Elkhart-South Bend Aquatic Community Monitoring

Annual Report
2013

City of Elkhart
Public Works and Utilities
Dick Moore, Mayor

Clean river Healthy neighborhoods

ELKHART ▪ SOUTH BEND

Cover Photo: Tyler Brenneman with an Elkhart River Greater Redhorse

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Nathan with a nice St. Joseph River crappie

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April, 2014

INTRODUCTION

For many years, the Cities of South Bend and Elkhart have collected surface water samples from our local rivers to determine pollutant concentrations. In 1998, the City of Elkhart initiated biological community monitoring to compliment chemical and microbial sampling. 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. Despite the drought conditions encountered during the summer of 2012, biological communities survived and were very strong in 2013. Adult fish were big and there was an abundance of juvenile fish collected during the 2013 season. Oxygen levels did sag to a certain degree during the summer of 2012, but waterways were stable and agricultural and urban runoff was minimal due to the lack of rain. These conditions were undoubtedly a major factor in the strong fish communities observed in 2013 illustrating the significance of run-off and non-point source pollution in the watershed.

In 2013, the Cities of Elkhart and South Bend, through the City of Elkhart's Aquatics Program, continued to monitor local fish populations in area rivers and streams. The information that was 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 past or long-term disturbance. 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). This year (2013) was the 7th year that the initial sites had been sampled since the baseline period, providing the stakeholders of South Bend with data to determine whether water quality in their area is improving or diminishing.

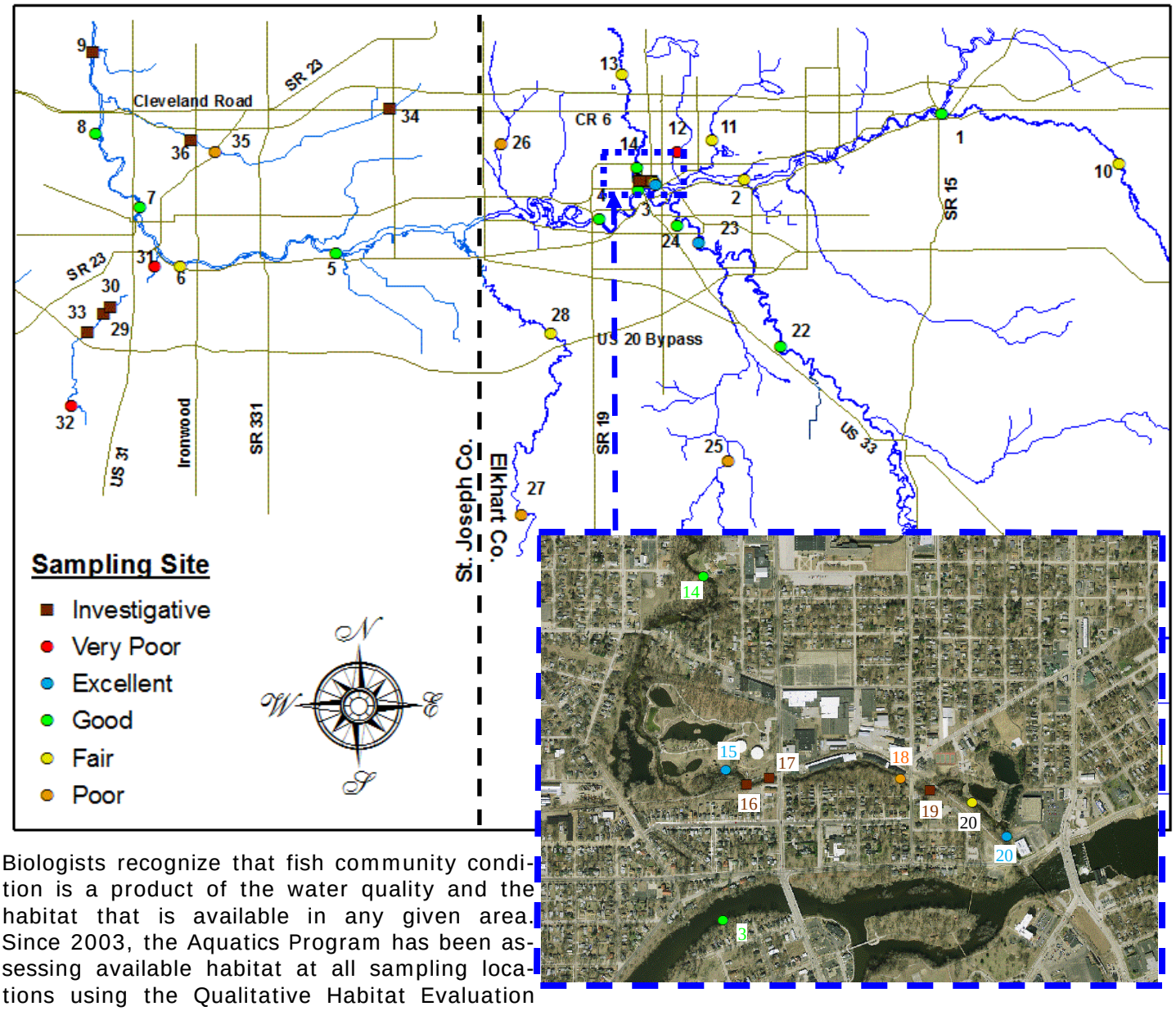
The Aquatics Program consists of more than just traversing through local streams collecting fish data. A considerable portion of the Program is education. The biologist travels to local schools and watershed stakeholder group meetings, giving presentations and demonstrations, in an effort to increase awareness about the health of our local streams.

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 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.

Figure 1. An MBI biologist gauges flow at a Hester-Dendy Sampler Location on the Elkhart River

Figure 2: Fish sampling sites in Elkhart and St. Joseph Counties and associated fish community conditions for 2013



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 (Figure 1) (MBI, Columbus, Ohio), the Aquatics Program is also monitoring benthic (bottom dwelling) macroinvertebrates (visible animals without backbones). Fourteen sites were sampled in 2013 and results were compared to their respective baseline values. 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 scores range from 0 to 60 and are classified similar to IBI scores. This combination of fish, habitat, macroinvertebrate, and chemical monitoring

Table 1: Fish sampling sites and Index Scores in Elkhart and St. Joseph Counties, 2013

Stream	Site	Site Number	Type of Site	County	Method	IBI Scores 2013	ICI Scores 2013	QHEI Scores 2013
St. Joseph River	State Road 15 (Bristol)	1	Index	Elkhart	Boat	54	48	81
	Homan Avenue	2	Index	Elkhart	Boat	44		57
	Sherman Street	3	Index	Elkhart	Boat	54	50	83
	Nappanee Street	4	Index	Elkhart	Boat	49		64
	Capital Avenue	5	Index	St. Joseph	Boat	50	46	60
	Sample Street	6	Index	St. Joseph	Boat	40		59
	Michigan Street	7	Index	St. Joseph	Boat	51	48	87
	Pinhook Park (Below)	8	Index	St. Joseph	Boat	54	44	81
	Auten Road	9	Investigative	St. Joseph	Boat			82
Little Elkhart River*	County Road 10	10	Index	Elkhart	Tote Barge	43	56	80
Puterbaugh Creek*	County Road 8	11	Index	Elkhart	Tote Barge	40	54	74
Lily Creek	Reckell Avenue	12	Index	Elkhart	Back Pack	19		37
Christiana Creek	County Road 4	13	Index	Elkhart	Tote Barge	46	46	80
	Willowdale Park	14	Index	Elkhart	Tote Barge	50		79
	North Main Well Field	15	Index	Elkhart	Tote Barge	55		81
	Wellfield Below	16	Investigative	Elkhart	Tote Barge			74
	Main Street Above	17	Investigative	Elkhart	Tote Barge			69
	Cassopolis (Above)	18	Index	Elkhart	Tote Barge	26		75
	Cassopolis (Below)	19	Investigative	Elkhart	Tote Barge			77
	High Dive Park (Above)	20	Index	Elkhart	Tote Barge	45		76
	High Dive Park (Below)	21	Index	Elkhart	Tote Barge	56	*VG*	77
Elkhart River	Oxbow Park	22	Index	Elkhart	Boat	53	54	82
	Indiana Avenue	23	Index	Elkhart	Boat	56		82
	Middlebury Street	24	Index	Elkhart	Boat	47	54	83
Yellow Creek	County Road 32	25	Index	Elkhart	Tote Barge	33		61
Cobus Creek*	County Road 8	26	Index	Elkhart	Tote Barge	30 (32)	*VG*	73

*** denotes a cool/cold water stream**
Underlined values are indicative of stream impairment
***VG* denotes a Very Good Qualitative Macroinvertebrate Score**
Coolwater scores are in (parenthesis)

Table 1: Fish sampling sites and Index Scores in Elkhart and St. Joseph Counties, 2013 (continued)

Stream	Site	Site Number	Type of Site	County	Method	IBI Scores 2013	ICI Scores 2013	QHEI Scores 2013
Baugo Creek	County Road 1 (S)	27	Index	Elkhart	Tote Barge	29		71
	County Road 3 (N)	28	Index	Elkhart	Tote Barge	40	34	90
Bowman Creek	AM General (South)	29	Investigative	St. Joseph	Tote Barge			55
	AM General (North)	30	Investigative	St. Joseph	Tote Barge			71
	Ravina Park	31	Index	St. Joseph	Tote Barge	0		40
Auten Ditch	Locust Road (S)	32	Index	St. Joseph	Tote Barge	14		40
Auten Ditch	Gertrude	33	Investigative	St. Joseph	Tote Barge			51
Juday Creek*	Bittersweet Road	34	Investigative	St. Joseph	Tote Barge			30
	State Road 23	35	Index	St. Joseph	Back Pack	36	48	65
	Warren Golf Course	36	Investigative	St. Joseph	Tote Barge			60

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 2010). 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. 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 4 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 16 years, the Aquatics staff has used 2 collection protocols (investigative sampling and index sampling) to quickly catalog the major fish species and to quantify water 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 are weighed and measured individually, while non-game fish are mass weighed.

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.

In 2013, 7 index and 6 investigative sites were sampled in St. Joseph County and 18 index and 3 investigative sites were sampled in Elkhart County. Two index sites on Baugo Creek were located right on the Elkhart/St. Joseph County border. (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 (Table 1).

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

Figure 3: Hester-Dendy sampler placed into the stream bed.

Table 2: Macroinvertebrate Sampling Sites, 2013

Site Number	Stream	Location	Site Number	Stream	Location
1	St. Joseph River	SR 15 (Bristol).	8	Christiana Creek	CR 4
2	St. Joseph River	Sherman Street	9	Christiana Creek	High Dive Park (B)
3	St. Joseph River	Capital Ave.	10	Elkhart River	Oxbow Park
4	St. Joseph River	Michigan Street	11	Elkhart River	Middlebury Street
5	St. Joseph River	Pinhook (B)	12	Cobus Creek	CR 8
6	Little Elkhart River	County Road 10	13	Baugo Creek	CR 3 (N)
7	Puterbaugh Creek	CR 8	14	Juday Creek	SR 23

