetation was abundant and was the only epifaunal substrate present. The macroinvertebrate community scored acceptable (-3; Tables 12 and 13). None of the pollution-sensitive mayfly or stonefly taxa were present and chironomids were 54% of the individuals found, which reflects the large silt deposits at this station.



Figure 8. Eagle Lake Drain at 40th Street.

EAGLE LAKE DRAIN 39TH STREET

The Eagle Lake Drain was sampled furthest downstream at 39th Street (Station 7; Table 4; Figure 9). The glide/pool habitat was rated as good (107; Table 11). The wetted width was wider at this station due to aquatic vegetation holding in water along the edge. The vegetation was silt laden. There was a small amount of gravel substrate at this station but silt deposits were dominant. The aquatic macrophytes and overhanging vegetation were the dominant epifaunal substrate. Pool diversity was greater than the two upstream sites in Eagle Lake Drain. The macroinvertebrate community scored acceptable (-2; Tables 12 and 13). There was a noticeably larger diversity and percentage of EPT taxa at this station, especially Trichoptera families, than was found at the upstream stations. Snails, oligochaetes, and chironomids were found to be the most abundant families, all of which can indicate environmental stressor impacts.



Figure 9. Eagle Lake Drain at 39th Street.

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

EAGLE LAKE DRAIN

Eagle Lake Drain is a tributary to the South Branch of the Paw Paw River in Van Buren County and is listed on the Section 303(d) list (MDEQ, 2016) of impaired and threatened waters as not attaining the OIALW designated use. Causes include anthropogenic flow regime and substrate alterations (due to historic dredging). In 2016 and 2011, the macroinvertebrate community scored nearly poor (-4) at 42nd Street and in 2006 the same station scored poor (-6).

Eagle Lake Drain was sampled as a result of a best management practices (BMP) incentive program occurring in Van Buren County. The Van Buren County Drain Commission has partnered with the Michigan Chapter of the Nature Conservancy and the Van Buren

Conservation District to offer incentives to install BMPs to prevent excessive sedimentation of entering waterways. Several BMPs have recently been implemented in the lower portions of the Eagle Lake Drain watershed. SWAS staff collected macroinvertebrate and habitat data in the Eagle Lake Drain watershed in the past and will do so in the future, as resources allow, when additional BMPs are implemented. Three stations were sampled in 2016 (as noted in Table 11) and these same results are compared with historic results in Tables 14, 15, and 16.

Habitat metrics can only be compared between 2006, 2011, and 2016 due to changes in the habitat scoring in Procedure 51. There was no noticeable difference in habitat scores from upstream to downstream with the exception of pool variability increasing (change of up to 10 points) from 42nd Street to 40th and 39th Street (Table 14). The habitat is rated at the higher end of poor or lower end of fair. Substrate is dominated by large deposits silt and shifting sand. Without a more quantitative stream geomorphology study, further comment cannot be made about changes in habitat.

Procedure 51 was not designed to determine incremental changes in BMP effectiveness. However, large changes in percentages and numbers of EPT taxa, taxa richness, or percent dominant taxon may be an indicator of changes in disturbance (MDEQ, 2015b). The most upstream station at 42nd Street was surveyed in 2006, 2011, and 2016. The percent dominance decreased and percent of EPT (caddisflies only, no stoneflies or mayflies were found) individuals increased since 2006, indicating a possible improvement in water quality. However, the number of taxa remained the same and the number of EPT taxa decreased from 4 families to 1 (caddisflies only).

The 40th Street station was sampled in 2001 and 2016. The number of taxa decreased, percent dominance increased, and both the number and percentage of EPT taxa found decreased (Tables 15 and 16). The results may indicate the water quality or habitat quality has worsened. The macroinvertebrate counting component of Procedure 51 changed between 2001 and 2016, therefore the metric changes observed may be partially due to procedural change. The most downstream station (39th Street) was only sampled in 2016 so changes cannot be evaluated.

When comparing all three stations in 2016, moving from upstream to downstream, there is not a noticeable improvement in the macroinvertebrate community between 42nd and 40th Street. There seems to be some improvement between 42nd Street and 39th Street. The limited results do not allow for definitive conclusions to be made about the impact of BMPs on macroinvertebrates in Eagle Lake Drain.

RYNO DRAIN

One external monitoring request was received in 2011 regarding concerns about potential impacts that a gun club's activities and the Orchard Hill Landfill may have on lead concentrations in Ryno Drain. The gun club has shooting ranges that are in the Ryno Drain watershed and adjacent to the Orchard Hill landfill. National Pollutant Discharge Elimination System records for the landfill do not indicate lead is a parameter of concern. The drain was sampled on July 14 after a rain event that occurred on July 13, at Tannery Drive and further upstream at Angling Road, which should be just downstream of any overland flow from the gun club. Lead was not detected in either sample.

