

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
WATER RESOURCES DIVISION
MARCH 2012

STAFF REPORT

BIOLOGICAL SURVEYS OF SELECTED STATIONS IN THE
PAW PAW RIVER WATERSHED
VAN BUREN AND BERRIEN COUNTIES, MICHIGAN
JULY, AUGUST, AND SEPTEMBER 2011

Introduction

Biological and physical habitat conditions of selected waterbodies in the Paw Paw River watershed in Van Buren and Berrien counties were assessed by staff of the Surface Water Assessment Section in June, August, and September 2011. The primary objectives of the assessments were:

1. To support the development of water quality-based effluent limits (WQBELs) for National Pollutant Discharge Elimination System (NPDES) permits.
2. Identify nonpoint sources (NPS) of water quality impairment.
3. Assess the current status and condition of individual water bodies and determine if Michigan Water Quality Standards (WQS) are being met.
4. Satisfy monitoring requests submitted by internal and external customers.
5. Evaluate biological integrity temporal trends.

The macroinvertebrate community and/or physical habitat was qualitatively assessed at each of 16 stations (Table 1, Figures 1 and 2), and the fish community and physical habitat was assessed at two of the 16 stations using the Surface Water Assessment Section Procedure 51 (MDEQ, 1990; Creal et al., 1996) for wadeable streams. Visual observations were made at one additional station. If a station is sampled at a road crossing, it is generally sampled upstream unless otherwise noted. The macroinvertebrate and fish communities were assessed and scored with metrics that rate water bodies from excellent (+5 to +9 [macroinvertebrates], +5 to +10 [fish]) to poor (-5 to -9 [macroinvertebrates], -5 to -10 [fish]). Scores from +4 to -4 are rated acceptable. Negative scores in the acceptable range are considered tending towards a poor rating, while positive scores in the acceptable range are tending towards an excellent rating. Habitat evaluations are based on 10 metrics, with a maximum total score of 200. A station habitat score of >154 is characterized as having excellent habitat, 105-154 is good, 56-104 is marginal, and <56 is poor.

Two site selection methods were used to assess the Paw Paw River watershed in 2011: (1) stratified random; and (2) targeted. Ten randomly selected sites within the Paw Paw River Watershed were assigned to support the Section's Status and Trend Program. These sites will be used to estimate the watershed attainment status for the "other indigenous aquatic life" designated use component of R 323.1100(e) of the Michigan WQS, and will be used as baseline data to facilitate a measurement of biointegrity temporal trends. A separate monitoring report will be written for the remainder of the Lower St. Joseph River watershed.

Figure 1. 2011 Survey stations, Paw Paw River watershed. (Kalamazoo, Van Buren, and Berrien County, MI.)

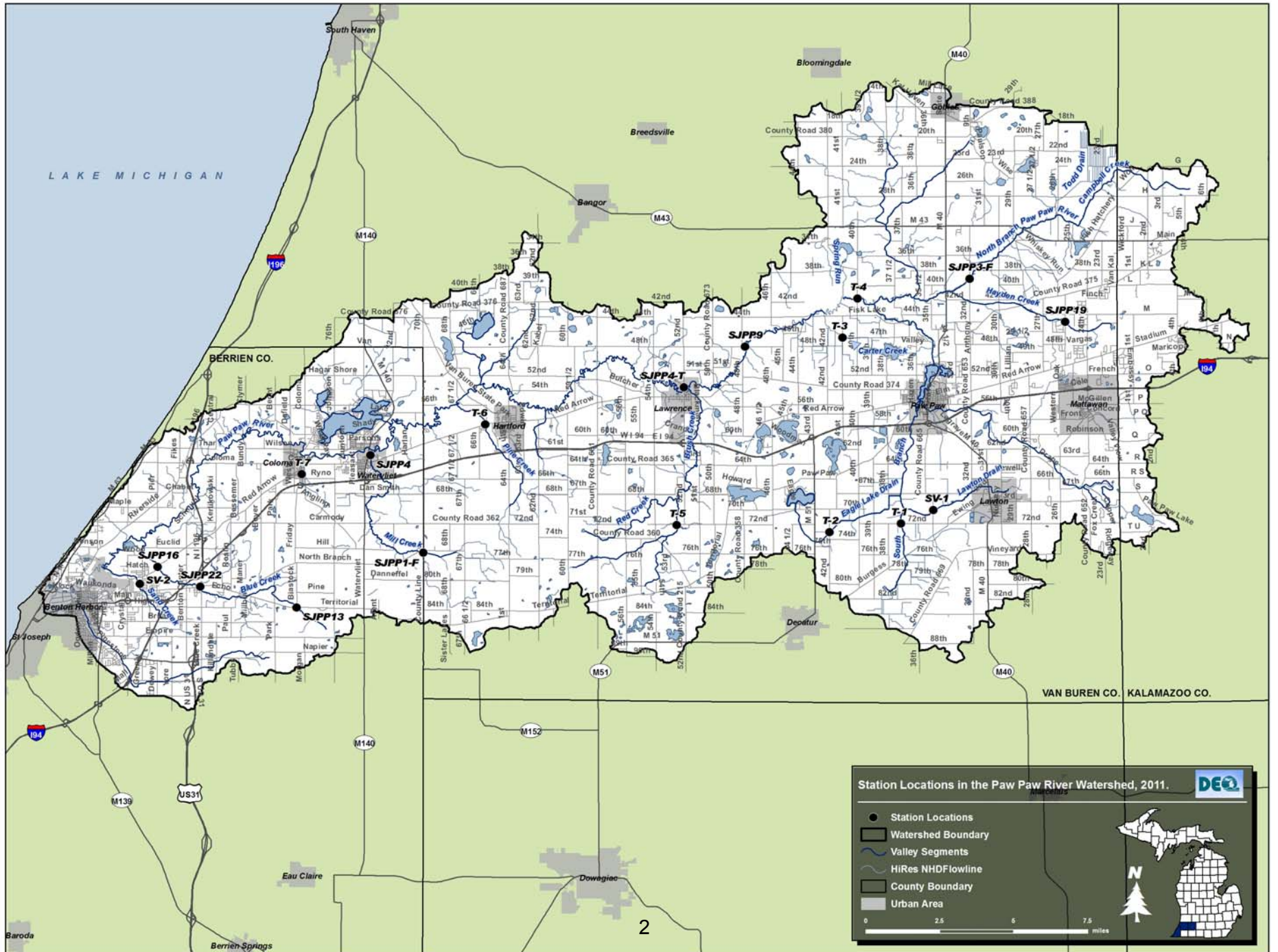


Table 1. Summary of the aquatic habitat and macroinvertebrate community evaluations for selected stations in the Paw Paw River watershed, June, August, and September 2011. S/T/Tr = Status, Trend, or Targeted station, SV = site visit only station, -- = not sampled, * = fish community was also sampled and scored acceptable.

Station #	Stream Name	Road Crossing	STORET #	TRS	County	Township	Latitude	Longitude	Habitat Evaluation		Macroinvertebrate Community		S, T, Tr	AUID#
									Rating	Score	Rating	Score		
1	Hayden Creek	County Road 652	800586	02S13WS35	Van Buren	Almena	42.25582	-85.80013	Good	148	Excellent	5	S	040500012406-02
2	North Branch Paw Paw River	32nd Street	800585	02S13WS20	Van Buren	Almena	42.27706	-85.86308	Good	115	Acceptable	-1	S	040500012406-01
3	South Branch Paw Paw River	72nd Avenue	800547	03S14W35	Van Buren	Paw Paw	42.15735	-85.90858	Marginal	103	Acceptable	3	T	040500012401-01
4	Eagle Lake Drain	42nd Street	800551	04S14W4	Van Buren	Decatur	42.15318	-85.95566	Marginal	64	Acceptable	-4	S	040500012405-09
5	Carter Creek	along north side of 47th Street	800589	02S14W33	Van Buren	Waverly	42.24832	-85.94690	Marginal	73	Acceptable*	0	T	040500012502-01
6	Carter Creek	upstream of 41st Street	800587	02S14WS33	Van Buren	Waverly	42.25012	-85.94700	Marginal	70	--*	--	T	040500012502-01
7	Paw Paw River	48th Avenue	800193	02S15WS36	Van Buren	Lawrence	42.24381	-86.01116	Good	141	Acceptable	4	S	040500012502-01
8	Brush Creek	72nd Ave.	800488	04S15W4	Van Buren	Hamilton	42.15667	-86.05603	Good	143	Acceptable	2	T	040500012501-02
9	Pine Creek	Red Arrow Hwy.	800466	03S16W16	Van Buren	Hartford	42.20571	-86.18215	Marginal	79	Acceptable	-4	T	040500012507-02
10	Paw Paw River	Off M-140	110719	03S17W14	Berrien	Watervliet	42.20604	-86.24354	Good	118	Acceptable	2	Tr	040500012507-01
11	Mill Creek	County Line Road	800584	04S16WS07	Van Buren	Keeler	42.14297	-86.22286	Marginal	88	Acceptable	-2	S	040500012506-02
12	Mill Creek	Butternut Street	110789	03S17WS23	Berrien	Watervliet	42.19050	-86.25791	Marginal	95	Acceptable	0	S	040500012506-01
13	Ryno Drain	Tannery Drive	110786	03S17W29	Berrien	Coloma	42.18111	-86.30300	Good	105	Acceptable	0	T	040500012507-01
14	Tributary to Blue Creek	Territorial Road (east)	110787	04S17WS20	Berrien	Bainbridge	42.11599	-86.30604	Marginal	90	Acceptable	4	S	040500012508-01
15	Blue Creek	Territorial Road (west)	110469	04S18WS14	Berrien	Benton	42.12586	-86.36973	Good	135	Acceptable	1	S	040500012508-01
16	Blue Creek	Red Arrow Highway	110788	04S18WS10	Berrien	Benton	42.13572	-86.39761	Good	114	Acceptable	1	S	040500012508-01
SV-1	Lawton Drain	County Road 665	800490	03S14W36	Van Buren	Paw Paw	42.16402	-85.88718	--	--	--	--	T	040500012401-01