Figure 4: Location of macroinvertebrate sampling sites for 2013

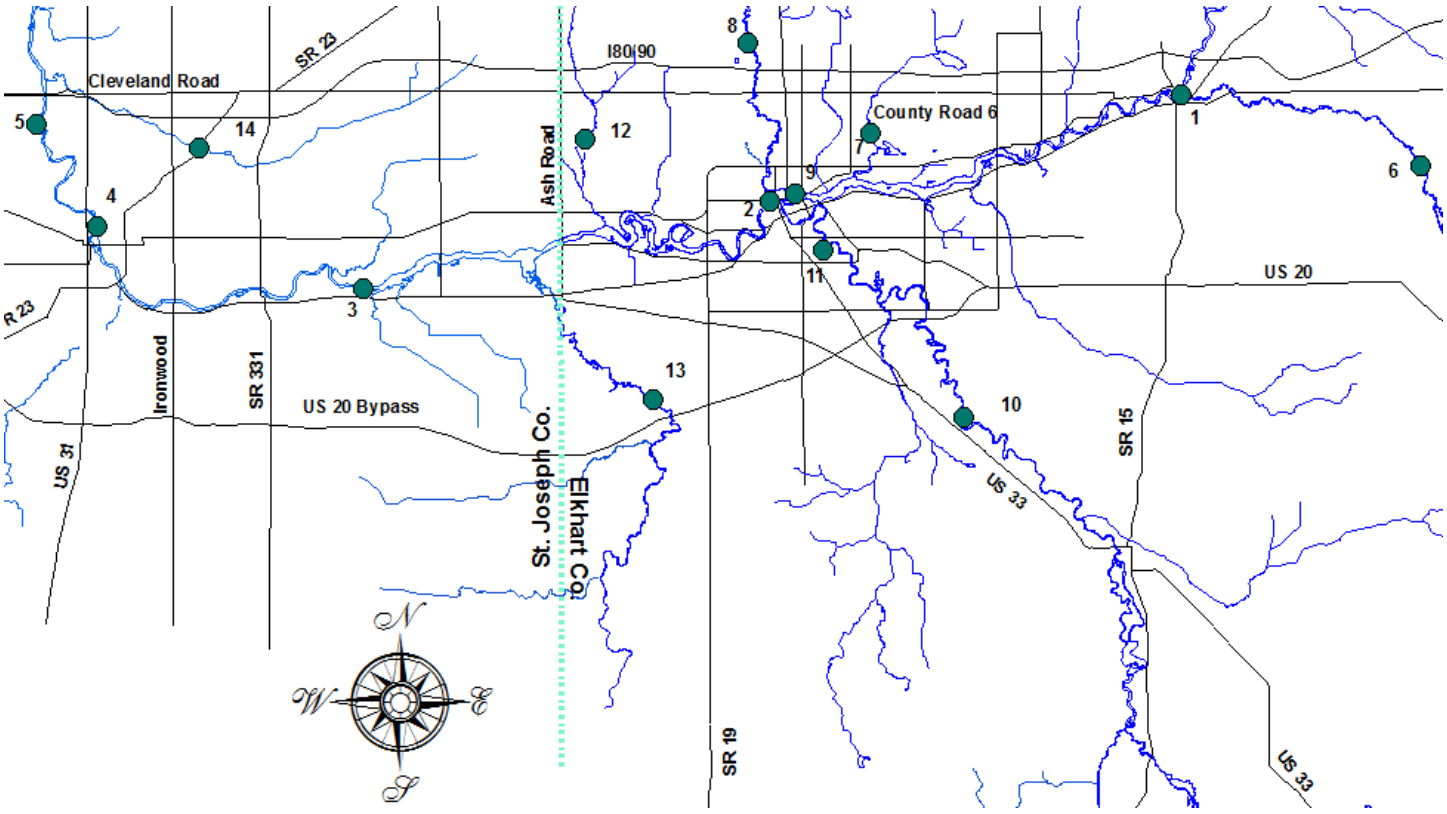
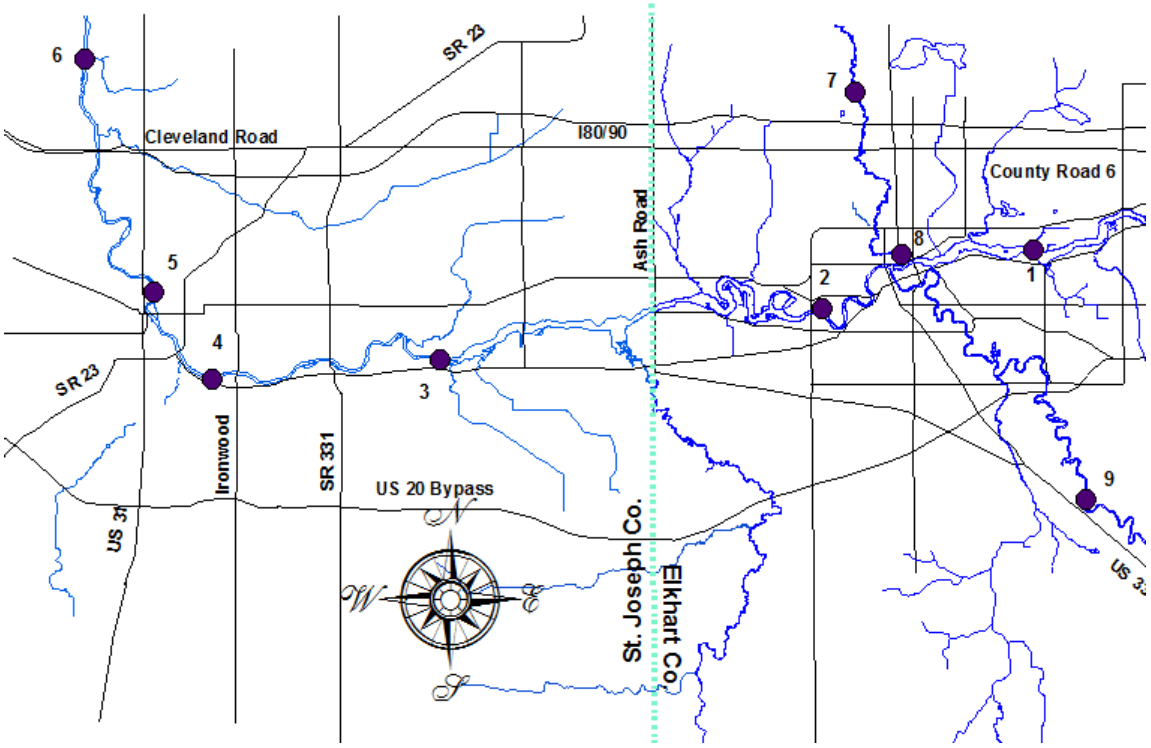


Figure 5: Location of fish tissue collection sites for 2013



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 2013, MBI personnel placed Hester-Dendy samplers (artificial substrates used to collect small aquatic organisms) (Figure 3) at 14 sites that were also sampled for fish (Table 2 and Figure 4) following Ohio EPA macroinvertebrate sampling procedures (Ohio EPA 1987, 1989). All 14 samplers were successfully retrieved approximately 7 weeks after being set and their contents were preserved in alcohol for later identification. 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.

Table 3: Location of fish tissue collection sites for 2013

Site Number	Stream	Location
1	St. Joseph River	Homan Avenue
2	St. Joseph River	Nappanee Street
3	St. Joseph River	Capital Avenue
4	St. Joseph River	Sample Street
5	St. Joseph River	Michigan Street
6	St. Joseph River	Auten Road
7	Christiana Creek	County Road 4
8	Christiana Creek	High Dive Below
9	Elkhart River	Oxbow

Fish tissue in the form of skin-on fillets was collected from smallmouth bass (*Micropterus dolomieu*), golden redhorse (*Moxostoma erythrurum*) walleye (*Sander vitreus),* and northern pike *(Esox Lucius).* Table 3 and Figure 5 display the locations of tissue sample collection. 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 previous sampling results.

Results and Discussion

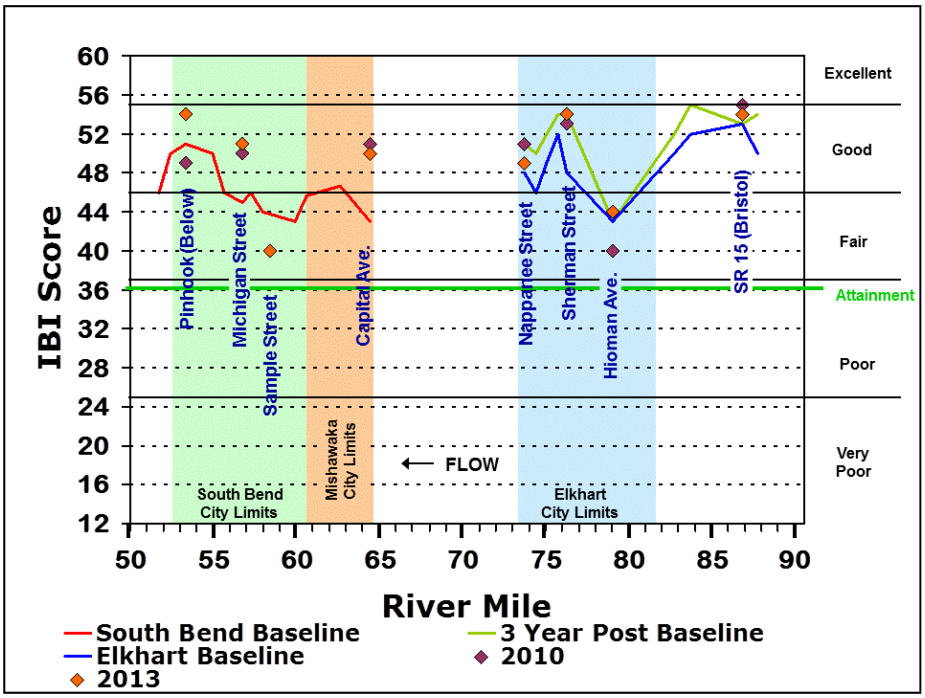
During the summer of 2013, a total of 21,014 fish, representing 15 families and 70 species, were collected in Elkhart County. The 2 sites along Baugo Creek accounted for 3,530 of the fish that were collected, most of which were small minnow species. In St. Joseph County, 6,231 fish, representing 14 families and 53 species were collected. In total, 71 different species were captured from the 2 counties. White suckers (*Catostomus commersonii*), bluegill (*Lepomis macrochirus*), and rock bass (*Ambloplites rupterus*) were the most abundant species collected in Elkhart County, while longear sunfish (*Lepomis megalotis*), rock bass, and smallmouth bass (*Micropterus dolomieu*) were the most abundant in St. Joseph County. See Appendix C for more detailed information.

Indices

Fish community conditions at the index sites ranged from very poor (0) at Ravina Park on Bowman Creek to excellent (56) at High Dive Park (B) on Christiana Creek. Macroinvertebrate community scores ranged from marginally good (34) at CR 3 (N) on Baugo Creek to exceptional (56) at CR 10 on the Little Elkhart River. Habitat quality ranged from very poor (30) at Bittersweet Road on Juday Creek to excellent (90) at CR 3 (N) on Baugo Creek.

Since the completion of baseline monitoring, fish IBI scores have been obtained 3 times over a period of 10 years at most index sites in Elkhart County. IBI scores can be influenced by natural conditions such as flooding or drought events and sometimes it can be difficult to determine whether stream quality is improving or diminishing because of natural variability. By averaging IBI scores from the last 3 monitoring events, variability can be reduced to give a good overall picture of stream health since the completion of baseline sampling. In this report we will present a comparison between baseline and post-baseline average IBI scores for most streams in Elkhart County.

Figure 6: IBI scores for the St. Joseph River, Elkhart and St. Joseph Counties



St. Joseph River

The longitudinal trends in fish community condition for the entire Indiana portion of the St. Joseph River are displayed in Figure 6. Fish, macroinvertebrate, and habitat index scores are presented in Table 4.

The Elkhart County portion of the river continues to support fair to excellent fish communities. IBI scores remained at or above initial baseline values at all sites. Post baseline average IBI scores suggest that fish community conditions have slightly improved since the inception of monitoring in 1998. Macroinvertebrate community assessments were performed at SR 15 in Bristol and at Sherman Street in Elkhart. The ICI scores for both sites were up significantly from baseline scores and both fell in the exceptional range. The Homan Avenue site is the only location that has not improved since initial baseline monitoring. This location continues to have the lowest IBI scores of all St. Joseph River sites in Elkhart County. It is located within the Johnson Street Dam impoundment where shallow riffles and swift current are absent. Limitations on the fish community at this site are more related to poor habitat than water quality, which is clearly reflected by this site's low habitat (QHEI) score of 57.

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

Station	County	River Mile	Fish IBI Scores				2013 Habitat Scores	(ICI) Macroinvertebrate Scores	
			Baseline	2007	2010	**2013**		Baseline/ Previous Score	**2013**
SR 15 (Bristol)	Elkhart	86.8	53	55	55	**54**	81	42	**48**
Homan Avenue	Elkhart	79	43	46	40	**44**	57		
Sherman Street	Elkhart	76.2	48	55	53	**54**	83	44	**50**
Nappanee Street	Elkhart	73.7	48	51	51	**49**	64		
Capital Avenue	St. Joseph	64.4	43	47	51	**50**	60	54	**46**
Sample Street	St. Joseph	58.4				**40**	59		
Michigan Street	St. Joseph	56.7	45	45	50	**51**	87	41	**48**
Pinhook (Below)	St. Joseph	53.3	51	46	49	**54**	81	46	**44**

In St. Joseph County, IBI scores were either 50 or above at all sites with the exception of Sample Street. Capital Avenue, Michigan Street, and Pinhook (B) all scored well above their respective baseline values. Although drought conditions in 2012 resulted in high water temperatures and relatively low dissolved oxygen concentrations (Deegan, 2013), there were very few storm events causing fluctuations in river velocity and pollutant input. River stability in 2012 appears to have greatly benefited the St. Joseph River as many juvenile fish were collected in 2013 indicating strong survival of fish hatched in 2012. In addition to the benefit to young fish, many healthy, large adult game species were collected in 2013 suggesting good growing conditions in 2012. Macroinvertebrates were sampled at Capital Avenue, Michigan Street, and Pinhook (B) in 2013. The ICI score at Pinhook (B) was slightly lower than when this site was previously sampled in 2010. Similar to the fish IBI score, the ICI score at Michigan Street was up significantly from the baseline value. The Michigan Street site also has excellent instream habitat that helps support its diverse communities of aquatic organisms. The ICI score at Capital Avenue dropped significantly since the last time it was sampled in 2010, although the score of 46 still falls into the very good range.

