Elkhart-South Bend Aquatic Community Monitoring

Annual Report 2016

City of Elkhart
Public Works & Utilities

Tim Neese, Mayor

Cover Photo: A stunning male longear sunfish collected from the Elkhart River

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Figure 1: A juvenile greater redhorse from the Elkhart River

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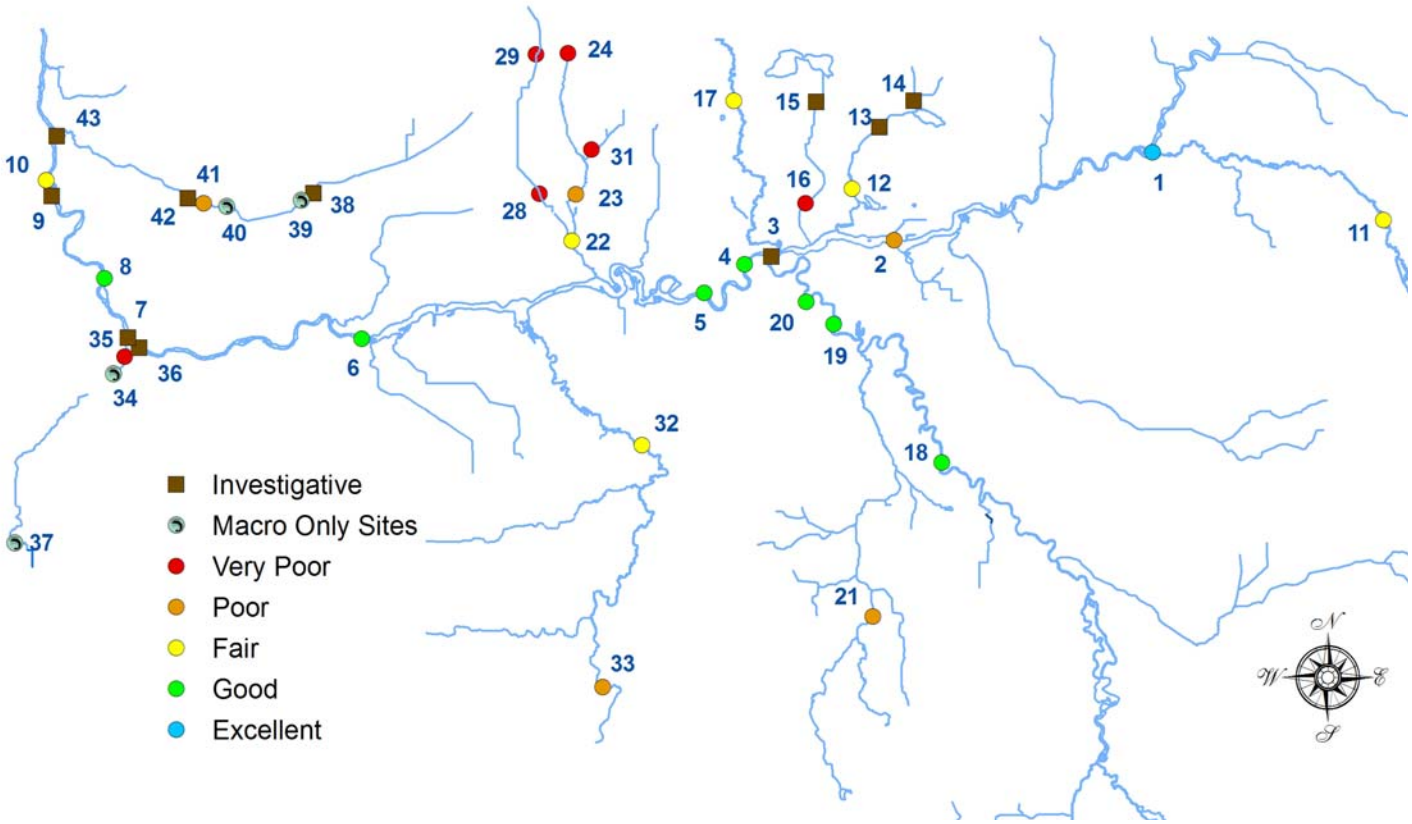
Introduction

For many years, the Cities of South Bend and Elkhart have collected surface water samples from our local rivers to evaluate pollutant concentrations. In 1998, the City of Elkhart initiated biological community monitoring to compliment chemical and microbial sampling and to establish a robust, long-term stream monitoring program. The City of South Bend joined forces with Elkhart in 2001, and since then both communities have gathered a great deal of information on the health of our local waterways.

Biological community monitoring results from 2016 demonstrate the ecological importance of the rivers and streams of Elkhart and St. Joseph Counties. Along the entire Indiana stretch of the St. Joseph River, fish communities continue to flourish despite some pollution and habitat loss issues. Efforts by government agencies, citizens and various stakeholders have improved the health of the St. Joseph River in the past few decades. But, there is still more work to be done.

Figure 2: Fish sampling sites in Elkhart and St. Joseph Counties and associated fish community conditions for 2016 (see Table 1 for site information)



In 2016, the cities of Elkhart and South Bend, through the City of Elkhart's Aquatics Program, continued to monitor local fish and macroinvertebrate communities in area rivers and streams. The information gathered was integrated into an overall water quality program for each City. While the cities measure the chemical and microbial composition of local stream water, having the additional biological data gives a more accurate representation of the overall health of each stream. The way that biological communities are assembled can change as a result of a disturbance, such as a chemical spill or alteration of habitat. Chemical and microbial testing, while very important in pinpointing contaminants, is simply a snapshot of current conditions. In many cases, having both sets of data can help determine the cause and effect of disturbances to our local streams.

During the first 6 years (1998-2003), Elkhart's Aquatics Program established core fish sampling sites on the St. Joseph River and many of its primary tributaries in the Elkhart area. For 3 consecutive years, data were collected from these sites and a baseline was established for each stream. Baseline data are now used to compare with current monitoring results to determine if impairments or enhancements are taking place in Elkhart area streams.

In 2001, the City of South Bend combined forces with Elkhart's Aquatics program, establishing a unique biological monitoring partnership between municipalities. As with the Elkhart area, core sampling sites were determined and similar baselines were established for South Bend over a 6 year period (2001-2006).

Other sampling efforts have been conducted in both Elkhart and St. Joseph Counties, offering a

A juvenille longnose gar from the St. Joseph River in South Bend

comprehensive view of stream conditions for the entire section of the St. Joseph River in Indiana. From 2007 to 2009, baseline monitoring was completed in the Mishawaka section of the St. Joseph River. Baseline monitoring was also conducted in the Goshen area of the Elkhart River in a partnership with the Elkhart River Restoration Association. Additionally, in 2016 baseline monitoring was conducted on numerous sites in the Cobus Creek Watershed to support a watershed study being conducted by the St. Joseph River Basin Commission (this study is available on the St. Joseph River Basin Commission's website: http://www.sjrbc.com/). While monitoring will not continue in these areas, the baseline data that were gathered will serve as an important reference for future biological comparisons.

The Aquatics Program consists of more than just traversing through local streams collecting fish data. A considerable portion of the Program is education. The biologist travels to local schools and watershed stakeholder group meetings, giving presentations and demonstrations, in an effort to increase awareness about the health of our local streams, and how it affects us. In 2016 alone, the Aquatics Program reached over 5,000 Michiana residents through public presentations and demonstrations.

Aquatics Intern Jared Miller shows off a common carp at Elkhart's Envirofest, one of many 2016 outreach events

Indices

The Index of Biotic Integrity (IBI) is the system that is used to assess the local fish communities. The IBI was developed by Dr. James Karr in 1981 as a tool for assessing water/stream quality based on the fish communities that are present. The IBI was modified by Dr. Thomas Simon in 1997 for use in the St. Joseph River Watershed. The IBI is a great tool in that complex biological information can be analyzed to provide measurements of

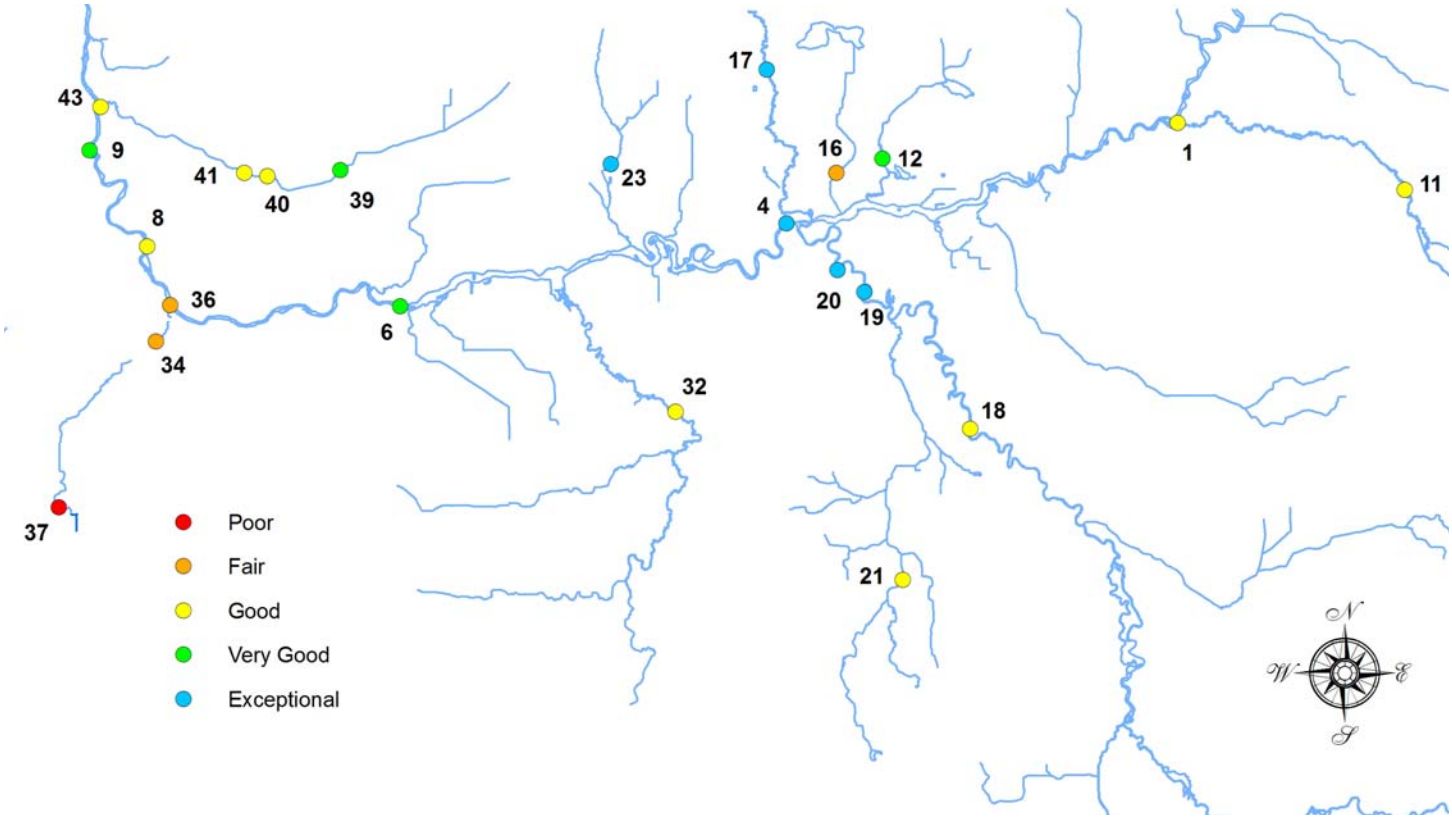


Figure 3: Macroinvertebrate sampling sites and associated condition for 2016 (see Table 2 for site information)

Kieran Fahey hold a nice South Bend Steelhead

stream quality for non-biologists and members of the general public. The IBI is comprised of 3 broad categories (species composition, trophic composition, and fish condition) which are broken down into 12 smaller categories, known as metrics (see Appendix A). These metrics are given a score based on their similarity to least impacted (reference) sites. One of 3 scores can be given for each metric: 1 (not similar to reference conditions), 3 (somewhat similar to reference conditions), or 5 (very similar to reference conditions). In general, the total score for a site will range from 12 to 60, but in an instance where no fish are present at a site, a score of 0 is given. These scores can then be graphed and placed into 1 to 5 classifications (very poor, poor, fair, good, or excellent), which describes the overall condition of the fish community being monitored.

Biologists recognize that fish community condition is a product of the water quality and the habitat that is available in any given area. Since 2003, the Aquatics Program has been assessing available habitat at all sampling locations using the Qualitative Habitat Evaluation Index (QHEI) (Rankin 1989). This index is similar to the IBI in its structure. It has 6 broad categories which are broken down into 21 smaller categories or metrics (Appendix A). This index will have a final score of 0 to 100 and the scores will be classified as excellent, good, fair-good, poor, and very poor. This assessment will help determine to what extent the IBI scores are being affected by habitat. It may also show specific habitat degradation issues that need to be addressed.

Fish are not the only aquatic organisms that can be monitored to determine overall health of rivers and streams. Through a sub-contract with the Midwest Biodiversity Institute (MBI, Columbus, Ohio), the Aquatics Program is also monitoring benthic (bottom dwelling) macroinvertebrates (visible animals without backbones). Twenty-two (22) sites were sampled in 2016 and results were compared to their respective baseline values or the value from the previous sampling event. The macroinvertebrate communities are assessed with the Invertebrate Community Index (ICI) developed by the Ohio Environmental Protection Agency (EPA) (Ohio EPA 1987). This index is broken down into 10 metrics (Appendix A). Like the IBI metrics, the ICI metrics are given a score based on their similarity to relatively undisturbed sites; 6 (comparable to exceptional community), 4 (comparable to typical community), 2 (slightly different from the typical community), or 1 (very different from the typical community). The site

The Aquatics Program frequently encounters other aquatic species beyond fish and macroinvertebrates. Pictured below is Cortney with a massive bullfrog from Bowman Creek and a Queen Snake from the St. Joseph River in Elkhart

scores range from 0 to 60 and are classified similar to IBI scores. This combination of fish, habitat, macroinvertebrate, and chemical monitoring provides the cities of Elkhart and South Bend with the most comprehensive view of stream health.

The Indiana Department of Environmental Management (IDEM) has established guidelines to determine if a body of water is impaired or if its condition is supportive of aquatic life for the IBI and QHEI (IDEM 2015). The ICI is not an index used by IDEM, however, similar guidelines have been established by OHIO EPA for a nearby region, and those values are being used with the Elkhart and St. Joseph County data. Values of 36 or higher for IBI and ICI scores are indicators of a stream with the ability to support aquatic life. IDEM refers to streams with score of 36 or higher, as those that are "attaining" aquatic life standards. QHEI scores of 51 or greater indicate enough quality habitat is available to support aquatic communities.

In addition to performing water quality monitoring in the St. Joseph River basin, fish collections are conducted to determine the overall species diversity throughout the watershed. Walleye (*Sander vitreus*) and smallmouth bass (*Micropterus dolomieu*) populations are monitored from previous tagging events in cooperation with the Indiana Department of Natural Resources (IDNR). Tissue from 10 fish species was collected and analyzed for mercury and polychlorinated biphenyl (PCB) content. Current Indiana Fish Consumption Advisory data for the State of Indiana (Table 12) displays many species from the Indiana portion of the St. Joseph River Watershed. The cities involved in the Program believe it is vital to continually provide local citizens with the most updated information on fish consumption.

Methods

For the past 18 years, the Aquatics staff has used 2 collection protocols (investigative sampling and index sampling) to quickly catalog the major fish species and to quantify stream quality in the St. Joseph River Watershed. Investigative sites are sampled once during the season and the fish collected at these sites are identified to species, the largest and smallest specimens are measured to the nearest millimeter (mm), and all fish are counted and then released. Index sites are sampled twice during the season, with a minimum 5 week "rest" period between sampling events. Individual species maximum and minimum lengths are recorded, all fish are counted, and game fish and are weighed and measured individually, while most non-game fish are mass weighed. Individual length and weight data are also collected for some of the important species like greater redhorse.

The length of stream sampled at an index site is dependent on the wetted width of the stream. The length of sites is 15 times this width, with a minimum of 50 meters and a maximum of 500 meters. Differences in sampling and processing (Foy 2004) have allowed multiple investigative sites to be sampled in a day versus 1 or 2 index sites. Every species collected at each site is verified either by retaining and preserving a small specimen for the Public Works & Utilities voucher museum or by photographing a large specimen. This practice allows for the verification of the field and lab identifications if needed.

A very pretty male rainbow darter from Middlebury Street on the Elkhart River

Table 1: Fish sampling sites and Index Scores in Elkhart and St. Joseph Counties, 2016

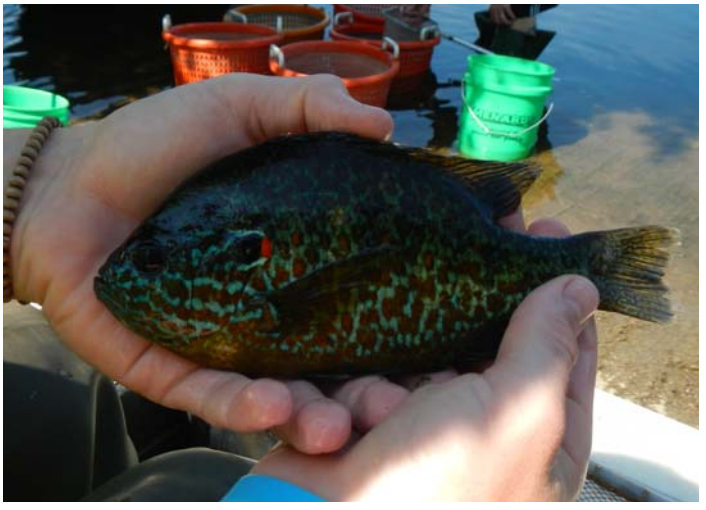
Stream	Site	Site Number	Type of Site	County	Method	IBI Scores 2016	ICI Scores 2016	QHEI Scores 2016
St. Joseph River	SR 15 (Bristol)	1	Index	Elkhart	Boat	55	38	85
	Homan Avenue	2	Index	Elkhart	Boat	32		59
	Island Park	3	Investigative	Elkhart	Tote Barge			84
	Sherman Street	4	Index	Elkhart	Boat	47	50	85
	Nappanee Street	5	Index	Elkhart	Boat	51		81
	Capital Ave	6	Index	St. Joseph	Boat	46	48	59
	Louise Street	7	Investigative	St. Joseph	Boat			57
	Michigan Street	8	Index	St. Joseph	Boat	46	42	87
	Pinhook Park	9	Investigative	St. Joseph	Boat			85
	Pinhook Park (B)	10	Index	St. Joseph	Boat	45	44	85
Little Elkhart River*	CR 10	11	Index	Elkhart	Tote Barge	43	40	81
Puterbaugh Creek*	CR 8	12	Index	Elkhart	Tote Barge	41	48	74
	Jeanwood Dr. (CR 13)	13	Investigative	Elkhart	Tote Barge			45
	CR 4	14	Investigative	Elkhart	Tote Barge			35
Lily Creek	CR 4	15	Investigative	Elkhart	BPS			34
	Reckell Ave	16	Index	Elkhart	Back Pack	19	26	39
Christiana Creek	CR 4	17	Index	Elkhart	Tote Barge	43	52	74
Elkhart River	Oxbow Park	18	Index	Elkhart	Boat	54	40	88
	Indiana Avenue	19	Index	Elkhart	Boat	53	50	86
	Middlebury Street	20	Index	Elkhart	Boat	48	50	82
Yellow Creek	CR 32	21	Index	Elkhart	Tote Barge	33	38	64
Cobus Creek*	CR 12	22	Index	Elkhart	Tote Barge	33 (40)		62
	CR 8	23	Index	Elkhart	Tote Barge	28 (34)	52	68
	CR 2	24	Index	Elkhart	Back Pack	22 (21)		53
	Redfield Road	25	Index	Cass (MI)	Tote Barge	16 (28)		44
	May Street	26	Index	Cass (MI)	Back Pack	24 (32)		50
	Upstream of Coberts Lake	27	Index	Cass (MI)	Back Pack	15 (10)		49

Table 1: Fish sampling sites and Index Scores in Elkhart and St. Joseph Counties, 2016 (continued)

Stream	Site	Site Number	Type of Site	County	Method	IBI Scores 2016	ICI Scores 2016	QHEI Scores 2016
Gast Ditch	Douglas Road	28	Index	St. Joseph	Back Pack	14 (8)		35
	Adams Road	29	Index	St. Joseph	Back Pack	18 (20)		60
	Redfield Road	30	Index	Cass (MI)	Back Pack	17 (10)		40
Cobus East Lateral A	CR 6	31	Index	Elkhart	Back Pack	6		40
Baugo Creek	CR 3 (N)	32	Index	Elkhart	Tote Barge	43	38	90
	CR 1 (S)	33	Index	Elkhart	Tote Barge	29		76
Bowman Creek	Studebaker GC	34	Macroinvertebrate Sampling (only)	St. Joseph			34	
	Ravina Park	35	Index	St. Joseph	Back Pack	12		50
	St. Joseph River at Mouth	36	Investigative	St. Joseph	Back Pack		F	66
Auten Ditch	Locust Road (S)	37	Macroinvertebrate Sampling (only)	St. Joseph			18	
Juday Creek*	Douglas Road (East Crossing)	38	Investigative	St. Joseph	Tote Barge			66
	Holy Cross Pkwy	39	Macroinvertebrate Sampling (only)	St. Joseph			44	
	Driftwood	40	Macroinvertebrate Sampling Only	St. Joseph			38	
	State Road 23	41	Index	St. Joseph	Tote Barge	35 (30)	G	62
	Juday Lake	42	Investigative	St. Joseph	Tote Barge			62
	St. Joseph River at Mouth	43	Investigative	St. Joseph	Back Pack		G	78

*** denotes a cool/cold water stream**
Underlined values are indicative of stream impairment
F—"Fair" rating given to the macroinvertebrate community due to lost HD sampler
G—"Good" rating given to the macroinvertebrate community due to lost HD sampler
Coolwater scores are in (parenthesis). Juday Creek and Cobus Creek were analyzed using coolwater methods

The top view of a stonecat from the Elkhart River



A pretty pumpkinseed from the South Bend section of the St. Joseph River

Figure 4: Hester-Dendy sampler placed into the stream bed.