Habitat Scoring				Macroinvertebrate Scoring		
Poor < 56	Marginal 56-104	Good 105-154	Excellent >154	Poor < -4	Acceptable -4 to +4	Excellent > +4

Six additional stations within the Paw Paw River watershed were selected for targeted monitoring to support decisions regarding the development of WQBELs for NPDES permits. One additional station was visited for observation only and any nonpoint sources of pollution impacting water quality were noted.

Watershed Information

The Paw Paw River watershed is approximately 466 square miles with 211 miles of perennial streams (MIRIS, 2006; Purdue, 2006) and has three main branches: the North Branch, South Branch, and East Branch (Figure 1). The Paw Paw River headwaters begin in Kalamazoo County and the river flows westerly approximately 60 miles to the confluence of the St. Joseph River in Benton Harbor. The North Branch headwaters are in Kalamazoo County, starting with Campbell Creek and then flowing in a westerly direction into Van Buren County. Hayden and Brandywine Creeks are two major tributaries that join the North Branch. The South Branch has headwaters in Van Buren County that flow in a primarily north direction. Eagle Lake Drain, Lawton Drain, and Three Mile Lake Drain are the major tributaries to the South Branch. The East Branch has headwaters that start in Kalamazoo County and flows in a westerly direction until the confluence with the South Branch in the city of Paw Paw. Immediately downstream of the confluence of the East Branch, the South Branch is impounded to form Maple Lake. Maple Lake is approximately 170 acres with approximate average and maximum depths of 7 feet and 12 feet, respectively. Downstream of the Maple Lake impoundment, the South Branch continues to flow north for approximately four miles to the confluence of the North Branch. This is where the main stem of the Paw Paw River begins. The Paw Paw River flows in a westerly direction to the confluence of the St. Joseph River in the city of Benton Harbor. Land use within the Paw Paw River watershed is approximately 59% agricultural, 20% forested, 15% water/wetlands, and 6% developed (SWMPC, 2008).

The soils in the Paw Paw River basin consist primarily of sandy loams with numerous gravel deposits (MDEQ, 1999). 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, et al. 1986). All stations are located in the Southern Michigan and Northern Indiana Till Plains Ecoregion (Omernik and Gallant, 1988).

The most recent surveys of the Paw Paw River watershed were conducted in 2005 and 2006 (Lipsey, 2006; Walterhouse, 2006). Macroinvertebrate community ratings ranged from poor to excellent with most stations scoring acceptable. Habitat ratings ranged from marginal to excellent. Ox Creek, the Yore-Stouffer Drain (a tributary to Ox Creek), Eagle Lake Drain, and Pine Creek scored poor. A Total Maximum Daily Load is being developed for Ox Creek and the Yore-Stouffer Drain. Pine Creek and Eagle Lake Drain were designated as 4C. Water and sediment chemistry samples were collected and are described in Lipsey 2006.

Prior to 2006, the Paw Paw watershed was most recently assessed in 2001 (Rockafellow, 2002a, 2002b). Water and/or sediment chemistry analysis, aquatic macroinvertebrate and/or fish community assessments, and habitat assessments were conducted at several stations. All stations met water quality standards with the exception of Ox Creek. A few select stations were also sampled in 1996 (Heaton, 1999). The macroinvertebrate community in Eagle Lake Drain at 40th Avenue scored poor and the fish community did not meet the coldwater standard. Aquatic vegetation was the only stable form of habitat available and there was a large amount of

sedimentation in the channelized stream. The drain was sampled in 2001 and scored acceptable for fish and macroinvertebrates and met the coldwater designation. Eagle Lake Drain is now categorized as a 4c stream.

2011 Sampling Results

Hayden Creek

Hayden Creek was sampled at County Road 652 (Station 1). It is designated as a coldwater stream. The glide/pool habitat was rated as good (148; Table 2a). This site is at the upper portion of the Hayden Creek watershed; therefore, the stream was fairly small with an average width of 3 feet. The riparian zone consisted of a wetland area with few trees and an abundance of shrubs and herbaceous vegetation. There was little large woody debris in the stream, so rootwads and overhanging vegetation provided the epifaunal substrate. Sand and silt deposition was evident making shallow pools much more prevalent than deep pools. The macroinvertebrate community scored excellent (5; Tables 2b, c) although no stonefly taxa and only two mayfly taxa were found. These taxa are less tolerant of environmental stress.



Figure 4: Hayden Creek upstream of County Road 652

North Branch Paw Paw River

The North Branch was sampled at 32nd Street (Station 2), and is designated as a coldwater stream. The glide/pool habitat was rated as good (115; Table 2a). The riparian zone on the left side of the stream consisted of a yard that was mowed nearly to the edge, but large trees had been left. The right bank consisted of a natural wooded floodplain. The substrate consisted of clay and shifting sand. Rip rap had been placed against the left bank for stabilization. Woody debris and leaf packs provided a majority of the epifaunal substrate. The stream was lacking sinuosity, possibly due to historic channelization. The macroinvertebrate community scored at acceptable (-1; Tables 2b, c). Amphipods made up more than 40% of the total individuals collected. A community dominated by one or two taxa can indicate an environmental stress (MDEQ, 1990).



Figure 3: North Branch Paw Paw River upstream of 32nd Street.

South Branch Paw Paw River

The South Branch of the Paw Paw River was sampled at 72nd Avenue (Station 3). It is designated as a coldwater stream. The South Branch of the Paw Paw River upstream of

Lawton Drain confluence and Lawton Drain are currently listed on the 305b list as having insufficient information for the other indigenous aquatic life and wildlife (OIALW) designated use. In 2001, the macroinvertebrate community was sampled in Lawton Drain at County Road 665 and scored acceptable. For the 2011 survey, the habitat at Station 3 was rated at the high end of marginal (103; Table 2a). The South Branch is actively maintained as a drain in this portion of the river. The channel has been straightened and dredged in the past. The riparian area was missing smaller shrubs but the riparian zone was approximately 100 feet on each side. Large woody debris was sparse, but where some was present a pool had formed just downstream of it. Undercuts banks and overhanging vegetation were extensive. Silt covered the large woody debris that was present and the substrate was dominated by shifting sand. Siltation and sedimentation was evident with the silt exceeding three feet in depth in some areas. The macroinvertebrate community scored acceptable (3; Tables 2b, c). Diversity was good at this station with 6 Ephemeroptera, Plecoptera, and Trichoptera (Mayflies, Stoneflies, and Caddisflies) families found. These families are typically less tolerant of environmental stress; however, the density of individuals was very low.



Figure 4: South Branch Paw Paw River, upstream of 72nd Avenue.

Eagle Lake Drain

Eagle Lake Drain is a tributary to the South Branch Paw Paw River upstream of the Maple Lake impoundment. It is designated as a warmwater stream. The drain was sampled at 42nd Street (Station 4). The glide/pool habitat was rated at the low end of marginal (64; Table 2a). Very little substrate was available for colonization at this station. Large woody debris was present in the stream channel; however, it was deeply embedded and covered with silt. Aquatic vegetation was the only other available epifaunal substrate. The stream channel had obviously been dredged and straightened in the past, and there was very little channel sinuosity or pool variability. Unstable silt and sand were as deep as 2 feet in places. The stream appeared very flashy with raw banks being held to some degree by roots from riparian trees and vegetation. The macroinvertebrate community scored at the low end of acceptable (-4; Tables 2b, c). No stonefly or mayfly taxa were found. The low score for macroinvertebrates can most likely be attributed to past and possibly current maintenance activities within the drain.