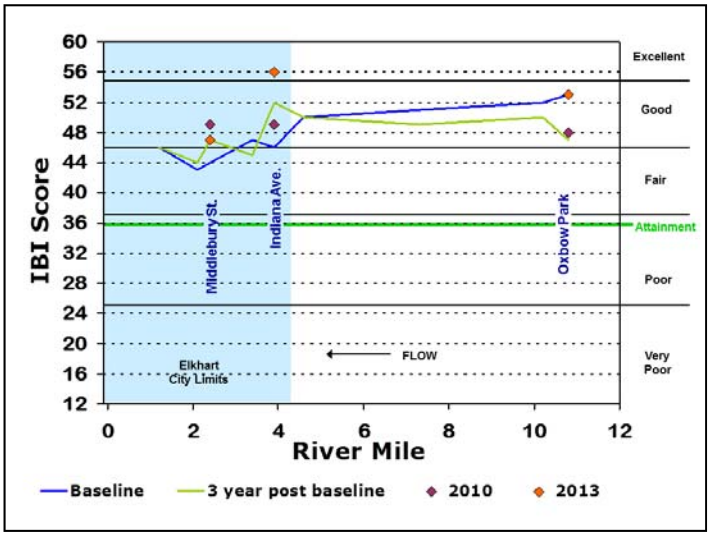
The Sample Street site was first sampled in 2012 resulting in a very low IBI score of 37. That score increased slightly in 2013 to 40. Similar to the Homan Avenue site in Elkhart, the Sample Street site is highly influenced by the nearby dam, which causes slower river flow, deeper water, and a lack of true riverine habitat. The "dam impoundment effect" is likely a major factor in the lower fish community scores at the site.

Elkhart River

IBI scores for the Elkhart River were promising in 2013 (Figure 7, Table 5). In previous sampling events (2007, 2010) IBI scores took a significant dip below the baseline at the Oxbow Park site suggesting a long-term impact at this site. Erosion issues immediately upstream of the site and enrichment problems from upstream sources were suspected causes of the impairment of the fish community (Kring, 2009). The IBI score in 2013 was 53 which is the same as the baseline value suggesting that the fish community has recovered from the disturbance. Furthermore, the ICI score at Oxbow Park was also up significantly from the baseline. The ICI baseline for this site was established during the same time period that the fish community showed signs of decline.

Although the IBI scores at the Middlebury Street site have not changed significantly since baseline monitoring, not too far upstream at Indiana Avenue, the fish communities were flourishing in 2013. The IBI score at Indiana Avenue was 56 in 2013 which is significantly higher than its

Figure 7: IBI scores for the Elkhart River, Elkhart County



baseline value of 46 and the score of 49 in 2010. The Indiana Avenue site has very good instream and riparian habitat as demonstrated by its habitat score of 83. Excellent habitat at this site along with the moderately stable stream conditions in 2012 and 2013 were likely important factors in the increased IBI score.

Although the fish IBI score at Middlebury Street remained close to the baseline, the ICI score was up significantly and fell within the exceptional range at 54. ICI scores in 2012 were very suppressed at Elkhart River sites likely due to the drought conditions during that summer, however, 2013 scores are promising and indicative of a quick recovery.

Bowman Creek

No fish were collected from Ravina Park during either sampling pass in 2013. When no fish are collected at a sampling site, an IBI score of 0 is applied. The drought conditions in 2012 were likely the reason for this occurrence. The last occurrence with no fish being collected at Ravina Park during a sampling season was back in 2003. Bowman Creek, close to the St. Joseph River will often run dry. As such, even when the stream has water in it, only the more tolerant species like juvenile creek chubs are present. The City of South Bend has been investigating ways to help restore portions of Bowman Creek. Reestablishing natural habitat and continuous flow in Bowman Creek should help restore biological communities. Macroinvertebrate sampling at Studebaker Golf Course in 2011 showed fair diversity of aquatic macroinvertebrates suggesting that Bowman Creek does have the ability to host diverse aquatic communities if water continues to flow (Deegan, 2012).

The Aquatics Program performed index sampling for the first time at Locust Road (South). Index sampling will occur at this location in 2014 and 2015 to establish a baseline at this site. IBI scores at Locust Road (S) also show an impaired fish community. This site, located in the headwaters of the Bowman Creek Watershed, has been ditched for agricultural drainage. In addition to poor habitat, agricultural drainage and other sources are likely impacting the water quality at this location. In 2013, 2 investigative sites within the AM General property north of Chippewa Avenue were sampled. In addition, another investigative site was sampled at Gertrude Street. All 3 investigative sites have natural riparian buffers and habitat. The AM General property in particular surrounds Bowman Creek with many acres of older growth forest and wetlands. However, the instream habitat is marred by a dense layer of fine sand and silty substrate, which is derived from stream instability in the upper Bowman Creek Watershed. Fish communities at these 3 investigative sites were dominated by tolerant species. Results from sampling in 2012, however, do show ecological improvement along Bowman Creek at Chippewa Avenue, which is located adjacent to the south of the AM General property.

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

Station	River Mile	Fish IBI Scores				2013 Habitat Scores	(ICI) Macroinvertebrate Scores	
		Baseline	2007	2010	**2013**		Baseline Score	**2013**
Oxbow Park	10.8	53	47	48	**53**	82	46	**54**
Indiana Avenue	3.9	46	53	49	**56**	82		
Middlebury Street	2.4	44	46	49	**47**	83	47	**54**

Figure 8: IBI scores for Bowman Creek and Juday Creek, St. Joseph County

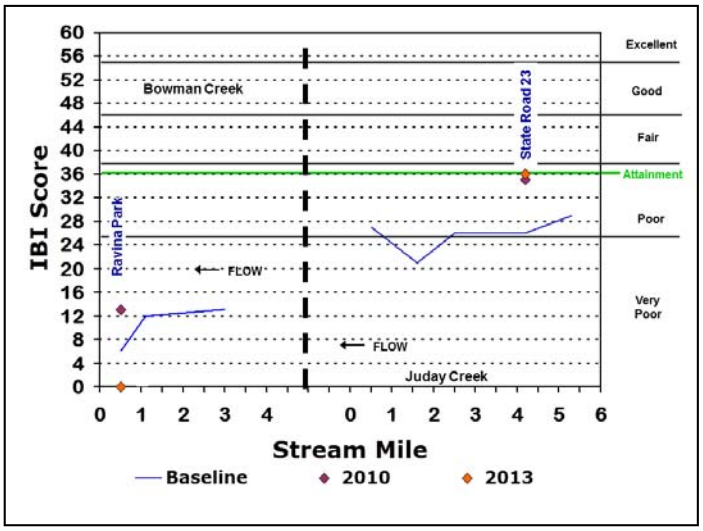
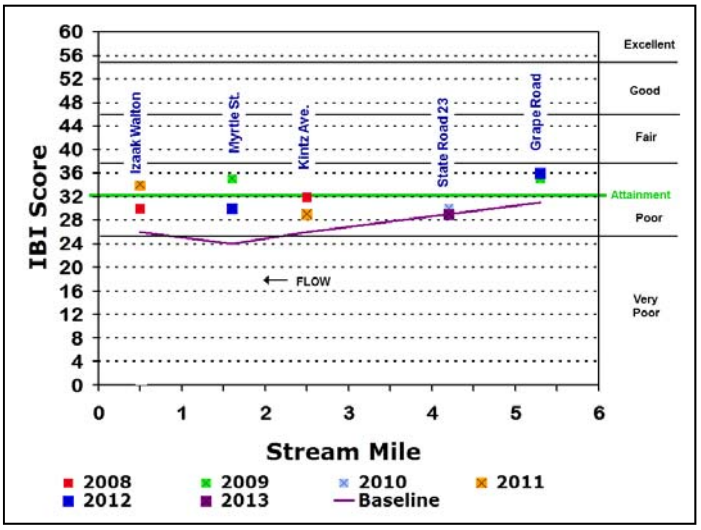


Figure 9: IBI Scores for Juday Creek using the coolwater methodolgy. Note that the attainment line is set at 32 using the coolwater methodology.



Juday Creek

IBI scores at Juday Creek at State Road 23 suggest that the fish community is relatively stable in this location (Figure 9 and Table 6). Because it is a coolwater stream, we have assessed Juday Creek using the conventional IBI system in addition to a system that has been developed for coolwater streams. The conventional system gives this site a score of 36, which is considered just attaining. The coolwater systems gives a score of 29 which is considered to be non-attaining or impaired. Regardless, IBI scores with either index, have remained relatively stable for this portion of Juday Creek. The macroinvertebrate ICI score in 2013 was 48, which was lower than the 2010 score of 52, but still in the exceptional range. Macroinvertebrate monitoring in area coolwater streams shows good stream conditions. Given some of the controversy with the fish community indices for coolwater streams in Indiana, more emphasis should be placed in macroinvertebrate community scores when considering the quality of Juday Creek.

Agencies in St. Joseph County, including the St. Joseph County Drainage Board, have been working aggressively to restore lower portions of Juday creek by stabilizing shoreline, reintroducing bends in the creek, and reestablishing native shoreline vegetation. Much of Juday Creek was historically straightened, and in certain sections stream diversions for residential water features were created. Unfortunately, many of these historic stream alterations have had a negative impact on the fish and wildlife habitat. However, these recent restoration activities will greatly improve habitat and will certainly help Juday Creek's aquatic life.

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

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

Stream	Station	Stream Mile	Fish IBI Scores (Coolwater IBI Scores)				2013 Habitat Scores	(ICI) Macroinvertebrate Scores	
			Baseline	2007	2010	**2013**		2010	**2013**
Auten Ditch	Locust Road (S)	6.0				14	40		
Bowman Creek	Ravina Park	0.5	6	7	13	0	40		
Juday Creek	SR 23	4.2	26 (29)	36 (30)	35 (30)	36 (29)	65	52	**48**

Figure 10: IBI scores for Lily Creek and Yellow Creek, Elkhart County

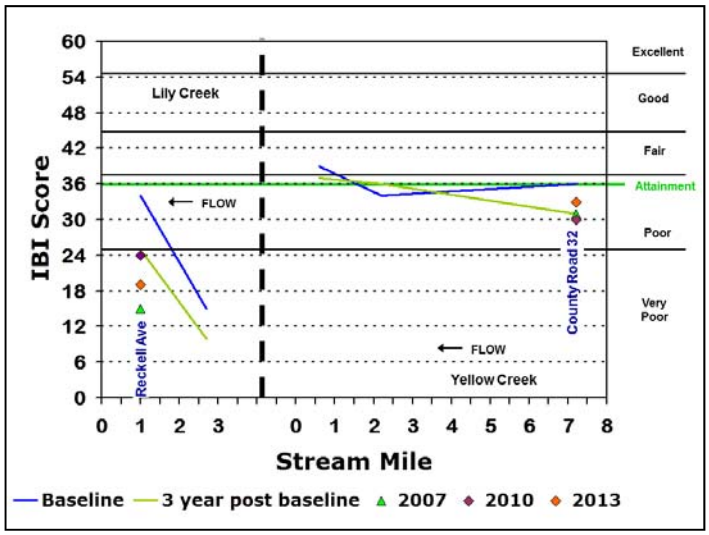
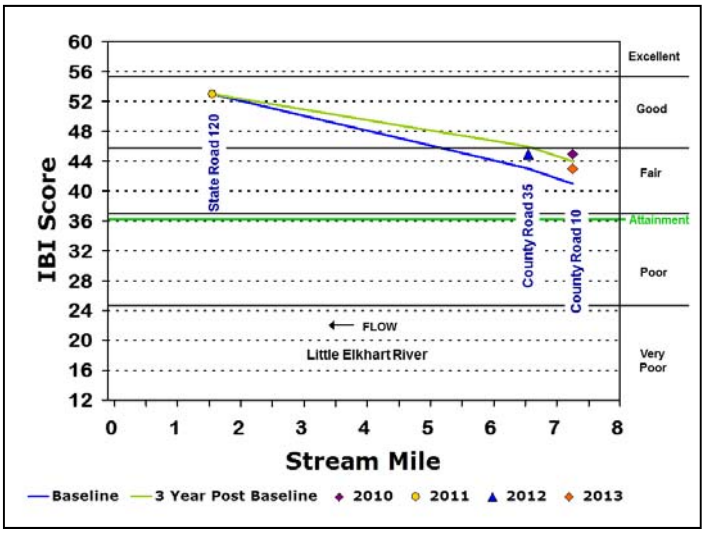


Figure 11: IBI scores for the Little Elkhart River, Elkhart County



(Kring, 2008). Piles of soil adjacent to the stream suggest that that streambed may have been excavated at the same time. Since baseline monitoring and drainage maintenance, IBI scores have been very poor (Table 7). 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 2013, this site is showing little signs of recovery.

Yellow Creek

The IBI score of 33 at CR 32 on Yellow Creek was well below the baseline score of 36 for the third consecutive monitoring event (Figure 10 and Table 7). This site, in the upper reaches of Yellow Creek, is highly influenced by agricultural activity and unsteady stream flow. Yellow Creek is 1 of many Elkhart County regulated drains that has been significantly straightened causing water levels to fluctuate drastically following a heavy rain event. Despite the impaired fish community, the habitat at this site almost falls within the good range (Table 7), indicating that water quality is the limiting factor at this site.

Little Elkhart River

The Little Elkhart River at County Road 10 had an IBI score slightly above the baseline in 2013. Long-term monitoring suggests a slight increase in fish community integrity at this location and downstream at County Road 35, while scores have not deviated too far from the baseline at State Road 120 closer to the mouth of St. Joseph River (Figure 11). The IBI score is down slightly from previous monitoring events in 2007 and 2010 when respective scores were 46 and 45.