Objective 3: Identify NPS of water quality impairment.

NORTH BRANCH PAW PAW RIVER

The culvert or road crossing of the North Branch Paw Paw River at Stevens Road (Station 1; Table 4) may need realignment and an old cement structure that serves as hardened shoreline

downstream of the crossing may need to be removed. Upstream of the road the stream is ponded and very deep. Downstream of the road crossing, the left bank is a maintained lawn, and the property owner reports that erosion has occurred consistently over the past several years. Current erosion was not evident due to the depth of the water. The water temperature was 78 degrees Fahrenheit, which is fairly warm for a coldwater stream and is likely at least partially due to the ponding at the road crossing. The property owner was directed to the district office for information concerning the erosion at their property.

LAWTON DRAIN

Lawton Drain at County Road 665 was revisited due to previous observations of unrestricted livestock access in 2011 and 2006 (Figure 10). Unrestricted livestock access is a concern due to the trampling of banks, which can cause excessive erosion, and livestock standing in the stream has the potential for pathogen contamination from livestock feces. Evidence of unrestricted livestock access (erosion and a lack of taller understory vegetation) was observed along an approximate 0.25-mile stretch of the drain upstream of the road crossing. MDEQ district staff is aware of the issue and will visit the stream again in the summer of 2018 and take appropriate actions with the Michigan Department of Agriculture and Rural Development, Right to Farm Program, if needed.



Figure 10. Lawton Drain at County Road 665. Sedimentation evident due upstream trampling of banks from unrestricted livestock access.

Objective 4: Evaluate biological community temporal trends.

The Paw Paw River off M-140 is located in a campground and is a long-term trend station that is sampled once every five years to support the SWAS's Trend Program and facilitate a measurement of statewide temporal trends (MDEQ, 2015a). The glide/pool habitat was rated as good (141; Table 8) and the macroinvertebrate community was rated excellent (5; Tables 9 and 10). Statewide trend information cannot be summarized until 2021, when a sufficient amount of data has been collected.

Conclusions and Future Monitoring Recommendations

In 2016, aquatic macroinvertebrate community and habitat assessments were conducted at a total of 8 stations in the Paw Paw River watershed (Table 3, Figure 1). The OIALW designated use was being met at all stations. The macroinvertebrate community most often scored at the lower end of acceptable (-4 to -1) with Eagle Lake Drain at 42nd Street and an unnamed tributary to Mud Lake at County Road 372/52nd Street both scoring near poor (-4). Eagle Lake Drain is currently listed on Michigan's Section 303(d) list of impaired and threatened waters, as a 4c stream (impaired by a cause that cannot be addressed through a TMDL) for the OIALW designated use due to a poor score in 2006 and will remain listed as not attaining. Both of the

tributaries are maintained drains. The unnamed tributary to Mud Lake is currently listed as attaining WQS and will not be listed unless a future survey indicates a poor score.

As indicated in the Paw Paw River Watershed Management Plan (SWMPC, 2008), sediment is known to be causing water and habitat degradation throughout the watershed. Sediment impacts aquatic life by covering up natural substrates needed for survival or spawning, damages gills needed to breath, and carries other pollutants such as nutrients to the stream. Sedimentation is often caused by runoff and soil erosion from crop lands, storm water runoff from urban areas, and construction in developing areas. Sediment deposits and sedimentation impacts have been observed throughout the watershed in the past and continued to be observed in 2016. Efforts to reduce sedimentation through protection, restoration, and conservation practices should continue in the Paw Paw River watershed.

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

- 1) Lawton Drain at County Road 665 can be revisited to determine if improvements have been made in restricting livestock access to the drain, and if not, report conditions to district staff and/or the Michigan Department of Agricultural and Rural Development. In addition, *E.coli* samples could be taken.
- 2) There are several locations noted in the Paw Paw River Watershed Management Plan where there were known areas of unrestricted livestock access in 2008 (SWMPC, 2008). These locations could also be visited to determine if impacts continue and need to be reported.
- 3) Eagle Lake Drain and an unnamed tributary to Mud Lake both scored near poor and have a large amount of silt deposits impacting biotic communities. BMPs that reduce sediment and increase habitat diversity and epifaunal substrate should be encouraged. If BMPs are planned for these watersheds, and it is a priority for NPS staff to show success, these two water bodies could be evaluated using a more quantitative in-stream habitat and macroinvertebrate sampling procedure.
- 4) Ox Creek, Pine Creek, Mill Creek, and the South Branch of the Paw Paw River from (and including) Three Mile Lake Drain downstream to 60th Avenue are on the Section 303(d) list of impaired and threatened waters, but were not sampled in 2016. Pine and Mill Creeks have an approved TMDL for *E.coli*, and are considered maintained drains for biota impairments. Ox Creek is impaired for biota and has a TMDL drafted to address storm water and needed sediment load reductions. This TMDL should be finalized in 2017. The South Branch of the Paw Paw River and Three Mile Drain are not attaining the coldwater fisheries designated use due to low dissolved oxygen levels. These water bodies should be considered when developing monitoring plans in the future.