Figure 5: Eagle Lake Drain upstream of 42nd Street. Erosion under tree likely to due to flashy flows.

Carter Creek

Carter Creek was sampled at two stations. The upstream station (Station 5) was sampled along 47th Avenue. This station is just upstream of the unnamed tributary that contains the effluent from the Coca Cola Paw Paw facility's outfall 002. The downstream station (Station 6) was located downstream of the same unnamed tributary and upstream of 41st Street. Carter Creek is designated as a warmwater stream.

The glide/pool habitat at Station 5 was rated at the low end of marginal (73; Table 3a). Carter Creek runs directly along 47th Avenue at this station. It has been completely straightened and channelized as a roadside ditch. There is very little riparian area on either side of the stream due to the road on the south side of the stream and due to livestock pastures on the north side of the stream. There is very little epifaunal substrate at this site. Undercut banks and overhanging vegetation were abundant, but the water level was fairly low except in an occasional pool. Sand dominates the substrate and there were many islands of sand throughout the station. The macroinvertebrate community scored in the mid-range of acceptable (0; Tables 3b, c). No mayfly or stonefly taxa were found. The fish community scored towards the low end of acceptable (-3; Tables 3d, e). Ninety-seven percent of the taxa collected are considered fish species that are tolerant species and are often common in degraded waterbodies. Two grass pickerels, 1 mottled sculpin, and 1 johnny darter were also collected and these species are considered sensitive to many types of degradation. The majority of the fish were collected from the pools.

The glide/pool habitat at Station 6 was rated at the low end of marginal (70; Table 3a). Carter Creek runs directly along 41st Street at this station. It has been completely straightened and channelized as a roadside ditch. The stream is slightly larger at this station when compared to Station 5. There is additional flow that comes from the unnamed tributary that contains the Coca Cola effluent. Similar to the upstream station, there is very little riparian area on either side of the stream at Station 6 due to the road on the west side of the stream and due to livestock pastures on the east side of the stream. There is very little epifaunal substrate at this station. Aquatic vegetation provided some substrate. Sand dominates the substrate and most of the pools were filled in by sand. The macroinvertebrate community was not sampled in 2011 because macroinvertebrates were sampled in 2006 and scored well within the range of acceptable (0; Lipsey, 2006). Conditions did not suggest the score would have changed. The fish community scored acceptable in the 2011 surveys (-1; Tables 3d, e). Sixty-five percent of the taxa collected are considered species that are tolerant species and are often common in degraded waterbodies. Seven grass pickerels, 40 mottled sculpin, and 11 johnny darters were also collected and these species are considered sensitive to many types of degradation.

Based on the macroinvertebrate and fish community information presented above, the warmwater fish and other indigenous aquatic life and wildlife designated uses appear to be in attainment in Carter Creek both upstream and downstream of the confluence of the unnamed tributary that contains the effluent from the Coca Cola Paw Paw facility's outfall 002.

Paw Paw River

The main branch of the Paw Paw River was sampled at two stations. The Paw Paw River is designated as a warmwater stream. The two stations had several habitat characteristics in common. Both of the stations had



Figure 6: Paw Paw River upstream of 48th Avenue.

deep areas (> 6 feet) along outside bends and in the mid channel and thus sampling was somewhat restricted to river margins or areas where sediment was deposited and large woody debris had settled and collected leaf packs. Sand dominated the substrate at each station and pools and run areas were equally available.

The most upstream station sampled on the Paw Paw River was at 48th Street northeast of the village of Lawrence (Station 7). The glide/pool habitat was rated at the higher end of good (141; Table 3a). The water levels were high in 2011, and therefore there was a limited amount of area that could be safely sampled. Rootwads and undercut banks were extensive but could not be sampled due to the depth of the pools along the streambanks formed by lateral scour. Woody debris and leaf packs were the primary epifaunal substrate. There was no cobble, gravel, or aquatic vegetation present. The stream channel had a large amount of shifting sand substrate. The riparian zone was an extensive, wooded floodplain area. The macroinvertebrate community scored acceptable (4; Tables 3b, c).

Station 10 was located further downstream on the Paw Paw River off of M-140. This station was located on the property of a campground behind the Ma and Pa Restaurant. The glide/pool habitat was rated as good (118; Table 4a). The dominant habitat available for macroinvertebrate colonization was woody debris and leaf packs. This site was on a bend and the outside portion of the bend is very deep and could not be sampled. The riparian area at this station was much different than most stations sampled on the Paw Paw. The right bank was mowed to the stream edge due to the campground, leaving only large trees in place. The left bank was an extremely high (> 20 feet) bluff and was left intact. The macroinvertebrate community scored acceptable (2; Tables 4b, c). This station is a trend station and was sampled in 2006. It will be sampled in future surveys to look at long term trends in water quality.



Figure 7: Paw Paw River off of M-140.

Brush Creek

The headwaters of Brush Creek begin south of the village of Lawrence. The Creek flows north to the confluence with the Paw Paw River, in the village of Lawrence. Brush Creek is designated as a coldwater stream and was sampled at 72nd Avenue (Station 8). The glide/pool habitat was rated good (143; Table 3a). Large woody debris, undercut banks, leaf packs, and rootwad made up the available epifaunal substrate. There was a good amount of pool variability, but the substrate was entirely shifting sand. The riparian zone was an intact wetland with overhanging alders. The macroinvertebrate community scored acceptable (2; Tables 3b, c).



Figure 8: Brush Creek upstream of 72nd Avenue. Sand sedimentation evident.

Pine Creek

Pine Creek is a tributary that flows from the south to its confluence with the Paw Paw River, just west of Hartford. Pine Creek is designated as a coldwater stream and was sampled at Red Arrow Highway (Station 9). The glide/pool habitat at Station 9 was rated as marginal (79; Table 4a). The stream channel at this station is very wide and straight and had a very shallow uniform depth (.5 feet). The substrate consisted of entirely sand with little pool variability. Large woody debris was present extensively throughout the site; however, it was deeply embedded in sand and covered in silt so that it could not be considered stable epifaunal



Figure 9: Pine Creek upstream of Red Arrow Highway.

substrate. The stream also appeared very flashy with deeply incised raw banks 5 feet above the surface of the water. The riparian area was fairly intact and the roots from the trees and vegetation helped stabilize the banks to prevent sloughing. Although it does not appear that channelization has occurred recently in the stream, it appears that the stream has not been able to recover from previous channelization and regain any significant amount of channel diversity. The macroinvertebrate community scored at the low end of acceptable (-4; Tables 4b, c). No stonefly taxa were found. Amphipods made up 44% of the total individuals found indicating that there is an environmental stress at this station. The low score for macroinvertebrates can most likely be attributed to past and possibly current maintenance activities within the drain.

Mill Creek

Mill Creek flows from the south to the confluence with the Paw Paw River in the village of Watervliet. It is designated as a coldwater stream, and was sampled at two stations. The most upstream station was sampled at County Line Road (Station 11). This station had riffle/run habitat, which is somewhat unique in the Paw Paw River watershed, and was rated as marginal (88; Table 4a). The epifaunal substrate included a small amount of cobble which was approximately 40% embedded and some woody debris that was covered with fine sand and silt. The channel was straight with a uniform channel width and depth, indicating that it has historically been a maintained channel. Large trees were missing from the riparian area. The stream seemed very flashy with erosion evident up to 5 feet above the surface of the water. The macroinvertebrate community scored at the lower end of acceptable (-2; Tables 4b, c). No stonefly taxa and only one mayfly taxa were found and amphipods consisted of 57% of the total individuals found, indicating that there is an environmental stress at this station.



Figure 10: Mill Creek upstream County Line Road.

The second station on Mill Creek (Station 12) was sampled upstream of Butternut Road, less than 0.1 miles upstream from the confluence with the Paw Paw River. This station was located at a park. The glide/pool habitat was rated as marginal (95; Table 4a). A built up area of cobble is most likely the remnants of an old mill dam. Upstream of the old dam is a shallow run with gravel substrate and then a deeper pool area. The gravel was mixed with silt and sand and is approximately 70% embedded. Downstream of the old dam is a mixture of gravel, cobble, and sand. Some woody debris was caught in the riffle area or could be found pushed against the sides of the stream. The stream appeared fairly flashy and a local person indicated that the stream is often cloudy. The riparian area was impacted greatly by the park on the one side and was mowed to the edge of the stream for quite a distance. The macroinvertebrate community scored acceptable (0; Tables 4b, c). No stonefly taxa were found and amphipods consisted of 47% of the total individuals found, indicating that there is an environmental stress at this station.