The macroinvertebrate ICI score was 56 which is significantly higher than the baseline score of 40 (Table 8). In 2012, similar results in biological indices occurred at CR 35, where the fish community score was relatively similar to the baseline, and the macroinvertebrate score was well above its baseline. Hopefully, these higher macroinvertebrate scores will continue into the future.

Cobus Creek

Cobus Creek is another coolwater system in the

Table 7: Index scores for Yellow Creek and Pine Creek, Elkhart County

Stream	Station	River Mile	Fish IBI Scores				2013 Habitat Scores
			Baseline	2007	2010	**2013**	
Yellow Creek	County Road 32	7.2	36	31	30	**33**	61
Lily Creek	Reckell Ave	1.1	34	15	24	**19**	37

Table 8: Index scores for the Little Elkhart River, Cobus Creek and Puterbaugh Creek, Elkhart County

Stream	Station	River Mile	Fish IBI Scores (Coolwater Index Scores)				2012 Habitat Scores	ICI Macroinvertebrate Scores	
			Baseline	2007	**2010**	**2013**		Baseline/Previous Scores	**2013**
Little Elkhart River	CR 10	7.3	41	46	45	**43**	80	40	**56**
Cobus Creek	CR 8	2.2	30 (36)	28 (40)	31 (36)	**30 (32)**	73	48	**Very Good**
Puterbaugh Creek	CR 8	1	39	44	48	**40**	74	47	**54**

St. Joseph River Watershed, meaning that there is a high amount of groundwater discharging into the creek that helps it maintain cooler water temperatures year round. As a result, fish communities vary slightly from typical warmwater streams, by hosting higher numbers of fish species that prefer or tolerate cooler conditions. Conversely, species that prefer warmwater conditions, tend to be absent or only present in low numbers. IBI scores for Cobus Creek have remained relatively consistent since the inception of monitoring, and in 2013 the score was 30 which is the same as the baseline (Table 8). In our 2010 report, we assessed Cobus Creek using the Coolwater IBI, which appears to provide a more accurate representation of the biological integrity of this stream (Deegan, 2011). Scores with the coolwater IBI reflected a stronger fish community. However, the 2013 results with the Coolwater IBI suggest a decline in the fish community. Coolwater IBI data suggest that any disturbance or alteration of this stream will likely cause the fish community to become impaired.

In 2013, the macroinvertebrate sampler was lost in Cobus Creek. As a result an ICI score could not be calculated. However, a qualitative sample was collected indicating that a very good macroinvertebrate community was present in 2013. The last time this site was sampled in 2010, the site had an ICI score of 48, which is also in the very good range.

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 coolwater fish species, but recruits warmwater species from the larger bodies of water. In 2013, the IBI score at CR 8 was 40, which is just above the baseline value of 39. The last time this site was sampled in 2010, the IBI score was 48 suggesting a water quality improvement (Deegan, 2011). The drop in scores in 2013 and consistency with the baseline reveal no long-term improvement in the fish community at this location. The ICI score for this site was 54 which is well above the baseline and the previous score of 50 that was recorded in 2010. As with other coolwater streams in our area, the macroinvertebrate community in Puterbaugh Creek continues to flourish.

Baugo Creek

In 2013, Baugo Creek at County Road 1 (South) and County Road 3 (North) were sampled for the first time since the baseline monitoring was completed in 2009. Respective IBI scores of 40 and 29 were recorded at CR 3 (N) and CR 1 (S). The score at CR 3 (N) was the same as the baseline value, while the score at CR 1 (S) was slightly

Figure 12: IBI scores of Baugo Creek, Elkhart and St. Joseph Counties

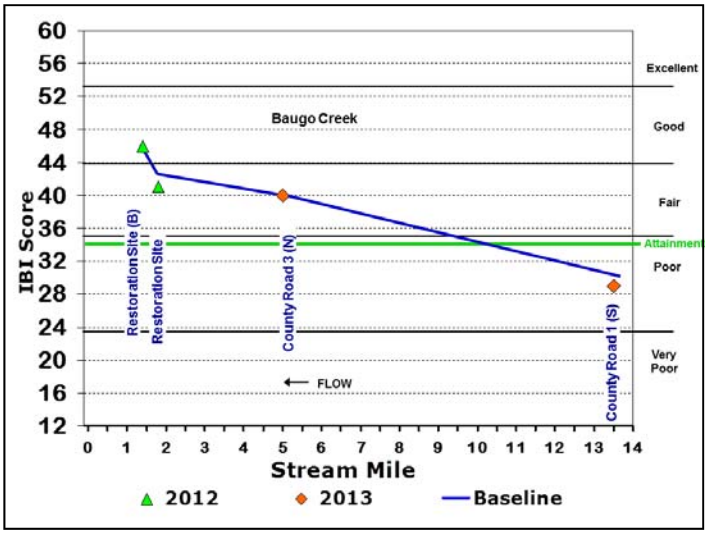


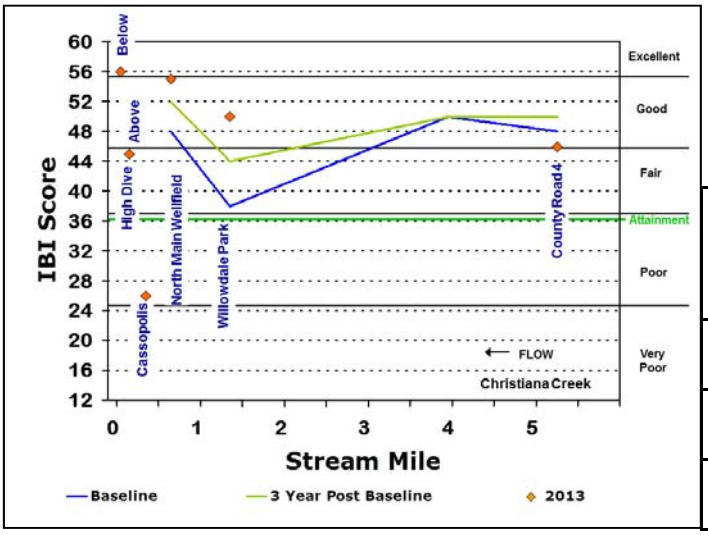
Table 9: Index Scores for Baugo Creek, Elkhart and St. Joseph County

Stream	Station	River Mile	Fish IBI Scores				2012 Habitat Scores	ICI Macroinvertebrate Scores	
			Baseline	2007	2010	2013		Baseline Score	2013
Baugo Creek	CR 1 (S)	5	30			29	71		
Baugo Creek	CR 3 (N)	1.5	40			40	90	25	34

lower than the baseline (Table 9). Fish community surveys in Baugo Creek reveal an overabundance of fish at all sites sampled. For example, at CR 3 (N) we collected an average of 1,506 fish during both sample passes in 2013, while a balanced fish community at that site should really only hold about 300-400 individual fish (Simon, 1997). This overabundance of fish is indicative of an enrichment problem, meaning that there are very high levels of nutrients in the system.

It is not very surprising that IBI scores have not improved in the 4 years after baseline sampling. Baugo Creek has a very flashy flow regime, meaning that water levels rise rapidly following a rain event but will drop back to normal levels relatively quickly. This instability in flow is a result of how the watershed has been modified for agricultural land use and drainage. According to wetlands assessments of the Baugo Creek Watershed conducted by the Friends of the St. Joseph River, approximately 90% of the wetlands in the Baugo Creek system have been lost, resulting in a loss of approximately 90% of the watershed's flood storage capacity (http://fotsjr.wildapricot.org/). Therefore, when it rains, 90% of the water that was previously stored by wetlands is quickly sent to Baugo Creek. Flooding events in Baugo Creek and other local streams is strongly correlated with input of sediment and other pollutants (Deegan, 2013). So, wetlands loss is a huge issue for the Baugo system and an indication that wetlands or some form of water storage is needed to protect Baugo Creek and the St. Joseph River downstream. The macroinvertebrate ICI score at CR 3 (N) of 34 in 2013 also reflects the water quality issues of Baugo Creek. The 2013 score was well above the baseline score of 25, but still considered impaired. Flashy hydrology and enrichment issues are undoubtedly suppressing the success of the macroinvertebrate communities in this stream.

Figure 13: IBI scores for Christiana Creek, Elkhart County



Christiana Creek

In 2013, the Aquatics Program sampled multiple sites along Christiana Creek. The site at County Road 4 was sampled as part of the ongoing long-term monitoring program. However, additional sites including Willowdale Park, North Main Wellfield, and several investigative sites were sampled as part of fish passage project along Christiana Creek. Results of 2013 surveys confirm that dams and other barriers within the first mile of Christiana Creek have a significant impact on fish migration from the St. Joseph River. For example, below the High Dive Dam, an average of 31 species were collected during both sampling passes in

Table 10: Index Scores at new sites along Christiana Creek, Elkhart County

Station	Stream Mile	2013 Fish IBI Scores	2013 Habitat Scores	2013 ICI Scores
Cassopolis Above	0.34	26	75	
High Dive Park (Above)	0.2	45	76	
High Dive Park (Below)	0.1	56	77	Very Good

Table 11: Index scores at long-term monitoring sites along Christiana Creek, Elkhart County

Station	Stream Mile	Fish IBI Scores								2013 Habitat Scores	(ICI) Scores 2013
		Baseline	2007	2008	2009	2010	2011	2012	**2013**		
County Road 4	5.3	48	49			52			46	80	**46**
Willowdale Park	1.4	38		45			56		50	79	
North Main Well Field	0.7	48			53			51	55	81	

2013, versus only 14 species from the site above the High Dive dam. IBI scores were also significantly different. The site below the dam had an excellent IBI score of 56, while the site above the dam had a fair IBI score of 45. Fish movement in an upstream direction within the first mile of Christiana Creek is very limited although downstream movement appears to occur to a certain degree. The site located above Cassopolis Street had a poor IBI score of 26. An average of 48 fish total represented by 8 different species were collected at this site during both sampling passes in 2013. Despite the impaired fish community at this site, instream habitat is relatively good giving rise to a QHEI score of 75. The reason for its low IBI score is likely its central location within the fish migrations barriers (3 barriers above and 3 barriers below).

The site located at County Road 4 received its lowest IBI score since the completion of baseline monitoring (Figure 13 and Table 11). This was rather disappointing news for this site since it scored very well in 2007 and 2010. However, the 2013 score was only slightly lower than the baseline value of 48. Furthermore, the ICI score at CR 4 was 46, the same as it was when the site was previously sampled in 2010 and just slightly lower than the baseline value of 47.

Fish Tissue

In 2013, 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 polychlorinated biphenyl (PCB) or mercury (Hg) concentrations, fish species within a certain size range will be placed within an FCA Grouping. Table 13 summarizes each grouping and the associated guidance. It should be noted that the State FCA has more restrictive guidance for individuals that are considered to be part of the "sensitive population." Women who are pregnant or are breastfeeding, women who plan to have children, or children under the age of 15 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).

Many variables play a role in contaminant concentrations in fish. Our results have shown varying contaminant concentrations from year to year and among different sizes of fish. However, concentrations do not tend to vary that significantly and an understanding of contaminant concentrations can be determined by gathering data multiple times. In general, larger fish will tend to have higher concentrations of contaminants in their tissue. The following narrative describes results of the Aquatics Programs fish tissue collections from Elkhart and St. Joseph Counties in 2013:

Smallmouth bass were collected from High Dive Park in downtown Elkhart and at County Road 4 at the edge of Elkhart City. Those collected at High Dive Park ranged in size from 10.3 to 10.7 inches, while those collected from County Road 4 were slightly larger at 10.6 to 11.5 inches. Fish from High Dive fell in Group 1 for both contaminants, while those from County Road 4 fell in Group 1 for PCBs and Group 2 for Hg. The FCA for Christiana Creek does not currently list smallmouth bass, however, other small game species like rock bass and yellow bullheads fall in Group 1 according to guidance in the FCA.

Four composite samples of northern pike were collected in 2013. One sample (23-24 inches) was collected from the Elkhart River at Oxbow Park. Two samples (22.5-24.5 inches and 26-28 inches) were collected above the Johnson Street Dam and 1 sample (22-24.5 inches) was collected at Nappanee Street on the St. Joseph River. With the ex-

Table 12: Fish consumption information taken from the Fish4Health Website

Location	Species	Fish Size (inches)	Contaminant	Group	Sensitive Population Group*
Elkhart River *Elkhart County*	Rock Bass	Up to 7		1	2
	Smallmouth Bass	Up to 12		1	2
Christiana Creek *Elkhart County*	Northern Hogsucker	Up to 14		1	2
	Rock Bass	Up to 7		1	2
	Yellow Bullhead	Up to 9		1	2
St. Joseph River *Elkhart County*	Bluegill	Up to 8		1	2
	Channel Catfish	All	PCBs	3	**5**
	Common Carp	Up to 31	PCBs	3	**5**
		31+	PCBs	4	**5**
	Rock Bass	Up to 7		1	2
	Northern Pike	Up to 30		1	**2**
	Smallmouth Bass	Up to 13		1	**2**
	Redhorse Species	17+	PCBs	3	**5**
	Walleye	25+	PCBs	3	**5**
	White Sucker	Up to 14		1	2
St. Joseph River *St. Joseph County (Baugo Bay Area to Twin Branch Dam)*	Bluegill	Up to 8		1	2
	Channel Catfish	Up to 20	PCBs	3	**5**
		20+	PCBs	4	**5**
	Largemouth Bass	Up to 13		1	2
	Rock Bass	Up to 8		1	2
	Spotted Sucker	Up to 17		1	2
	White Sucker	Up to 14		1	2
St. Joseph River *St. Joseph County (Twin Branch Dam to Indiana State Line)*	Bluegill	7+	PCBs	4	**5**
	Channel Catfish	All	PCBs	4	**5**
	Chinook Salmon	28+	PCBs	4	**5**
	Rock Bass	Up to 8	PCBs	2	3
	Smallmouth Bass	Up to 12	PCBs & Hg	2	3
	Steelhead Trout	30+	PCBs	4	**5**
	Yellow Bullhead	Up to 10	PCBs	2	3
Juday Creek	White Sucker	17+	PCBs	3	**5**

In previous years, the State of Indiana published an annual Fish Consumption Advisory (FCA) providing guidance for consuming fish for many water bodies throughout the state of Indiana. Indiana is no longer publishing an annual report, but has shifted to presenting results on the Fish4Health website (http://fn.cfs.purdue.edu/fish4health/). The former FCA reports also provided guidance groupings (see Table 13 for Groupings). Although these guidance groupings are not used on the Fish4Health website, we will continue to use them for consistency in our report. According to Indiana State Officials, future fish consumption advisories may be more focused on the protecting the sensitive population which may result in more conservative advisories.