Field Work By: Tamara Lipsey and Kelly Turek, Aquatic Biologists
Surface Water Assessment Section
Water Resources Division

Report By: Tamara Lipsey, Aquatic Biologist
Surface Water Assessment Section
Water Resources Division

Citations

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Table 5. Habitat evaluation for selected stations in the Paw Paw River watershed, Van Buren County, August 2 and 3, 2016.

	North Branch Paw Paw River @	Brandywine Creek @	Unnamed Tributary to Mud Lake @
	Stevens Road GLIDE/POOL	M-40 RIFFLE/RUN	County Road 372/52 nd GLIDE/POOL
	Station 1	Station 2	Station 3
HABITAT METRIC			
Substrate and In-stream Cover			
Epifaunal Substrate/ Available Cover (20)	6	13	3
Embeddedness (20)*		16	
Velocity/Depth Regime (20)*		13	
Pool Substrate Characterization (20)**	10		5
Pool Variability (20)**	5		2
Channel Morphology			
Sediment Deposition (20)	5	12	5
Flow Status - Maintenance Flow Volume (10)	10	7	9
Flow Status - Flashiness (10)	8	5	7
Channel Alteration (20)	15	14	11
Frequency of Riffles/Bends (20)*		17	
Channel Sinuosity (20)**	12		1
Riparian and Bank Structure			
Bank Stability (L) (10)	6	6	8
Bank Stability (R) (10)	9	6	8
Vegetative Protection (L) (10)	2	6	7
Vegetative Protection (R) (10)	9	8	7
Riparian Vegetative Zone Width (L) (10)	1	5	9
Riparian Vegetative Zone Width (R) (10)	10	7	9
TOTAL SCORE (200):	108	135	91
HABITAT RATING:	GOOD	GOOD	FAIR
Date:	8/3/2016	8/2/2016	8/3/2016
Weather:	Sunny	Sunny	Sunny
Air Temperature: °F	80	80	80
Water Temperature: °F	78	78	74
Average Stream Width: Feet	31.8	8.1	21.5
Average Stream Depth: Feet	3.2	0.5	1.4
Surface Velocity: Feet/Second	0.5	0.7	0.3
Estimated Flow: Cubic Feet/Second	54.7	3.1	9.7
Stream Modifications:	Canopy Removal	None	Dredged
Nuisance Plants (Y/N):	N	N	N
STORET No.:	800497	800594	800596
County Code:	80	80	80
TRS:	02S13W10	02S14W01	03S16W04
Latitude (dd):	42.307251	42.3317	42.22951
Longitude (dd):	-85.805393	-85.879	-86.18587
Ecoregion:	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Warmwater	Warmwater
USGS Basin Code:	4050001	4050001	4050001
*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 Paw Paw River watershed, Van Buren County, August 2 and 3, 2016.

TAXA	North Branch Paw Paw River @ Stevens Road	Brandywine Creek @ M40	Unnamed Tributary to Mud Lake @ County Road 372/52 nd
	8/3/2016	8/2/2016	8/3/2016
TAXA	Station 1	Station 2	Station 3
PORIFERA (sponges)			
PLATYHELMINTHES (flatworms)			
Turbellaria			11
ANNELIDA (segmented worms)			
Hirudinea (leeches)			6
Oligochaeta (worms)	4		19
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	32	210	36
Decapoda (crayfish)	1		1
Isopoda (sowbugs)	8		1
Arachnoidea			
Hydracarina	13	1	
Insecta			
Ephemeroptera (mayflies)			
Baetidae	6		
Caenidae	10	1	1
Ephemerellidae			
Ephemeridae			
Heptageniidae	3	1	
Leptophlebiidae			
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	1	1	
Cordulegastridae		1	
Corduliidae			
Gomphidae	1		
Libellulidae	1		
Zygoptera (damselflies)			
Calopterygidae	4	5	4
Coenagrionidae	16		3
Plecoptera (stoneflies)			
Nemouridae			
Perlidae			
Perlodidae			
Hemiptera (true bugs)			
Belostomatidae	1		1
Corixidae	40		1
Gerridae		1	
Mesoveliidae		1	1
Nepidae			1
Notonectidae	1		1
Megaloptera			
Corydalidae (dobson flies)			
Sialidae (alder flies)	2		1