Figure 11: Mill Creek upstream at Butternut Road.

Ryno Drain

Ryno Drain is a warmwater designated tributary to the Paw Paw River. The confluence of the drain is located in the village of Coloma. Ryno Drain was sampled at Tannery Drive (Station 13). The riffle/run habitat was rated at the low end of good (105; Table 5a). Riffle/run habitat is somewhat unique in the Paw Paw River watershed. The riparian area at this station was very narrow and was impacted greatly by an adjacent park lawn and an adjacent neighborhood. The creek appeared to get a fair amount of fishing use and a lot of trash was present in the stream channel. Large woody debris was present but sparse and riffles and undercut banks provided some epifaunal substrate. Pools were not abundant and further upstream islands of gravel were present indicating sediment deposition. The macroinvertebrate community scored acceptable (0; Tables 5b, c). No stonefly taxa were found and amphipods consisted of 47% of the total individuals found.

Blue Creek

Blue Creek is a coldwater designated tributary to the Paw Paw River. The confluence of the creek and river is located just northeast of Benton Harbor. Three stations were sampled in the Blue Creek watershed. The most upstream station (Station 14) was located on Unnamed Tributary to Blue Creek at Territorial Road. The glide/pool habitat at Station 14 was rated as marginal (90; Table 5a). The epifaunal substrate consisted of woody debris and gravel that was deeply embedded, thus limiting colonization potential. The reach was shortened by the presence of a second culvert approximately 125 feet downstream. The culvert was perched which resulted in a fairly deep plunge pool. A large amount of trash was located in the pool and throughout the reach, indicating things were often dumped in this area. The substrate was dominated by fine sand that was 6 inches or more in depth in some areas. The riparian areas had heavy shading from trees; therefore, not much understory was available for riparian

vegetation. The channel looked like it had been relocated or altered in some way in the past. The banks were very unstable with a large amount of erosion and it was apparent that the stream had a flashy flow regime. The macroinvertebrate community scored at the high end of acceptable (4; Tables 5b, c).

The next station sampled in the Blue Creek watershed (Station 15) was Blue Creek at its most downstream Territorial Road crossing. The glide/pool habitat at Station 15 was rated as good (135; Table 5a). The water was very cold (49 degrees Fahrenheit) and turbid at this station. The water was also somewhat high. These same conditions were observed earlier in the year. According to MDEQ district staff, the turbidity is somewhat common in the area and is the result of clay particle suspension in the water column. Large woody debris and leaf packs were the primary epifaunal substrate.

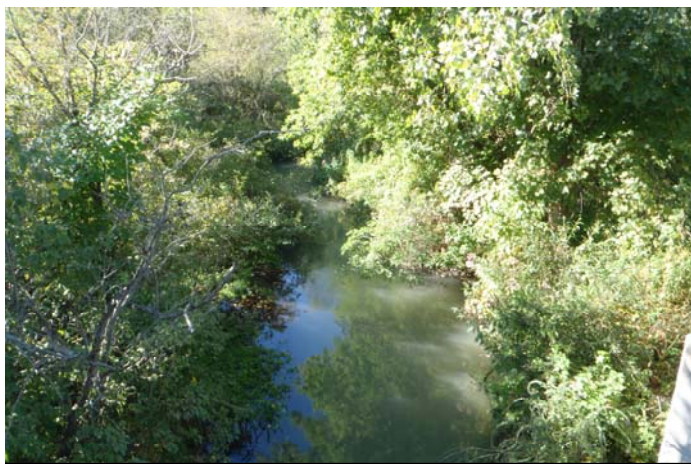


Figure 12: Blue Creek upstream of Territorial Road.

Watercress was available on areas where sandbars had developed. Sand and silt were the dominant substrate types along with clay areas. The riparian area was impacted by the road on the left side, but was intact on the right side with wetland shrub vegetation. The macroinvertebrate community scored acceptable (1; Tables 5b, c).

The most downstream station sampled in the Blue Creek watershed (Station 16) was sampled at Red Arrow Highway. The glide/pool habitat at Station 16 was rated as good (114; Table 5a). The water was still turbid at this downstream station, but clearer than Station 15. The substrate was dominated by shifting sand, but there was a lot of woody debris and leaf packs available as epifaunal substrate. The riparian area was intact on both sides of the stream with a small mown path on the left side. The stream appeared somewhat flashy with more than 2 feet of erosion in areas along the left bank. The stream was fairly straight and may have been channelized in the past. The macroinvertebrate community scored acceptable (1; Tables 5b, c).



Figure 13: Blue Creek upstream of Red Arrow Highway. Turbidity due to clay particles is evident.

Summary of Results of Monitoring Objectives

1. Support WQBEL development for NPDES permits.

Targeted monitoring was conducted in relation to the Coca-Cola Paw Paw facility (Permit # MI MI0056367). Coca Cola Paw Paw has two outfalls. One discharges to the

Thompson-Harrington Drain, and the second discharges to an unnamed tributary to Carter Creek. In 2009, as part of a total dissolved solids mixing zone study, consultants working for the permittee conducted fish community surveys in the Paw Paw River upstream of 40th Street and in Carter Creek upstream of 47th Avenue at 41st Street. Fish communities were reported to score poor at both stations; however, the Paw Paw River station was 39 feet wide and was sampled using a backpack shocker, which is not appropriate for this size of stream. As part of the 2011 surveys, the fish community was sampled in Carter Creek upstream of 41st Street (Station 5, downstream of the unnamed tributary) and along 47th Avenue (Station 6, upstream of the unnamed tributary). The fish community scored acceptable at both stations. Macroinvertebrates were collected in 2006 at Station 5 and scored acceptable (Lipsey, 2006) and were collected in 2011 at Station 6 and scored acceptable. The habitat was rated marginal at both stations. Details can be found above in the section titled Carter Creek or in Tables 4a, b, c, d. This information can be used for future permit decisions and analysis. The Paw Paw River at 40th Street could not be sampled due to the high water levels in the Paw Paw River.

2. Identify NPS of water quality impairment.

The following NPS issues were identified from the 2011 sampling and were reported to MDEQ, Kalamazoo office, NPS staff. Locations are noted in Figure 1 and Table 1.

Lawton Drain at County Road 665 (Site Visit -1)

Sheep and horses were observed grazing near Lawton Drain at County Road 665. There was no exclusion of the livestock from the stream. Extreme bank erosion was not observed; however, the native riparian vegetation was obviously much reduced and altered due to grazing, and there is higher potential for bank sloughing due to the lack of riparian vegetation. There is also the potential for pathogens to enter the stream with direct access of livestock to the stream. This unrestricted livestock access was noted in 2006 as well (Lipsey, 2006).

Carter Creek along 47th Avenue (Station 5).

Horses were observed grazing near Carter Creek along 47th Avenue. Extreme bank erosion was not observed; however, the native riparian vegetation was obviously much reduced and altered due to grazing, and there is higher potential for bank sloughing due to the lack of riparian vegetation. There is also the potential for pathogens to enter the stream with direct access of livestock to the stream.

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

Aquatic macroinvertebrate community, fish community, and habitat assessments were conducted at a total of 16 stations in the Paw Paw River watersheds (Table 1, Figure 1). Eleven of these stations are considered status or trend stations, which were chosen with a randomized design. Five stations were targeted. The “other indigenous wildlife and aquatic life” designated use was being met at all stations.

The South Branch of the Paw Paw River upstream of the Lawton Drain confluence and including Lawton Drain are currently listed on the 305b list as having insufficient information for the other indigenous aquatic life and wildlife (OIALW) designated use. In 2001, the macroinvertebrate community was sampled in Lawton Drain at County Road 665 and scored acceptable. The macroinvertebrate community in this portion of South Branch of the Paw Paw River has not been sampled since 1991. In 2011, the habitat and macroinvertebrate community were surveyed at 72nd Avenue (Station 3, Table 1, and Figure 1). The habitat was rated

marginal and the macroinvertebrate community scored at the high end of acceptable (3; Tables 2a,b,c).

Eagle Lake Drain is listed on the 303d list as not attaining the other indigenous aquatic life and wildlife designated use. Causes include anthropogenic flow regime and substrate alterations (due to historic dredging and drain maintenance). In 2006, the macroinvertebrate community scored poor (-6) at 42nd St. In 2011, the macroinvertebrate community and habitat was surveyed again at this station (Station 4, Table 1, and Figure 1) to see if non-attainment conditions persist. The habitat was rated as marginal and the macroinvertebrate community scored at the very low end of acceptable (-4; Tables 2a,b,c). The drain has not been recently dredged, but causes of the low score would still include anthropogenic flow regime and substrate alterations due to historic drain maintenance activities.