Table 13: Consumption Groups and Guidance

Group	Guidance	Group 3	Limit consumption to 1 meal every month
Group 1	Unrestricted consumption	Group 4	Restrict consumption to 1 meal every 2 months
Group 2	Limit consumption to 1 meal per week	**Group 5**	**DO NOT EAT**

**The sensitive population is described as women of a child bearing age, nursing mothers, or children under the age of 15.*

ception of the larger (26-28 inch) fish collected above the Johnson Street dam, all collections of northern pike fell in Group 1 for both contaminants. The 26-28 inches fish from above Johnson Street dam fell in Group 1 for PCBs and Group 2 for Hg. In 2012, the northern pike in the same size range collected from the Nibbyville area of the St. Joseph River fell in Group 2 for both contaminants. The FCA currently lists all northern pike up to 30 inches long in Elkhart County in Group 1. It is great to see northern pike included in the FCA. Pike are a commonly sought game species and are very abundant on the St. Joseph River. Anglers sometimes compare the taste of the pike to that of a walleye, although they can be difficult to clean because of their "y-bones." Given their size, and their position on the food chain as a top predatory fish, it is surprising to see low concentrations of mercury and PCBs in northern pike in Elkhart County. However, it is good news for anglers who consume this species.

Golden redhorse, approximately 17 inches long, were collected from Sample Street, Michigan Street, and Auten Road on the St. Joseph River in South Bend. All fish fell in Group 1 for Hg. However, those collected from Michigan Street and Auten Road fell in Group 3 for PCBs and those collected from Sample Street fell in Group 2 for PCBs. The FCA does not currently list golden redhorse or other redhorse species. In 2012, the Aquatics Program collected shorthead redhorse from the South Bend section of the St. Joseph River. Shorthead redhorse had higher concentrations of both contaminants and those collected downstream of the South Bend dam fell in Group 5 for PCBs.

Walleye. 15.5-16 inches long, were collected from the St. Joseph River at Capital Avenue. Walleye are a popular game species throughout the Indiana section of the St. Joseph River and are often targeted by anglers downstream of the Twin Branch Dam in the vicinity of Capital Avenue. Analysis of the composite walleye sample revealed low concentrations of PCBs and mercury putting them in Group 1 for both contaminants. Previous fish tissue testing by the Aquatics Program and the State of Indiana has documented relatively high concentrations of PCBs in many fish species downstream of the Twin Branch Dam. The difference between PCBs contamination upstream and downstream of the dam is noticeable in the FCA (Table 12). Therefore, the fact that legal, keeper sized, walleye are in Group 1 downstream of Twin Branch is good news for anglers. The Aquatics Program will perform additional sampling of walleye downstream of Twin Branch Dam in coming years to confirm these results.

Conclusion

Biological monitoring during the summer of 2013 suggests that the St. Joseph River continues to thrive. Drought conditions in 2012 appear to have favorably affected the St. Joseph River and most of its tributaries, as most index scores were good and fish communities appeared to be very strong. One of the biggest issues facing the St. Joseph River Watershed is impaired hydrology and non-point sources of pollution attributed to urban and agricultural runoff. Due to the lack of rain in 2012, streams in the St. Joseph River Watershed were relatively stable and runoff was minimal giving rise to the increased success of the fish communities observed in 2013.

Although most St. Joseph River tributaries appear to be doing well, Baugo Creek, Lily Creek, Bowman Creek, and Yellow Creek continue to show little signs of improvement. The Baugo and Yellow Creek watersheds have been highly modified to drain many square miles of agricultural land. Bowman Creek and Lily Creek are 2 relatively small streams with significant urban stressors.

In 2013, work in area coolwater streams like the Little Elkhart River, Cobus Creek, and Juday Creek demonstrate the importance of collecting macroinvertebrate samples from these streams. In each of these streams, fish communities appear to be lacking, but macroinvertebrate community data help reflect the true quality of each of these streams.

Acknowledgements

Thanks to the 2013 field crew of Abigail Merrick, Cortney Quick, Nathan Hahaj, and Tyler Brenneman. 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, 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.

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SUMMER 2013

Abigail, Cortney, and Nathan with a sample of quality smallmouth bass at Capital Avenue

Tyler and Nathan pose with 2 nice walleye at the Pinhook (B) site in South Bend

A collection of different macroinvertebrates collected during a survey

Nathan poses with one of many steelhead that made their way into the St. Joe from Lake Michigan in 2013.

A young spotted gar from the St. Joe

An Elkhart River stonecat

Cortney with a Christiana Creek golden redhorse

Cortney with a nice pike at Auten Road

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

Station(s)	Species	Length Range (inches)	Advisory Length Range (inches)	Hg Advisory Group (PW)	Hg Advisory Group (state)	PCB Advisory Group (PW)	PCB Advisory Group (State)
Christiana Creek High Dive (B)	Smallmouth Bass	10.3-10.7	NA	1	NA	1	NA
Christiana Creek County Road 4	Smallmouth Bass	10.6-11.5	NA	2	NA	1	NA
Elkhart River Ox-bow Park	Northern Pike	23.0-24.0	NA	1	NA	1	NA
St. Joseph River Homan Avenue	Northern Pike	22.6-24.7	Up to 30	1	Group 1	1	Group 1
St. Joseph River Homan Avenue	Northern Pike	25.8-28.0	Up to 30	2	Group 1	1	Group 1
St. Joseph River Nappanee Street	Northern Pike	21.9-24.6	Up to 30	1	Group 1	1	Group 1
St. Joseph River Capital Avenue	Walleye	15.5-16.1	All	1	NA	1	Group 3
St. Joseph River Sample Street	Golden Redhorse	16.5-17.2	All	2	NA	2	Group 3
St. Joseph River Michigan Street	Golden Redhorse	16.5-17.3	All	1	NA	3	Group 3
St. Joseph River Auten Road	Golden Redhorse	16.5-16.9	All	1	NA	3	Group 3

Appendix C

Summary of fish collected by county, 2013

Summary of species captured at index sites in Elkhart County, 2013

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
White Sucker	1,847	8.79	129,977	286.55	8.57
Bluegill	1,594	7.59	54,217	119.53	3.57
Rock Bass	1,490	7.09	108,105	238.33	7.12
Striped Shiner	1,461	6.95	13,424	29.59	0.88
Creek Chub	1,211	5.76	19,453	42.89	1.28
Longear Sunfish	1,135	5.40	26,996	59.52	1.78
Smallmouth Bass	1,091	5.19	112,481	247.98	7.41
Bluntnose Minnow	1,043	4.96	3,439	7.58	0.23
Sand Shiner	1,028	4.89	2,223	4.90	0.15
Northern Hog Sucker	889	4.23	94,404	208.13	6.22
Stoneroller, Central	876	4.17	7,305	16.10	0.48
Mimic Shiner	803	3.82	1,028	2.27	0.07
Logperch	755	3.59	4,282	9.44	0.28
Blacknose Dace	736	3.50	2,611	5.76	0.17
Golden Redhorse	624	2.97	313,649	691.48	20.67
Spotfin Shiner	601	2.86	3,481	7.67	0.23
Silverjaw Minnow	505	2.40	1,667	3.68	0.11
Common Shiner	411	1.96	6,185	13.64	0.41
Rosyface Shiner	349	1.66	936	2.06	0.06
Shorthead Redhorse	336	1.60	156,300	344.58	10.30
Largemouth Bass	312	1.48	62,755	138.35	4.14
Hornyhead Chub	283	1.35	7,293	16.08	0.48
Steelcolor Shiner	204	0.97	967	2.13	0.06
Mottled Sculpin	173	0.82	936	2.06	0.06
Johnny Darter	143	0.68	205	0.45	0.01
Rainbow Darter	138	0.66	214	0.47	0.01
Orangethroat Darter	99	0.47	139	0.31	0.01
Blackside Darter	77	0.37	262	0.58	0.02
Yellow Bullhead	74	0.35	6,766	14.92	0.45
Chestnut Lamprey	68	0.32	555	1.22	0.04
Common Carp	65	0.31	118,294	260.79	7.80
Green Sunfish	64	0.30	1,623	3.58	0.11
Pumpkinseed	45	0.21	1,951	4.30	0.13
Redear Sunfish	34	0.16	1,200	2.65	0.08
Silver Redhorse	33	0.16	54,400	119.93	3.59
Spotted Sucker	33	0.16	9,364	20.64	0.62
Black Crappie	28	0.13	3,533	7.79	0.23
Brown Bullhead	27	0.13	5,282	11.64	0.35
Grass Pickerel	25	0.12	455	1.00	0.03
Bowfin	24	0.11	49,700	109.57	3.28
Northern Pike	22	0.10	28,652	63.17	1.89
Warmouth	21	0.10	823	1.81	0.05

Summary of species captured at index sites in Elkhart County, 2013 (continued)

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Longnose Dace	21	0.10	71	0.16	0.00
Brown Trout	20	0.10	5,625	12.39	0.37
Greenside Darter	19	0.09	70	0.15	0.00
River Redhorse	16	0.08	38,900	85.70	2.56
River Chub	14	0.07	168	0.37	0.01
Golden Shiner	13	0.06	42	0.09	0.00
Greater Redhorse	12	0.06	5,607	12.35	0.37
Walleye	12	0.06	3,486	7.68	0.23
Quillback	11	0.05	29,200	64.33	1.92
Hybrid Sunfish	11	0.05	448	0.99	0.03
Black Bullhead	9	0.04	835	1.84	0.06
Spottail Shiner	9	0.04	44	0.10	0.00
Yellow Perch	8	0.04	849	1.87	0.06
Channel Catfish	6	0.03	5,322	11.72	0.35
Black Redhorse	6	0.03	2,200	4.85	0.14
Stonecat	6	0.03	318	0.70	0.02
American Brook Lamprey	6	0.03	18	0.04	0.00
Blackstripe Topminnow	6	0.03	11	0.02	0.00
Longnose Gar	5	0.02	3,007	6.62	0.20
Gizzard Shad	5	0.02	2,043	4.50	0.13
Spotted Gar	5	0.02	570	1.26	0.04
Banded Killifish	5	0.02	24	0.05	0.00
Central Mudminnow	3	0.01	40	0.09	0.00
Fathead Minnow	3	0.01	6	0.01	0.00
Rainbow Trout	2	0.01	824	1.82	0.05
Silver Lamprey	2	0.01	15	0.03	0.00
Lake Chubsucker	1	0.00	4	0.01	0.00
Brook Silverside	1	0.00	2	0.00	0.00
Total	**21,014**	**100**	**1,517,281**	**3343**	**100.00**