	North Branch Paw Paw River @ Stevens Road	Brandywine Creek @ M40	Unnamed Tributary to Mud Lake @ County Road 372/52 nd
	8/3/2016	8/2/2016	8/3/2016
TAXA	Station 1	Station 2	Station 3
Trichoptera (caddisflies)			
Brachycentridae	2	8	
Glossosomatidae			
Helicopsychidae	1		
Hydropsychidae		28	6
Lepidostomatidae		2	
Leptoceridae		2	
Limnephilidae		3	
Molannidae			
Philopotamidae			
Polycentropodidae	11		
Uenoidae			
Coleoptera (beetles)			
Gyrinidae (adults)	1		
Haliplidae (adults)	5		1
Hydrophilidae (total)		1	
Elmidae	1	11	
Diptera (flies)			
Athericidae			
Ceratopogonidae			
Chironomidae	55	4	12
Culicidae	1		
Simuliidae	4	9	
Tabanidae		1	
Tipulidae			
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)		3	1
Bithyniidae			
Hydrobiidae			3
Physidae	3	1	3
Planorbidae	2		1
Pleuroceridae	15		
Viviparidae	1		1
Pelecypoda (bivalves)			
Dreissenidae			
Sphaeriidae (clams)	22	6	6
Unionidae (mussels)			
TOTAL INDIVIDUALS	268	302	122

Table 7. Macroinvertebrate metric evaluation of selected stations in the Paw Paw River watershed, Van Buren County, August 2 and 3, 2016.

	North Branch Paw Paw River @ Stevens Road 8/3/2016		Brandywine Creek @ M-40 8/2/2016		Unnamed Tributary to Mud Lake @ Country Road 372/52 nd 8/3/2016	
	Station 1		Station 2		Station 3	
METRIC	Value	Score	Value	Score	Score	Value
TOTAL NUMBER OF TAXA	31	1	23	0	24	0
NUMBER OF MAYFLY TAXA	3	0	2	0	1	-1
NUMBER OF CADDISFLY TAXA	3	0	5	1	1	-1
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	7.09	0	0.66	-1	0.82	-1
PERCENT CADDISFLY COMPOSITION	5.22	0	14.24	0	4.92	0
PERCENT DOMINANT TAXON	20.52	0	69.54	-1	29.51	0
PERCENT ISOPOD, SNAIL, LEECH	10.82	-1	1.32	1	13.11	-1
PERCENT SURFACE AIR BREATHERS	20.15	-1	0.99	1	5.74	1
TOTAL SCORE		-2		0		-4
MACROINVERTEBRATE COMMUNITY RATING	Acceptable		Acceptable		Acceptable	

Table 8. Habitat evaluation for selected stations in the Paw Paw River watershed, Berrien and Van Buren County, August 3, 2016.

	Paw Paw River @	Paw Paw River @
	45 th Street	Off M-140
	GLIDE/POOL	GLIDE/POOL
	Station 4	Station 5
HABITAT METRIC		
Substrate and In-stream Cover		
Epifaunal Substrate/ Available Cover (20)	7	12
Embeddedness (20)*		
Velocity/Depth Regime (20)*		
Pool Substrate Characterization (20)**	6	8
Pool Variability (20)**	13	13
Channel Morphology		
Sediment Deposition (20)	12	14
Flow Status - Maintenance Flow Volume (10)	9	10
Flow Status - Flashiness (10)	5	8
Channel Alteration (20)	16	20
Frequency of Riffles/Bends (20)*		
Channel Sinuosity (20)**	18	16
Riparian and Bank Structure		
Bank Stability (L) (10)	9	9
Bank Stability (R) (10)	9	
Vegetative Protection (L) (10)	9	9
Vegetative Protection (R) (10)	9	3
Riparian Vegetative Zone Width (L) (10)	8	9
Riparian Vegetative Zone Width (R) (10)	9	2
TOTAL SCORE (200):	139	141
HABITAT RATING:	GOOD	GOOD
Date:	8/3/2016	8/3/2016
Weather:	Sunny	Sunny
Air Temperature: °F	85	70
Water Temperature: °F	75	72
Average Stream Width: Feet	72.5	87
Average Stream Depth: Feet		
Surface Velocity: Feet/Second	1.5	0.9
Estimated Flow: Cubic Feet/Second		
Stream Modifications:	None	Canopy Removal
Nuisance Plants (Y/N):	N	N
STORET No.:	800595	110719
County Code:	80	11
TRS:	02S14W31	03S17W14
Latitude (dd):	42.25273	42.20604
Longitude (dd):	-85.98792551	-86.24354
Ecoregion:	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater
USGS Basin Code:	4050001	4050001
*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 Paw Paw River watershed, Van Buren and Berrien County, August 3, 2016.