In 2016, 7 index and 6 investigative sites were sampled in St. Joseph County and 16 index and 4 investigative sites were sampled in Elkhart County. Four (4) index sites were also sampled in Cass County, Michigan in the Cobus Creek Watershed. (Figure 2 and Table 1). IBI scores were calculated for each of the index sites and an average from the 2 visits was obtained to give the final score.

Fish were collected using either boat mounted, tote barge, or backpack electrofishing equipment. The type of gear used depended on the size of the stream. The St. Joseph and Elkhart Rivers were sampled with the boat. Smaller, wadeable streams were sampled with the tote barge, unless the stream was extremely small and shallow, in which case, the backpack was used. Power output from the 3 devices differed. The boat output was 8-16 amperes, the tote barge was 4-6 amperes, and the backpack was 0.5-1.5 amperes.

During each fish sampling event, stream habitat information was methodically collected using the QHEI as developed by Ohio EPA (Rankin 1989). Given that each index site was sampled twice, scores were averaged to give a final score (Table 1).

In early July 2016, Aquatics personnel placed Hester-Dendy samplers (artificial substrates used to collect small aquatic organisms) (Figure 4) at 22 sites (Table 2 and Figure 3) following Ohio EPA macroinvertebrate sampling procedures (Ohio EPA 1987, 1989). Of the 22 that were set, only 19 were recovered successfully due to flooding conditions that occurred during the summer of 2016. The data gathered from the samplers is considered a quantitative sample where species are identified and specimens are counted. This information was then used to calculate ICI scores for each site. Qualitative sampling also took place at each site with the use of a kick net through all available habitat near the location of the sampler. This extra sampling is used to capture additional species as well as provide information to make an estimate of stream health in the case where an ICI score can not be calculated due to the loss or vandalism of a sampler.

Fish tissue in the form of fillets was collected from bluegill (*Lepomis macrochirus),* brown bullhead *(Ameiurus nebulosus),* channel catfish *(Ictalurus punctatus),* rock bass *(Ambloplites rupestris),* shorthead redhorse *(Moxostoma macrolepidotum),* smallmouth bass *(Micropterus dolomieu),* steelhead *(Oncorhynchus mykiss), and* walleye (*Sander vitreus).* Collection locations for fish tissue samples are presented in Table 3. Each tissue sample sent in for laboratory analysis (Pace Analytical, Green Bay, WI) was a composite of fillets from 3 fish of the same species from the sample reach. The shortest specimen was within 90% of the length of the longest specimen. The samples were collected following the procedures in Appendix B (this report) and Appendix III in "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory" (1993).

Long-term index monitoring consists of rotational sampling of stream stations. Each station is visited at least once every 3 years to gather biological and chemical data and to compare against previ-

Table 2: Macroinvertebrate Sampling Sites, 2016

Site Number	Stream	Location	Site Number	Stream	Location
1	St. Joseph River	SR 15 (Bristol)	20	Elkhart River	Middlebury Street
4	St. Joseph River	Sherman Street	21	Yellow Creek	CR 32
6	St. Joseph River	Capital Avenue	23	Cobus Creek	CR 8
8	St. Joseph River	Michigan Street	32	Baugo Creek	CR 3 (N)
9	St. Joseph River	Pinhook Park (B)	34	Bowman Creek	Studebaker GC
11	Little Elkhart River	CR 10	36	Bowman Creek	St. Joe River Mouth
12	Puterbaugh Creek	CR 8	37	Auten Ditch	Locust Road (S)
16	Lily Creek	Reckell Avenue	39	Juday Creek	Holy Cross Pkwy
17	Christiana Creek	CR 4	40	Juday Creek	Driftwood
18	Elkhart River	Oxbow Park	41	Juday Creek	State Road 23
19	Elkhart River	Indiana Avenue	43	Juday Creek	St. Joe River Mouth

Table 3: Location of fish tissue collection sites for 2016

Site Number	Stream	Location
1	St. Joseph River	SR 15 (Bristol)
2	St. Joseph River	Twin Branch Dam (Below)
3	St. Joseph River	Capital Avenue
4	St. Joseph River	Pinhook (B)
5	St. Joseph River	Homan Avenue
6	Elkhart River	Indiana Avenue

ous sampling results, and baseline data.

Results and Discussion

During the summer of 2016, a total of 19,170 fish, representing 16 families and 67 species, were collected in Elkhart County. In St. Joseph County, 5,918 fish, representing 13 families and 50 species were collected. In total, 71 different species were captured from the 2 counties.

Creek chub (*Semotilus atromacatus*), striped shiner (*Luxilus chrysocephalus*), and mimic shiner (*Notropis volucellus*) were the most abundant species collected in Elkhart County, while smallmouth bass (*Micropterus dolomieu*), longear sunfish (*Lepomis megalotis), and* rock bass (*Ambloplites rupestris*) were the most abundant in St. Joseph County. For more detailed information on the number and types of fish species collected, see Appendix C.

Indices

Fish community conditions at the index sites ranged from very poor (6) at CR 6 on Cobus East Lateral A to excellent (55) at SR 15 (Bristol) on the St. Joseph River. Macroinvertebrate community scores ranged from poor (18) at Locust Road (S) on Auten Ditch to exceptional (52) at CR 8 on Cobus Creek and CR 4 on Christiana Creek. Habitat quality ranged from poor (34) at CR 4 on Lily Creek to excellent (90) at CR 3 (North) on Baugo Creek.

St. Joseph River

The longitudinal trends in fish community condition for the entire Indiana portion of the St. Joseph River are displayed in Figure 5. Fish, macroinvertebrate, and habitat index scores are presented in Table 4.

In 2016, the Elkhart County portion of the St. Joseph River continued to produce good to excellent fish community scores, with the exception of the Homan Avenue site. The Homan Avenue site is located in the impoundment of the Johnson Street dam and the fish communities are significantly affected by this influence (Deegan, 2016). This site scored very low (32) in 2016, putting this section of the St. Joseph River in the impaired category for the first time. The Sherman Street site also scored relatively low in 2016 falling one point below the initial baseline, but significantly lower than the last three times has been sampled. While, recent results at Sherman Street may be a result of natural variables, this site will be monitored closely in future events to determine if conditions are degrading.

Macroinvertebrate (ICI) scores showed almost the opposite results from fish community scores with the SR 15 site ICI being down significantly from the baseline, but the Sherman Street site being up significantly from the baseline. While fish and macroinvertebrate scores can sometimes seem contradicting, both communities tell us something a little different about the health of the St. Joseph

An old ugly channel catfish collected from Island Park on the St. Joseph River in Elkhart

Table 4. Index scores for St. Joseph River sites, Elkhart and St. Joseph Counties

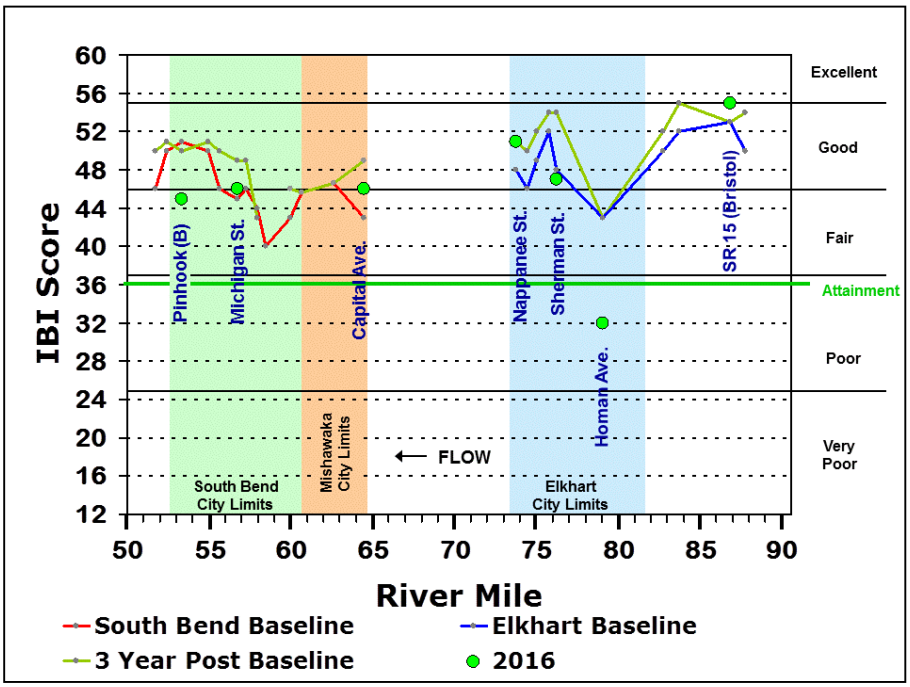
Station	County	River Mile	Fish IBI Scores				2016 Habitat Scores	(ICI) Macroinvertebrate Scores	
			Baseline	2010	2013	**2016**		Baseline/ Previous Score	**2016**
SR 15 (Bristol)	Elkhart	86.8	*53*	55	54	**55**	85	42	**38**
Homan Avenue	Elkhart	79	*43*	40	44	**32**	59		
Sherman Street	Elkhart	76.2	*48*	53	54	**47**	85	44	**50**
Nappanee Street	Elkhart	73.7	*48*	51	49	**51**	81		
Capital Avenue	St. Joseph	64.4	*43*	51	50	**46**	59	46	**48**
Michigan Street	St. Joseph	56.7	*45*	50	51	**46**	87	41	**42**
Pinhook Park (B)	St. Joseph	53.3	*51*	49	54	**45**	81	44	**44**

River. Flooding conditions occurred during the mid to late summer of 2016 in northern Elkhart and St. Joseph County. These conditions may have had an adverse affect on the macroinvertebrate communities at SR 15 as macroinvertebrates are known to react negatively to a short-term disturbance.

IBI scores in the St. Joseph County portion of the St. Joseph River were not as impressive as they have been in recent years (Figure 5; Table 4) The score at Capital Avenue remained above the baseline, but the scores from the sites sampled below the South Bend Dam, were somewhat concerning. The Pinhook (B) score of 45 fell six points below the initial baseline value. Should scores for this section of the river remain low in coming years, this would present a concern. The Aquatics Program has observed low scores periodically that were likely a result of natural variables.

On a bright note, the macroinvertebrate community scores for both sites below the South Bend Dam did not deviate from previous sample events. The Michigan Street site had an ICI score slightly higher than the baseline, while the Pinhook (B) score of 44 was the same as it was when it was last sampled in 2013. Macroinvertebrate communities often provide a good short-term glimpse of the health of the river or can sometimes indicate that a recent disturbance has occurred. Fish, on the other hand, can live longer and have an ability to move away from pollution and habitat disturbance, and thus their communities are more representative of long-term conditions. While fish community health did drop significantly in 2016, macroinvertebrate results suggest that river conditions were relatively stable in 2016.

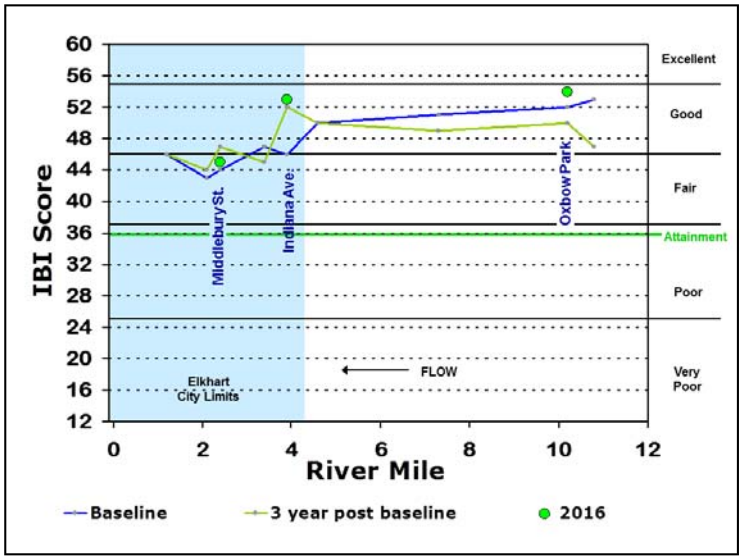
Figure 5: IBI scores for the St. Joseph River, Elkhart and St. Joseph Counties



Elkhart River

IBI scores at Elkhart River sites were

Figure 6: IBI scores for the Elkhart River, Elkhart County



above intial baseline scores in 2016 (Figure 6; Table 5). The Aquatics Program has been monitoring the Oxbow Park site very closely in the past few years, as the IBI scores dipped significantly from 2007 to 2010 suggesting a major disturbance in the area. However, based on the past two sampling events, the Oxbow Park section of the river appears to have rebounded. The Indiana Avenue site scored very well in 2016, up significantly from the initial baseline score (46), but slightly lower than the last time it was sampled in 2013. Similar to the Oxbow Park site, Indiana Avenue has excellent habitat for aquatic organisms.

While the fish communities at Oxbow Park appear to have rebounded, macroinvertebrate scores for 2016 do warrant some concern. Although the Indiana Avenue and Middlebury Street sites had exceptional ICI scores of 50, the Oxbow Park score of 40 was well below the baseline down significantly from 2013, when the site had a score of 54. Results from 2016 suggest a short-term disturbance in the Elkhart River. The Aquatics program

A pretty warmouth from the Elkhart River at Oxbow

will monitor fish and macroinvertebrate communities closely at Oxbow Park in coming years.

Bowman Creek

In 2016, the IBI score at Ravina Park on Bowman Creek was 12 which is up from its baseline value of 6 and much better that score of 0 it received in 2013 (Figure 7; Table 6). Bowman Creek's biggest hurdle of intermittent flow continues to plague its recovery. In 2016, the stream was flowing in July, but ran dry as the heat of the summer progressed. This common occurrence in Bowman Creek, significantly limits the establishment of fish communities. In 2016, the Aquatics Program sampled Bowman Creek from the Mouth of the St. Joseph River and upstream approximately 200 hundred feet. Remarkably, 8 different species were collected including several fish species that are sensitive to environmental disturbance. Some noteworthy species include rainbow darter, shorthead redhorse, smallmouth bass, and walleye. The presence of these species at the mouth of Bowman Creek indicate that while the creek is highly impaired from lack of flow, it would not take

Table 5: Index scores for Elkhart River sites, Elkhart County

Station	River Mile	Fish IBI Scores				2016 Habitat Scores	(ICI) Macroinvertebrate Scores	
		Baseline	2010	2013	**2016**		2013	**2016**
Oxbow Park	10.8	53	48	53	**54**	88	46	**40**
Indiana Avenue	3.9	46	49	56	**53**	86		**50**
Middlebury Street	2.4	43	45	42	**45**	82	47	**50**

Table 6: Index scores for Bowman Creek and Juday Creek sites, St. Joseph County

Stream	Station	Stream Mile	Fish IBI Scores (Coolwater IBI Scores)				2016 Habitat Scores
			Baseline	2010	2013	**2016**	
Bowman Creek	Ravina Park	0.5	6	13	0	**12**	50
Juday Creek	State Road 23	5.3	26 (29)	35 (30)	36 (29)	**35 (30)**	62

long for fish species to reoccupy the creek, should natural flow be reestablished.

Bowman Creek was sampled for macroinvertebrates at two locations in 2016 (Studebaker Golf Course and at the Mouth of the St. Jospeh River). An attempt was also made to sample at Ravina Park, but the creek ran dry between deployment and retrieval of the Hester Dendy samplers. Studebaker Golf Course had an ICI score of 34, which is an indicator of an impaired stream, but a good score for this stream considering that fish community scores are always very poor. This site had an ICI score of 34 in 2014 and a score 36 in 2011. While the Hester Dendy samplers were also lost at the mouth of the St. Joseph River due to low flow; there was enough water in the stream to obtain a qualitative sample. Qualitative sampling results provided a "Fair" rating for this site.

Table 7: Macroinvertebrate Scores for additional Bowman and Juday Creek Sites

Stream	Station	Stream Mile	ICI Macroinvertebrate Scores (**2016**)
Bowman Creek	Studebaker GC	1.1	**34**
Bowman Creek	St. Joe River Mouth	0	**Fair***
Auten Ditch	Locust Road (S)	6	**18**
Juday Creek	Holy Cross Pkwy	6.6	**44**
Juday Creek	Driftwood	4.6	**38**
Juday Creek	State Road 23	4.2	**Good***
Juday Creek	St. Joe River Mouth	0	**Good***

*** - Narrative rating based on qualitative sample results because Hester Dendy Samplers were lost.**

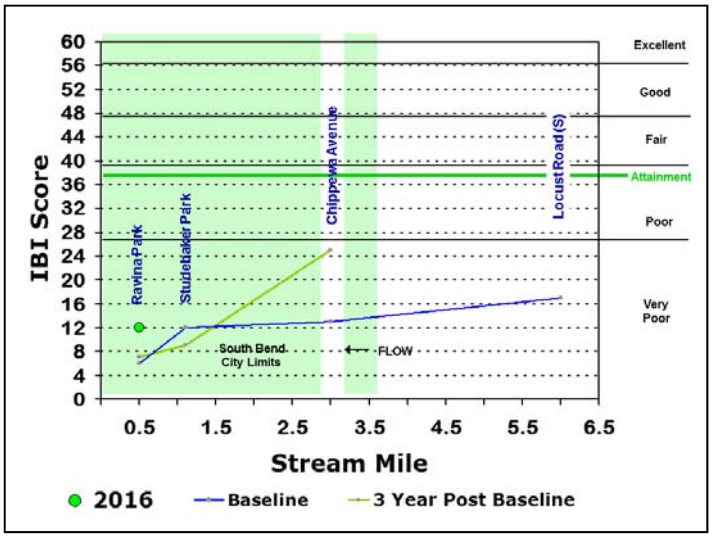
Macroinvertebrate communities were also sampled on Auten Ditch in the headwaters of the Bowman Creek Watershed. The ICI score at this station was 18, down from the score of 28 it received in 2016. Fish community scores at this station in previous years yielded very poor results. The Aquatics Program will sample this site once again in 2017 to establish a baseline to compare against future monitoring results.

Juday Creek

The IBI score for Juday Creek at SR 23 was close to its baseline value in 2016 (see Coolwater IBI Scores— Table 6). Fish communities in coolwater streams like Juday Creek can be difficult to assess (Deegan, 2011). Instead, we rely more on the macroinvertebrate communities as indicators of the health of Juday Creek. In 2016, several sites were sampled for macroinvertebrates on Juday Creek. Macroinvertebrate community scores ranged from good to very good on Juday Creek

Maddie with a big rock bass from Juday Creek

Figure 7: IBI scores for Bowman Creek, St. Joseph County



A young northern pike collected from the Elkhart River

(Table 7). Hester Dendy samplers were lost at State Road 23 and at the St. Joseph River Mouth site due to flooding conditions that occurred during the late summer of 2016. However qualitative ratings both indicated good scores at each location. The site at Driftwood, which is located just downstream of a large ponded section of Juday Creek, west of Grape Road, received an ICI score of 38. While this score is still considered good, its likely that the pond upstream of this location causes warming conditions and habitat alteration that negatively affect the aquatic communities in Juday Creek.

Juday Creek was sampled right at the mouth of the St. Joseph River in 2016 for the first time for fish and macroinvertebrates. During the fish survey, longnose dace (a Species of Special Concern in the State of Indiana) was collected. This was the first record of this species in Juday Creek and in St. Joseph County.