Pine Creek is listed on the 303d list as not attaining the other indigenous aquatic life and wildlife designated use from the confluence with the Paw Paw River upstream to an unnamed tributary to Pine Creek that is located approximately 0.3 miles upstream of 66th Avenue. Causes include anthropogenic flow regime and substrate alterations (due to historic dredging). In 2005 and 2006, the macroinvertebrate community scored poor (-6) at Red Arrow Highway, and poor at 66th Avenue in 2005. In 2011, the macroinvertebrate community and habitat was surveyed again at Red Arrow Highway (Station 9, Table 1, and Figure 1) to see if non-attainment conditions persist. The habitat was rated as marginal and the macroinvertebrate community scored at the very low end of acceptable (-4; Tables 4a,b,c). The drain has not been recently dredged, but causes of the low score would still include anthropogenic flow regime and substrate alterations due to historic drain maintenance activities.

4. Satisfy monitoring requests submitted by internal and external customers.

There were three monitoring requests received for the Paw Paw River watershed that were addressed with the 2011 surveys.

Fisheries Division has concerns about impacts of sedimentation in Brush Creek. A sand trap was installed upstream of 72nd Avenue, but they would have to empty it monthly to keep it operational. Bank erosion to a wetland area adjacent to Brush Creek was reported to MDEQ in 2010 and was responded to by MDEQ district office personnel. The habitat and macroinvertebrate community was surveyed at one station (Station 8) upstream of 72nd Avenue (Table 1, Figure 1). The substrate was dominated by sand and the habitat was rated as good. The macroinvertebrate community scored acceptable (2; Tables 3a, b,c). Shifting sand did dominated the stream substrate as is shown Figure 8 and habitat parameters metrics are detailed in Table 3a.

A monitoring request was submitted by Coloma Township. They have some general concerns about impacts a gun club's activities and the Orchard Hill Landfill may have on Ryno Drain. The gun club has shooting ranges that are adjacent to the drain and the Orchard Hill landfill recently was permitted to discharge 0.05 million gallons per day of treated landfill leachate. They have not yet begun discharging. The habitat and macroinvertebrate community was surveyed prior to the new discharge at one station (Station 13) at Tannery Drive. (Table 1, Figure 1). The habitat was rated at the very low end of good and the macroinvertebrate community scored acceptable (0; Tables 5a,b,c).

5. Evaluate biological integrity temporal trends.

Ten randomly selected sites within the Paw Paw River Watershed were assigned to support attainment status calculation. These sites will be used to estimate the attainment status in the

Lower St. Joe and Paw Paw Rivers watershed group for the “other indigenous aquatic life” designated use component of R 323.1100(e) of the Michigan WQS. This information will be available in a future report.

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Literature Cited

- Albert, Dennis A. 1995. Regional Landscape Ecosystems of Michigan, Minnesota, and Wisconsin: A Working Map and Classification. Gen. Tech. Rep. NC-178. St. Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station. Jamestown, ND: Northern Prairie Wildlife Research Center Online. *(The link provided was broken and has been removed.)* (Version 03JUN1998).
- Creal, W., S. Hanshew, S. Kosek, M. Oemke, and M. Walterhouse. et al. 1996. Update of GLEAS Procedure 51 Metric Scoring and Interpretation. MDEQ Staff Report MI/DEQ/SWQ-96/068. Revised May 1998.
- Heaton, S. 1999. Biological surveys of selected tributaries in the Paw Paw River watershed in Van Buren County, July 1996. Report # MI/DEQ/SWQ-99/158
- LeSage, S. and J. Smith 2010. Water Quality and Pollution Control in Michigan: 2008 Sections 303(d) and 305(b) Integrated Report. MI/DEQ/WB-10/001.
- Lipsey, T. 2006. Biological and water chemistry surveys of selected stations in the Paw Paw River watershed, Van Buren and Berrien Counties, Michigan, July, August, and September 2006. Report # MI/DEQ/SWQ-07/081.
- MDEQ, 1990. GLEAS Procedure 51 - Qualitative Biological and Habitat Survey Protocols for Wadable Streams and Rivers, April 24, 1990. Revised June 1991, August 1996, January 1997, and May 2002.
- MIRIS. 2006. Database Coverages from the Michigan Resource Information Database.
- Omernik, J. and A. Gallant. 1988. Ecoregions of the Upper Midwest States. USEPA, Environmental Research Laboratory. EPA/600/3-88/037.
- Purdue. 2006. Long-Term Impact Assessment Models. Purdue Research Foundation, West Lafayette, Indiana. ERL: *(The link provided was broken and has been removed.)*
- Rockafellow, D. 2002a. A biological survey of the North and South Branches of the Paw Paw River and selected tributaries, Van Buren County, Michigan, July and September 2001. Report # MI/DEQ/SWQ-02/062.
- Rockafellow, D. 2002b. A biological survey of the Paw Paw River and selected tributaries, Van Buren County, Michigan, June, July, and September 2001. Report # MI/DEQ/SWQ-02/063.
- Southwest Michigan Planning Commission. 2008. Paw Paw River Watershed Management Plan. *(The link provided was broken and has been removed)*
- Walterhouse, M. 2006. A biological and water chemistry survey of Mill and Pine Creeks in the vicinity of the Hartford Dairy Concentrated Animal Feeding Operation, Berrien and Van Buren Counties, Michigan, July through September 2005. Report # MI/DEQ/SWQ-06/035.

Table 2A. Habitat evaluation for selected stations in the Paw Paw River watershed, Van Buren County, MI. August 2011.

	Hayden Creek @ County Road 652 GLIDE/POOL	North Branch Paw Paw River @ 32nd Street GLIDE/POOL	South Branch Paw Paw River @ 72nd Avenue GLIDE/POOL	Eagle Lake Drain @ 42nd Street GLIDE/POOL
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	8	7	6	3
Embeddedness (20)*				
Velocity/Depth Regime (20)*				
Pool Substrate Characterization (20)**	13	7	10	10
Pool Variability (20)**	10	15	9	1
Channel Morphology				
Sediment Deposition (20)	9	9	6	0
Flow Status - Maintained Flow Volume (10)	10	10	10	10
Flow Status - Flashiness (10)	8	4	8	2
Channel Alteration (20)	19	15	8	10
Frequency of Riffles/Bends (20)*				
Channel Sinuosity (20)**	16	6	0	0
Riparian and Bank Structure				
Bank Stability (L) (10)	9	6	9	5
Bank Stability (R) (10)	9	8	9	3
Vegetative Protection (L) (10)	9	5	7	6
Vegetative Protection (R) (10)	9	10	7	6
Riparian Vegetation Zone Width (L) (10)	9	3	6	4
Riparian Vegetation Zone Width (R) (10)	10	10	8	4
TOTAL SCORE (200):	148	115	103	64

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	8/10/2011	8/10/2011	8/12/2011	8/10/2011
Weather:	Partly Cloudy	Sunny	Sunny	Sunny
Air Temperature:	72 Deg. F.	72 Deg. F.	Deg. F.	75 Deg. F.
Water Temperature:	58 Deg. F.	68 Deg. F.	59 Deg. F.	65 Deg. F.
Ave. Stream Width:	3 Feet	16 Feet	21 Feet	17 Feet
Ave. Stream Depth:	0.5 Feet	0.3 Feet	2 Feet	0.67 Feet
Surface Velocity:	1 Ft./Sec.	1.25 Ft./Sec.	1 Ft./Sec.	0.71 Ft./Sec.
Estimated Flow:	1.5 CFS	6 CFS	42 CFS	8.0869 CFS
Stream Modifications:	None	Bank Stabilization	Dredged	Dredged
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				

STORET No.:	800586	800585	800547	800551
Stream Name:	Hayden Creek	North Branch Paw Paw River	South Branch Paw Paw River	Eagle Lake Drain
Road Crossing/Location:	County Road 652	32nd Street	72nd Avenue	42nd Street
County Code:	80	80	80	80
TRS:	02S13W35	02S13W35	03S14W35	04S14W04
Latitude (dd):	42.25582	42.25582	42.15735	42.15318
Longitude (dd):	-85.80013	-85.80013	-85.90858	-85.95566
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Coldwater	Coldwater	Warmwater
USGS Basin Code:	4050001	4050001	4050001	4050001

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

Table 2B. Qualitative macroinvertebrate sampling results for selected stations in the Paw Paw River watershed, Van Buren County, MI. August 2011