	Paw Paw River @ 45th Street 8/3/2016	Paw Paw River @ M-140 8/3/2016
TAXA	Station 4	Station 5
PORIFERA (sponges)		
PLATYHELMINTHES (flatworms)		
Turbellaria		
ANNELIDA (segmented worms)		
Hirudinea (leeches)	2	
Oligochaeta (worms)	30	6
ARTHROPODA		
Crustacea		
Amphipoda (scuds)	64	13
Decapoda (crayfish)	1	4
Isopoda (sowbugs)	5	
Arachnoidea		
Hydracarina		
Insecta		
Ephemeroptera (mayflies)		
Baetidae	4	11
Caenidae		
Ephemerellidae		
Ephemeridae	1	
Heptageniidae	4	18
Isonychiidae		1
Leptophlebiidae		
Tricorythidae		1
Odonata		
Anisoptera (dragonflies)		
Aeshnidae	1	3
Cordulegastridae		
Corduliidae		
Gomphidae		
Libellulidae		
Zygoptera (damselflies)		
Calopterygidae	5	8
Coenagrionidae	2	
Plecoptera (stoneflies)		
Nemouridae		
Perlidae		1
Perlodidae		
Hemiptera (true bugs)		
Belostomatidae		
Corixidae	77	16
Gerridae	1	6
Mesoveliidae	1	27
Naucoridae		1
Nepidae		1
Notonectidae	2	
Pleidae		1
Veliidae		1
Megaloptera		

	Paw Paw River @ 45 th Street 8/3/2016	Paw Paw River @ M-140 8/3/2016
TAXA	Station 4	Station 5
Corydalidae (dobson flies)		
Sialidae (alder flies)	1	1
Trichoptera (caddisflies)		
Brachycentridae	11	1
Glossosomatidae		
Helicopsychidae		
Hydropsychidae	2	4
Lepidostomatidae		
Leptoceridae		6
Limnephilidae		
Molannidae		
Philopotamidae		
Polycentropodidae		
Uenoidae		
Coleoptera (beetles)		
Dytiscidae (total)	5	
Haliplidae (adults)	1	
Hydrophilidae (total)		
Elmidae	3	4
Gyrinidae (larvae)	1	
Diptera (flies)		
Athericidae		2
Ceratopogonidae	2	
Chironomidae	11	7
Simuliidae	3	4
Tabanidae		
Tipulidae		
MOLLUSCA		
Gastropoda (snails)		
Ancylidae (limpets)		
Bithyniidae		
Hydrobiidae	1	
Physidae	2	1
Planorbidae		
Pleuroceridae	1	
Viviparidae		
Pelecypoda (bivalves)		
Dreissenidae		
Sphaeriidae (clams)	5	1
Unionidae (mussels)		
TOTAL INDIVIDUALS	249	150

Table 10. Macroinvertebrate metric evaluation of selected stations in the Paw Paw River watershed, Van Buren and Berrien County, August 3, 2016.

	Paw Paw River @ 45th Street 8/3/2016		Paw Paw River @ M-140 8/3/2016	
	Station 4		Station 5	
METRIC	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	29	1	27	1
NUMBER OF MAYFLY TAXA	3	0	4	1
NUMBER OF CADDISFLY TAXA	2	0	3	0
NUMBER OF STONEFLY TAXA	0	-1	1	1
PERCENT MAYFLY COMPOSITION	3.61	0	20.67	1
PERCENT CADDISFLY COMPOSITION	5.22	0	7.33	0
PERCENT DOMINANT TAXON	30.92	0	18	1
PERCENT ISOPOD, SNAIL, LEECH	4.42	0	0.67	1
PERCENT SURFACE AIR BREATHERS	35.34	-1	35.33	-1
TOTAL SCORE		-1		5
MACROINVERTEBRATE COMMUNITY RATING	Acceptable		Excellent	

Table 11. Habitat evaluation for selected stations in the Paw Paw River watershed, Van Buren County, August 2 and 3, 2016.