Yellow Creek

In 2016, the IBI score at CR 32 on Yellow Creek of 36 fell right at the point in which the fish community is considered "non-impaired" or "attaining" (Figure 8; Table 8). This IBI score was the same as the baseline score which was established from sampling events from 1998 to 2000. In recent years (2010 and 2013), respective IBI scores have been below 36, falling into the 'impaired" range. Macorinvertebrates were sampled for the first time in 2016, also providing an attaining score of 38, which is considered to be good. While its good to see Yellow Creek attaining, it is far from being a high quality stream. Although a relatively large sub-watershed, Yellow Creek continues to be one of the most stressed streams in the St. Joseph River Watershed. As noted in previous annual reports, Yellow Creek is highly modified for agricultural drainage. It's instability and poor water quality also contribute to degradation of the Elkhart River.

Lily Creek

Lily Creek at Reckell Avenue provides the perfect example of what can happen to the biological communities in a stream when it is maintained for drainage. The baseline IBI score for this site is 34. At some point between 2004 and 2007, riparian and streambank vegetation was removed (Kring, 2008). Piles of soil adjacent to the stream suggest that that streambed may have been exca-

Table 8: Index scores for Yellow Creek and Lily Creek, Elkhart County

Stream	Station	River Mile	Fish IBI Scores				2016 Habitat Scores	ICI Macroinvertebrate Scores (2016)
			Baseline	2010	2013	**2016**		
Yellow Creek	County Road 32	7.2	36	30	33	**36**	64	38
Lily Creek	Reckell Ave	1.1	34	24	19	**19**	39	26

Figure 8: IBI scores for Lily Creek and Yellow Creek, Elkhart County

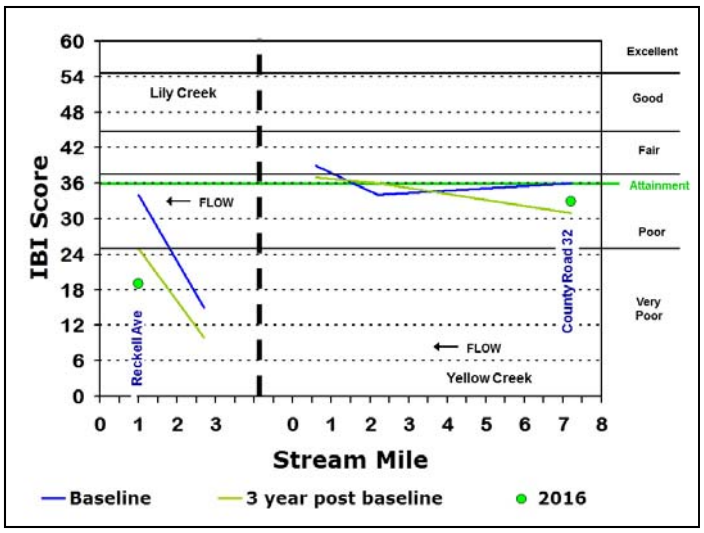
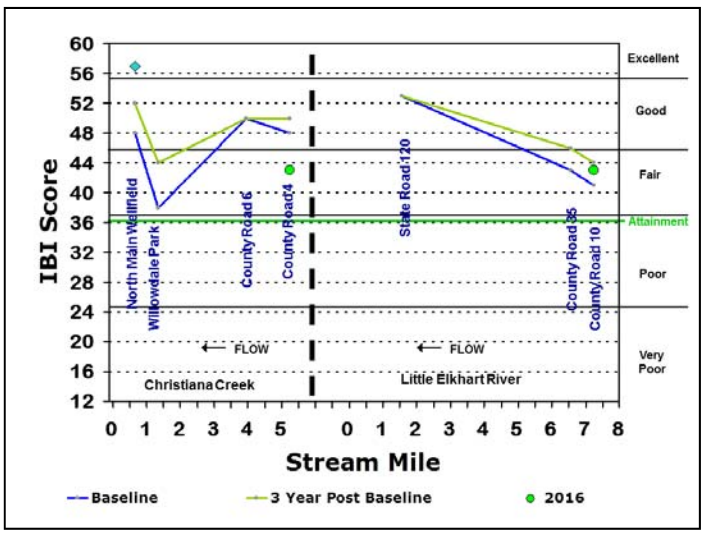


Figure 9: IBI scores for the Little Elkhart River, Elkhart County



vated at the same time. These alterations, which are generally devastating for aquatic life, are typical practices for drainage maintenance. Since baseline monitoring and drainage maintenance, IBI scores have been very poor (Table 8). Given that Lily Creek in this location has historically been ditched, a relatively quick recovery was expected following drainage maintenance activities. However, based on IBI results in 2016, this site is showing little signs of recovery. Macroinvertebrates were also sampled at this site for the first time in 2016. The ICI score of 26, while considered fair, is indicative of an impaired stream.

Grant with a beautiful brown trout from the Little Elkhart River

Little Elkhart River

The IBI score at the Little Elkhart River at CR 10 of 43 was up slightly from the baseline and the same as it was in 2013. Long-term monitoring indicates a slight improvement at this location and downstream at County Road 35, while results have remained unchanged at State Road 120 closer to the mouth of St. Joseph River (Figure 9). The IBI score is down slightly from 2007 and 2010 when respective scores were 46 and 45. The Little Elkhart River offers excellent habitat and is a large coolwater stream that supports a good population of brown trout.

Macroinvertebrate community scores in 2016 were disappointing at CR 10. While the ICI score in 2016 was the same as the baseline, the last time the site was sampled in 2013, the ICI score was 56. In 2012, the ICI score at the next station downstream (CR 35) was also very good suggesting favorable stream conditions in 2012 and 2013. Results from 2016, however, suggest that these improvments in the macorivnertebrate community were short lived.

Christiana Creek

The 2016 IBI score of 43 at CR 4 on Christiana Creek is discouraging (Figure 9; Table 9). This is the lowest score that has been recorded at this

Table 9: Index scores for the Little Elkhart River and Puterbaugh Creek, Elkhart County

Stream	Station	River Mile	Fish IBI Scores				2016 Habitat Scores	ICI Macroinvertebrate Scores	
			Baseline	2010	2013	**2016**		Baseline/Previous Scores	**2016**
Little Elkhart River	CR 10	7.3	41	45	43	**43**	81	40	**40**
Christiana Creek	CR 4	5.3	48	52	46	**43**	74	47	**52**
Puterbaugh Creek	CR 8	1	39	48	40	**41**	74	47	**48**

site and it is significantly below the baseline value of 48. Some aspects of the fish community were slightly lacking in 2016 relative to previous years. For example, diversity of darter, sunfish, and sucker species was slightly lower in 2016. However, one stark difference was the total abundance of fish. In 2016, an average of 1,186 fish were collected during both sampling passes, most of which were striped shiners. In comparison, in 2013 an average of 285 fish were collected indicating a 300% increase in 2016.

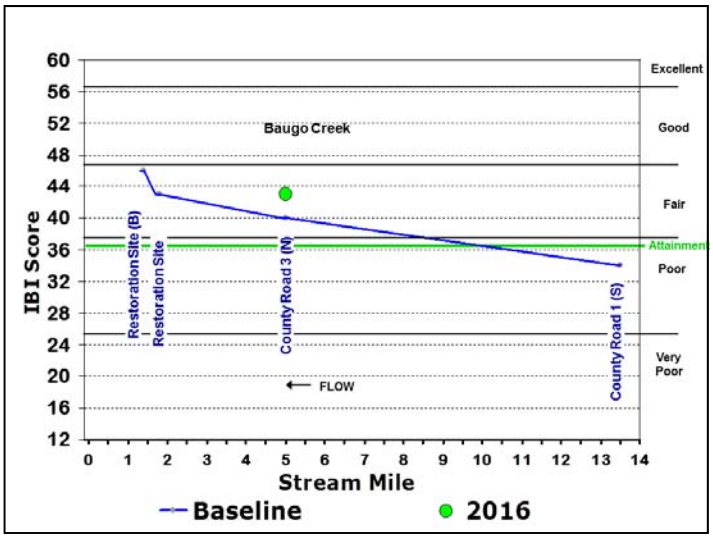
While fish community results were discouraging, the macroinvertebrate community score of 52 in 2016 was the highest recorded for this site and significantly higher than the baseline. Biological community monitoring on the St. Joseph County section of the St. Joseph River provided similar results in 2016, with fish community scores dropping and macroinvertebrate community scores increasing. Results in 2016 may just be an artifact of natural variables. The Aquatics Program will continue to pay close attention to CR 4 on Christiana Creek in the future.

Puterbaugh Creek

Puterbaugh Creek is another Elkhart County coolwater stream. While connecting Heaton Lake north of Elkhart with the St. Joseph River, it expands less than 4 miles. This creek has several

A nice bowfin collected from Puterbaugh Creek

Figure 10: IBI scores of Baugo Creek, Elkhart and St. Joseph Counties



coolwater fish species, but recruits warmwater species from the larger bodies of water. In 2016, the IBI score at CR 8 was 41, which is just above the baseline value of 39 and the score of 40 that it received in 2013 (Table 9). In 2010, the IBI score did sky rocket to 48, but recent scores suggest no long-term improvement in the fish community at this location. Macroinvertebrate community scores also suggest relative stability in this stream with the 2016 score being 48, just slightly higher than the baseline score of 47.

Baugo Creek

Baugo Creek sites at CR 1 (S) and CR (3) N were sampled for the second time since the completion of baseline monitoring (Table 10). The site at CR 3 (N) had an improved score of 43, while CR 1 (S) scored slightly lower than the baseline. Baugo Creek is an interesting stream. Its watershed has been drastically modified for agricultural drainage causing it to suffer from water quality problems that impact the health of the stream. Yet, it also has exceptional habitat in several places, like at CR 3 (N) where the QHEI score in 2016 was 90. Given its exceptional habitat, it hosts diverse communities of fish and even a very high abundance of longnose dace, an Indiana State Species of Special Concern (IDNR, 2016). Macorinvertebrates were only sampled at the CR 3 (N) site in 2016. The ICI score was an impressive 38, which is well above the baseline score of 25.

Cobus Creek

Cobus Creek and two of its tributaries, Gast Ditch and Cobus East Lateral A, were sampled in several locations during the summer of 2016 (Table 11). This extensive sampling regime in the Cobus Creek Watershed was performed to assist the St. Joseph River Basin Commission (SJRBC) in a diagnostic study of the Watershed. Given that Cobus Creek originates in Cass County, Michigan, three sites were sampled on the Michigan side of the line. Of all the sites sampled, CR 8 on Cobus Creek is the only Index site where long-term data have been collected by the Aquatics Program. IBI scores at CR 8 do not appear to have declined in recent sampling events. Macroinvertebrate ICI scores have been very good to exceptional at CR 8 in the last three sampling events with the 2016 score of 52 being the highest ICI score recorded at this site.

Although ICI scores were impressive at CR 8, IBI scores reflect very poor to fair fish communities in most of the sites in the Cobus Creek Watershed. Cobus East Lateral A is a very small headwater tributary of Cobus Creek. As with most former headwater streams in Northern Indiana, it is no longer recognized as a natural stream; it is considered a regulated drain and has been drastically modified and altered to drain land. As a result, only one species of fish, the central mudminnow, remains in this stream.

Gast Ditch, another tributary to Cobus Creek was sampled in 3 locations. During the heat of the summer, this stream ran dry at Douglas Road, indicating that hydrology is significantly impacted on this stream. Similar to Cobus East Lateral A, Gast

Table 10: Index Scores for Baugo Creek, Elkhart and St. Joseph County

Stream	Station	River Mile	Fish IBI Scores				2016 Habitat Scores	ICI Macroinvertebrate Scores	
			Baseline	2010	**2013**	**2016**		Baseline Score	**2016**
Baugo Creek	CR 1 (S)	5	30		**29**	**29**	76		
Baugo Creek	CR 3 (N)	1.5	40		**40**	**43**	90	25	**38**

Ditch is also a regulated drain. IBI scores for Gast Ditch were very poor to poor.

Sites along the main stem of Cobus Creek had stronger fish community scores than the tributary sites. The IBI score at CR 12 of 40, was the highest of the all the sites sampled. The site at May Street, which is just upstream of Garver Lake in Edwardsburg offered a small population of Iowa darters, a species that had not been documented by the Aquatics Program before.

Table 11: Index Scores for sites sampled in the Cobus Creek Watershed, 2016

Stream	Station	County	Stream Mile	Fish IBI Scores (Coolwater Index Scores)
				2016
Cobus Creek	Upstream of Coberts Lake	Cass (MI)	11	15 (10)
Cobus Creek	May Street	Cass (MI)	8	24 (32)
Cobus Creek	Redfield Road	Cass (MI)	6.8	16 (18)
Cobus Creek	CR 2	Elkhart	5.8	22 (21)
Cobus Creek	CR 8	Elkhart	2.2	28 (34)
Cobus Creek	CR 12	Elkhart	1.1	33 (40)
Cobus East Lateral A	CR 6	Elkhart	0.3	6
Gast Ditch	Redfield Road	St. Joseph	5.8	17 (10)
Gast Ditch	Adams Road	St. Joseph	4.7	18 (20)
Gast Ditch	Douglas Road	St. Joseph	1.3	14 (8)

Fish Tissue

In 2016, tissue was collected from fish in both Elkhart and St. Joseph Counties. Collections were based on the current Fish Consumption Advisory (FCA) for area streams and potential data gaps within the FCA. The FCA provides guidance on the rate of consumption of local wild fishes (Table 12), based on the concentration of polychlorinated biphenyl (PCB) or mercury (Hg) concentrations in their tissue. It should be noted that the State FCA has more restrictive guidance for individuals that are considered to be part of the "sensitive population." Females under the age of 50 and males under the age of 18 are considered to be part of the sensitive population. For more information on local fish consumption, visit the Indiana State Department of Health's website (http://www.in.gov/isdh/23650.htm).

A male Iowa darter collected from Cobus Creek upstream of Garver Lake

Many variables play a role in contaminant concentrations in fish. In general, larger fish will tend to have higher concentrations of contaminants in their tissue. Concentrations of contaminants can vary from one fish to another, so the methodology for collecting tissue samples requires collecting three fish and compositing all fish into one sample.

Table 12: Fish consumption guidance from the Indiana Fish Consumption Advisory

Location	Species	Fish Size (inches)	Contaminant	Consumption Guidance	***Sensitive Population Guidance***
Elkhart River *Elkhart County*	Channel Catfish	ALL	PCBs	1 meal/month	***Do Not Eat***
	Northern Pike	Up to 24		Unrestricted	*1 meal/week*
	Rock Bass	Up to 7		Unrestricted	*1 meal/week*
Christiana Creek *Elkhart County*	Northern Hogsucker	Up to 14		Unrestricted	*1 meal/week*
	Rock Bass	Up to 7		Unrestricted	*1 meal/week*
	Yellow Bullhead	Up to 9		Unrestricted	*1 meal/week*
St. Joseph River *Elkhart County*	Bluegill	Up to 8		Unrestricted	*1 meal/week*
	Channel Catfish	All	PCBs	1 meal/month	***Do Not Eat***
	Common Carp	Up to 31	PCBs	1 meal/month	***Don Not Eat***
		31+	PCBs	1 meal/2 months	***Do Not Eat***
	Northern Pike	Up to 24		Unrestricted	*1 meal/week*
	Redhorse Species	17+	PCBs	1 meal/month	***Do Not Eat***
	Rock Bass	Up to 7		Unrestricted	*1 meal/week*
	Smallmouth Bass	Up to 13		Unrestricted	*1 meal/week*
	Walleye	25+	PCBs	1 meal/month	***Do Not Eat***
	White Sucker	Up to 14		Unrestricted	*1 meal/week*
St. Joseph River *St. Joseph County (Baugo Bay Area to Twin Branch Dam)*	Bluegill	Up to 8		Unrestricted	*1 meal/week*
	Channel Catfish	Up to 20	PCBs	1 meal/month	***Do Not Eat***
		20+	PCBs	1 meal/2 months	***Do Not Eat***
	Common Carp	Up to 15	PCBs	1 meal/week	1 meal/month
		15-20	PCBs	1 meal/month	***Do Not Eat***
		20-25	PCBs	1 meal/2 months	***Do Not Eat***
		25+	PCBs	***Do Not Eat***	***Do Not Eat***
	Largemouth Bass	Up to 13		Unrestricted	*1 meal/week*
	Rock Bass	Up to 8		Unrestricted	*1 meal/week*
	Spotted Sucker	Up to 17		Unrestricted	*1 meal/week*
	White Sucker	Up to 14		Unrestricted	*1 meal/week*
St. Joseph River *St. Joseph County (Twin Branch Dam to Indiana State Line)*	Bluegill	7+	PCBs	1 meal/2 months	***Do Not Eat***
	Channel Catfish	All	PCBs	1 meal/2 months	***Do Not Eat***
	Chinook Salmon	28+	PCBs	1 meal/2 months	***Do Not Eat***
	Common Carp	Up to 15	PCBs	1 meal/week	1 meal/month
		15-20	PCBs	1 meal/month	***Do Not Eat***
		20-25	PCBs	1 meal/2 months	***Do Not Eat***
		25+	PCBs	***Do Not Eat***	***Do Not Eat***
	Golden Redhorse	ALL	PCBs	1 meal/month	***Do Not Eat***
	Rock Bass	Up to 8	PCBs	1 meal/week	*1 meal/month*
	Smallmouth Bass	Up to 12	PCBs & Hg	1 meal/week	*1 meal/month*
	Steelhead Trout	30+	PCBs	1 meal/2 months	***Do Not Eat***
	Yellow Bullhead	Up to 10	PCBs	1 meal/week	*1 meal/month*
Juday Creek	White Sucker	17+	PCBs	1 meal/month	***Do Not Eat***

Sensitive Population— *Females under the age of 50 and males under the age of 18*
1 Meal—*8oz. For adults, 3oz. for children ages 3 to 6*

In addition, the Aquatics Program will often sample the same fish species more than once to get a more accurate understanding of contaminant concentrations.

In 2016, contaminant concentrations in tissue samples were very low relative to previous years. Mercury was detected in trace amounts in all tissue samples. In the years collecting tissue samples from the St. Joseph River Watershed, the Aquatics Program has rarely encountered high concentrations of mercury in fish tissue. In accordance with Indiana State Fish Consumption Advisory Criteria, all tissue samples from 2016 fall in the unrestricted consumption guidance for the general population, and a 1 meal per week recommendation for the sensitive population.

PCBs, which are found in relatively high concentrations in some fish species in the St. Joseph River represent more a concern for human consumption. The following narrative describes results of the Aquatics Program's fish tissue collections from Elkhart and St. Joseph Counties in 2016 based on the concentration of PCBs detected:

Walleye, ranging in size from 21.9 to 23.7 inches were collected below the South Bend Dam. Concentrations of PCBs were relatively low for these larger walleye, at levels that would warrant limiting consumption to one meal per week for the general population and one meal per month for the sensitive population. These results are interesting considering that the Aquatics Program documented much higher concentrations in 15 inch walleye from the same section of river in 2015. The Aquatics Program will do some follow up sampling in South Bend in the future to get a better understanding of PCB concentrations in walleye.

Smallmouth bass (10.9 inches) were collected from Indiana Avenue on the Elkhart River. Concentrations of PCBs were very low indicating unrestricted consumption for the general population and one meal per month for the sensitive population. Size limits (the size ranges in which fish can be legally kept by anglers) for river smallmouth bass changed in 2012. The state of Indiana adopted a "slot limit" allowing five smallmouth bass below 12 inches to be kept and 2 smallmouth bass above 15 inches to be kept; fish between 12 to 15 inches are no longer legal. Previously, only fish above 12 inches could be kept. Given this change, we targeted smallmouth bass smaller than 12 inches in 2016 for tissue samples and will continue to do so in future sampling events. The FCA currently recommends that smallmouth bass up to 13 inches should be consumed with 1 meal per week guidance.

Rock bass samples were collected from Indiana Avenue on the Elkhart River and from State Road 15 (Bristol) on the St. Joseph River. The Elkhart River rock bass were between 7.2 and 7.6 inches long, while the St. Joseph River fish were slightly larger at 8 inches. Fish from both rivers had trace concentrations of PCBs indicating that they can be consumed without restrictions for the general population and with 1 meal per week guidance for the sensitive population. These findings concur with the FCA for rock both in both rivers.

Channel catfish, 22 to 23.2 inches were collected from the St. Joseph River at SR 15 (Bristol). PCB concentrations were relatively low indicating that they can be consumed once per week for the general population and once per month for the sensitive population. FCA guidance currently recommends 1 meal per month for the general

Spemcer Rossow with 2 nice largemouth bass from the St. Joseph River

Cortney with a nice shorthead redhorse from Bowman Creek at the Mouth of the St. Joseph River

population and "Do Not Eat" guidance for the sensitive population for all channel catfish in Elkhart County.