Elkhart County Total # of Fish	21,014

Summary of species captured at index sites in St. Joseph County, 2013

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Longear Sunfish	1,282	24.83	34,590	76.26	4.38
Rock Bass	815	15.78	52,061	114.77	6.59
Smallmouth Bass	660	12.78	108,168	238.47	13.69
Bluegill	467	9.04	12,729	28.06	1.61
Spotfin Shiner	420	8.13	2,527	5.57	0.32
Golden Redhorse	164	3.18	134,940	297.49	17.08
Green Sunfish	148	2.87	4,236	9.34	0.54
Black Redhorse	113	2.19	81,963	180.70	10.37
Bluntnose Minnow	107	2.07	408	0.90	0.05
Mimic Shiner	104	2.01	212	0.47	0.03
Sand Shiner	93	1.80	203	0.45	0.03
Northern Hog Sucker	90	1.74	23,896	52.68	3.02
Shorthead Redhorse	88	1.70	55,294	121.90	7.00
Largemouth Bass	60	1.16	11,060	24.38	1.40
Logperch	55	1.07	1,052	2.32	0.13
Johnny Darter	44	0.85	54	0.12	0.01
Pumpkinseed	42	0.81	1,772	3.91	0.22
Steelcolor Shiner	41	0.79	255	0.56	0.03
Walleye	40	0.77	28,243	62.27	3.57
Creek Chub	39	0.76	1,095	2.41	0.14
White Sucker	34	0.66	14,188	31.28	1.80
Mottled Sculpin	26	0.50	208	0.46	0.03
Common Carp	25	0.48	140,200	309.09	17.74
Yellow Bullhead	22	0.43	4,698	10.36	0.59
Quillback	21	0.41	24,350	53.68	3.08
Spotted Sucker	21	0.41	9,200	20.28	1.16
Hybrid Sunfish	17	0.33	1,054	2.32	0.13
Chestnut Lamprey	17	0.33	183	0.40	0.02
Rainbow Trout	14	0.27	3,408	7.51	0.43
Greenside Darter	10	0.19	62	0.14	0.01
Blackside Darter	10	0.19	48	0.11	0.01
Rainbow Darter	10	0.19	22	0.05	0.00
Redear Sunfish	8	0.15	341	0.75	0.04
Black Crappie	7	0.14	620	1.37	0.08
Silver Redhorse	6	0.12	10,800	23.81	1.37
Gizzard Shad	6	0.12	2,800	6.17	0.35
Warmouth	6	0.12	95	0.21	0.01
Brook Silverside	6	0.12	12	0.03	0.00
Brown Bullhead	5	0.10	955	2.11	0.12
Banded Killifish	4	0.08	14	0.03	0.00
Greater Redhorse	3	0.06	7,000	15.43	0.89

Summary of species captured at index sites in St. Joseph County, 2013 (continued)

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Central Mudminnow	3	0.06	6	0.01	0.00
River Redhorse	2	0.04	9,000	19.84	1.14
Common Shiner	2	0.04	13	0.03	0.00
Channel Catfish	1	0.02	4,000	8.82	0.51
Northern Pike	1	0.02	1,900	4.19	0.24
Longnose Gar	1	0.02	74	0.16	0.01
Stonecat	1	0.02	50	0.11	0.01
White Crappie	1	0.02	20	0.04	0.00
Fathead Minnow	1	0.02	4	0.01	0.00
Rosyface Shiner	1	0.02	3	0.01	0.00
Total	**5,164**	**100**	**790,086**	**1,741.84**	**100**

Summary of species captured at investigative sites in St. Joseph County, 2013

Common Name	Total Number	% by Number	Common Name	Total Number	% by Number
Creek Chub	497	46.58	Pumpkinseed	8	0.75
Longear Sunfish	111	10.40	White Sucker	4	0.37
Golden Redhorse	54	5.06	Northern Pike	3	0.28
Green Sunfish	54	5.06	Quillback	3	0.28
Mottled Sculpin	48	4.50	Golden Shiner	2	0.19
Bluegill	45	4.22	Chestnut Lamprey	2	0.19
Central Mudminnow	43	4.03	Redear Sunfish	2	0.19
Blacknose Dace	40	3.75	Hybrid Sunfish	2	0.19
Smallmouth Bass	28	2.62	Mimic Shiner	2	0.19
Fathead Minnow	20	1.87	Gizzard Shad	2	0.19
Johnny Darter	17	1.59	Northern Hog Sucker	1	0.09
Spotted Sucker	16	1.50	Shorthead Redhorse	1	0.09
Rock Bass	16	1.50	Greater Redhorse	1	0.09
Spotfin Shiner	15	1.41	Bluntnose Minnow	1	0.09
Largemouth Bass	10	0.94	Yellow Bullhead	1	0.09
Black Bullhead	9	0.84	Longnose Gar	1	0.09
Black Redhorse	8	0.75	**Total**	**1,067**	**100.00**

Index Sites	5,164
Investigative Sites	1,067
St. Joseph County Total	6,231

Appendix D

Summary of fish collected by site, 2013
(Reference Table 1 for site numbers and locations)

Stream	St. Joseph River, Elkhart County, 2013							
Site	State Road 15 (Bristol)		Homan Avenue		Sherman Street		Nappanee Street	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
#Banded Killifish						X	X	
Black Crappie	X		X	X	X	X	X	X
~Black Redhorse	X				X			
Blackside Darter	X	X			X	X	X	X
Bluegill	X	X	X	X	X	X	X	X
#Bluntnose Minnow	X	X	X	X	X		X	X
Bowfin	X	X					X	X
Brown Bullhead	X		X	X			X	
Brown Trout					X			
#Channel Catfish					X	X	X	X
Chestnut Lamprey		X	X		X			
#Common Carp	X	X	X	X	X	X	X	X
#Gizzard Shad					X		X	
~Golden Redhorse	X		X	X	X	X	X	X
#Golden Shiner		X					X	
Grass Pickerel	X	X						
#Green Sunfish			X	X		X		X
~Greenside Darter					X	X		
~Hornyhead Chub	X	X						
Hybrid Sunfish			X					
Johnny Darter		X						
Largemouth Bass	X	X	X	X	X	X	X	X
~Logperch	X	X	X	X	X	X	X	X
~Longear Sunfish	X	X	X	X	X	X	X	X
#Longnose Gar					X			
~Mimic Shiner		X		X	X	X	X	X
~Northern Hog Sucker	X	X			X	X	X	X
Northern Pike	X	X	X	X			X	X
Pumpkinseed	X	X	X	X	X	X	X	X
#Quillback					X		X	
~Rainbow Darter						X		X
Redear Sunfish		X	X	X	X	X		X
~River Redhorse					X	X	X	X
~Rock Bass	X	X	X	X	X	X	X	X
~Rosyface Shiner	X	X			X	X		
~Sand Shiner	X	X			X		X	X
~Shorthead Redhorse	X	X	X		X	X	X	X
~Silver Redhorse		X	X	X	X	X	X	X

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Stream	St. Joseph River, Elkhart County, 2013							
Site	State Road 15 (Bristol)		Homan Avenue		Sherman Street		Nappanee Street	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~Smallmouth Bass	X	X	X	X	X	X	X	X
Spotfin Shiner	X				X	X	X	X
Spottail Shiner							X	
#Spotted Gar					X			
Spotted Sucker	X		X	X			X	
Steelcolor Shiner		X				X	X	X
Striped Shiner	X	X	X	X	X		X	X
Walleye					X	X	X	X
Warmouth						X	X	X
#White Sucker	X		X		X	X	X	X
#Yellow Bullhead	X	X	X	X	X	X		X
Yellow Perch	X	X	X	X				

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Stream	St. Joseph River, St. Joseph County, 2013								
Site	Capital Avenue		Sample Street		Michigan Street		Pinhook Park (B)		Auten Road
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
#Banded Killifish	X			X					
Black Crappie		X		X					
~Black Redhorse					X	X	X	X	X
Blackside Darter		X				X		X	
Bluegill	X	X	X	X	X	X	X	X	X
#Bluntnose Minnow	X	X	X	X		X		X	X
~Brook Silverside	X	X							
#Brown Bullhead		X		X					
#Channel Catfish	X								
Chestnut Lamprey	X		X		X		X		X
#Common Carp	X	X	X	X		X		X	
Common Shiner			X						
#Gizzard Shad	X	X							X
~Golden Redhorse	X	X	X	X	X	X	X	X	X
~Greater Redhorse			X						X
#Green Sunfish	X	X	X	X	X	X	X	X	X
~Greenside Darter		X			X	X	X	X	
Hybrid Sunfish	X	X	X	X	X		X		
Johnny Darter		X							
Largemouth Bass		X	X	X	X	X	X	X	X
~Logperch		X			X	X	X	X	
~Longear Sunfish	X	X	X	X	X	X	X	X	X
#Longnose Gar					X		X		X
~Mimic Shiner	X	X		X		X		X	X
~Northern Hog Sucker	X	X			X	X	X	X	X
Northern Pike	X								X
Pumpkinseed	X	X	X			X		X	X
#Quillback	X		X	X		X		X	X
~Rainbow Darter						X		X	
Rainbow Trout	X		X		X		X		
Redear Sunfish					X	X	X		X
~River Redhorse					X		X	X	
~Rock Bass	X	X	X	X	X	X	X	X	X
~Rosyface Shiner									
~Sand Shiner				X					
~Shorthead Redhorse	X	X	X		X	X	X	X	X
~Silver Redhorse	X				X		X		
~Smallmouth Bass	X	X	X	X	X	X	X	X	X

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Stream	St. Joseph River, St. Joseph County, 2013								
Site	Capital Avenue		Sample Street		Michigan Street		Pinhook Park (B)		Auten Road
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
Spotfin Shiner	X	X	X	X	X	X	X	X	X
Spotted Sucker	X	X		X	X	X	X	X	X
Steelcolor Shiner		X							
~Stonecat						X		X	
Walleye	X	X	X	X	X		X		
Warmouth					X	X	X	X	
White Crappie	X								
#White Sucker	X	X		X	X		X		X
#Yellow Bullhead			X	X	X	X	X	X	

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Tributaries of St. Joseph River, Elkhart County, 2013										
Stream	Little Elkhart River		Puterbaugh Creek		Lily Creek		Yellow Creek		Cobus Creek	
Site	CR 10		CR 8		Reckell Avenue		CR 32		CR 8	
	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	
#Blacknose Dace	X	X	X		X		X	X	X	X
Blackside Darter	X	X		X						
Bluegill	X	X	X	X	X	X	X		X	
#Bluntnose Minnow	X	X					X			
Brown Trout		X						X	X	X
#Central Mudminnow	X		X							
Chestnut Lamprey	X	X					X			
Common Shiner	X	X					X			
#Creek Chub	X	X	X	X	X	X	X	X	X	X
#Fathead Minnow							X			
Grass Pickerel			X	X		X		X		X
#Green Sunfish	X	X		X			X			
Hybrid Sunfish							X			
Johnny Darter	X	X		X	X	X	X			
Lake Chubsucker								X		X
Largemouth Bass	X	X		X			X			
~Longear Sunfish			X							
Mottled Sculpin	X	X	X	X	X			X	X	X
~Northern Hog Sucker	X	X								
Northern Pike					X					
~Orangethroat Darter										
Pumpkinseed	X								X	
~Rainbow Darter	X		X	X						
Rainbow Trout	X									
Redear Sunfish			X							
~Rock Bass		X		X					X	
~Shorthead Redhorse		X								
Silverjaw Minnow							X			
~Smallmouth Bass	X	X								
Stoneroller, Central		X			X	X	X			
Striped Shiner	X		X	X						
Warmouth		X								
#White Sucker	X	X	X	X	X	X	X	X	X	X
Yellow Perch				X						

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Tributaries of St. Joseph River, Elkhart County, 2013								
Stream	Christiana Creek							
Site	Wellfield (Below)		Main Street (Above)		Cassopolis Street (A)		Cassopolis Street (B)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Blackside Darter			X					
Bluegill	X	X	X	X		X		X
#Bluntnose Minnow	X		X					
#Brown Bullhead							X	
#Channel Catfish						X		
#Creek Chub	X	X		X	X			
~Golden Redhorse		X						
Grass Pickerel		X						
~Greenside Darter			X	X				
~Hornyhead Chub			X	X				
Johnny Darter								X
Largemouth Bass		X						
~Logperch	X	X	X	X	X	X	X	X
~Longear Sunfish				X				
~Northern Hog Sucker	X	X	X	X	X	X	X	X
~Rainbow Darter	X	X	X	X		X		
~Rock Bass	X	X	X	X		X	X	
~Shorthead Redhorse	X				X		X	
Smallmouth Bass	X	X	X	X	X	X	X	X
Spotfin Shiner	X	X	X	X	X		X	X
Steelcolor Shiner		X			X			
~Stonecat				X				
Striped Shiner	X	X	X	X	X			X
#White Sucker			X					
#Yellow Bullhead	X	X				X		X

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Tributaries of St. Joseph River, Elkhart County, 2013										
Stream	Christiana Creek									
Site	CR 4		Willowdale Park		NMWF		High Dive Park (A)		High Dive Park (B)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
#Black Bullhead						X			X	
Blackside Darter					X	X			X	
Blackstripe Topminnow	X	X								
Bluegill	X	X	X	X	X	X	X	X	X	X
#Bluntnose Minnow	X	X	X	X	X	X		X	X	X
Bowfin	X	X						X		
~Brook Silverside									X	
#Brown Bullhead						X			X	X
#Channel Catfish									X	
Chestnut Lamprey		X	X	X	X	X	X		X	
#Common Carp										X
Common Shiner										X
#Creek Chub			X		X	X				
~Golden Redhorse	X	X	X	X	X	X	X	X	X	X
Grass Pickerel		X		X		X				
#Green Sunfish						X			X	X
~Greenside Darter									X	X
~Hornyhead Chub		X							X	
Largemouth Bass	X	X	X	X		X	X	X	X	X
~Logperch				X	X	X	X	X	X	X
~Longear Sunfish						X			X	X
#Longnose Gar										X
~Mimic Shiner									X	X
~Northern Hog Sucker	X	X	X	X	X	X	X	X	X	X
~Orangethroat Darter	X	X	X			X				
Pumpkinseed				X	X					X
~Rainbow Darter		X	X	X	X	X	X	X	X	X
Redear Sunfish					X	X				X
~River Chub	X									
~River Redhorse				X						X
~Rock Bass	X	X	X	X	X	X	X	X	X	X
~Rosyface Shiner					X					X
~Sand Shiner							X			X
~Shorthead Redhorse			X	X	X	X	X	X	X	X
~Silver Redhorse					X				X	X
~Smallmouth Bass	x	X	X	X	X	X	X	X	X	X