	Eagle Lake Drain @ 42 nd Street	Eagle Lake Drain @ 40 th Street	Eagle Lake Drain @ 39 th Street
	GLIDE/POOL	GLIDE/POOL	GLIDE/POOL
	Station 6	Station 7	Station 8
HABITAT METRIC			
Substrate and In-stream Cover			
Epifaunal Substrate/ Available Cover (20)	6	6	6
Embeddedness (20)*			
Velocity/Depth Regime (20)*			
Pool Substrate Characterization (20)**	10	10	11
Pool Variability (20)**	1	11	11
Channel Morphology			
Sediment Deposition (20)	6	5	6
Flow Status - Maintenance Flow Volume (10)	9	7	9
Flow Status - Flashiness (10)	7	6	7
Channel Alteration (20)	13	11	11
Frequency of Riffles/Bends (20)*			
Channel Sinuosity (20)**	1	1	2
Riparian and Bank Structure			
Bank Stability (L) (10)	8	6	8
Bank Stability (R) (10)	8	6	8
Vegetative Protection (L) (10)	7	7	8
Vegetative Protection (R) (10)	7	7	6
Riparian Vegetative Zone Width (L) (10)	5	3	8
Riparian Vegetative Zone Width (R) (10)	5	5	8
TOTAL SCORE (200):	93	91	107
HABITAT RATING:	FAIR	FAIR	GOOD
Date:	8/2/2016	8/2/2016	8/2/2016
Weather:	Sunny	Sunny	Sunny
Air Temperature: °F	70	80	84
Water Temperature: °F		62	64
Average Stream Width: Feet	18.2	22.1	18.1
Average Stream Depth: Feet	1.1	1.1	1.2
Surface Velocity: Feet/Second	0.4	0.6	0.6
Estimated Flow: Cubic Feet/Second	8.5	14.3	12.7
Stream Modifications:	Dredged	Dredged	None
Nuisance Plants (Y/N):	N	N	N
STORET No.:	800551	800491	800503
County Code:	80	80	80
TRS:	04S14W04	03S14W33	03S14W34
Latitude (dd):	42.15318	42.1605	42.1625
Longitude (dd):	-85.95566	-85.93638	-85.92664
Ecoregion:	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4050001	4050001	4050001
*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 12. Qualitative macroinvertebrate community sampling results at selected stations, Eagle Lake Drain, in the Paw Paw River watershed, Van Buren County, August 2, 2016.

	Eagle Lake Drain @ 42nd Street 8/2/2016	Eagle Lake Drain @ 40th Street 8/2/2016	Eagle Lake Drain @ 39th Street 8/2/2016
TAXA	Station 6	Station 7	Station 8
PORIFERA (sponges)			
PLATYHELMINTHES (flatworms)			
Turbellaria	9	1	2
ANNELIDA (segmented worms)			
Hirudinea (leeches)	4	1	
Oligochaeta (worms)	79	215	80
ARTHROPODA			
Crustacea			
Amphipoda (scuds)			1
Decapoda (crayfish)			
Isopoda (sowbugs)			
Arachnoidea			
Hydracarina	1	9	12
Insecta			
Ephemeroptera (mayflies)			
Baetidae			12
Caenidae			
Ephemerellidae			
Ephemeridae			
Heptageniidae			
Leptophlebiidae			
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	1		1
Cordulegastridae			
Corduliidae			
Gomphidae			
Libellulidae			
Zygoptera (damselflies)			
Calopterygidae			1
Coenagrionidae	1		2
Plecoptera (stoneflies)			
Nemouridae			
Perlidae			
Perlodidae			
Hemiptera (true bugs)			
Belostomatidae			
Corixidae	1		
Gerridae			
Mesoveliidae	6	2	1
Nepidae			
Notonectidae	1		

	Eagle Lake Drain @ 42 nd Street 8/2/2016	Eagle Lake Drain @ 40 th Street 8/2/2016	Eagle Lake Drain @ 39 th Street 8/2/2016
TAXA	Station 6	Station 7	Station 8
Megaloptera			
Corydalidae (dobson flies)			
Sialidae (alder flies)			
Trichoptera (caddisflies)			
Brachycentridae			
Glossosomatidae			
Helicopsychidae			
Hydropsychidae		1	6
Hydroptilidae	26	15	44
Lepidostomatidae			
Leptoceridae			
Limnephilidae			
Molannidae			3
Philopotamidae			
Phryganeidae			1
Polycentropodidae			
Uenoidae			
Coleoptera (beetles)			
Dytiscidae	1	2	5
Haliplidae (adults)		2	1
Hydrophilidae (total)		1	
Elmidae			
Diptera (flies)			
Athericidae			
Ceratopogonidae		1	
Chironomidae	60	124	95
Culicidae	5	1	
Dixidae		1	
Empididae	2		2
Simuliidae	13	4	33
Tabanidae			
Tipulidae			
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)			
Bithyniidae			
Hydrobiidae	86	5	4
Lymnaeidae			7
Physidae	1	13	34
Planorbidae	21		10
Pleuroceridae			
Viviparidae			
Pelecypoda (bivalves)			
Dreissenidae			
Sphaeriidae (clams)	3	1	2
Unionidae (mussels)			
TOTAL INDIVIDUALS	321	400	359