Shorthead redhorse, in the 17.7 to 18.7 inch size range were collected below the Twin Branch Dam in Mishawaka. PCB concentrations were relatively high indicating that this species should only be eaten once per month by the general population and "Do Not Eat" guidance should be applied to the sensitive population. Results from 2016, however, should be interpreted with caution. Previous sampling results for shorthead redhorse in St. Joseph County in recent years yielded very high concentrations of PCBs putting this species in the "Do Not Eat" category for both the general and sensitive populations. The Aquatics Program will collect more samples for shorthead redhorse in coming years to obtain a more accurate understanding of PCB concentrations in this species.

Bluegill samples were collected from two locations on the St. Joseph River in 2016; below the Twin-Branch Dam and at Homan Avenue above the Johnson Street Dam. The fish collected at Homan Avenue were 7.7 to 8.5 inches long, while the samples collected below the Twin Branch Dam were 7.2 to 7.7 inches long. All samples had trace concentrations of PCBs indicating unrestricted consumption for the general population and one meal per week for the sensitive population. Similar to shorthead redhorse, the Aquatics Program has also documented high concentrations of PCBs in bluegill in St. Joseph County in previous years. Furthermore, the current FCA guidance for bluegill in St. Joseph County is one meal every two months. Additional sampling for bluegill in St. Joseph County in future years will also take place.

Steelhead trout, in the 26 inch size range, were collected below Pinhook Park on the St. Joseph River in 2016. PCB concentrations were relatively low compared to previous years at levels that would warrant FCA guidance of one meal per week for the general population and one meal every month for the sensitive population. The FCA currently recommends conservative guidance of one meal every two months for the general population for steelhead over 30 inches.

Brown bullhead catfish (11.8 to 11.9 inches) were collected from the St. Joseph River at the Homan Avenue site above the Johnson Street Dam. PCB concentrations were very low indicating unrestricted guidance for the general population and one meal per week for the sensitive population.

Conclusion

Long-term biological monitoring by the cities of Elkhart and South Bend is starting to provide a more thorough understanding of the health of our rivers and streams. Along with our rivers and streams, the Elkhart-South Bend Aquatics Program also continues to evolve by sampling more locations within the watershed, expanding our macroinvertebrate sampling program, and changing our techniques slightly to fill data gaps. In Juday Creek and other coolwater streams we will continue to place more of an emphasis on macroinvertebrate monitoring.

In 2016, IBI scores for several sites including Homan Avenue, Michigan Street, and Pinhook (B) on the St. Joseph River and CR 4 on Christiana Creek were all very low. With the exception of Homan site, however, all of these sites had high macroinvertebrate (ICI) scores, indicating that it may have just been an "off year" for the fish communities. Often natural variables such as flood or drought conditions, population cycles and complex species interactions can have an influence on fish communities. These sites will be monitored closely in subsequent years.

While the biological communities in the St. Joseph River continue to thrive, the same cannot be said for several tributaries of the St. Joseph River. Yellow Creek, Lily Creek, Baugo Creek, and Bowman continue to produce stressed and imbalanced fish communities.

Results from fish tissue samples in 2016 were very interesting, as most tissue samples had very low concentrations of Hg and PCBs relative to samples from previous years. While, we are hopeful that this may be a sign that highly toxic pollutants starting to fade from our aquatic environments, 2016 results may have been anomalous given that they are based on just a few fish from large populations.

In 2016, two interesting fish species were documented in new areas of the St. Joseph River Watershed. The Aquatics Program found longnose dace in Juday Creek for the first time and also found a relatively large population of Iowa darters in the upper reaches of the Cobus Creek Watershed.

Acknowledgements

Thanks to the 2016 field crew of Cortney Quick, Grant Flaming, Jared Miller, and Maddie Boyer. Thanks also to the staff of Elkhart Public Works and Utilities and their counterparts at the City of South Bend for their continued support of the Aquatics Program. Recognition is also extended to local groups such as the Michiana Walleye Association, the Elkhart River Restoration Association, Friends of the St. Joe River, and the many other groups, schools, and people that support the work of the Aquatics Program and the improvement of the St. Joseph River Watershed.

References

Aquatic Research Center of the Indiana Biological Survey. 2007. Development of Coolwater Indiana of Biotic Integrity Expectations for Use in Streams and Rivers of Indiana and Review of Existing Data. Technical Report 2007-01. Indiana Biological Survey, Aquatic Research Center, Bloomington IN.

Deegan, 2016. Elkhart-South Bend aquatic community monitoring. Loose-leaf pub. n.p.

Deegan, 2011. Elkhart-South Bend aquatic community monitoring. Loose-leaf pub. n.p.

Foy, J. 2004. Elkhart—South Bend fish community monitoring. Loose-leaf pub. n.p.

Great Lakes Sport Fish Advisory Task Force. 1993. Appendix III, Species associated analysis and compositing of samples. in Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory.

Indiana Department of Environmental Management (IDEM). 2015. Indiana's 2014 303 (d) List of Impaired Waterways: NOC Attachment 1 Consolidated Assessment and Listing Methodology (CALM). Watershed Planning and Restoration Section. Indianapolis, IN.

Indiana Department of Natural Resources (IDNR). 2016. Endangered and Special Concern Species List. http://www.in.gov/dnr/fishwild/files/fw-Endangered_Species_List.pdf

Indiana State Department of Health. Fish Consumption Advisory. http://www.in.gov/isdh/23650.htm

Karr, J.R. 1981. Assessment of biotic integrity using fish communities. Fisheries 6 (6): 21-27.

Ohio Environmental Protection Agency. 1987. Biological criteria for the protection of aquatic life. Volumes I, II, III. Division of Water Quality Planning and Assessment, Surface Water Section. Columbus, Ohio.

Kring, 2008. Elkhart-South Bend aquatic community monitoring. Loose-leaf pub. n.p.

Ohio Environmental Protection Agency. 1989. Biological criteria for the protection of aquatic life. Volume III: Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Division of Water Quality Monitoring and Assessment. Columbus, Ohio.

Rankin, E.T. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application. Ohio Environmental Protection Agency, Division of Water Quality Planning and Assessment. Columbus, Ohio.

Simon, T.P. 1997. Development of Index of Biotic Integrity expectations for the Ecoregions of Indiana. III. Northern Indiana Till Plain. U.S. Environmental Protection Agency, Region V, Water Division, Watershed and Non-Point Source Branch, Chicago, IL. EPA 905/R-96/002.

APPENDICES

Appendix A
Metrics for Biological Indices

The Northern Indiana Till Plain Index of Biotic Integrity metrics used to evaluate headwater stream (<20 square miles drainage area) sites in the St. Joseph River drainage:

1. Total number of species
2. Number of darter/madtom/sculpin species
3. Percent headwater species
4. Number of minnow species
5. Number of sensitive species
6. Percent tolerant
7. Percent omnivores
8. Percent insectivores
9. Percent pioneer species (individuals)
10. Number of fish collected
11. Percent simple lithophils
12. Percent DELT anomalies

The Northern Indiana Till Plain Index of Biotic Integrity metrics used to evaluate wadeable stream (>20-<1,000 square miles drainage area) sites in the St. Joseph River drainage:

1. Total number of species
2. Number of darter species
3. Number of sunfish species
4. Number of sucker species
5. Number of sensitive species
6. Percent tolerant
7. Percent omnivores
8. Percent insectivores
9. Percent carnivores
10. Number of fish collected
11. Percent simple lithophils
12. Percent DELT anomalies

Invertebrate Community Index categories and metrics used to evaluate sites in the St. Joseph River drainage:

1. Total number of taxa
2. Total number of mayfly taxa
3. Total number of caddisfly taxa
4. Total number of dipteran taxa
5. Percent mayfly composition
6. Percent caddisfly composition
7. Percent tribe Tanytarsini midge composition
8. Percent other dipteran and non-insect composition
9. Percent tolerant organisms
10. Total number of qualitative EPT (mayflies, stoneflies and caddisflies) taxa

Qualitative Habitat Evaluation Index categories and metrics used to evaluate sites in the St. Joseph River drainage:

1. Substrate
    - type
    - number of types present
    - origin
    - silt cover
    - extent of embeddedness

2. Instream Cover
    - type
    - amount

3. Channel Morphology
    - sinuosity
    - development
    - channelization
    - stability

4. Riparian Zone and Bank Erosion
    - riparian width
    - floodplain quality
    - bank erosion

5. Pool/Glide and Riffle/Run Quality
    - maximum pool depth
    - pool/riffle morphology
    - pool/riffle/run current velocity
    - riffle/run depth
    - riffle/run substrate
    - riffle/run embeddedness

6. Gradient

The Coolwater Index of Biotic Integrity metrics used to evaluate sites in Indiana with less than or equal to 100 square miles drainage area:

1. Number of Native Species
2. Number of darter/madtom/sculpin species
3. Percent headwater species
4. Percent coolwater species
5. Percent sensitive and intolerant Species
6. Percent tolerant
7. Percent detritivore
8. Percent invertivore
9. Percent pioneer species
10. Number of fish collected (minus tolerant individuals)
11. Percent simple lithophils
12. Percent DELT anomalies

The Coolwater Index of Biotic Integrity metrics used to evaluate sites in Indiana with greater than 100 square miles drainage area:

1. Number of Native Species
2. Number of darter/madtom/sculpin species
3. Percent catostomidae (sucker family)
4. Percent coolwater species
5. Percent sensitive and intolerant Species
6. Percent tolerant
7. Percent detritivore
8. Percent invertivore
9. Percent carnivore
10. Number of fish collected (minus tolerant individuals)
11. Percent simple lithophils
12. Percent DELT anomalies

Appendix B

Fish tissue preparation and results

Materials needed:

- Reynolds aluminum foil
- freezer wrap
- deionized (DI) water
- 1/2 gallon, 1 gallon, and jumbo size freezer bags w/write-on labels
- skinners
- stainless steel fillet knives
- knife sharpener
- scalers
- ice
- cooler

A group of three fish per species was selected based on size. The smallest fish in each group was greater than or equal to 90% of the length of the largest fish in that group. The largest fish or fish that fell into a length range for species on the advisory were selected. The fish were kept as close in size as possible within a group because the tissue from the three fish in each group was composited (mixed together) before the analyses were completed.

All of the tissue was in the form of boneless fillets taken from the fish. All of the fish had skin-on fillets taken. Before the tissue was removed, the fillet knives, scalers and skinners were cleaned and rinsed with DI water, and freezer wrap was placed where the fish were to be processed. The knives, scalers and skinners were washed in river water and rinsed with DI water after each species was processed and new freezer wrap was placed before another species was processed. For skin-on samples, the scales were removed before the fillet was taken. It was important to be consistent with where the cut of the fillet ended and to not include any of the body cavity or viscera. Once the fillets were removed, they were rinsed in river water and then rinsed with DI water before being placed on aluminum foil. The foil was large enough to hold the three fillets for each species at a site. When all three fillets were placed on the foil, it was then wrapped and placed in a labeled freezer bag and placed on ice in a cooler. The fish tissue was placed in a freezer upon returning to the lab, and kept frozen until sent to the contract lab for analyses.

Fish Tissue Results, Aquatics Program 2016

Station	Species	Length Range (in)	PCB Group General Population	Hg Group General Population	PCB Group Sensitive Population	Hg Group Sensitive Population
St. Joseph River Below South Bend Dam	Walleye	21.9-23.7	1 Meal per Week	Unrestricted	1 Meal per month	1 Meal per Week
Elkhart River Indiana Avenue	Smallmouth Bass	10.9	Unrestricted	Unrestricted	1 Meal per Week	1 Meal per Week
Elkhart River Indiana Avenue	Rock Bass	7.2-7.6	Unrestricted	Unrestricted	1 Meal per Week	1 Meal per Week
St. Joseph River Bristol	Rock Bass	8	Unrestricted	Unrestricted	1 Meal per Week	1 Meal per Week
St. Joseph River Bristol	Channel Catfish	22.0-23.2	1 Meal per Week	Unrestricted	1 Meal per month	1 Meal per Week
St. Joseph River Below Twin Branch Dam	Shorthead Redhorse	17.7-18.7	1 Meal per month	Unrestricted	DO NOT EAT	1 Meal per Week
St. Joseph River Below Twin Branch Dam	Bluegill	7.2-7.7	Unrestricted	Unrestricted	1 Meal per Week	1 Meal per Week
St. Joseph River Pinhook (B)	Steelhead	25.0-25.4	1 Meal per Week	Unrestricted	1 Meal per month	1 Meal per Week
St. Joseph River Homan Avenue	Bluegill	7.7-8.5	Unrestricted	Unrestricted	1 Meal per Week	1 Meal per Week
St. Joseph River Homan Avenue	Brown Bullhead	11.8-11.9	Unrestricted	Unrestricted	1 Meal per Week	1 Meal per Week

Sensitive Population— *Females under the age of 50 and males under the age of 18*
1 Meal—*8oz. For adults, 3oz. for children ages 3 to 6*

Appendix C

Summary of fish collected by county, 2016

Summary of species captured at index sites in Elkhart County, 2016

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Creek Chub	2,450	13.01	28,692	63.26	2.69
Striped Shiner	1,839	9.76	16,204	35.72	1.52
Mimic Shiner	1,569	8.33	2,196	4.84	0.21
White Sucker	1,175	6.24	134,650	296.85	12.62
Blacknose Dace	1,118	5.94	3,984	8.78	0.37
Rock Bass	1,033	5.48	81,801	180.34	7.67
Bluntnose Minnow	789	4.19	2,328	5.13	0.22
Mottled Sculpin	774	4.11	3,605	7.95	0.34
Rainbow Darter	725	3.85	1,072	2.36	0.10
Stoneroller, Central	723	3.84	8,285	18.27	0.78
Johnny Darter	697	3.70	1,160	2.56	0.11
Spotfin Shiner	537	2.85	1,996	4.40	0.19
Golden Redhorse	497	2.64	267,914	590.65	25.11
Northern Hog Sucker	440	2.34	64,139	141.40	6.01
Smallmouth Bass	425	2.26	55,178	121.65	5.17
Longear Sunfish	407	2.16	15,775	34.78	1.48
Hornyhead Chub	400	2.12	5,829	12.85	0.55
Logperch	369	1.96	2,886	6.36	0.27
Rosyface Shiner	355	1.88	900	1.98	0.08
Bluegill	328	1.74	17,561	38.72	1.65
Common Shiner	311	1.65	4,167	9.19	0.39
Green Sunfish	249	1.32	4,048	8.92	0.38
Largemouth Bass	239	1.27	36,641	80.78	3.43
Shorthead Redhorse	205	1.09	119,826	264.17	11.23
Sand Shiner	176	0.93	421	0.93	0.04
Blackside Darter	98	0.52	346	0.76	0.03
Central Mudminnow	94	0.50	571	1.26	0.05
Longnose Dace	93	0.49	539	1.19	0.05
Brown Trout	87	0.46	9,999	22.04	0.94
Chestnut Lamprey	85	0.45	693	1.53	0.06
Silverjaw Minnow	70	0.37	215	0.47	0.02
Blackstripe Topminnow	64	0.34	126	0.28	0.01
Grass Pickerel	62	0.33	1,146	2.53	0.11
Yellow Bullhead	55	0.29	3,799	8.38	0.36
American Brook Lamprey	52	0.28	219	0.48	0.02
Spotted Sucker	28	0.15	4,925	10.86	0.46
Common Carp	22	0.12	43,123	95.07	4.04
Bowfin	17	0.09	27,634	60.92	2.59
Walleye	16	0.08	7,809	17.22	0.73
Longnose Gar	16	0.08	5,503	12.13	0.52
Silver Redhorse	15	0.08	36,898	81.35	3.46
Northern Pike	12	0.06	6,319	13.93	0.59

Summary of species captured at index sites in Elkhart County, 2016 (continued)

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Brown Bullhead	12	0.06	4,641	10.23	0.43
Pirate Perch	12	0.06	110	0.24	0.01
Fathead Minnow	10	0.05	32	0.07	0.00
Silver Lamprey	8	0.04	51	0.11	0.00
Channel Catfish	7	0.04	12,700	28.00	1.19
Rainbow Trout	7	0.04	1,498	3.30	0.14
Warmouth	6	0.03	759	1.67	0.07
Banded Killifish	6	0.03	15	0.03	0.00
Gizzard Shad	6	0.03	9	0.02	0.00
Black Crappie	5	0.03	370	0.82	0.03
Stonecat	5	0.03	299	0.66	0.03
Quillback	4	0.02	5,800	12.79	0.54
Pumpkinseed	4	0.02	380	0.84	0.04
Tadpole Madtom	4	0.02	36	0.08	0.00
Black Redhorse	3	0.02	1,500	3.31	0.14
Greenside Darter	3	0.02	11	0.02	0.00
Brook Silverside	3	0.02	5	0.01	0.00
River Redhorse	2	0.01	6,000	13.23	0.56
Greater Redhorse	2	0.01	1,234	2.72	0.12
Redear Sunfish	2	0.01	277	0.61	0.03
Yellow Perch	2	0.01	54	0.12	0.01
Northern Brook Lamprey	2	0.01	7	0.02	0.00
Golden Shiner	2	0.01	3	0.01	0.00
Hybrid Sunfish	1	0.01	194	0.43	0.02
Iowa Darter	1	0.01	1	0.00	0.00
Totals	**18,835**	**100.00**	**1,067,108.00**	**2,352.57**	**100.00**

Summary of species captured at investigative sites in Elkhart County, 2016

Common Name	Total Number	% by Number
Bluegill	77	22.99
Spotfin Shiner	36	10.75
Central Mudminnow	34	10.15
Rock Bass	33	9.85
Smallmouth Bass	24	7.16
Grass Pickerel	15	4.48
Rainbow Darter	15	4.48
Mottled Sculpin	12	3.58
Rosyface Shiner	11	3.28
Northern Hog Sucker	10	2.99
Shorthead Redhorse	10	2.99
Creek Chub	9	2.69
Mimic Shiner	8	2.39
Largemouth Bass	6	1.79
White Sucker	6	1.79
Logperch	6	1.79
Johnny Darter	4	1.19
Sand Shiner	3	0.90
Walleye	3	0.90
Yellow Bullhead	2	0.60
Bowfin	2	0.60
Green Sunfish	2	0.60
Blackside Darter	1	0.30
Striped Shiner	1	0.30
Pirate Perch	1	0.30
Common Shiner	1	0.30
Channel Catfish	1	0.30
Warmouth	1	0.30
Stonecat	1	0.30
Totals	335	100

Index Sites	18,835
Investigative Sites	335
Elkhart County Total	19,170

Summary of species captured at investigative sites in St. Joseph County, 2016

Common Name	Total Number	% by Number
Mottled Sculpin	169	18.37
Creek Chub	142	15.43
Longear Sunfish	114	12.39
Smallmouth Bass	89	9.67
Rock Bass	89	9.67
Blacknose Dace	79	8.59
Green Sunfish	68	7.39
White Sucker	31	3.37
Largemouth Bass	29	3.15
Johnny Darter	25	2.72
Rainbow Darter	19	2.07
Rainbow Trout	13	1.41
Yellow Bullhead	9	0.98
Blackside Darter	6	0.65
Spotted Sucker	6	0.65
Stoneroller, Central	4	0.43
Common Carp	4	0.43
Bluegill	3	0.33
Bluntnose Minnow	3	0.33
Greenside Darter	3	0.33
Central Mudminnow	3	0.33
Logperch	3	0.33
Walleye	2	0.22
Golden Redhorse	2	0.22
Brown Trout	1	0.11
Spotted Gar	1	0.11
Longnose Dace	1	0.11
Shorthead Redhorse	1	0.11
Golden Shiner	1	0.11
Totals	920	100