TAXA	Hayden Creek @ County Road 652 8/10/2011 STATION 1	North Branch Paw Paw River @ 32nd Street 8/10/2011 STATION 2	South Branch Paw Paw River @ 72nd Avenue 8/12/2011 STATION 3	Eagle Lake Drain @ 42nd Street 8/10/2011 STATION 4
ANNELIDA (segmented worms)				
Hirudinea (leeches)		1	1	1
Oligochaeta (worms)		4	10	4
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	52	116	14	84
Decapoda (crayfish)	1	2	6	1
Isopoda (sowbugs)	2	33		13
Arachnoidea				
Hydracarina			7	
Insecta				
Ephemeroptera (mayflies)				
Baetidae	52	3	10	
Caenidae			1	
Heptageniidae		14	4	
Leptophlebiidae	2			
Odonata				
Anisoptera (dragonflies)				
Aeshnidae	3	2	2	1
Zygoptera (damselflies)				
Calopterygidae	10	18	12	2
Plecoptera (stoneflies)				
Perlidae			1	
Hemiptera (true bugs)				
Corixidae			8	18
Gerridae	1			
Mesoveliidae	6		2	
Notonectidae				5
Pleidae			1	
Veliidae		1		
Megaloptera				
Sialidae (alder flies)	1		6	3
Trichoptera (caddisflies)				
Brachycentridae	19	41	8	2
Hydropsychidae	1	9	12	15
Leptoceridae		8	44	1
Limnephilidae		4		
Phryganeidae	1	3		
Coleoptera (beetles)				
Dytiscidae (total)	2		2	3
Gyrinidae (adults)	1			
Halplidae (adults)				1
Elmidae		14	9	1
Diptera (flies)				
Ceratopogonidae				
Chironomidae	47		73	81
Culicidae			1	
Dixidae	1			
Simuliidae	39		1	
Stratiomyidae		1		
Tabanidae	1			
Tipulidae	6			
MOLLUSCA				
Gastropoda (snails)				
Physidae	2		11	18
Planorbidae	1			1
Pelecypoda (bivalves)				
Pisidiidae	1			
Sphaeriidae (clams)			1	
TOTAL INDIVIDUALS	252	274	249	255

Table 2C. Macroinvertebrate metric evaluation of selected stations in the Paw Paw River watershed, Van Buren County, MI. August 2011

METRIC	Hayden Creek @ County Road 652 8/10/2011 STATION 1		North Branch Paw Paw River @ 32nd Street 8/10/2011 STATION 2		South Branch Paw Paw River @ 72nd Avenue 8/12/2011 STATION 3		Eagle Lake Drain @ 42nd Street 8/10/2011 STATION 4	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	23	1	17	0	26	1	19
NUMBER OF MAYFLY TAXA	2	1	2	0	3	0	0	-1
NUMBER OF CADDISFLY TAXA	3	1	5	1	3	0	3	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	1	1	0	-1
PERCENT MAYFLY COMPOSITION	21.43	1	6.20	0	6.02	0	0.00	-1
PERCENT CADDISFLY COMPOSITION	8.33	0	23.72	0	25.70	0	7.06	0
PERCENT DOMINANT TAXON	20.63	0	42.34	-1	29.32	0	32.94	0
PERCENT ISOPOD, SNAIL, LEECH	1.98	1	12.41	-1	4.82	0	12.94	-1
PERCENT SURFACE AIR BREATHERS	3.97	1	0.73	1	5.62	1	10.59	0
TOTAL SCORE		5		-1		3		-4
MACROINVERTEBRATE COMMUNITY RATING		EXCELLENT		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE

Table 3A. Habitat evaluation for selected stations in the Paw Paw River watershed, Van Buren County, MI. August and September 2011.

	Carter Creek @ along 47th Avenue GLIDE/POOL STATION 5	Carter Creek @ upstream 41st Street GLIDE/POOL STATION 6	Paw Paw River @ 48th Avenue GLIDE/POOL STATION 7	Brush Creek @ 72nd Avenue GLIDE/POOL STATION 8
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	5	3	11	16
Embeddedness (20)*				
Velocity/Depth Regime (20)*				
Pool Substrate Characterization (20)**	6	8	8	8
Pool Variability (20)**	4	3	13	15
Channel Morphology				
Sediment Deposition (20)	2	1	6	5
Flow Status - Maintained Flow Volume (10)	10	7	10	10
Flow Status - Flashiness (10)	8	8	6	7
Channel Alteration (20)	6	8	18	19
Frequency of Riffles/Bends (20)*				
Channel Sinuosity (20)**	0	0	11	11
Riparian and Bank Structure				
Bank Stability (L) (10)	8	8	9	9
Bank Stability (R) (10)	8	8	9	9
Vegetative Protection (L) (10)	5	3	10	8
Vegetative Protection (R) (10)	6	6	10	8
Riparian Vegetation Zone Width (L) (10)	2	2	10	10
Riparian Vegetation Zone Width (R) (10)	3	5	10	8
TOTAL SCORE (200):	73	70	141	143

HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	8/12/2011	9/8/2011	8/12/2011	8/11/2011
Weather:	Sunny	Cloudy	Sunny	Sunny
Air Temperature:	81 Deg. F.	68 Deg. F.	80 Deg. F.	75 Deg. F.
Water Temperature:	72 Deg. F.	55 Deg. F.		67 Deg. F.
Ave. Stream Width:	5 Feet	7 Feet	70 Feet	18 Feet
Ave. Stream Depth:	0.58 Feet	0.25 Feet	5 Feet	2 Feet
Surface Velocity:	0.5 Ft./Sec.	0.83 Ft./Sec.	1 Ft./Sec.	1.25 Ft./Sec.
Estimated Flow:	1.45 CFS	1.4525 CFS	350 CFS	45 CFS
Stream Modifications:	Dredged	Dredged	None	None
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	800589	800587	800193	800488
Stream Name:	Carter Creek	Carter Creek	Paw Paw River	Brush Creek
Road Crossing/Location:	47th Avenue	upstream 41st Street	48th Avenue	72nd Avenue
County Code:	80	80	80	80
TRS:	02S14W33	02S14W33	02S15W36	04S15W04
Latitude (dd):	42.248314	42.25012	42.24381	42.15667
Longitude (dd):	-85.946877	-85.947	-86.0116	-86.05603
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Warmwater	Warmwater	Coldwater
USGS Basin Code:	4050001	4050001	4050001	4050001

Table 3B. Qualitative macroinvertebrate sampling results for selected stations in the Paw Paw River watershed, Van Buren County, MI. August 2011.

TAXA	Carter Creek @ along 47th Avenue 8/12/2011 STATION 5	Paw Paw River @ 48th Avenue 8/12/2011 STATION 7	Brush Creek @ 72nd Avenue 8/11/2011 STATION 8
ANNELIDA (segmented worms)			
Hirudinea (leeches)	2		
Oligochaeta (worms)	3	2	1
ARTHROPODA			
Crustacea			
Amphipoda (scuds)	60	16	24
Decapoda (crayfish)	2		7
Isopoda (sowbugs)		3	
Arachnoidea			
Hydracarina			1
Insecta			
Ephemeroptera (mayflies)			
Baetidae		55	86
Heptageniidae		28	7
Leptophlebiidae			2
Odonata			
Anisoptera (dragonflies)			
Aeshnidae	9	1	1
Zygoptera (damselflies)			
Calopterygidae	66		7
Coenagrionidae	2		
Plecoptera (stoneflies)			
Perlidae		5	
Hemiptera (true bugs)			
Belostomatidae			1
Gerridae	5		2
Mesoveliidae	14		
Nepidae			1
Megaloptera			
Corydalidae (dobson flies)			1
Trichoptera (caddisflies)			
Brachycentridae	2	5	18
Hydropsychidae	22	31	31
Leptoceridae	2		1
Limnephilidae			4
Philopotamidae		2	
Phryganeidae	5		
Coleoptera (beetles)			
Dytiscidae (total)	1		
Gyrinidae (adults)	1		
Elmidae	6	22	6
Diptera (flies)			
Athericidae		4	
Ceratopogonidae			4
Chironomidae	39	21	7
Culicidae	1		
Empididae		3	
Psychodidae		1	
Simuliidae	17	14	38
Tabanidae	1		
Tipulidae	1	2	
MOLLUSCA			
Gastropoda (snails)			
Ancylidae (limpets)	1		
Hydrobiidae		1	
Physidae	3		
Planorbidae	1		
Viviparidae	1		
Pelecypoda (bivalves)			
Pisidiidae	1		
TOTAL INDIVIDUALS	268	216	250

Table 3C. Macroinvertebrate metric evaluation of selected stations in the Paw Paw River watershed, Van Buren County, MI. August 2011.