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Tributaries of St. Joseph River, Elkhart County, 2013										
Stream	Christiana Creek									
Site	CR 4		Willowdale Park		NMWF		High Dive Park (A)		High Dive Park (B)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Spotfin Shiner	X		X	X	X	X	X	X	X	X
Steelcolor Shiner		X	X			X		X		X
~Stonecat			X			X			X	
Stoneroller, Central										X
Striped Shiner	X	X	X		X	X	X	X	X	X
Walleye						X			X	X
Warmouth									X	X
#White Sucker	X	X	X	X	X				X	
#Yellow Bullhead	X	X	X	X	X	X		X	X	X
Yellow Perch								X		

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Tributaries to St. Joseph River, Elkhart County, 2013										
Stream	Elkhart River						Baugo Creek			
Site	Oxbow Park		Indiana Avenue		Middlebury Street		CR 1 (South)		CR 3 (North)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
~American Brook Lamprey				X						
#Banded Killifish									X	X
#Black Bullhead					X					
#Blacknose Dace							X	X	X	X
Blackside Darter	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	X
#Brown Bullhead								X		
#Central Mudminnow									X	
Chestnut Lamprey	X	X	X	X	X	X				
#Common Carp							X	X		
Common Shiner								X		X
#Creek Chub	X						X	X	X	X
#Fathead Minnow	X									X
~Golden Redhorse	X	X	X	X	X	X			X	X
#Golden Shiner										X
~Greater Redhorse	X	X								
#Green Sunfish	X		X		X		X	X		
~Hornyhead Chub	X	X	X	X	X	X				
Hybrid Sunfish										
Johnny Darter				X			X	X	X	X
Largemouth Bass	X	X	X		X	X			X	X
~Logperch									X	X
~Longear Sunfish	X	X	X	X	X	X				
~Longnose Dace									X	X
~Mimic Shiner								X		
~Northern Hog Sucker	X	X	X	X	X	X				
Northern Pike	X	X								
~Orangethroat Darter						X			X	X
Pumpkinseed			X					X		X
~Rainbow Darter			X	X					X	X
Redear Sunfish		X	X	X						
Rock Bass	X	X	X	X	X	X	X	X	X	X
~Rosyface Shiner	X	X	X	X	X	X				
~Sand Shiner			X			X	X	X	X	X
~Shorthead Redhorse	X			X						
~Silver Lamprey					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 St. Joseph River, Elkhart County, 2013										
Stream	Elkhart River						Baugo Creek			
Site	Oxbow Park		Indiana Avenue		Middlebury Street		CR 1 (South)		CR 3 (North)	
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Silverjaw Minnow							X	X	X	X
~Smallmouth Bass	X	X	X	X	X	X			X	X
Spotfin Shiner	X	X	X	X	X	X				
Spotted Sucker	X	X	X	X						
Steelcolor Shiner		X	X	X						
~Stonecat					X					
Stoneroller, Central							X	X	X	X
Striped Shiner	X	X	X	X	X	X	X		X	
Walleye					X					
Warmouth				X						
#White Sucker	X	X	X	X	X	X	X	X	X	X
#Yellow Bullhead		X			X	X		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 St. Joseph River, St. Joseph County, 2013				
Stream	Juday Creek			
Site	Bittersweet Road	State Road 23		Warren Golf Course
		1st Pass	2nd Pass	
#Blacknose Dace				X
Bluegill	X	X	X	X
#Central Mudminnow	X			
#Creek Chub		X	X	X
#Green Sunfish	X	X	X	X
Johnny Darter		X	X	X
Largemouth Bass		X		
Mottled Sculpin	X	X	X	X
~Rock Bass		X	X	X
~Smallmouth Bass		X	X	X
#White Sucker		X	X	X
#Yellow Bullhead				X

Tributaries to St. Joseph River, St. Joseph County, 2013							
Stream	Auten Ditch			Bowman Creek			
Site	Locust Road (South)		Gertrude	AM General South	AM General North	Ravina Park	
	1st Pass	2nd Pass				1st Pass	2nd Pass
#Black Bullhead				x	x	No Fish	No Fish
Bluegill				x	x		
#Central Mudminnow	X	X		x	x		
#Creek Chub	X	X	X	x	x		
#Fathead Minnow	X		X	x	x		
#Golden Shiner			X		x		
#Green Sunfish				x	x		
Hybrid Sunfish					x		
Largemouth Bass				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

Appendix E

Summary of macroinvertebrates (insects) collected by site, 2013

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: 08/26/13 Site #: 1

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Spongillidae	0	+	Hydropsyche aerata	10	
Hydra sp	12		Hydropsyche phalerata	62	
Turbellaria	426		Macrostemum zebratum	10	+
Oligochaeta	4	+	Hydroptila sp	173	
Hyalella azteca	39	+	Brachycentrus numerosus	4	
Gammarus sp	0	+	Neophylax sp	0	+
Gammarus fasciatus	0	+	Pycnopsyche sp	0	+
Baetidae	9		Helicopsyche borealis	4	+
Plauditus dubius	0	+	Oecetis persimilis	0	+
Plauditus dubius or P. virilis	10	+	Coleoptera	4	
Baetis flavistriga	11	+	Dineutus sp	3	+
Baetis intercalaris	395	+	Peltodytes sp	0	+
Labiobaetis propinquus	8	+	Dytiscidae	0	+
Iswaeon anoka	79	+	Psephenus herricki	0	+
Procloeon sp (w/ hindwing pads)	0	+	Macronychus glabratus	16	+
Procloeon sp (w/o hindwing pads)	0	+	Stenelmis sp	28	+
Isonychia sp	83	+	Simulium sp	5	+
Leucrocuta sp	9	+	Chironomidae	25	
Stenacron sp	246	+	Nilotanypus fimbriatus	12	
Maccaffertium exiguum	95	+	Pentaneura inconspicua	48	+
Maccaffertium mediopunctatum	11		Corynoneura lobata	97	
Maccaffertium mexicanum integrum	9		Cricotopus (C.) bicinctus	12	
Maccaffertium pulchellum	208	+	Thienemanniella xena	32	
Maccaffertium terminatum	23		Tvetenia discoloripes group	48	
Paraleptophlebia sp	9		Dicrotendipes neomodestus	6	
Eurylophella sp	4		Microtendipes "caelum"	0	+
Teloganopsis deficiens	16	+	Microtendipes pedellus group	6	+
Tricorythodes sp	252	+	Polypedilum (Uresipedilum) flavum	243	+
Caenis sp	20	+	Polypedilum (P.) illinoense	36	+
Anthopotamus sp	0	+	Polypedilum (P.) laetum group	6	
Ephemera sp	0	+	Stenochironomus sp	0	+
Hetaerina sp	0	+	Rheotanytarsus sp	30	
Coenagrionidae	0	+	Elimia sp	1	+
Argia sp	8	+	Ferrissia sp	8	
Nasiaeschna pentacantha	0	+	Corbicula fluminea	0	+
Pteronarcys sp	0	+	Pisidiidae	4	
Perlidae	8		Elliptio dilatata	0	+
Acroneuria internata	0	+	Ptychobranchus fasciolaris	0	+
Agnetina capitata complex	18	+			
Corydalus cornutus	6	+	No. Quantitative Taxa:	59	
Chimarra obscura	61		No. Qualitative Taxa:	55	
Neureclipsis sp	10		Total Taxa:	83	
Polycentropus sp	4	+	Number of Organisms:	4221	
Cheumatopsyche sp	1193	+	Qual EPT:	28	
Ceratopsyche sparna	2		**ICI:**	**48**	

Site: St. Joseph River Sherman Street

Date Collected: 08/26/13 Site #: 2

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Spongillidae	0	+	Oxyethira sp	24	
Hydra sp	8		Brachycentrus numerosus	2	+
Turbellaria	234	+	Neophylax sp	0	+
Oligochaeta	9	+	Pycnopsyche sp	0	+
Hyalella azteca	9	+	Ceraclea sp	0	+
Gammarus sp	0	+	Nectopsyche sp	0	+
Orconectes (Procericambarus) rusticus	0	+	Nectopsyche exquisita	0	+
Hydrachnidia	8	+	Oecetis persimilis	1	
Baetidae	8		Petrophila sp	8	
Acentrella sp	0	+	Dineutus sp	0	+
Plauditus dubius or P. virilis	16	+	Psephenus herricki	0	+
Baetis intercalaris	15		Macronychus glabratus	8	+
Labiobaetis propinquus	0	+	Simulium sp	0	+
Iswaeon anoka	0	+	Chironomidae	28	
Isonychia sp	25	+	Ablabesmyia rhamphe group	0	+
Leucrocuta sp	16		Pentaneura inconspicua	83	+
Stenacron sp	261	+	Cricotopus (C.) sp	0	+
Maccaffertium exiguum	66	+	Cricotopus (C.) bicinctus	97	+
Maccaffertium mediopunctatum	31		Thienemanniella lobapodema	16	+
Maccaffertium mexicanum integrum	37		Thienemanniella xena	21	
Maccaffertium pulchellum	285	+	Tvetenia discoloripes group	69	+
Maccaffertium terminatum	54		Dicrotendipes modestus	14	+
Eurylophella sp	9	+	Dicrotendipes neomodestus	83	+
Teloganopsis deficiens	67		Polypedilum (Uresipedilum) flavum	332	+
Tricorythodes sp	1315	+	Polypedilum (P.) illinoense	0	+
Caenis sp	8	+	Xenochironomus xenolabis	0	+
Coenagrionidae	0	+	Rheotanytarsus sp	469	+
Argia sp	0	+	Tanytarsus glabrescens group sp 7	14	
Agnetina capitata complex	12		Hemerodromia sp	16	
Cyrnellus fraternus	1		Elimia sp	16	+
Polycentropus sp	0	+	Fossaria sp	0	+
Cheumatopsyche sp	981	+	Ferrissia sp	8	
Hydropsyche aerata	100	+	Corbicula fluminea	0	+
Hydropsyche depravata group	14		Dreissena polymorpha	0	+
Hydropsyche frisoni	1				
Hydropsyche phalerata	1	+	No. Quantitative Taxa:	50	
Hydropsyche venularis	13		No. Qualitative Taxa:	53	
Macrostemum zebratum	50	+	Total Taxa:	75	
Protoptila sp	0	+	Number of Organisms:	5228	
Hydroptila sp	264	+	Qual EPT:	24	
Ochrotrichia sp	1		**ICI:**	**50**	

Site: St. Joseph River Capital Avenue

Date Collected: 08/26/13 Site #: 3

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Turbellaria	2482	+	Oecetis persimilis	35	+
Lophopodella carteri	14		Petrophila sp	16	
Plumatella sp	0	+	Peltodytes sp	0	+
Oligochaeta	0	+	Dubiraphia quadrinotata	0	+
Caecidotea sp	0	+	Dubiraphia vittata group	0	+
Hyalella azteca	4	+	Macronychus glabratus	0	+
Crangonyx sp	0	+	Stenelmis sp	0	+
Hydrachnidia	4		Simulium sp	134	+
Plauditus sp	1		Chironomidae	48	
Plauditus dubius	1		Tanypodinae	0	+
Plauditus dubius or P. virilis	0	+	Hayesomyia senata	59	
Baetis flavistriga	2	+	Nilotanypus fimbriatus	8	
Baetis intercalaris	222	+	Pentaneura inconspicua	0	+
Labiobaetis propinquus	0	+	Cardiocladius albiplumus	10	
Iswaeon anoka	42		Corynoneura floridaensis	4	
Callibaetis sp	0	+	Cricotopus sp	10	
Isonychia sp	138	+	Cricotopus (C.) bicinctus	214	+
Leucrocuta sp	0	+	Thienemanniella lobapodema	4	
Stenacron sp	213	+	Thienemanniella similis	4	
Maccaffertium exiguum	56	+	Thienemanniella xena	8	
Maccaffertium mediopunctatum	23	+	Tvetenia discoloripes group	10	+
Maccaffertium mexicanum integrum	2		Demicryptochironomus sp	0	+
Maccaffertium pulchellum	211	+	Phaenopsectra obediens group	0	+
Maccaffertium terminatum	22	+	Polypedilum (Uresipedilum) flavum	485	+
Tricorythodes sp	156	+	Polypedilum (P.) illinoense	10	+
Caenis sp	0	+	Xenochironomus xenolabis	10	
Coenagrionidae	0	+	Rheotanytarsus sp	155	+
Argia sp	34	+	Tanytarsus glabrescens group sp 7	19	
Chimarra obscura	4		Hemerodromia sp	4	
Dolophilodes distinctus	4		Elimia sp	0	+
poss. Cernotina sp or Polycentropus sp	1		Fossaria sp	0	+
Cheumatopsyche sp	4340	+	Physella sp	0	+
Hydropsyche aerata	41		Planorbella (Pierosoma) pilsbryi	0	+
Hydropsyche bidens	3		Corbicula fluminea	0	+
Hydropsyche orris	57		Dreissena polymorpha	0	+
Hydropsyche venularis	0	+	Sphaerium sp	0	+
Macrostemum zebratum	11	+	Utterbackia imbecillis	0	+
Potamyia flava	0	+	Actinonaias ligamentina carinata	0	+
Hydroptila sp	111		Leptodea fragilis	0	+
Brachycentrus numerosus	0	+	Lampsilis cardium	0	+
Neophylax sp	0	+	No. Quantitative Taxa:	48	
Pycnopsyche sp	0	+	No. Qualitative Taxa:	59	
Mystacides sepulchralis	0	+	Total Taxa:	86	
Nectopsyche sp	0	+	Number of Organisms:	9450	
Oecetis avara	0	+	Qual EPT:	25	
			ICI:	**46**	