Summary of species captured at index sites in St. Joseph County, 2016

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Smallmouth Bass	420	16.12	44,920	99.03	9.86
Rock Bass	336	12.90	27,369	60.34	6.00
Longear Sunfish	332	12.74	15,226	33.57	3.34
Creek Chub	247	9.48	2,407	5.31	0.53
Bluegill	153	5.87	6,988	15.41	1.53
Spotfin Shiner	102	3.92	343	0.76	0.08
Black Redhorse	94	3.61	73,038	161.02	16.02
Shorthead Redhorse	92	3.53	80,372	177.19	17.63
Mimic Shiner	92	3.53	172	0.38	0.04
Golden Redhorse	80	3.07	69,350	152.89	15.22
Mottled Sculpin	80	3.07	380	0.84	0.08
Green Sunfish	70	2.69	2,139	4.72	0.47
Logperch	67	2.57	861	1.90	0.19
Northern Hog Sucker	54	2.07	25,674	56.60	5.63
White Sucker	53	2.03	13,785	30.39	3.02
Johnny Darter	53	2.03	58	0.13	0.01
Bluntnose Minnow	37	1.42	84	0.19	0.02
Pumpkinseed	33	1.27	1,409	3.11	0.31
Blacknose Dace	30	1.15	118	0.26	0.03
Largemouth Bass	19	0.73	2,810	6.19	0.62
Spotted Sucker	15	0.58	8,038	17.72	1.76
Greenside Darter	13	0.50	36	0.08	0.01
Banded Killifish	13	0.50	27	0.06	0.01
Spottail Shiner	13	0.50	14	0.03	0.00
Longnose Gar	12	0.46	3,856	8.50	0.85
Chestnut Lamprey	10	0.38	106	0.23	0.02
Blackside Darter	10	0.38	22	0.05	0.00
Quillback	9	0.35	16,100	35.49	3.53
Common Carp	8	0.31	29,583	65.22	6.49
Rainbow Trout	8	0.31	6,924	15.26	1.52
Walleye	8	0.31	5,136	11.32	1.13
Grass Pickerel	8	0.31	48	0.11	0.01
Yellow Bullhead	6	0.23	781	1.72	0.17
Warmouth	5	0.19	332	0.73	0.07
Creek Chubsucker	3	0.12	81	0.18	0.02
Rainbow Darter	3	0.12	4	0.01	0.00
Golden Shiner	3	0.12	4	0.01	0.00
Hybrid Sunfish	2	0.08	145	0.32	0.03
Black Crappie	2	0.08	41	0.09	0.01
Central Mudminnow	2	0.08	19	0.04	0.00
Sand Shiner	2	0.08	3	0.01	0.00
Muskellunge	1	0.04	8,600	18.96	1.89

Summary of species captured at index sites in St. Joseph County, 2016 (continued)

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Channel Catfish	1	0.04	5,000	11.02	1.10
Bowfin	1	0.04	1,600	3.53	0.35
Northern Pike	1	0.04	1,560	3.44	0.34
Redear Sunfish	1	0.04	210	0.46	0.05
Stoneroller, Central	1	0.04	6	0.01	0.00
Totals	**2,605**	**100**	**455,779**	**1,004.82**	**100.00**

Index Sites	2,605
Investigative Sites	920
St. Joseph County Total	3,525

Summary of species captured at index sites in St. Joseph County, 2016

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Central Mudminnow	62	28.31	342	0.75	4.00
Bluegill	45	20.55	1151	2.54	13.47
Grass Pickerel	35	15.98	960	2.12	11.23
Iowa Darter	22	10.05	25	0.06	0.29
Largemouth Bass	13	5.94	3023	6.66	35.37
Yellow Bullhead	8	3.65	369	0.81	4.32
Creek Chub	8	3.65	41	0.09	0.48
White Sucker	7	3.20	317	0.70	3.71
Bowfin	5	2.28	2109	4.65	24.68
Lake Chubsucker	4	1.83	107	0.24	1.25
Hornyhead Chub	3	1.37	41	0.09	0.48
Golden Shiner	3	1.37	8	0.02	0.09
Green Sunfish	2	0.91	21	0.05	0.25
Brown Bullhead	1	0.46	32	0.07	0.37
Bluntnose Minnow	1	0.46	1	0.00	0.01
Totals	**219**	**100.00**	**8547**	**18.84**	**100.00**

Appendix D

Summary of fish collected by site, 2016
(Reference Table 1 for site numbers and locations)

Stream	St. Joseph River, Elkhart County, 2016								
Site	SR 15 (Bristol)		Homan Ave		Sherman St		Island Park	Nappanee Street	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass		1st Pass	2nd Pass
#Banded Killifish			X	X	X				X
Black Crappie	X							X	
~Black Redhorse					X				
Blackside Darter	X	X		X	X	X	X	X	X
Bluegill	X	X	X	X	X	X	X	X	X
#Bluntnose Minnow	X	X	X	X	X	X		X	X
Bowfin	X	X							X
~Brook Silverside		X	X						X
#Brown Bullhead	X	X	X	X					
#Channel Catfish	X	X			X	X	X		
Chestnut Lamprey	X	X	X		X	X		X	
#Common Carp		X	X	X	X	X			X
Common Shiner							X		
#Creek Chub	X	X							
~Golden Redhorse	X	X	X	X	X	X		X	X
#Golden Shiner									
Grass Pickerel		X			X				
#Green Sunfish				X	X	X	X	X	X
~Greenside Darter		X				X			
~Hornyhead Chub	X	X			X			X	X
Johnny Darter	X	X			X	X	X	X	X
Largemouth Bass	X	X	X	X	X			X	X
~Logperch	X	X	X	X	X	X	X	X	X
~Longear Sunfish	X	X	X	X	X	X		X	X
#Longnose Gar		X	X		X	X		X	X
~Mimic Shiner	X	X	X	X	X	X	X	X	X
Mottled Sculpin		X							
Muskellunge									
~Northern Hog Sucker	X	X			X	X	X	X	X
Northern Pike		X		X	X				X
Pumpkinseed			X	X		X		X	
#Quillback					X			X	
~Rainbow Darter					X	X	X	X	X
Rainbow Trout								X	
Redear Sunfish	X	X							
~River Redhorse						X			X
~Rock Bass	X	X	X	X	X	X	X	X	X
~Rosyface Shiner	X						X		
~Sand Shiner				X			X		

Stream	St. Joseph River, Elkhart County, 2016								
Site	SR 15 (Bristol)		Homan Ave		Sherman St		Island Park	Nappanee Street	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass		1st Pass	2nd Pass
~Shorthead Redhorse	X	X			X	X	X	X	X
~Silver Redhorse	X	X	X	X	X			X	
~Smallmouth Bass	X	X	X	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	X	X	X	X
Spottail Shiner									
Spotted Gar									
Spotted Sucker	X	X	X	X				X	X
~Stonecat		X					X		
Striped Shiner	X	X	X	X	X	X	X	X	
Walleye					X	X	X	X	X
Warmouth					X			X	X
#White Sucker	X	X	X	X		X		X	X
#Yellow Bullhead	X		X	X				X	
Yellow Perch	X				X				

~ - denotes a species that is SENSITIVE to environmental disturbances such as degraded water quality or habitat
# - denotes a species that is TOLERANT of environmental disturbances such as degraded water quality or habitat

Stream	St. Joseph River, St. Joseph County, 2016							
Site	Capital Ave		Louise St	Michigan St.		Pinhook Park	Pinhook Park (Below)	
	1st Pass	2nd Pass		1st Pass	2nd Pass		1st Pass	2nd Pass
#Banded Killifish	X							
Black Crappie	X							
Blackside Darter		X	X	X				X
Bluegill	X	X	X	X	X	X	X	X
#Bluntnose Minnow	x	X	X	X				
Bowfin						X		
#Channel Catfish		X						
Chestnut Lamprey	X			X			X	X
#Common Carp	X	X	X					X
~Golden Redhorse	X	X	X	X	X	X	X	X
#Golden Shiner		X	X					
#Green Sunfish	X	X	X		X		X	X
~Greenside Darter		X	X	X	X		X	X
Johnny Darter	X	X	X				X	X
Largemouth Bass	X	X	X				X	
~Logperch		X	X	X	X		X	X
~Longear Sunfish	X	X	X	X	X	X	X	X
#Longnose Gar		X		X	X	X	X	X
~Mimic Shiner	X	X		X		X	X	
Muskellunge	X							X
~Northern Hog Sucker	X			X	X	X	X	
Northern Pike		X						
Pumpkinseed	X	X						
#Quillback	X			X			X	
~Rainbow Darter				X	X			
Rainbow Trout	X			X				
Redear Sunfish							X	
~Rock Bass	X	X	X	X	X	X	X	X
~Sand Shiner								X
~Shorthead Redhorse	X	X		X	X		X	X
~Smallmouth Bass	X	X	X	X	X	X	X	X
Spotfin Shiner	X	X		X	X	X		X
Spottail Shiner	X	X						
Spotted Gar			X					
Spotted Sucker	X	X	X			X	X	X
Walleye	X	X	X		X		X	X
Warmouth							X	X
#White Sucker	X	X	X	X		X		
#Yellow Bullhead		X	X		X			X

Tributaries to the St. Joseph River, 2016						
Stream	**Elkhart River**					
Site	**Oxbow Park**		**Indiana Ave**		**Middlebury Street**	
	1st Pass	**2nd Pass**	**1st Pass**	**2nd Pass**	**1st Pass**	**2nd Pass**
~American Brook Lamprey		X	X			X
Black Crappie						X
Blackside Darter	X	X	X	X	X	X
Bluegill		X	X	X	X	X
#Bluntnose Minnow	X	X	X	X	X	X
Chestnut Lamprey	X	X	X	X	X	X
Common Shiner	X	X	X		X	
#Creek Chub	X	X	X	X		
#Fathead Minnow	X					
~Golden Redhorse	X	X	X	X	X	X
~Greater Redhorse		X				
#Green Sunfish	X	X	X	X	X	X
~Hornyhead Chub	X	X	X	X	X	X
Johnny Darter	X	X	X	X	X	X
Largemouth Bass	X	X	X	X		X
~Longear Sunfish	X	X	X	X	X	X
~Northern Brook Lamprey					X	
~Northern Hog Sucker	X	X	X	X	X	X
Northern Pike		X		X		
Pirate Perch				X		X
~Rainbow Darter	X	X	X	X		X
~Rock Bass	X	X	X	X	X	X
~Rosyface Shiner	X	X	X	X	X	X
~Sand Shiner	X		X	X	X	X
Silver Lamprey	X					X
~Smallmouth Bass	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X	X
Spotted Sucker		X				
Stonecat	X			X		X
Striped Shiner	X	X	X	X	X	X
Walleye	X	X				
Warmouth	X					
White Sucker	X	X	X	X	X	X
Yellow Bullhead					X	X

~ - denotes a species that is SENSITIVE to environmental disturbances such as degraded water quality or habitat
# - denotes a species that is TOLERANT of environmental disturbances such as degraded water quality or habitat

Tributaries to the St. Joseph River, 2016								
Stream	Little Elkhart River		Christiana Creek		Baugo Creek			
Site	CR 35		CR 4		CR 1 (S)		CR 3 (N)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey	X	X						
Banded Killifish							X	
#Blacknose Dace	X	X			X	X	X	X
Blackside Darter	X	X						
Bluegill					X	X		
#Blackstripe Topminnow			X	X				
#Bluntnose Minnow	X	X	X	X	X	X	X	X
Bowfin			X	X				
Brown Trout	X	X						
#Central Mudminnow	X	X	X		X	X		
Central Stonelroller		X			X	X	X	X
#Channel Catfish								
Chestnut Lamprey	X		X	X	X		X	
Common Carp				X	X			
Common Shiner	X	X			X	X	X	X
#Creek Chub	X	X	X	X	X	X	X	X
Fathead Minnow						X	X	X
~Golden Redhorse			X	X				
Gizzard Shad		X						
Grass Pickerel	X	X		X				
#Green Sunfish	X	X				X	X	X
~Greenside Darter							X	
~Hornyhead Chub			X	X				
Johnny Darter	X	X			X	X	X	X
Largemouth Bass	X	X	X	X		X		
~Logperch	X	X		X			X	X
~Longnose Dace							X	X
Mottled Sculpin	X	X						
~Northern Hog Sucker	X	X	X	X				
Pirate Perch						X		
~Rainbow Darter	X	X	X	X			X	X
Rainbow Trout	X							
~Rock Bass	X	X	X	X	X	X	X	X
~Sand Shiner					X	X	X	X
~Silver Redhorse								X
Silver Lamprey			X	X				
Silverjaw Minnow					X	X	X	X
`Smallmouth Bass	X	X	X	X				X
Spotfin Shiner			X	X			X	
~Stonecat				X				

Tributaries to the St. Joseph River, 2015 (Continued)								
Stream	Little Elkhart River		Christiana Creek		Baugo Creek			
Site	CR 35		CR 4		CR 1 (S)		CR 3 (N)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Striped Shiner		X	X	X		X		X
Tadpole Madtom			X					
#White Sucker	X	X		X	X	X	X	X
#Yellow Bullhead			X	X	X	X		

Tributaries to the St. Joseph River, 2016												
Stream	Cobus Creek											
Site	US of Coberts		May Street		Redfield Road		CR 2		CR 8		CR 12	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey		x	x						x	x	x	x
#Blacknose Dace							x	x	x	x	x	x
Bluegill	x			x	x	x					x	
#Bluntnose Minnow			x									
Bowfin					x	x						
#Brown Bullhead					x							
Brown Trout									x	x	x	x
#Central Mudminnow	x	x	x	x	x	x	x		x	x	x	x
Chesnut Lamprey												x
Common Shiner	x										x	
#Creek Chub		x	x	x			x	x	x	x	x	x
Creek Chubsucker												
#Golden Shiner			x			x		x				
Grass Pickerel				x	x	x		x	x	x	x	x
#Green Sunfish										x	x	x
~Hornyhead Chub		x		x								
Iowa Darter			x	x						x		
Lake Chubsucker					x	x						
Largemouth Bass	x		x	x	x	x		x				
Mottled Sculpin								x	x	x	x	x
Rainbow Trout											x	x
~Rock Bass									x	x	x	
Striped Shiner												x
#White Sucker			x		x				x	x		x
#Yellow Bullhead					x	x						

~ - denotes a species that is SENSITIVE to environmental disturbances such as degraded water quality or habitat
# - denotes a species that is TOLERANT of environmental disturbances such as degraded water quality or habitat

Tributaries to the St. Joseph River, 2016									
Stream	**Puterbaugh Creek**				**Lily Creek**			**Yellow Creek**	
Site	**CR 8**		**Jeanwood Drive**	**CR 4**	**Reckell Ave**		**CR 4**	**CR 32**	
	1st Pass	**2nd Pass**			**1st Pass**	**2nd Pass**		**1st Pass**	**2nd Pass**
~American Brook Lamprey		X							
Blacknose Dace								X	X
Blackside Darter		X							
Bluegill	X	X	X	X				X	X
#Bluntnose Minnow								X	X
Bowfin				X					
#Central Mudminnow	X		X	X	X	X	X		X
Chestnut Lamprey								X	
Common Shiner								X	
#Creek Chub	X	X	X		X	X		X	X
#Fathead Minnow								X	
Grass Pickerel	X	X	X	X		X			X
~Greater Redhorse									
#Green Sunfish	X	X	X					X	X
~Hornyhead Chub									
Johnny Darter	X	X	X		X	X		X	X
Largemouth Bass		X		X					X
~Logperch		X							
Mottled Sculpin	X	X	X						
Pirate Perch		X		X	X	X			
~Rainbow Darter	X	X	X						X
Silverjaw Minnow								X	X
Stoneroller, Central								X	
Warmouth	X		X						
White Sucker	X	X	X		X	X		X	X
Yellow Bullhead	X		X						

~ - denotes a species that is SENSITIVE to environmental disturbances such as degraded water quality or habitat
# - denotes a species that is TOLERANT of environmental disturbances such as degraded water quality or habitat

Tributaries to the St. Joseph River, 2016								
Stream	**Gast Ditch**						**Cobus Lateral A**	
Site	**Redfield Road**		**Adams Road**		**Douglas Road**		**CR 6**	
	1st Pass	**2nd Pass**	**1st Pass**	**2nd Pass**	**1st Pass**	**2nd Pass**	**1st Pass**	**2nd Pass**
~American Brook Lamprey				x				No Fish
#Blacknose Dace			x			x		
Bluegill	x							
#Central Mudminnow		x	x				x	
#Creek Chub			x	x	x			
Creek Chubsucker				x				
#Golden Shiner						x		
Grass Pickerel	x	x	x	x				
#Green Sunfish	x	x	x	x				
Largemouth Bass	x							
#White Sucker	x			x				
#Yellow Bullhead				x				

Tributaries to the St. Joseph River, St. Joseph County, 2016								
Stream	**Bowman Creek**			**Juday Creek**				
Site	**Ravina Park**		**St. Joseph River Mouth**	**Douglas Road (East Crossing)**	**SR 23**		**Juday Lake**	**St. Joseph River Mouth**
	1st Pass	**2nd Pass**			**1st Pass**	**2nd Pass**		
#Blacknose Dace				X	X	X	X	X
Brown Trout							X	
#Central Mudminnow				X			X	
Central Stoneroller	X							X
#Common Carp						X		
#Creek Chub	X	X		X	X	X	X	X
#Green Sunfish		X	X	X	X	X	X	
Greenside Darter								X
Johnny Darter				X	X	X	X	
Largemouth Bass			X	X		X	X	
~Longear Sunfish			X					
~Longnose Dace								X
Mottled Sculpin				X	X	X	X	X
~Rainbow Darter			X					X
Rainbow Trout			X					X
~Rock Bass					X	X	X	
~Shorthead Redhorse			X					
~Smallmouth Bass			X		X	X	X	
#White Sucker				X	X	X	X	X
Walleye			X					

Appendix E

Summary of macroinvertebrates (insects) collected by site, 2016

Macroinvertebrates were collected in two ways to calculate the Invertebrate Community Index (ICI). The first method employed a sampling device known as a Hester-Dendy multi-plate sampler (HD sampler). Macroinvertebrates collected using this method were identified and counted (Quantitative column in the following tables). The second method was a sweep with a net of all the available habitat types in the area of the Hester-Dendy in an effort to identify other macroinvertebrates in the stream that may not colonize the HD samplers. Macroinvertebrates collected in this way were identified and simply counted as being present (Qualitative column).

Site: St. Joseph River - SR 15 (Bristol)
Date Collected: 08/17/2016 Site #: 1

Taxa Name	Quantitative	Qualitative	Tol
Hydra sp	3		F
Turbellaria	24	+	F
Nemertea	1		F
Oligochaeta	10		T
Caecidotea sp	0	+	T
Hyalella azteca	20	+	F
Orconectes sp	0	+	F
Baetis intercalaris	7	+	F
Labiobaetis propinquus	0	+	MI
Procloeon sp (w/ hindwing pads)	0	+	MI
Leucrocuta sp	0	+	MI
Stenacron sp	27	+	F
Maccaffertium mediopunctatum	4		MI
Maccaffertium terminatum	0	+	MI
Teloganopsis deficiens	1		I
Tricorythodes sp	10	+	MI
Caenis sp	1	+	F
Anthopotamus sp	0	+	MI
Hetaerina sp	0	+	F
Coenagrionidae	0	+	T
Argia sp	1	+	F
Anax sp	0	+	MT
Nasiaeschna pentacantha	0	+	MT
Pteronarcys sp	1	+	MI
Acroneuria abnormis	3		MI
Agnetina capitata complex	5	+	MI
Belostoma sp	0	+	T
Corydalus cornutus	1	+	MI
Neureclipsis sp	8		MI
Polycentropus sp	1		MI
Cheumatopsyche sp	4		F
Hydropsyche phalerata	10		MI
Hydroptila sp	17		F
Oxyethira sp	1		F
Brachycentrus numerosus	0	+	MI
Neophylax sp	0	+	MI
Pycnopsyche sp	0	+	MI
Helicopsyche borealis	5	+	MI
Dineutus sp	0	+	F
Gyrinus sp	0	+	F
Peltodytes sp	0	+	MT
Psephenus herricki	0	+	MI
Macronychus glabratus	7	+	F
Stenelmis sp	0	+	F
Ablabesmyia peleensis	0	+	
Larsia sp	1		MT
Nilotanypus fimbriatus	1		F
Pentaneura inconspicua	1		F
Cricotopus (C.) bicinctus	6		T
Cryptochironomus sp	1	+	F
Dicrotendipes neomodestus	2		F
Microtendipes "caelum"	1		MI
Polypedilum (Uresipedilum) flavum	25		F
Polypedilum (P.) illinoense	6	+	T
Polypedilum (P.) laetum group	1		MI
Stenochironomus sp	5		F
Rheotanytarsus sp	9		F
Elimia sp	2		MI
Physella sp	3		T
Ferrissia sp	6		F
Corbicula fluminea	0	+	F
Elliptio dilatata	0	+	MI

No. Quantitative Taxa:	39
No. Qualitative Taxa:	37
Total Taxa:	62
Number of Organisms:	242
Qual EPT:	15
ICI:	**38**