METRIC	Carter Creek @ along 47th Avenue 8/12/2011 STATION 5		Paw Paw River @ 48th Avenue 8/12/2011 STATION 7		Brush Creek @72nd Avenue 8/11/2011 STATION 8	
	Value	Score	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	26	1	18	0	21	0
NUMBER OF MAYFLY TAXA	0	-1	2	0	3	0
NUMBER OF CADDISFLY TAXA	4	1	3	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	1	1	0	-1
PERCENT MAYFLY COMPOSITION	0.00	-1	38.43	1	38.00	1
PERCENT CADDISFLY COMPOSITION	11.57	0	17.59	0	21.60	0
PERCENT DOMINANT TAXON	24.63	0	25.46	0	34.40	0
PERCENT ISOPOD, SNAIL, LEECH	2.99	1	1.85	1	0.00	1
PERCENT SURF. AIR BREATHERS	8.21	0	0.00	1	1.60	1
TOTAL SCORE		0		4		2
MACROINVERTEBRATE COMMUNITY RATING		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE

Table 3D. Qualitative fish sampling results for selected stations in the Paw Paw River watershed, Van Buren County, MI. September 2011.

TAXA	Carter Creek @ 47th Avenue 9/8/2011 STATION 5	Carter Creek @ upstream 41st Street 9/8/2011 STATION 6
	Umbridae (mudminnows)	
<i>Umbra limi</i> (Central mudminnow)	123	78
Esocidae (pikes)		
<i>Esox americanus</i> (Grass Pike)	2	7
Cyprinidae (minnows and carps)		
<i>Semotilus atromaculatus</i> (Creek chub)	19	1
Cottidae (sculpins)		
<i>Cottus bairdii</i> (Mottled sculpin)	1	40
Catostomidae (suckers)		
<i>Catostomus commersoni</i> (White sucker)		2
<i>Erimyzon sucetta</i> (Lake chubsucker)		1
Centrarchidae (sunfish)		
<i>Lepomis macrochirus</i> (Bluegill sf)	1	
Percidae (perch)		
<i>Etheostoma nigrum</i> (Johnny darter)	1	11
TOTAL INDIVIDUALS	147	140
Number of hybrid sunfish	0	0
Number of anomalies	0	0
Percent anomalies	0.000	0.000
Percent salmonids	0.000	0.000
Reach sampled (ft)	450	600
Area sampled (sq ft)	2,250	4,200
Density (# fish/sq ft)	0.065	0.033
Gear	bps	bps

Table 3E. Fish metric evaluation of selected stations in the Paw Paw River watershed, Van Buren County, MI. September 2011.

METRIC	Carter Creek @ 47th Avenue 9/8/2011 STATION 5		Carter Creek @ upstream 41st Street 9/8/2011 STATION 6	
	Value	Score	Value	Score
TOTAL NUMBER OF TAXA	6	1	7	1
NO. OF DARTER, SCULPIN, MADTOM TAXA	2	1	2	1
NUMBER OF SUNFISH TAXA	1	0	0	-1
NUMBER OF SUCKER TAXA	0	-1	2	1
NUMBER OF INTOLERANT TAXA	1	0	1	0
PERCENT TOLERANT	97.28	-1	65.71	-1
PERCENT OMNIVOROUS TAXA	96.60	-1	57.86	-1
PERCENT INSECTIVOROUS TAXA	2.04	-1	37.14	0
PERCENT PISCIVOROUS TAXA	1.36	0	5.00	0
% SIMPLE LITHOPHILIC SPAWNER TAXA	0.00	-1	1.43	-1
TOTAL SCORE		-3		-1
FISH COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE	

Table 4A. Habitat evaluation for selected stations in the Paw Paw River watershed, Van Buren County, MI. August and September 2011.

	Pine Creek @ Red Arrow Highway GLIDE/POOL STATION 9	Paw Paw @ Off M-140 GLIDE/POOL STATION 10	Mill Creek @ County Line Road RIFFLE/RUN STATION 11	Mill Creek @ Butternut Road GLIDE/POOL STATION 12
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	6	10	9	10
Embeddedness (20)*			12	
Velocity/Depth Regime (20)*			7	
Pool Substrate Characterization (20)**	6	7		13
Pool Variability (20)**	2	15		6
Channel Morphology				
Sediment Deposition (20)	2	6	5	8
Flow Status - Maint. Flow Volume (10)	9	10	10	9
Flow Status - Flashiness (10)	2	4	1	2
Channel Alteration (20)	10	16	13	11
Frequency of Riffles/Bends (20)*			1	
Channel Sinuosity (20)**	0	15		8
Riparian and Bank Structure				
Bank Stability (L) (10)	5	8	5	5
Bank Stability (R) (10)	5	6	5	6
Vegetative Protection (L) (10)	8	2	6	2
Vegetative Protection (R) (10)	8	9	6	8
Riparian Veg. Zone Width (L) (10)	8	1	5	0
Riparian Veg. Zone Width (R) (10)	8	9	3	7
TOTAL SCORE (200):	79	118	88	95

HABITAT RATING:	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	8/11/2011	9/7/2011	8/11/2011	9/7/2011
Weather:	Sunny	Partly Cloudy	Sunny	Partly Cloudy
Air Temperature:	75 Deg. F.	65 Deg. F.	78 Deg. F.	70
Water Temperature:	68 Deg. F.	58 Deg. F.	64 Deg. F.	56
Ave. Stream Width:	18 Feet	90 Feet	8 Feet	27
Ave. Stream Depth:	0.5 Feet	4 Feet	0.67 Feet	1
Surface Velocity:	0.45 Ft./Sec.	1.25 Ft./Sec.	0.83 Ft./Sec.	0.55
Estimated Flow:	4.05 CFS	450 CFS	4.4488 CFS	14.85
Stream Modifications:	None	Canopy Removal	None	Canopy Removal
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	800466	110719	800584	110789
Stream Name:	Pine Creek	Paw Paw	Mill Creek	Mill Creek
Road Crossing/Location:	Red Arrow Highway	Off M-140	County Line Road	Butternut Road
County Code:	80	11	80	11
TRS:	03S16W16	03S17W14	04S16W7	03S17W23
Latitude (dd):	42.20571	42.20604	42.14297	42.1905
Longitude (dd):	-86.18215	-86.24354	-86.22286	-86.25791
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Coldwater	Warmwater	Coldwater	Coldwater
USGS Basin Code:	4050001	4050001	4050001	4050001

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

Table 4B. Qualitative macroinvertebrate sampling results for selected stations in the Paw Paw River watershed, Van Buren and Berrien County, MI. August and September 2011.

TAXA	Pine Creek @ Red Arrow Highway 8/11/2011 STATION 9	Paw Paw @ Off M-140 9/7/2011 STATION 10	Mill Creek @ County Line Road 8/11/2011 STATION 11	Mill Creek @ Butternut Road 9/7/2011 STATION 12
PLATYHELMINTHES (flatworms)				
Turbellaria			3	
ANNELIDA (segmented worms)				
Hirudinea (leeches)		1	1	
Oligochaeta (worms)	1	7	7	5
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	77	122	172	28
Decapoda (crayfish)	2	1	9	1
Isopoda (sowbugs)		9		
Arachnoidea				
Hydracarina	1			1
Insecta				
Ephemeroptera (mayflies)				
Baetidae	5	10		34
Caenidae		1		
Ephemeridae		1		
Heptageniidae	1	28	6	5
Isonychiidae		4		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		1	1	
Gomphidae		1	1	
Zygoptera (damselflies)				
Calopterygidae	5	15	4	7
Plecoptera (stoneflies)				
Perlidae		3		
Pteronarcyidae		4		
Hemiptera (true bugs)				
Corixidae		13		1
Gerridae	6		1	1
Mesoveliidae	8	1		
Notonectidae	1			
Veliidae		14		
Megaloptera				
Corydalidae (dobson flies)				1
Sialidae (alder flies)			3	
Trichoptera (caddisflies)				
Brachycentridae		1	11	
Hydropsychidae	6	2	18	28
Leptoceridae			2	
Limnephilidae	1			1
Phryganeidae		2		
Coleoptera (beetles)				
Gyrinidae (adults)	1	1		
Haliplidae (adults)	3	1		
Hydrophilidae (total)		1		
Dryopidae	1		1	
Elmidae	12	4	24	3
Haliplidae (larvae)		1		
Diptera (flies)				
Athericidae		4		
Ceratopogonidae			3	
Chironomidae	132	3	8	33
Empididae		1		2
Simuliidae		19	2	142
Tabanidae		1		
Tipulidae	1		1	1
MOLLUSCA				
Gastropoda (snails)				
Ancylidae (limpets)	5		2	3
Physidae	27	1	20	
Viviparidae	1		1	
Pelecypoda (bivalves)				
Sphaeriidae (clams)			2	1
TOTAL INDIVIDUALS	297	278	303	298

Table 4C. Macroinvertebrate metric evaluation of selected stations in the Paw Paw River watershed, Van Buren and Berrien County. August and September 2011.