Table 13. Macroinvertebrate metric evaluation of selected stations, Eagle Lake Drain, in the Paw Paw River watershed, Van Buren County, August 2, 2016.

	Eagle Lake Drain 42nd Street 8/2/2016		Eagle Lake Drain 40th Street 8/2/2016		Eagle Lake Drain 39th Street 8/2/2016	
	Station 6		Station 7		Station 8	
METRIC	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	19	0	19	0	23	0
NUMBER OF MAYFLY TAXA	0	-1	0	-1	1	-1
NUMBER OF CADDISFLY TAXA	1	-1	2	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	0	-1	0	-1	3.34	0
PERCENT CADDISFLY COMPOSITION	8.10	0	4	0	15.04	0
PERCENT DOMINANT TAXON	26.79	0	53.75	-1	26.46	0
PERCENT ISOPOD, SNAIL, LEECH	34.89	-1	4.75	0	15.32	-1
PERCENT SURFACE AIR BREATHERS	4.36	1	2.50	1	2.23	1
TOTAL SCORE		-4		-3		-2
MACROINVERTEBRATE COMMUNITY RATING	Acceptable		Acceptable		Acceptable	

Table 14. Comparison of habitat metrics evaluation results at selected stations, Eagle Lake Drain, Paw Paw River watershed, Van Buren County.

	Eagle Lake Drain @ 42 nd Street			Eagle Lake Drain @ 40 th Street	Eagle Lake Drain @ 39 th Street
	GLIDE/POOL			GLIDE/POOL	GLIDE/POOL
Date:	7/11/2006	8/10/2011	8/2/2016	8/2/2016	8/2/2016
HABITAT METRIC					
Substrate and In-stream Cover					
Epifaunal Substrate/ Available Cover (20)	5	3	6	6	6
Embeddedness (20)*					
Velocity/Depth Regime (20)*					
Pool Substrate Characterization (20)**	8	10	10	10	11
Pool Variability (20)**	4	1	1	11	11
Channel Morphology					
Sediment Deposition (20)	5	0	6	5	6
Flow Status - Maintenance Flow Volume (10)	10	10	9	7	9
Flow Status - Flashiness (10)	8	2	7	6	7
Channel Alteration (20)	11	10	13	11	11
Frequency of Riffles/Bends (20)*					
Channel Sinuosity (20)**	2	0	1	1	2
Riparian and Bank Structure					
Bank Stability (L) (10)	7	5	8	6	8
Bank Stability (R) (10)	7	3	8	6	8
Vegetative Protection (L) (10)	8	6	7	7	8
Vegetative Protection (R) (10)	8	6	7	7	6
Riparian Vegetative Zone Width (L) (10)	6	4	5	3	8
Riparian Vegetative Zone Width (R) (10)	4	4	5	5	8
TOTAL SCORE (200):	93	64	93	91	107
HABITAT RATING:	FAIR	FAIR	FAIR	FAIR	GOOD
Weather:	Cloudy	Sunny	Sunny	Sunny	Sunny
Air Temperature: °F	75	75	70	80	84
Water Temperature: °F	60	65		62	64
Average Stream Width: Feet	12	17	18.2	22.1	18.1
Average Stream Depth: Feet	.67	.67	1.1	1.1	1.2
Surface Velocity: Feet/Second	.5	.71	0.4	0.6	0.6
Estimated Flow: Cubic Feet/Second	4.02	8.09	8.5	14.3	12.7
Stream Modifications:	Dredged	Dredged	Dredged	Dredged	None
Nuisance Plants (Y/N):	N	N	N	N	N
STORET No.:	800551	800551	800551	800491	800503
County Code:	80	80	80	80	80
TRS:	04S14W04	04S14W04	04S14W04	03S14W33	03S14W34
Latitude (dd):	42.15318	42.15318	42.15318	42.1605	42.1625
Longitude (dd):	-85.95566	-85.95566	-85.95566	-85.93638	-85.92664
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4050001	4050001	4050001	4050001	4050001
*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 15. Comparison of qualitative macroinvertebrate community sampling results at selected stations, Eagle Lake Drain, in the Paw Paw River watershed, Van Buren County, 2001-2016.