Site: St. Joseph River - Sherman Street

Date Collected: 08/11/2016 Site #: 4

Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	139	+	F
Oligochaeta	0	+	T
Placobdella ornata	0	+	MT
Caecidotea sp	0	+	T
Gammarus sp	1	+	F
Plauditus dubius or P. virilis	73	+	I
Baetis flavistriga	15		F
Baetis intercalaris	158		F
Iswaeon anoka	117	+	MI
Isonychia sp	368	+	MI
Leucrocuta sp	0	+	MI
Stenacron sp	151	+	F
Maccaffertium exiguum	103	+	MI
Maccaffertium mediopunctatum	154	+	MI
Maccaffertium terminatum	214	+	MI
Teloganopsis deficiens	266		I
Tricorythodes sp	555	+	MI
Caenis sp	8		F
Coenagrionidae	0	+	T
Argia sp	0	+	F
Corydalus cornutus	3		MI
Neuroptera	0	+	
Chimarra obscura	1		MI
Neureclipsis sp	1		MI
Polycentropus sp	1	+	MI
Cheumatopsyche sp	349	+	F
Ceratopsyche morosa group	39	+	MI
Hydropsyche aerata	14	+	MI
Hydropsyche phalerata	42	+	MI
Macrostemum zebratum	63	+	I
Hydroptila sp	166	+	F
Brachycentrus numerosus	1		MI
Neophylax sp	0	+	MI
Pycnopsyche sp	0	+	MI
Lepidostoma sp	0	+	MI
Helicopsyche borealis	0	+	MI
Nectopsyche exquisita	0	+	MI
Oecetis cinerascens	0	+	F
Oecetis persimilis	0	+	MI
Petrophila sp	35	+	MI
Dineutus sp	8		F
Psephenus herricki	0	+	MI
Macronychus glabratus	17	+	F
Stenelmis sp	0	+	F
Antocha sp	16		MI
Simulium sp	9	+	F
Hayesomyia senata or T. norena	6		F
Nilotanypus fimbriatus	3		F
Pentaneura inconspicua	15		F
Corynoneura floridaensis	16		MI
Cricotopus sp	12		F
Eukiefferiella sp	3		
Thienemanniella taurocapita	9		MI
Thienemanniella xena	24		F
Tvetenia discoloripes group	6		MI
Cryptochironomus sp	0	+	F
Dicrotendipes neomodestus	0	+	F
Dicrotendipes neomodestus	25		F
Microtendipes pedellus group	0	+	F
Polypedilum (Uresipedilum) flavum	150	+	F
Polypedilum (P.) fallax group	6		F
Stenochironomus sp	9		F
Rheotanytarsus sp	52		F
Hemerodromia sp	10	+	F
Elimia sp	2	+	MI
Physella sp	0	+	T
Corbicula fluminea	0	+	F
Dreissena polymorpha	0	+	F
Sphaerium sp	0	+	F

No. Quantitative Taxa:	46
No. Qualitative Taxa:	46
Total Taxa:	69
Number of Organisms:	3435
Qual EPT:	23
ICI:	**50**

Site: St. Joseph River - Capital Ave

Date Collected: 08/12/2016 Site #: 6

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Spongillidae	0	+	F	Oecetis persimilis	75		MI
Hydra sp	8		F	Petrophila sp	1		MI
Turbellaria	1446	+	F	Psephenus herricki	0	+	MI
Nemertea	8		F	Dubiraphia vittata group	0	+	F
Lophopodella carteri	1		MI	Macronychus glabratus	0	+	F
Oligochaeta	0	+	T	Stenelmis sp	0	+	F
Glossiphonia complanata	0	+	MT	Simulium sp	0	+	F
Helobdella papillata	3		MT	Ceratopogonidae	0	+	T
Caecidotea sp	0	+	T	Ablabesmyia rhamphe group	38		MT
Crangonyx sp	0	+	MT	Ablabesmyia peleensis	0	+	
Gammarus sp	93	+	F	Nilotanypus fimbriatus	8		F
Orconectes sp	0	+	F	Pentaneura inconspicua	10		F
Hydrachnidia	0	+	F	Cricotopus (C.) bicinctus	0	+	T
Baetis intercalaris	0	+	F	Nanocladius sp	0	+	F
Callibaetis sp	0	+	MT	N. (N.) crassicornus or N. (N.) "rectinervis"	19		F
Isonychia sp	38	+	MI	Thienemanniella xena	10		F
Stenacron sp	729	+	F	Dicrotendipes neomodestus	114	+	F
Maccaffertium exiguum	126	+	MI	Polypedilum (Uresipedilum) flavum	513	+	F
Maccaffertium mediopunctatum	7		MI	Polypedilum (P.) illinoense	0	+	T
Maccaffertium mexicanum in-	0	+	MI	Stictochironomus sp	38		F
Maccaffertium terminatum	60	+	MI	Tribelos jucundum	29		MT
Tricorythodes sp	77	+	MI	Paratanytarsus sp	0	+	F
Caenis sp	8	+	F	Rheotanytarsus sp	10	+	F
Coenagrionidae	0	+	T	Hemerodromia sp	8		F
Boyeria vinosa	0	+	F	Elimia sp	12	+	MI
Climacia sp	0	+	F	Physella sp	0	+	T
Chimarra obscura	0	+	MI	Corbicula fluminea	0	+	F
Cyrnellus fraternus	1		F	Pisidiidae	0	+	
Polycentropus sp	12	+	MI	Anodontoides ferussacianus	0	+	F
Cheumatopsyche sp	1131	+	F				
Hydropsyche aerata	1		MI	No. Quantitative Taxa:	35		
Hydropsyche bidens or H. orris	77		MI	No. Qualitative Taxa:	46		
Hydropsyche phalerata	6		MI	Total Taxa:	66		
Macrostemum zebratum	6	+	I	Number of Organisms:	4772		
Hydroptila sp	49		F	Qual EPT:	15		
Pycnopsyche sp	0	+	MI	**ICI:**	**48**		
Oecetis cinerascens	0	+	F				

Site: St. Joseph River - Michigan

Date Collected: 09/1/2016 Site #: 8

Taxa Name	Quantitative	Qualitative	Tol
Hydra sp	4		F
Turbellaria	132	+	F
Nemertea	4		F
Oligochaeta	20	+	T
Caecidotea sp	0	+	T
Gammarus sp	62	+	F
Hydrachnidia	0	+	F
Acerpenna sp	4		MI
Plauditus dubius or P. virilis	0	+	I
Baetis intercalaris	11	+	F
Iswaeon anoka	0	+	MI
Isonychia sp	0	+	MI
Stenacron sp	209	+	F
Maccaffertium exiguum	16		MI
Maccaffertium pulchellum	13	+	MI
Maccaffertium terminatum	7	+	MI
Teloganopsis deficiens	10	+	I
Tricorythodes sp	238	+	MI
Coenagrionidae	4		T
Argia sp	0	+	F
Gomphus sp	0	+	F
Cheumatopsyche sp	58	+	F
Hydropsyche phalerata	13	+	MI
Macrostemum zebratum	26		I
Hydroptilidae	2	+	F
Brachycentrus numerosus	1		MI
Pycnopsyche sp	0	+	MI
Lepidostoma sp	0	+	MI
Helicopsyche borealis	0	+	MI
Leptoceridae	4	+	
Oecetis avara	0	+	I
Petrophila sp	13		MI
Psephenus herricki	0	+	MI
Macronychus glabratus	80		F
Stenelmis sp	0	+	F
Simulium sp	0	+	F
Ablabesmyia rhamphe group	2		MT
Hayesomyia senata or T. norena	3		F
Chironominae	2		
Dicrotendipes neomodestus	3		F
Polypedilum (Uresipedilum) flavum	48	+	F
Polypedilum (P.) illinoense	1	+	T
Polypedilum scalaenum group	1		F
Stenochironomus sp	41		F
Rheotanytarsus sp	2		F
Stratiomyidae	0	+	
Hemerodromia sp	4		F
Elimia sp	32	+	MI
Physella sp	0	+	T
Ferrissia sp	4		F
Corbicula fluminea	0	+	F
Pisidiidae	0	+	

No. Quantitative Taxa:	34
No. Qualitative Taxa:	34
Total Taxa:	52
Number of Organisms:	1074
Qual EPT:	17
ICI:	**42**

Site: St. Joseph River - Pinhook (B)

Date Collected: 09/01/2016 Site #: 9

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	43	+	F	Macronychus glabratus	25	+	F
Oligochaeta	0	+	T	Stenelmis sp	5	+	F
Caecidotea sp	0	+	T	Simulium sp	8	+	F
Gammarus sp	11	+	F	Ablabesmyia peleensis	0	+	
Baetis tricaudatus	1		MI	Hayesomyia senata or T. norena	10		F
Baetis intercalaris	150	+	F	Procladius (Holotanypus) sp	0	+	MT
Iswaeon anoka	0	+	MI	Tvetenia discoloripes group	10		MI
Isonychia sp	26	+	MI	Chironomus sp	0	+	MT
Stenacron sp	9	+	F	Cryptochironomus sp	0	+	F
Maccaffertium exiguum	15		MI	Polypedilum flavum	110		F
M. mediopunctatum	9		MI	Stenochironomus sp	38		F
Maccaffertium terminatum	22	+	MI	Rheotanytarsus sp	36		F
Teloganopsis deficiens	40		I	Empididae	5		F
Tricorythodes sp	21	+	MI	Elimia sp	0	+	MI
Hetaerina sp	0	+	F	Physella sp	0	+	T
Coenagrionidae	0	+	T				
Argia sp	0	+	F				
Chimarra obscura	9		MI	No. Quantitative Taxa:	28		
Cheumatopsyche sp	35		F	No. Qualitative Taxa:	28		
Hydropsyche phalerata	354	+	MI	Total Taxa:	44		
Macrostemum zebratum	14		I	Number of Organisms:	1059		
Hydroptilidae	44		F	Qual EPT:	11		
Brachycentrus numerosus	3		MI	**ICI:**	**44**		
Neophylax sp	0	+	MI				
Pycnopsyche sp	0	+	MI				
Helicopsyche borealis	0	+	MI				
Oecetis sp	4	+	F				
Petrophila sp	2		MI				
Psephenus herricki	0	+	MI				

Site: Little Elkhart River CR 10

Date Collected: 08/12/2016 Site #: 11

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	3		F	Brillia flavifrons group	3		F
Oligochaeta	4	+	T	Corynoneura lobata	12		F
Caecidotea sp	0	+	T	Cricotopus (C.) bicinctus	3		T
Gammarus pseudolimnaeus	0	+	F	Parametriocnemus sp	3		F
Orconectes sp	0	+	F	Rheocricotopus robacki	49	+	F
Hydrachnidia	0	+	F	Thienemanniella xena	144		F
Baetis flavistriga	34	+	F	Tvetenia bavarica group	62	+	MI
Baetis intercalaris	12		F	Microtendipes "caelum"	3		MI
Leucrocuta sp	1		MI	Microtendipes pedellus group	3	+	F
Stenacron sp	2		F	P. albimanus or P. duplicatus	0	+	F
Maccaffertium exiguum	37		MI	Polypedilum (Uresipedilum) aviceps	10		MI
Maccaffertium vicarium	80	+	MI	Polypedilum (P.) fallax group	7		F
Tricorythodes sp	1		MI	Stictochironomus sp	0	+	F
Cheumatopsyche sp	160	+	F	Rheotanytarsus pellucidus	10		MI
Ceratopsyche morosa group	52	+	MI	Rheotanytarsus sp	59		F
Ceratopsyche sparna	46	+	F	Tanytarsus sp	3		F
Glossosoma sp	0	+	MI	Neoplasta sp	2		MI
Brachycentrus numerosus	19	+	MI	Elimia sp	5	+	MI
Neophylax sp	0	+	MI	Physella sp	0	+	T
Pycnopsyche sp	0	+	MI	Ferrissia sp	2		F
Anacaena sp	0	+	MT	Corbicula fluminea	0	+	F
Ancyronyx variegata	0	+	F				
Macronychus glabratus	21	+	F	No. Quantitative Taxa:	34		
Optioservus trivittatus	0	+	MI	No. Qualitative Taxa:	31		
Stenelmis sp	0	+	F	Total Taxa:	52		
Antocha sp	0	+	MI	Number of Organisms:	874		
Dixella sp	0	+	F	Qual EPT:	9		
Simulium sp	2	+	F	**ICI:**	**40**		
Conchapelopia sp	16		F				
Nilotanypus fimbriatus	4		F				
Prodiamesa olivacea	0	+	MT				

Site: Puterbaugh CR 8

Date Collected: 08/17/2016 Site #: 12

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	2		F	Helopelopia sp	36		F
Oligochaeta	16	+	T	Brillia flavifrons group	0	+	F
Helobdella stagnalis	2		T	Corynoneura sp	2		
Placobdella ornata	0	+	MT	Corynoneura lobata	2		F
Erpobdella punctata punc-	1		MT	Parametriocnemus sp	6		F
Erpobdella fervida	1	+	MT	Rheocricotopus (Psilocricotopus) robacki	3		F
Caecidotea sp	1		T	Tvetenia bavarica group	0	+	MI
Crangonyx sp	0	+	MT	Cryptochironomus sp	0	+	F
Gammarus pseudolimnaeus	0	+	F	Microtendipes "caelum"	16		MI
Baetis tricaudatus	0	+	MI	Microtendipes pedellus group	47		F
Baetis flavistriga	2		F	Microtendipes rydalensis	73		MI
Labiobaetis sp	0	+	MI	Paratendipes albimanus or P. dupli-catus	16		F
Stenacron sp	10	+	F	Polypedilum (Uresipedilum) aviceps	6	+	MI
Maccaffertium exiguum	5	+	MI	Polypedilum (P.) fallax group	16		F
Maccaffertium vicarium	64	+	MI	Polypedilum (P.) illinoense	0	+	T
Leptophlebia sp or P. sp	6		F	Polypedilum scalaenum group	0	+	F
Caenis sp	5	+	F	Micropsectra sp	3		MT
Calopteryx sp	0	+	F	Paratanytarsus sp	3		F
Boyeria vinosa	0	+	F	Rheotanytarsus pellucidus	13	+	MI
Belostoma sp	0	+	T	Rheotanytarsus sp	22		F
Sialis sp	1		MT	Stempellinella fimbriata	16		MI
Lype diversa	3		MI	Tanytarsus sepp	3		F
Polycentropus sp	9		MI	Chrysops sp	2		F
Cheumatopsyche sp	99		F	Hemerodromia sp	1		F
Hydropsyche depravata	8	+	F	Syrphidae	0	+	
Hydroptilidae	2		F	Ephydridae	0	+	F
Brachycentrus numerosus	26	+	MI	Elimia sp	30	+	MI
Neophylax sp	0	+	MI	Physella sp	0	+	T
Helicopsyche borealis	11	+	MI	Ferrissia sp	23		F
Nectopsyche sp	1		MI	Corbicula fluminea	0	+	F
Oecetis sp	4		F	Pisidium sp	5		MT
Macronychus glabratus	56	+	F				
Optioservus sp	15		MI	No. Quantitative Taxa:	48		
Stenelmis sp	4		F	No. Qualitative Taxa:	34		
Lampyridae	0	+	F	Total Taxa:	69		
Tipulidae	0	+		Number of Organisms:	719		
Simulium sp	0	+	F	Qual EPT:	10		
Conchapelopia sp	21		F	**ICI:**	**48**		

Site: Lily Creek Reckell Avenue

Date Collected: 08/11/2016 Site #: 16

Taxa Name	Quantitative	Qualitative	Tol
Hydra sp	11		F
Turbellaria	40	+	F
Oligochaeta	138		T
Helobdella stagnalis	0	+	T
Erpobdella punctata punctata	0	+	MT
Gammarus pseudolimnaeus	466	+	F
Baetis flavistriga	8		F
Notonecta sp	0	+	T
Hydroptila sp	5	+	F
Peltodytes sp	0	+	MT
Hydroporini	0	+	T
Laccophilus sp	0	+	T
Enochrus sp	0	+	MT
Tropisternus sp	0	+	T
Pilaria sp	0	+	F
Tipula sp	0	+	F
Ceratopogonidae	1		T
Conchapelopia sp	7		F
Prodiamesa olivacea	0	+	MT
Cricotopus (C.) tremulus group	149		MT
Parametriocnemus sp	20		F
Chironomus (C.) sp	27		MT
Dicrotendipes sp	7		F
Dicrotendipes fumidus	66	+	F
Dicrotendipes neomodestus	43		F
Microtendipes pedellus group	27		F
Phaenopsectra obediens group	7		F
Phaenopsectra flavipes	7		MT
Polypedilum sp	14		
Stictochironomus sp	0	+	F
Micropsectra sp	81		MT
Paratanytarsus sp	129		F
Tanytarsus sp	7		F
Tanytarsus glabrescens group sp 4	7		F
Tanytarsus glabrescens group sp 7	7		F
Stratiomys sp	0	+	MT
Neoplasta sp	3		MI
Limnophora sp	0	+	F
Ferrissia sp	3		F
Pisidiidae	0	+	

No. Quantitative Taxa:	25
No. Qualitative Taxa:	19
Total Taxa:	40
Number of Organisms:	1280
Qual EPT:	1
ICI:	**26**

Site: Christiana Creek CR 4

Date Collected: 08/18/2016 Site #: 17

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	12	+	F	Psephenus herricki	1	+	MI
Oligochaeta	1		T	Macronychus glabratus	8		F
Caecidotea sp	0	+	T	Optioservus sp	0	+	MI
Gammarus sp	34	+	F	Stenelmis sp	10	+	F
Hydrachnidia	0	+	F	Simulium sp	1	+	F
Baetis intercalaris	16		F	Ceratopogonidae	4		T
Labiobaetis propinquus	0	+	MI	Conchapelopia sp	5		F
Iswaeon anoka	2	+	MI	Hayesomyia senata or T. norena	6		F
Procloeon viridoculare	0	+	MI	Pentaneura inconspicua	20	+	F
Isonychia sp	1		MI	Cricotopus (C.) or Orthocladius (O.) sp	0	+	
Stenacron sp	79	+	F	Nanocladius sp	5		F
Maccaffertium exiguum	107	+	MI	Parametriocnemus sp	5		F
Maccaffertium mediopuncta-	90		MI	Thienemanniella xena	5		F
Maccaffertium terminatum	423		MI	Tvetenia discoloripes group	1		MI
Teloganopsis deficiens	17	+	I	Chironomus sp	1		MT
Tricorythodes sp	110	+	MI	Microtendipes "caelum"	1		MI
Caenis sp	0	+	F	Microtendipes pedellus group	1		F
Hetaerina sp	0	+	F	Polypedilum (Uresipedilum) flavum	86	+	F
Coenagrionidae	8		T	Polypedilum (P.) fallax group	2	+	F
Acroneuria abnormis	3	+	MI	Polypedilum scalaenum group	5		F
Sialis sp	0	+	MT	Tribelos jucundum	1	+	MT
Corydalus cornutus	5	+	MI	Tanytarsus sp	0	+	F
Chimarra obscura	1		MI	Tanytarsus sepp	2		F
Neureclipsis sp	7		MI	Stratiomyidae	2		
Nyctiophylax sp	4		MI	Hemerodromia sp	2		F
Polycentropus sp	2		MI	Cipangopaludina sp	0	+	MT
Cheumatopsyche sp	50		F	Elimia sp	1		MI
Ceratopsyche morosa group	0	+	MI	Physella sp	0	+	T
Ceratopsyche sparna	11		F	Gyraulus sp	0	+	MT
Hydropsyche sp	4			Planorbella (Pierosoma) pilsbryi	0	+	T
Hydropsyche frisoni	7		MI	Ferrissia sp	1		F
Hydropsyche phalerata	39	+	MI	Pisidiidae	0	+	
Hydroptila sp	15		F	No. Quantitative Taxa:	53		
Oxyethira sp	1		F	No. Qualitative Taxa:	38		
Helicopsyche borealis	5	+	MI	Total Taxa:	71		
Leptoceridae	0	+		Number of Organisms:	1248		
Nectopsyche diarina	7	+	MI	Qual EPT:	15		
Oecetis persimilis	11	+	MI	**ICI:**	**52**		
Dineutus sp	0	+	F				