METRIC	Pine Creek @ Red Arrow Highway 8/11/2011 STATION 9		Paw Paw @ Off M-140 9/7/2011 STATION 10		Mill Creek @ County Line Road 8/11/2011 STATION 11		Mill Creek @ Butternut Road 9/7/2011 STATION 12	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	21	0	31	1	24	0	19
NUMBER OF MAYFLY TAXA	2	0	5	1	1	0	2	0
NUMBER OF CADDISFLY TAXA	2	0	3	0	3	0	2	0
NUMBER OF STONEFLY TAXA	0	-1	2	1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	2.02	-1	15.83	0	1.98	-1	13.09	0
PERCENT CADDISFLY COMPOSITION	2.36	-1	1.80	-1	10.23	0	9.73	0
PERCENT DOMINANT TAXON	44.44	-1	43.88	-1	56.77	-1	47.65	-1
PERCENT ISOPOD, SNAIL, LEECH	11.11	-1	3.96	1	7.92	0	1.01	1
PERCENT SURF. AIR BREATHERS	6.40	1	11.15	0	0.33	1	0.67	1
TOTAL SCORE		-4		2		-2		0
MACROINVERTEBRATE COMMUNITY RATING		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE

Table 5A. Habitat evaluation for selected stations in the Paw Paw River watershed, Berrien County, MI. June, August, and September 2011.

	Ryno Creek @ Tannery Drive RIFFLE/RUN STATION 13	Unnamed Tributary to Blue Creek @ Territorial Road GLIDE/POOL STATION 14	Blue Creek @ Territorial Road GLIDE/POOL STATION 15	Blue Creek @ Red Arrow Highway GLIDE/POOL STATION 16
HABITAT METRIC				
Substrate and Instream Cover				
Epifaunal Substrate/ Available Cover (20)	11	11	11	13
Embeddedness (20)*	7			
Velocity/Depth Regime (20)*	9			
Pool Substrate Characterization (20)**		10	11	8
Pool Variability (20)**		8	15	11
Channel Morphology				
Sediment Deposition (20)	10	3	5	5
Flow Status - Maintained Flow Volume (10)	6	9	10	10
Flow Status - Flashiness (10)	6	2	5	5
Channel Alteration (20)	15	15	18	15
Frequency of Riffles/Bends (20)*	13			
Channel Sinuosity (20)**		8	13	6
Riparian and Bank Structure				
Bank Stability (L) (10)	6	0	8	4
Bank Stability (R) (10)	6	0	8	5
Vegetative Protection (L) (10)	5	4	9	9
Vegetative Protection (R) (10)	5	4	9	9
Riparian Vegetative Zone Width (L) (10)	3	9	4	5
Riparian Vegetative Zone Width (R) (10)	3	7	9	9
TOTAL SCORE (200):	105	90	135	114

HABITAT RATING:	GOOD (SLIGHTLY IMPAIRED)	MARGINAL (MODERATELY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)	GOOD (SLIGHTLY IMPAIRED)
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Note: Individual metrics may better describe conditions directly affecting the biological community while the Habitat Rating describes the general riverine environment at the site(s).

Date:	6/17/2011	8/11/2011	9/7/2011	9/7/2011
Weather:	Sunny	Sunny	Sunny	Partly Cloudy
Air Temperature:	75 Deg. F.	65 Deg. F.	65 Deg. F.	66
Water Temperature:	55 Deg. F.	55 Deg. F.	49 Deg. F.	50
Ave. Stream Width:	7 Feet	9 Feet	15 Feet	18
Ave. Stream Depth:	0.5 Feet	0.5 Feet	3 Feet	3
Surface Velocity:	1 Ft./Sec.	1 Ft./Sec.	0.83 Ft./Sec.	1.25
Estimated Flow:	3.5 CFS	4.5 CFS	37.35 CFS	67.5
Stream Modifications:	None	Relocated	None	None
Nuisance Plants (Y/N):	N	N	N	N
Report Number:				
STORET No.:	110786	110787	110469	110788
Stream Name:	Ryno Creek	Trib. to Blue Creek	Blue Creek	Blue Creek
Road Crossing/Location:	Tannery Drive	Territorial Road	Territorial Road	Red Arrow Highway
County Code:	11	11	11	11
TRS:	03S17W29	04S17W20	04S18W14	04S18W10
Latitude (dd):	42.18111	42.11599	42.12592	42.13572
Longitude (dd):	-86.303	-86.30604	-86.36969	-86.39761
Ecoregion:	SMNITP	SMNITP	SMNITP	SMNITP
Stream Type:	Warmwater	Coldwater	Coldwater	Coldwater
USGS Basin Code:	4050001	4050001	4050001	4050001

* Applies only to Riffle/Run stream Surveys

** Applies only to Glide/Pool stream Surveys

Table 5B. Qualitative macroinvertebrate sampling results for selected stations in the Paw Paw River watershed, Berrien County, MI. June, August, and September 2011.

TAXA	Ryno Creek @ Tannery Drive 6/17/2011 STATION 13	Unnamed Tributary to Blue Creek @ Territorial Road 8/11/2011 STATION 14	Blue Creek @ Territorial Road 9/7/2011 STATION 15	Blue Creek @ Red Arrow Highway 9/7/2011 STATION 16
PLATYHELMINTHES (flatworms)				
Turbellaria				1
ANNELIDA (segmented worms)				
Oligochaeta (worms)		5	1	4
ARTHROPODA				
Crustacea				
Amphipoda (scuds)	165	79	107	105
Decapoda (crayfish)			2	1
Isopoda (sowbugs)		8	6	6
Arachnoidea				
Hydracarina	1	3		
Insecta				
Ephemeroptera (mayflies)				
Baetidae	21	18	27	44
Heptageniidae		4	11	9
Leptophlebiidae		1		
Odonata				
Anisoptera (dragonflies)				
Aeshnidae		2	2	5
Libellulidae				1
Zygoptera (damselflies)				
Calopterygidae	1	1	13	19
Hemiptera (true bugs)				
Belostomatidae			1	
Gerridae	1	2		
Mesoveliidae		5	1	
Notonectidae			1	2
Megaloptera				
Sialidae (alder flies)			1	
Trichoptera (caddisflies)				
Brachycentridae		100	15	8
Hydropsychidae	6	16	40	22
Hydroptilidae			1	
Lepidostomatidae	21	1		
Limnephilidae	2	2	2	1
Molannidae		1		
Phryganeidae				1
Coleoptera (beetles)				
Dytiscidae (total)			1	
Haliplidae (adults)			1	
Hydrophilidae (total)		1		
Dryopidae		1		
Elmidae	1	8		
Diptera (flies)				
Chironomidae	36	22	29	20
Empididae		5		1
Simuliidae	48	18	17	49
Tabanidae			3	
Tipulidae	1	1	3	2
MOLLUSCA				
Gastropoda (snails)				
Physidae				1
Planorbidae			1	
Pelecypoda (bivalves)				
Sphaeriidae (clams)		1	1	
TOTAL INDIVIDUALS	304	305	287	302

Table 5C. Macroinvertebrate metric evaluation of selected stations in the Paw Paw River watershed, Berrien County, MI. June, August, and September 2011.

METRIC	Ryno Creek @ Tannery Drive 6/17/2011 STATION 13		Unnamed Tributary to Blue Creek @ Territorial Road 8/11/2011 STATION 14		Blue Creek @ Territorial Road 9/7/2011 STATION 15		Blue Creek @ Red Arrow Highway 9/7/2011 STATION 16	
	Value	Score	Value	Score	Value	Score	Value	Score
	TOTAL NUMBER OF TAXA	12	0	24	0	24	0	20
NUMBER OF MAYFLY TAXA	1	0	3	1	2	0	2	0
NUMBER OF CADDISFLY TAXA	3	0	5	1	4	0	4	0
NUMBER OF STONEFLY TAXA	0	-1	0	-1	0	-1	0	-1
PERCENT MAYFLY COMPOSITION	6.91	0	7.54	0	13.24	0	17.55	0
PERCENT CADDISFLY COMPOSITION	9.54	0	39.34	1	20.21	0	10.60	0
PERCENT DOMINANT TAXON	54.28	-1	32.79	0	37.28	0	34.77	0
PERCENT ISOPOD, SNAIL, LEECH	0.00	1	2.62	1	2.44	1	2.32	1
PERCENT SURF. AIR BREATHERS	0.33	1	2.62	1	1.74	1	0.66	1
TOTAL SCORE		0		4		1		1
MACROINVERTBRATE COMMUNITY RATING	ACCEPTABLE		ACCEPTABLE		ACCEPTABLE		ACCEPTABLE	