Road Crossings	Eagle Lake Drain						
	42nd Street			40th Street		39th Street	
	Taxa	7/11/2006	8/10/2011	8/2/2016	7/17/2001	8/2/2016	8/2/2016
PLATYHELMINTHES (flatworms)							
Turbellaria	1		9		1	2	
ANNELIDA (segmented worms)							
Hirudinea (leeches)	18	1	4	1	1		
Oligochaeta (worms)	2	4	79		215	80	
ARTHROPODA							
Crustacea							
Amphipoda (scuds)	40	84		20		1	
Decapoda (crayfish)		1		1			
Isopoda (sowbugs)	1	13		2			
Arachnoidea							
Hydracarina	3		1		9	12	
Insecta							
Ephemeroptera (mayflies)							
Baetidae	1			10		12	
Tricorythidae							
Odonata							
Anisoptera (dragonflies)							
Aeshnidae		1	1	1		1	
Zygoptera (damselflies)							
Calopterygidae		2		1		1	
Coenagrionidae			1			2	
Hemiptera (true bugs)							
Belostomatidae				1			
Corixidae	22	18	1	10			
Gerridae	1			1			
Mesoveliidae			6		2	1	
Notonectidae	1	5	1				
Pleidae	1						
Megaloptera							
Sialidae (alder flies)		3		1			
Trichoptera (caddisflies)							
Brachycentridae		2					
Hydropsychidae	2	15		3	1	6	
Hydroptilidae			26		15	44	
Leptoceridae		1					
Limnephilidae	1			2			

	Eagle Lake Drain					
Road Crossings	42nd Street			40th Street		39th Street
Taxa	7/11/2006	8/10/2011	8/2/2016	7/17/2001	8/2/2016	8/2/2016
Molannidae	1			1		3
Phryganeidae				1		1
Coleoptera (beetles)						
Dytiscidae (total)	1	3	1	1	2	5
Haliplidae (adults)	2	1			2	1
Hydrophilidae (total)				1	1	
Elmidae		1		1		
Diptera (flies)						
Ceratopogonidae					1	
Chironomidae	217	81	60	20	124	95
Culicidae			5		1	
Dixidae					1	
Empididae			2			2
Simuliidae			13	20	4	33
MOLLUSCA						
Gastropoda (snails)						
Hydrobiidae	35		86		5	4
Lymnaeidae						7
Physidae		18	1	1	13	34
Planorbidae	5	1	21			10
Viviparidae				1		
Pelecypoda (bivalves)						
Sphaeriidae (clams)			3	1	1	2
TOTAL INDIVIDUALS	355	255	321	103	400	359

Table 16. Comparison of macroinvertebrate metric evaluations of selected stations, Eagle Lake Drain, Paw Paw River watershed, Van Buren County, 2001-2016.

	Eagle Lake Drain											
Road Crossing	42nd Street						40th Street				39th Street	
Date	7/11/2006		8/10/2011		8/2/2016		7/17/2001		8/2/2016		8/2/2016	
METRIC	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	19	0	19	0	19	0	24	0	19	0	23	0
NUMBER OF MAYFLY TAXA	1	-1	0	-1	0	-1	1	-1	0	-1	1	-1
NUMBER OF CADDISFLY TAXA	3	0	3	0	1	-1	4	0	2	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	0.28	-1	0.00	-1	0.00	-1	9.71	0	0.00	-1	3.34	0
PERCENT CADDISFLY COMPOSITION	1.13	-1	7.06	0	8.10	0	6.80	0	4.00	0	15.04	0
PERCENT DOMINANT TAXON	61.13	-1	32.94	0	26.79	0	19.42	1	53.75	-1	26.46	0
PERCENT ISOPOD, SNAIL, LEECH	16.62	-1	12.94	-1	34.89	-1	4.85	0	4.75	0	15.32	-1
PERCENT SURFACE AIR BREATHERS	8.45	0	10.98	0	4.36	1	13.59	0	2.50	1	2.23	1
TOTAL SCORE		-6		-4		-4		-1		-3		-2
MACROINVERTEBRATE COMMUNITY RATING	Poor		Acceptable		Acceptable		Acceptable		Acceptable		Acceptable	
Total # EPT TAXA	4		3		1		5		2		5	
% EPT TAXA	1.41		7.1		8.1		16.5		4		18.4	