Site: Elkhart River - Oxbow Park

Date Collected: 08/15/2016 Site #: 18

Taxa Name	Quantitative	Qualitative	Tol
Spongillidae	0	+	F
Turbellaria	46	+	F
Oligochaeta	0	+	T
Caecidotea sp	0	+	T
Gammarus sp	24	+	F
Orconectes sp	0	+	F
Hydrachnidia	1		F
Baetis flavistriga	97	+	F
Baetis intercalaris	2	+	F
Labiobaetis propinquus	0	+	MI
Iswaeon anoka	11	+	MI
Leucrocuta sp	12	+	MI
Stenacron sp	29	+	F
Maccaffertium exiguum	9		MI
Maccaffertium mediopuncta-	7	+	MI
Maccaffertium pulchellum	0	+	MI
Maccaffertium terminatum	18		MI
Tricorythodes sp	10	+	MI
Calopteryx sp	0	+	F
Hetaerina sp	0	+	F
Coenagrionidae	0	+	T
Argia sp	8	+	F
Pteronarcys sp	0	+	MI
Neoperla clymene complex	0	+	I
Agnetina capitata complex	2		MI
Psychomyia flavida	1		MI
Cheumatopsyche sp	100	+	F
Ceratopsyche morosa group	9	+	MI
Neophylax sp	0	+	MI
Pycnopsyche sp	0	+	MI
Leptoceridae	1		
Hydrophilidae	1		F
Psephenus herricki	0	+	MI
Dubiraphia bivittata	0	+	F
Macronychus glabratus	5	+	F
Optioservus sp	0	+	MI
Stenelmis sp	0	+	F
Conchapelopia sp	5		F
Hayesomyia senata or T. norena	3		F
Nilotanypus fimbriatus	7		F
Pentaneura inconspicua	3		F
Corynoneura lobata	83		F
Cricotopus (Isocladius) sylvestris group	0	+	T
Thienemanniella sp	4		
Tvetenia discoloripes group	3		MI
Cryptochironomus sp	0	+	F
Dicrotendipes neomodestus	35		F
Microtendipes pedellus group	22	+	F
Paratendipes albimanus or P. duplicatus	3	+	F
Polypedilum (Uresipedilum) flavum	105	+	F
Polypedilum (P.) fallax group	5	+	F
Polypedilum (P.) illinoense	3	+	T
Polypedilum scalaenum group	8	+	F
Stenochironomus sp	16		F
Rheotanytarsus pellucidus	3		MI
Rheotanytarsus sp	5	+	F
Tanytarsus sepp	5		F
Elimia sp	53	+	MI
Fossaria sp	0	+	MT
Physella sp	1	+	T
Planorbella (Pierosoma) pilsbryi	0	+	T
Ferrissia sp	2		F
Dreissena polymorpha	0	+	F
Pisidium sp	0	+	MT

No. Quantitative Taxa:	41
No. Qualitative Taxa:	45
Total Taxa:	64
Number of Organisms:	767
Qual EPT:	15
ICI:	**40**

Site: Elkhart River - Indiana Avenue

Date Collected: 09/01/2016 Site #: 19

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	89		F	Optioservus sp	0	+	MI
Oligochaeta	0	+	T	Stenelmis sp	0	+	F
Caecidotea sp	0	+	T	Antocha sp	0	+	MI
Gammarus sp	5	+	F	Ablabesmyia sp	0	+	
Hydrachnidia	0	+	F	Conchapelopia sp	1		F
Plauditus dubius or P. virilis	0	+	I	Hayesomyia senata or T. norena	1		F
Baetis flavistriga	306	+	F	Corynoneura lobata	39		F
Baetis intercalaris	147	+	F	Cricotopus (C.) bicinctus	8		T
Iswaeon anoka	19	+	MI	Cricotopus (C.) trifascia	3		F
Procloeon viridoculare	0	+	MI	Parametriocnemus sp	1		F
Isonychia sp	6	+	MI	Thienemanniella taurocapita	10	+	MI
Leucrocuta sp	8	+	MI	Tvetenia discoloripes group	56		MI
Stenacron sp	38	+	F	Chironomus sp	0	+	MT
Maccaffertium exiguum	59	+	MI	Cryptochironomus sp	0	+	F
Maccaffertium mediopuncta-tum	19	+	MI	Cryptotendipes sp	0	+	F
Maccaffertium terminatum	48	+	MI	Dicrotendipes neomodestus	5	+	F
Teloganopsis deficiens	33	+	I	Microtendipes pedellus group	0	+	F
Tricorythodes sp	17	+	MI	Phaenopsectra obediens group	0	+	F
Gomphidae	0	+	F	Polypedilum (Uresipedilum) flavum	23		F
Pteronarcys sp	5	+	MI	Polypedilum (P.) fallax group	5		F
Acroneuria abnormis	1	+	MI	Stenochironomus sp	16		F
Acroneuria carolinensis	0	+	MI	Rheotanytarsus pellucidus	8		MI
Acroneuria lycorias	1	+	I	Rheotanytarsus sp	24		F
Paragnetina sp	0	+	MI	Hemerodromia sp	3		F
Agnetina capitata complex	3		MI	Elimia sp	12	+	MI
Corixidae	0	+	F	Fossaria sp	0	+	MT
Corydalus cornutus	5		MI	Planorbella (Pierosoma) pilsbryi	0	+	T
Cheumatopsyche sp	16	+	F	Ferrissia sp	4		F
Ceratopsyche morosa group	52	+	MI	Corbicula fluminea	0	+	F
Ceratopsyche sparna	81	+	F	Pisidium sp	0	+	MT
Hydropsyche phalerata	1		MI	Sphaerium sp	0	+	F
Hydroptila sp	15		F	No. Quantitative Taxa:	42		
Brachycentrus numerosus	0	+	MI	No. Qualitative Taxa:	50		
Neophylax sp	0	+	MI	Total Taxa:	69		
Pycnopsyche sp	0	+	MI	Number of Organisms:	1230		
Lepidostoma sp	1	+	MI	Qual EPT:	25		
Dubiraphia vittata group	0	+	F	**ICI:**	**50**		
Macronychus glabratus	36	+	F				

Site: Elkhart River Middlebury Street

Date Collected: 08/11/2016 Site #: 20

Taxa Name	Quantitative	Qualitative	Tol
Spongillidae	0	+	F
Turbellaria	4	+	F
Nemertea	4		F
Oligochaeta	2	+	T
Helobdella stagnalis	0	+	T
Caecidotea sp	1	+	T
Gammarus sp	34	+	F
Orconectes sp	0	+	F
Hydrachnidia	0	+	F
Baetis flavistriga	152	+	F
Baetis intercalaris	67		F
Iswaeon anoka	13	+	MI
Isonychia sp	18	+	MI
Leucrocuta sp	0	+	MI
Stenacron sp	32	+	F
Maccaffertium exiguum	109	+	MI
Maccaffertium mediopunctatum	32	+	MI
Maccaffertium pulchellum	40		MI
Maccaffertium terminatum	29	+	MI
Teloganopsis deficiens	11	+	I
Tricorythodes sp	10	+	MI
Boyeria vinosa	0	+	F
Stylurus sp	0	+	MI
Pteronarcys sp	0	+	MI
Acroneuria carolinensis	1		MI
Paragnetina sp	1		MI
Neoplea sp	0	+	F
Sialis sp	0	+	MT
Corydalus cornutus	0	+	MI
Climacia sp	0	+	F
Lype diversa	3		MI
Polycentropus sp	2		MI
Cheumatopsyche sp	37	+	F
Ceratopsyche morosa group	17	+	MI
Ceratopsyche sparna	6	+	F
Hydroptila sp	5		F
Brachycentrus numerosus	2	+	MI
Neophylax sp	0	+	MI
Pycnopsyche sp	0	+	MI
Lepidostoma sp	0	+	MI
Liodessus sp	0	+	MT
Psephenus herricki	0	+	MI
Ancyronyx variegata	1		F
Dubiraphia bivittata	0	+	F
Macronychus glabratus	19	+	F
Optioservus sp	0	+	MI
Stenelmis sp	6	+	F
Simulium sp	0	+	F
Hayesomyia senata or T. norena	3		F
Nilotanypus fimbriatus	9		F
Pentaneura inconspicua	2		F
Corynoneura lobata	11		F
Parametriocnemus sp	3		F
Rheocricotopus (Psilocricotopus) robacki	2		F
Thienemanniella sp	22	+	
Tvetenia discoloripes group	0	+	MI
Dicrotendipes neomodestus	20		F
Microtendipes "caelum"	4	+	MI
Paratendipes albimanus or P. duplica-	0	+	F
Polypedilum (Uresipedilum) flavum	27	+	F
Polypedilum (P.) fallax group	7	+	F
Polypedilum (Tripodura) scalaenum	2		F
Rheotanytarsus sp	25		F
Tanytarsus glabrescens group sp 7	5		F
Hemerodromia sp	5		F
Elimia sp	39	+	MI
Corbicula fluminea	0	+	F
Dreissena polymorpha	0	+	F
Pisidium sp	0	+	MT

No. Quantitative Taxa:	44
No. Qualitative Taxa:	49
Total Taxa:	69
Number of Organisms:	844
Qual EPT:	18
ICI:	**50**

Site: Yellow Creek CR 32

Date Collected: 08/17/2016 Site #: 21

Taxa Name	Quantitative	Qualitative	Tol
Hydra sp	8		F
Turbellaria	144	+	F
Oligochaeta	58	+	T
Erpobdella punctata punctata	0	+	MT
Gammarus fasciatus	62		F
Orconectes sp	1		F
Hydrachnidia	0	+	F
Baetis tricaudatus	0	+	MI
Baetis flavistriga	0	+	F
Stenacron sp	110	+	F
Caenis sp	0	+	F
Calopteryx sp	17	+	F
Coenagrionidae	0	+	T
Argia sp	0	+	F
Cheumatopsyche sp	468	+	F
Hydropsyche depravata group	134	+	F
Hydroptilidae	2		F
Oecetis sp	1		F
Peltodytes sp	0	+	MT
Anacaena sp	0	+	MT
Helichus sp	1		F
Ancyronyx variegata	9	+	F
Dubiraphia vittata group	9	+	F
Macronychus glabratus	46	+	F
Stenelmis sp	9	+	F
Anopheles sp	0	+	F
Conchapelopia sp	61	+	F
Hayesomyia senata or T.norena	15		F
Procladius (Holotanypus) sp	0	+	MT
Corynoneura lobata	12		F
Cricotopus (C.) tremulus group	0	+	MT
Parametriocnemus sp	0	+	F
Rheocricotopus robacki	7		F
Thienemanniella xena	4		F
Chironomus (C.) sp	0	+	MT
Cryptochironomus sp	0	+	F
Cryptotendipes pseudotener	0	+	F
Dicrotendipes neomodestus	41	+	F
Microtendipes "caelum"	27	+	MI
Microtendipes pedellus group	155		F
Paratendipes albimanus or P. dupli-	7	+	F
Polypedilum (Uresipedilum) aviceps	7	+	MI
Polypedilum (Uresipedilum) flavum	128	+	F
Polypedilum (P.) fallax group	14		F
Polypedilum (P.) illinoense	0	+	T
Polypedilum (Tripodura) scalaenum	0	+	F
Saetheria tylus	0	+	F
Stictochironomus sp	0	+	F
Cladotanytarsus mancus group	0	+	F
Cladotanytarsus vanderwulpi group	0	+	MI
Paratanytarsus sp	47		F
Rheotanytarsus sp	196		F
Tanytarsus sp	14		F
Hemerodromia sp	11		F
Physella sp	0	+	T
Planorbidae	1		MT
Ferrissia sp	7		F
Sphaerium sp	0	+	F

No. Quantitative Taxa:	34
No. Qualitative Taxa:	40
Total Taxa:	58
Number of Organisms:	1833
Qual EPT:	6
ICI:	**38**

Site: Cobus Creek CR 8

Date Collected: 08/18/2016 Site #: 23

Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	0	+	F
Oligochaeta	3	+	T
Helobdella stagnalis	0	+	T
Caecidotea sp	21	+	T
Gammarus pseudolimnaeus	94	+	F
Hydrachnidia	2	+	F
Acerpenna pygmaea	2		MI
Baetis tricaudatus	10	+	MI
Baetis flavistriga	13	+	F
Labiobaetis propinquus	0	+	MI
Stenacron sp	128	+	F
Maccaffertium exiguum	62	+	MI
Maccaffertium pulchellum	3	+	MI
Maccaffertium vicarium	22	+	MI
Tricorythodes sp	0	+	MI
Calopteryx sp	0	+	F
Coenagrionidae	0	+	T
Lype diversa	8		MI
Polycentropus sp	4		MI
Cheumatopsyche sp	68	+	F
Ceratopsyche morosa group	0	+	MI
Hydropsyche depravata group	18		F
Brachycentrus numerosus	0	+	MI
Neophylax sp	0	+	MI
Pycnopsyche sp	0	+	MI
Helicopsyche borealis	3	+	MI
Oecetis sp	0	+	F
Laccobius sp	0	+	F
Macronychus glabratus	24	+	F
Optioservus trivittatus	2	+	MI
Stenelmis sp	0	+	F
Pilaria sp	0	+	F

Taxa Name	Quantitative	Qualitative	Tol
Dixella sp	0	+	F
Conchapelopia sp	3		F
Pagastia orthogonia	0	+	F
Corynoneura lobata	8		F
Parametriocnemus sp	3	+	F
Thienemanniella xena	16		F
Tvetenia bavarica group	2	+	MI
Dicrotendipes sp	1		F
Microtendipes "caelum"	5		MI
Paratendipes albimanus or P. duplica-	1		F
Polypedilum (Uresipedilum) aviceps	2		MI
Polypedilum (Uresipedilum) flavum	2		F
Polypedilum (P.) fallax group	5		F
Polypedilum (P.) illinoense	0	+	T
Stictochironomus sp	0	+	F
Cladotanytarsus vanderwulpi group	9	+	MI
Rheotanytarsus pellucidus	22	+	MI
Rheotanytarsus sp	43		F
Tanytarsus sp	1		F
Tanytarsus glabrescens group	2		F
Neoplasta sp	1		MI
Physella sp	0	+	T
Planorbella sp	1		T
Ferrissia sp	36		F
Corbicula fluminea	0	+	F

No. Quantitative Taxa:	37
No. Qualitative Taxa:	38
Total Taxa:	57
Number of Organisms:	650
Qual EPT:	15
ICI:	**52**

Site: Baugo Creek - CR 3 (N)
Date Collected: 08/12/2016 Site #: 32

Taxa Name	Quantitative	Qualitative	Tol
Hydra sp	12		F
Turbellaria	19	+	F
Erpobdella sp (= Mooreobdella)	0	+	MT
Caecidotea sp	0	+	T
Gammarus sp	1		F
Hydrachnidia	4		F
Baetis flavistriga	10	+	F
Leucrocuta sp	0	+	MI
Stenacron sp	7	+	F
Stenonema femoratum	1		F
Tricorythodes sp	0	+	MI
Caenis sp	1	+	F
Calopteryx sp	2	+	F
Argia sp	1	+	F
Cheumatopsyche sp	15	+	F
Ceratopsyche morosa group	26	+	MI
Hydropsyche depravata group	0	+	F
Hydroptila sp	18		F
Peltodytes sp	0	+	MT
Dubiraphia quadrinotata	0	+	F
Stenelmis sp	13	+	F
Antocha sp	8		MI
Tipula sp	0	+	F
Simulium sp	0	+	F
Ablabesmyia mallochi	135		F
Conchapelopia sp	80	+	F
Hayesomyia senata or T. norena	27		F
Meropelopia sp	27		F
Corynoneura lobata	16		F
Cricotopus (C.) bicinctus	0	+	T
Cricotopus (C.) tremulus group	0	+	MT
Cricotopus (C.) trifascia	0	+	F

Taxa Name	Quantitative	Qualitative	Tol
Cryptochironomus sp	22	+	F
Cryptotendipes sp	0	+	F
Dicrotendipes neomodestus	90	+	F
Microtendipes "caelum"	67		MI
Paratendipes albimanus or P. duplicatus	67	+	F
Polypedilum (Uresipedilum) aviceps	22		MI
Polypedilum (Uresipedilum) flavum	315	+	F
Polypedilum (P.) fallax group	67		F
Polypedilum (P.) illinoense	0	+	T
Polypedilum (Tripodura) scalaenum group	67	+	F
Stenochironomus sp	22		F
Stictochironomus sp	0	+	F
Cladotanytarsus mancus group	0	+	F
Paratanytarsus sp	135		F
Rheotanytarsus pellucidus	22		MI
Rheotanytarsus sp	22		F
Tanytarsus glabrescens group sp 7	427		F
Tanytarsus sepp	45		F
Hemerodromia sp	11		F
Elimia sp	1	+	MI
Physella sp	8		T
Helisoma anceps anceps	9		F
Ferrissia sp	12		F

No. Quantitative Taxa:	39
No. Qualitative Taxa:	32
Total Taxa:	55
Number of Organisms:	1854
Qual EPT:	8
ICI:	**38**

Site: Bowman Creek - Studebaker GC

Date Collected: 08/12/2016 Site #: 34

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Spongillidae	0	+	F	Procladius (Holotanypus) sp	0	+	MT
Hydra sp	16		F	Corynoneura lobata	48		F
Turbellaria	88	+	F	Cricotopus (C.) tremulus group	49		MT
Plumatella sp	1		F	Parametriocnemus sp	49		F
Oligochaeta	0	+	T	Microtendipes "caelum"	627	+	MI
Erpobdella punctata punctata	2	+	MT	Microtendipes pedellus group	183	+	F
Caecidotea sp	0	+	T	Paratendipes albimanus or P.	49	+	F
Gammarus fasciatus	1		F	Polypedilum (Uresipedilum) avi-	25		MI
Gammarus pseudolimnaeus	4	+	F	Polypedilum (Uresipedilum) fla-vum	932	+	F
Hydrachnidia	0	+	F	Polypedilum (P.) fallax group	25		F
Baetis flavistriga	44	+	F	Polypedilum (P.) illinoense	0	+	T
Stenacron sp	1	+	F	Paratanytarsus sp	74		F
Caenis sp	0	+	F	Rheotanytarsus sp	123		F
Corduliidae or Libellulidae	0	+		Tanytarsus sp	123	+	F
Cheumatopsyche sp	27		F	Tanytarsus glabrescens group sp	25		F
Hydropsyche depravata group	17	+	F	Tanytarsus sepp	49		F
Hydroptila sp	157		F	Stratiomys sp	0	+	MT
Oecetis sp	2		F	Hemerodromia sp	35		F
Peltodytes sp	0	+	MT	Physella sp	0	+	T
Tropisternus sp	0	+	T	Pisidiidae	1		
Macronychus glabratus	37	+	F	Pisidium sp	0	+	MT
Optioservus sp	2		MI	No. Quantitative Taxa:	34		
Stenelmis sp	49	+	F	No. Qualitative Taxa:	31		
Anopheles sp	0	+	F	Total Taxa:	49		
Ablabesmyia simpsoni	0	+	F	Number of Organisms:	3462		
Conchapelopia sp	62	+	F	Qual EPT:	49		
Helopelopia sp	527	+	F	**ICI:**	**34**		
Nilotanypus fimbriatus	8	+	F				

Site: Bowman Creek - St. Joseph River Mouth
Date Collected: 09/09/2016 Site #: 36

Taxa Name	Quantitative	Qualitative	Tol
Turbellaria		0+	F
Oligochaeta		0+	T
Erpobdella punctata punctata		0+	MT
Hyalella azteca		0+	F
Gammarus sp		0+	F
Baetis flavistriga		0+	F
Stenacron sp		0+	F
Calopteryx sp		0+	F
Coenagrionidae		0+	T
Cheumatopsyche sp		0+	F
Hydropsyche depravata group		0+	F
Peltodytes sp		0+	MT
Psephenus herricki		0+	MI
Dubiraphia vittata group		0+	F
Macronychus glabratus		0+	F
Optioservus sp		0+	MI
Stenelmis sp		0+	F
Ablabesmyia mallochi		0+	F
Conchapelopia sp		0+	F
Helopelopia sp		0+	F
Chironomus (C.) decorus group		0+	T
Polypedilum (Uresipedilum) flavum		0+	F
Polypedilum (P.) illinoense		0+	T
Stictochironomus sp		0+	F
Physella sp		0+	T
Ferrissia sp		0+	F

No. Quantitative Taxa:	0
No. Qualitative Taxa:	26
Total Taxa:	26
Number of Organisms:	0
Qual EPT:	4
ICI:	**Fair**

Site: Auten Ditch - Locust Road (South)

Date Collected: 09/09/2016 Site #: 37

Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	F	3	+
Oligochaeta	T	12	
Hirudinida	MT	0	+
Caecidotea sp	T	1	+
Gammarus sp	F	28	+
Orconectes sp	F	1	+
Baetis flavistriga	F	0	+
Hetaerina sp	F	1	+
Boyeria vinosa	F	0	+
Cheumatopsyche sp	F	0	+
Hydropsyche depravata group	F	0	+
Ironoquia sp	F	0	+
Dubiraphia sp	F	1	
Dubiraphia quadrinotata	F	0	+
Optioservus sp	MI	0	+
Stenelmis sp	F	0	+
Conchapelopia sp	F	14	
Natarsia sp	F	0	+
Corynoneura sp		4	
Parametriocnemus sp	F	0	+
Tvetenia discoloripes group	MI	0	+
Cryptochironomus sp	F	0	+
Dicrotendipes sp	F	14	
Microtendipes pedellus group	F	755	+
Paratendipes albimanus or P. duplicatus	F	41	
Phaenopsectra flavipes	MT	27	
Polypedilum (Uresipedilum) flavum	F	27	+
Polypedilum (P.) fallax group	F	41	
Polypedilum (Tripodura) scalaenum group	F	0	+
Paratanytarsus sp	F	288	
Hemerodromia sp	F	1	+
Physella sp	T	2	+
Planorbella (Pierosoma) trivolvis	MT	0	+
Ferrissia sp	F	22	
Pisidiidae		1	

No. Quantitative Taxa:	20
No. Qualitative Taxa:	24
Total Taxa:	35
Number of Organisms:	1284
Qual EPT:	4
ICI:	**18**

Site: Juday Creek - Holy Cross Parkway
Date Collected: 08/22/2016 Site #: 39

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	4	+	F	Prodiamesa olivacea	0	+	MT
Oligochaeta	20	+	T	Brillia flavifrons group	2		F
Gammarus pseudolimnaeus	9	+	F	Corynoneura lobata	6		F
Orconectes sp	0	+	F	Cricotopus (C.) bicinctus	2		T
Hydrachnidia	4	+	F	Cricotopus (C.) or Orthocladius (O.) sp	2		
Baetis tricaudatus	6	+	MI	Cricotopus (Isocladius) sylvestris group	2		T
Labiobaetis sp	0	+	MI	Parametriocnemus sp	2	+	F
Stenacron sp	1	+	F	Rheocricotopus (Psilocricotopus)	6		F
Maccaffertium sp	1		MI	Thienemanniella xena	16		F
Maccaffertium vicarium	0	+	MI	Tvetenia bavarica group	4		MI
Calopteryx sp	0	+	F	Microtendipes "caelum"	4		MI
Hetaerina sp	0	+	F	Microtendipes pedellus group	2		F
Coenagrionidae	0	+	T	Polypedilum (Uresipedilum) aviceps	16		MI
Boyeria vinosa	0	+	F	Polypedilum (Uresipedilum) flavum	4		F
Notonecta sp	0	+	T	Polypedilum (P.) illinoense	6	+	T
Cheumatopsyche sp	11	+	F	Polypedilum (Tripodura) scalaenum	2		F
Ceratopsyche sparna	2	+	F	Cladotanytarsus vanderwulpi group	2		
Hydropsyche depravata	13	+	F	Paratanytarsus sp	2		F
Brachycentrus numerosus	1	+	MI	Rheotanytarsus pellucidus	14		MI
Leptoceridae	0	+		Rheotanytarsus sp	54	+	F
Nectopsyche diarina	0	+	MI	Tanytarsus sp	2	+	F
Oecetis sp	1		F	Tanytarsus glabrescens group sp 7	2		F
Haliplus sp	0	+	MT	Physella sp	0	+	T
Dubiraphia quadrinotata	0	+	F	Pisidium sp	1		MT
Macronychus glabratus	0	+	F				
Simulium sp	4	+	F				
Conchapelopia sp	12		F				
Natarsia species A	2		T				
Pentaneura sp	2		F				
Pentaneura inconspicua	0	+	F				

No. Quantitative Taxa:	38
No. Qualitative Taxa:	31
Total Taxa:	54
Number of Organisms:	246
Qual EPT:	10
ICI:	**44**

Site: Juday Creek - Driftwood

Date Collected: 08/22/2016 Site #: 40

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Hydra sp	F	224		Thienemannimyia group	F	457	
Turbellaria	F	1383	+	Pagastia orthogonia	F	457	+
Nemertea	F	33		Cricotopus (C.) bicinctus	T	0	+
Oligochaeta	T	224	+	Parametriocnemus sp	F	914	
Erpobdella sp (= Mooreobdella)	MT	0	+	Rheocricotopus robacki	F	152	
Gammarus pseudolimnaeus	F	284	+	Tvetenia bavarica group	MI	152	
Hydrachnidia	F	64		Endochironomus nigricans	MT	152	
Hydrachnidia	F	0	+	Phaenopsectra obediens group	F	152	+
Baetis tricaudatus	MI	0	+	Polypedilum (Uresipedilum) aviceps	MI	152	
Stenacron sp	F	0	+	Polypedilum (Uresipedilum) flavum	F	1828	+
Caenis sp	F	65	+	Polypedilum (P.) illinoense	T	0	+
Calopterygidae	F	0	+	Rheotanytarsus sp	F	10968	+
Boyeria vinosa	F	0	+	Hemerodromia sp	F	32	
Lype diversa	MI	17		Physella sp	T	0	+
Cheumatopsyche sp	F	313	+	Corbicula fluminea	F	10	+
Ceratopsyche morosa group	MI	136	+	Pisidiidae		1	
Hydropsyche depravata group	F	1385		Pisidium sp	MT	1	
Nectopsyche diarina	MI	0	+	No. Quantitative Taxa:	27		
Macronychus glabratus	F	1		No. Qualitative Taxa:	24		
Tipula sp	F	0	+	Total Taxa:	40		
Tipula abdominalis	F	1		Number of Organisms:	19558		
Conchapelopia sp	F	0	+	Qual EPT:	6		
Pentaneura inconspicua	F	0	+	**ICI:**	**38**		

Site: Juday Creek - SR 23

Date Collected: 08/22/2016 Site #: 41

Taxa Name	Quantitative	Qualitative	Tol	Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	0	+	F	Microtendipes pedellus group	0	+	F
Oligochaeta	0	+	T	Polypedilum (Uresipedilum) fla-	0	+	F
Gammarus pseudolimnaeus	0	+	F	Polypedilum (P.) illinoense	0	+	T
Hydrachnidia	0	+	F	Polypedilum (Tripodura)	0	+	F
Baetis tricaudatus	0	+	MI	Cladotanytarsus vanderwulpi	0	+	MI
Baetis intercalaris	0	+	F	Rheotanytarsus pellucidus	0	+	MI
Stenacron sp	0	+	F	Rheotanytarsus sp	0	+	F
Maccaffertium vicarium	0	+	MI	Physella sp	0	+	T
Tricorythodes sp	0	+	MI	Helisoma anceps anceps	0	+	F
Hexagenia sp	0	+	F	Corbicula fluminea	0	+	F
Aeshna sp	0	+	MT				
Boyeria vinosa	0	+	F				
Cheumatopsyche sp	0	+	F	No. Quantitative Taxa:	0		
Ceratopsyche morosa group	0	+	MI	No. Qualitative Taxa:	33		
Ceratopsyche sparna	0	+	F	Total Taxa:	0		
Hydropsyche depravata group	0	+	F	Number of Organisms:	33		
Brachycentrus numerosus	0	+	MI	Qual EPT:	11		
Dubiraphia vittata group	0	+	F	**ICI:**	**Good**		
Macronychus glabratus	0	+	F				
Procladius (Holotanypus) sp	0	+	MT				
Corynoneura lobata	0	+	F				
Cricotopus (C.) bicinctus	0	+	T				
Rheocricotopus (Psilocricotopus)	0	+	F				

Site: Juday Creek - St. Joseph River Mouth

Date Collected: 09/07/2016 Site #: 43

Taxa Name	Quantitative	Qualitative	Tol
Turbellaria	F	0	+
Oligochaeta	T	0	+
Caecidotea sp	T	0	+
Gammarus sp	F	0	+
Orconectes sp	F	0	+
Baetis tricaudatus	MI	0	+
Baetis flavistriga	F	0	+
Stenacron sp	F	0	+
Maccaffertium vicarium	MI	0	+
Tricorythodes sp	MI	0	+
Ephemera sp	MI	0	+
Calopteryx sp	F	0	+
Boyeria vinosa	F	0	+
Chimarra obscura	MI	0	+
Ceratopsyche sparna	F	0	+
Brachycentrus numerosus	MI	0	+
Pycnopsyche sp	MI	0	+
Nectopsyche diarina	MI	0	+
Macronychus glabratus	F	0	+
Optioservus sp	MI	0	+
Stenelmis sp	F	0	+
Tipulidae		0	+
Simulium sp	F	0	+
Pagastia sp	F	0	+
Cricotopus (C.) bicinctus	T	0	+
Parametriocnemus sp	F	0	+
Polypedilum (Uresipedilum) flavum	F	0	+
Physella sp	T	0	+

No. Quantitative Taxa:	0
No. Qualitative Taxa:	28
Total Taxa:	28
Number of Organisms:	0
Qual EPT:	11
ICI:	**Good**

Appendix F

Aerial Site Location Maps

Site #1: St. Joseph River SR 15 (Bristol)

Site #2: St. Joseph River Homan Avenue

Site #3: St. Joseph River Sherman Street

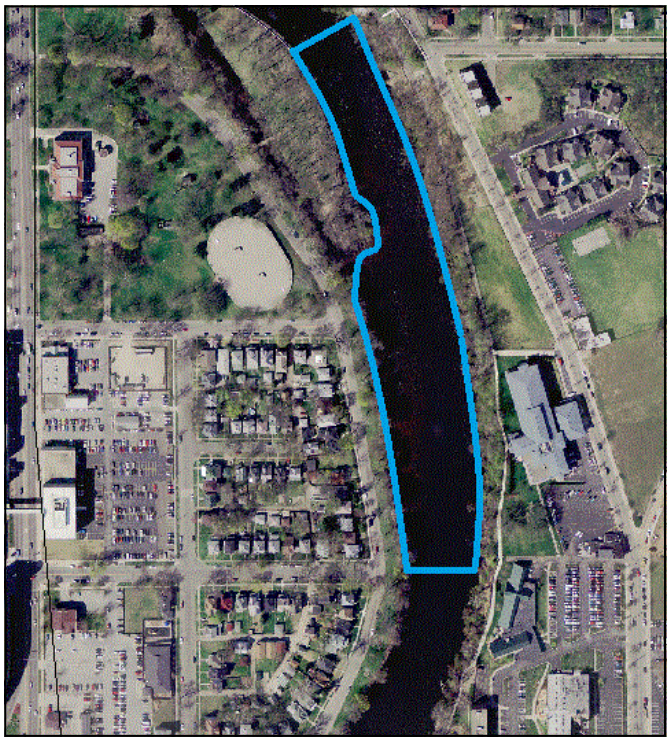
Site #4: St. Joseph River Island Park

Site #5: St. Joseph River Nappanee Street

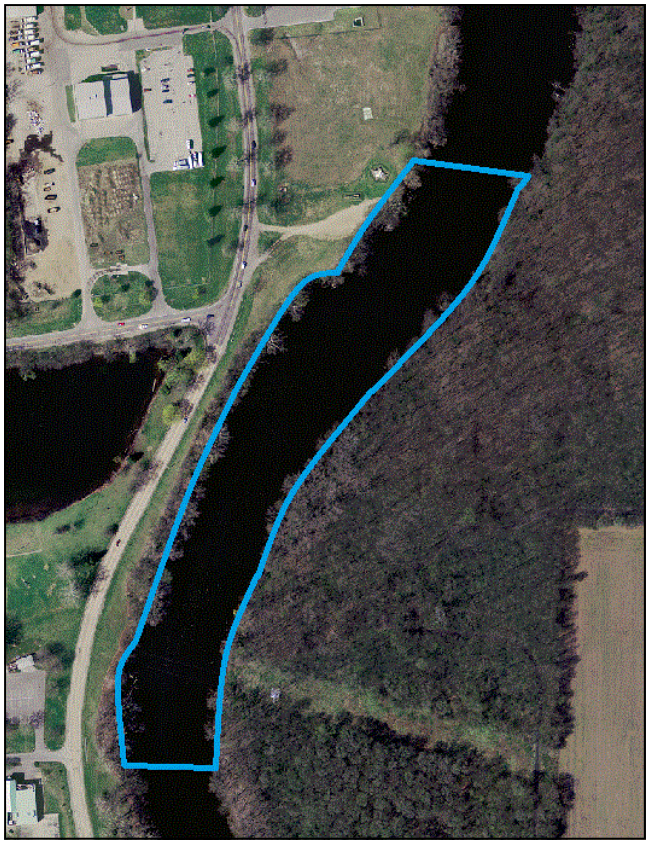
Site #6: St. Joseph River Capital Avenue

Site #7: St. Joseph River Louise Street

Site #8: St. Joseph River Michigan Street



Site #9: St. Joseph River Pinhook Park



Site #10: St. Joseph River Pinhook Park (B)

Site #11: Little Elkhart River CR 10

Site #12: Puterbaugh Creek CR 8

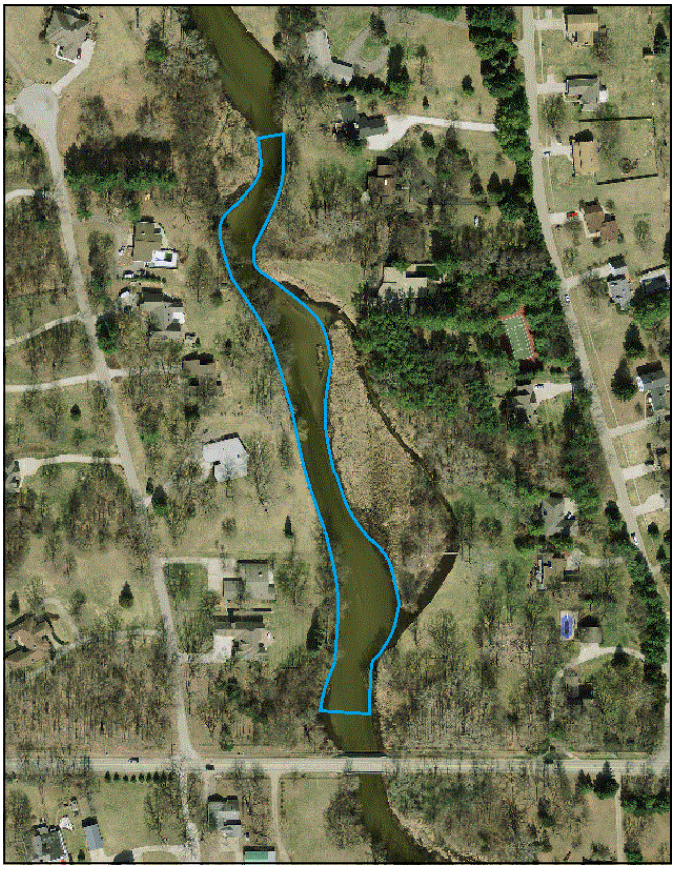
Site #13: Puterbaugh Creek Jeanwood Drive (CR 13)

Site #13: Christiana Creek CR4

Site #14: Puterbaugh Creek CR 4

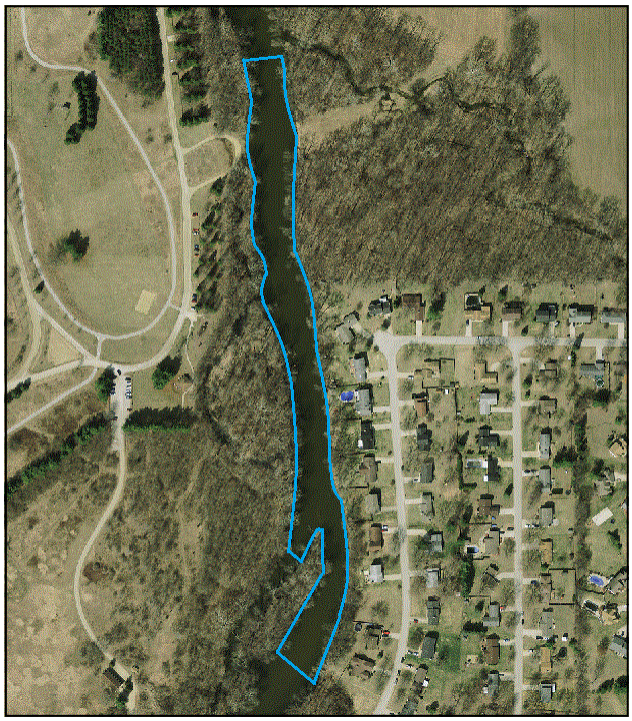
Site #15: Lily Creek CR 4

Site #16: Lily Creek Reckell Ave



Site #17: Christiana Creek CR 4

Site #18: Elkhart River Oxbow Park



Site #19: Elkhart River Indiana Avenue

Site #20: Elkhart River Middlebury Street

Site #21: Yellow Creek CR 32

Site #22: Cobus Creek CR 12

Site #23: Cobus Creek CR 8

Site #24: Cobus Creek CR 2

Site #25: Cobus Redfield Road

Site #26: Cobus Creek May St.

Site #27: Cobus Creek US of Coberts

Site #28: Gast Ditch Douglas Road

Site #29: Gast Ditch Adams Road

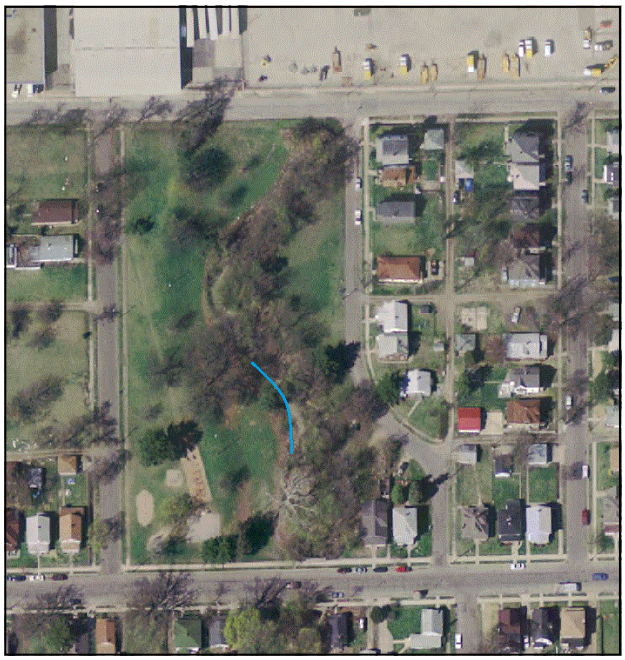
Site #30: Gast Ditch Redfield Road

Site #31: Cobus East Lateral A CR 6

Site #32: Baugo Creek CR 3 (N)

Site #34: Bowman Creek Studebaker Golf Couse Macroinvertebrate Sampler Location

Site #33: Baugo Creek CR 1 (S)



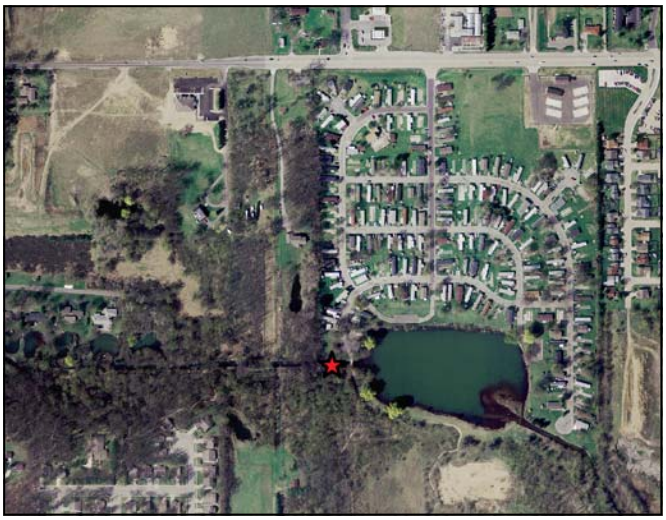
Site #35: Bowman Creek, Ravina Park

Site #36: Bowman Creek, St. Joseph River Mouth

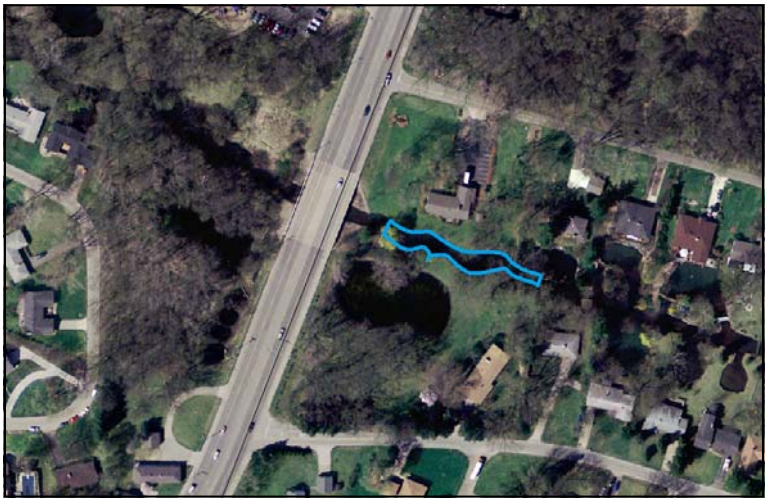
Site #37: Auten Ditch Locust Road South
Macroinvertebrate Sampler Location

Site #38: Juday Creek Douglas Road

Site #39: Juday Creek Holy Cross Pkwy
Macroinvertebrate Sampler Location



Site #40: Juday Creek Driftwood
Macroinvertebrate Sampler Location



Site # 41: Juday Creek SR23

Site # 42: Juday Creek—Juday Lake

Site # 43: Juday Creek SJR Mouth