Site: St. Joseph River Michigan Street

Date Collected: 08/26/13 Site #: 4

Taxa Name	Quantitative	Qualitative
Spongillidae	0	+
Turbellaria	534	+
Nemertea	9	
Nematoda	1	
Oligochaeta	3	+
Gammarus fasciatus	2	+
Hydrachnidia	2	
Acentrella sp	0	+
Plauditus dubius	22	+
Plauditus dubius or P. virilis	0	+
Baetis intercalaris	749	+
Iswaeon anoka	24	+
Plauditus virilis	21	
Isonychia sp	19	+
Leucrocuta sp	0	+
Stenacron sp	109	+
Maccaffertium exiguum	31	+
Maccaffertium pulchellum	47	+
Maccaffertium terminatum	33	+
Teloganopsis sp	9	
Tricorythodes sp	62	+
Argia sp	0	+
Chimarra obscura	21	
Neureclipsis sp	1	
Cheumatopsyche sp	1539	+
Hydropsyche aerata	165	+
Hydropsyche depravata group	12	
Hydropsyche frisoni	6	
Hydropsyche orris	17	
Hydropsyche phalerata	323	+
Macrostemum zebratum	165	+
Hydroptila sp	222	
Brachycentrus numerosus	4	
Pycnopsyche sp	0	+
Crambidae	8	
Petrophila sp	9	
Macronychus glabratus	2	
Stenelmis sp	2	+
Simulium sp	41	+
Rheopelopia paramaculipennis	4	
Thienemannimyia group	4	
Cardiocladius obscurus	4	+
Cricotopus sp	4	
Cricotopus (C.) bicinctus	119	
Thienemanniella similis	8	
Thienemanniella xena	82	
Tvetenia discoloripes group	68	
Dicrotendipes neomodestus	4	
Polypedilum flavum	81	
Polypedilum (P.) illinoense	4	
Rheotanytarsus sp	13	
Hemerodromia sp	19	
Elimia sp	53	+
Fossaria sp	0	+
Physella sp	0	+
Ferrissia sp	0	+
Corbicula fluminea	0	+
Sphaerium sp	1	
Actinonaias ligamentina carinata	0	+

No. Quantitative Taxa:	48
No. Qualitative Taxa:	31
Total Taxa:	59
Number of Organisms:	4682
Qual EPT:	17
ICI:	**48**

Site: St. Joseph River Pinhook (B)

Date Collected: 08/26/13 Site #: 5

Taxa Name	Quantitative	Qualitative
Spongillidae	0	+
Hydra sp	500	+
Turbellaria	9	+
Fredericella sp	1	
Oligochaeta	2	+
Caecidotea sp	0	+
Crangonyx sp	1	+
Gammarus sp	0	+
Gammarus fasciatus	0	+
Orconectes rusticus	0	+
Hydrachnidia	2	
Baetis flavistriga	2	
Baetis intercalaris	13	
Isonychia sp	12	+
Leucrocuta sp	5	
Stenacron sp	220	+
Maccaffertium exiguum	24	
Maccaffertium mediopunctatum	4	
Maccaffertium pulchellum	19	+
Maccaffertium terminatum	1	
Teloganopsis deficiens	4	
Tricorythodes sp	42	+
Coenagrionidae	0	+
Argia sp	15	+
Chimarra obscura	1	
Polycentropus sp	4	+
Cheumatopsyche sp	34	+
Hydropsyche phalerata	9	
Macrostemum zebratum	23	+
Hydroptila sp	10	
Brachycentrus numerosus	4	+
Pycnopsyche sp	0	+
Helicopsyche borealis	3	+
Mystacides sepulchralis	0	+
Oecetis persimilis	2	+
Psephenus herricki	0	+
Dubiraphia vittata group	0	+
Macronychus glabratus	10	+
Stenelmis sp	6	+
Simulium sp	2	
Chironomidae	4	
Tanypodinae	1	
Ablabesmyia janta	4	
Conchapelopia sp	1	
Nilotanypus fimbriatus	1	
Corynoneura sp	1	
Corynoneura doriceni	1	
Cricotopus (C.) bicinctus	1	
Thienemanniella xena	2	
Phaenopsectra obediens group	4	
Polypedilum flavum	4	
Polypedilum (P.) illinoense	5	
Stictochironomus sp	0	+
Rheotanytarsus sp	2	
Hemerodromia sp	2	
Elimia sp	201	+
Fossaria sp	2	
Menetus dilatatus	3	
Ferrissia sp	2	
Corbicula fluminea	2	+

No. Quantitative Taxa:	49
No. Qualitative Taxa:	30
Total Taxa:	60
Number of Organisms:	1227
Qual EPT:	12
ICI:	**44**

Site: Little Elkhart River CR 10

Date Collected: 08/27/13 Site #: 6

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Spongillidae	0	+	Conchapelopia sp	149	
Oligochaeta	8	+	Hayesomyia senata	100	
Caecidotea sp	0	+	Procladius (Holotanypus) sp	0	+
Crangonyx sp	5	+	Pagastia orthogonia	0	+
Gammarus pseudolimnaeus	12	+	Corynoneura lobata	32	
Orconectes sp	0	+	Eukiefferiella brehmi group	124	
Hydrachnidia	24	+	Orthocladius lignicola	25	
Baetis tricaudatus	10	+	Parakiefferiella n.sp 2	25	+
Plauditus dubius or P. virilis	11	+	Parametriocnemus sp	25	
Baetis flavistriga	511	+	Paratrichocladius sp	102	
Baetis intercalaris	23		Rheocricotopus robacki	75	
Labiobaetis propinquus	0	+	Thienemanniella taurocapita	40	
Iswaeon anoka	15	+	Thienemanniella lobapodema	16	
Procloeon sp	0	+	Thienemanniella xena	72	
Leucrocuta sp	1		Tvetenia bavarica group	199	
Stenacron sp	41	+	Chironomus sp	0	+
Maccaffertium exiguum	24	+	Dicrotendipes neomodestus	0	+
Maccaffertium pulchellum	43	+	Microtendipes "caelum"	0	+
Maccaffertium terminatum	20		Paratendipes albimanus	0	+
Maccaffertium vicarium	77	+	Phaenopsectra obediens group	0	+
Tricorythodes sp	0	+	Polypedilum (Uresipedilum) flavum	75	
Calopteryx sp	8	+	Polypedilum (P.) laetum group	0	+
Coenagrionidae	0	+	Saetheria tylus	0	+
Gomphus sp	0	+	Rheotanytarsus pellucidus	100	+
Stylurus sp	0	+	Rheotanytarsus sp	1690	+
Palmacorixa sp	0	+	Tanytarsus sp	0	+
Lype diversa	8	+	Tanytarsus glabrescens group sp 7	75	+
Cheumatopsyche sp	351	+	Neoplasta sp	4	
Ceratopsyche morosa group	209	+	Hemerodromia sp	8	
Ceratopsyche sparna	259	+	Elimia sp	4	+
Hydropsyche depravata group	222	+	Fossaria sp	16	
Hydroptila sp	9		Physella sp	10	+
Brachycentrus numerosus	12	+	Planorbella (Pierosoma) pilsbryi	0	+
Neophylax sp	0	+	Ferrissia sp	29	
Pycnopsyche sp	1	+	Corbicula fluminea	0	+
Mystacides sepulchralis	0	+	Sphaerium sp	0	+
Nectopsyche diarina	0	+	No. Quantitative Taxa:	52	
Gyrinus sp	0	+	No. Qualitative Taxa:	59	
Haliplus sp	0	+	Total Taxa:	81	
Peltodytes sp	0	+	Number of Organisms:	4986	
Ancyronyx variegata	1	+	Qual EPT:	59	
Macronychus glabratus	35	+	**ICI:**	**56**	
Stenelmis sp	9	+			
Antocha sp	9				
Simulium sp	33	+			

Site: Puterbaugh Creek CR 8

Date Collected: 08/25/13 Site #: 7

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Hydra sp	1		Ablabesmyia mallochi	5	+
Turbellaria	22		Conchapelopia sp	5	+
Oligochaeta	19		Hayesomyia senata	7	
Gammarus fasciatus	1		Helopelopia sp	2	
Gammarus pseudolimnaeus	17	+	Labrundinia pilosella	2	
Hydrachnidia	2	+	Procladius sp	2	
Baetis tricaudatus	5	+	Procladius (Holotanypus) sp	0	+
Baetis flavistriga	0	+	Thienemannimyia group	2	
Baetis intercalaris	2		Corynoneura sp	3	
Iswaeon anoka	0	+	Corynoneura lobata	35	
Stenacron sp	54	+	Cricotopus (C.) bicinctus	2	
Maccaffertium exiguum	5		Cricotopus (C.)	2	
Maccaffertium pulchellum	5		Parametriocnemus sp	7	+
Maccaffertium vicarium	347	+	Thienemanniella xena	12	
Paraleptophlebia sp	6		Tvetenia bavarica group	2	
Caenis sp	2	+	Microtendipes pedellus group	17	
Calopteryx sp	0	+	Paratendipes albimanus	17	+
Hetaerina sp	0	+	Phaenopsectra obediens group	2	
Coenagrionidae	0	+	Polypedilum (Uresipedilum) aviceps	12	+
Notonecta sp	0	+	Polypedilum (Uresipedilum) flavum	3	
Cheumatopsyche sp	124	+	Polypedilum (P.) fallax group	14	
Hydropsyche depravata group	36	+	Polypedilum (P.) laetum group	2	
Hydropsyche dicantha	0	+	Polypedilum scalaenum group	0	+
Glossosoma sp	0	+	Rheotanytarsus pellucidus	9	+
Hydroptilidae	1		Rheotanytarsus sp	16	
Brachycentrus numerosus	6	+	Stempellinella fimbriata	11	
Neophylax sp	0	+	Hemerodromia sp	4	+
Pycnopsyche sp	2	+	Elimia sp	48	+
Helicopsyche borealis	24	+	Fossaria sp	5	
Mystacides sepulchralis	1	+	Physella sp	2	+
Nectopsyche sp	0	+	Gyraulus sp	0	+
Nectopsyche diarina	1		Ferrissia sp	1	+
Oecetis persimilis	1		Corbicula fluminea	0	+
Triaenodes melaca	0	+	Pisidium sp	4	
Peltodytes sp	0	+	Sphaerium sp	4	+
Ancyronyx variegata	1		No. Quantitative Taxa:	59	
Macronychus glabratus	6	+	No. Qualitative Taxa:	42	
Optioservus sp	4		Total Taxa:	76	
Simulium sp	3	+	Number of Organisms:	959	
Chironomidae	2		Qual EPT:	17	
Tanypodinae	0	+	**ICI:**	**54**	

Site: Christiana Creek CR 4

Date Collected: 08/26/13 Site #: 8

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Turbellaria	9	+	Psephenus herricki	0	+
Nemertea	1		Stenelmis sp	0	+
Placobdella ornata	1		Simulium sp	0	+
Erpobdella punctata punctata	0	+	Conchapelopia sp	17	
Caecidotea sp	0	+	Hayesomyia senata	2	
Hyalella azteca	0	+	Nilotanypus fimbriatus	2	
Gammarus fasciatus	25	+	Pentaneura sp	8	
Hydrachnidia	0	+	Corynoneura lobata	16	+
Baetis flavistriga	43	+	Cricotopus (C.) sp	0	+
Baetis intercalaris	0	+	Rheocricotopus robacki	6	
Labiobaetis propinquus	0	+	Thienemanniella taurocapita	1	
Iswaeon anoka	0	+	Tvetenia discoloripes group	1	+
Procloeon viridoculare	0	+	Cryptochironomus sp	0	+
Nixe sp	0	+	Microtendipes pedellus group	0	+
Stenacron sp	48	+	Microtendipes rydalensis	1	
Maccaffertium exiguum	452	+	Phaenopsectra flavipes	0	+
Maccaffertium mediopunctatum	95	+	Polypedilum (Uresipedilum) flavum	21	+
Maccaffertium terminatum	309	+	Polypedilum (P.) fallax group	1	
Teloganopsis sp	34	+	Tribelos jucundum	0	+
Tricorythodes sp	31	+	Rheotanytarsus sp	3	
Caenis sp	0	+	Tanytarsus sp	1	
Anthopotamus sp	0	+	Tanytarsus sepp	1	
Hetaerina sp	0	+	Empididae	1	
Coenagrionidae	0	+	Hydrobiidae	0	+
Anax sp	0	+	Physella sp	0	+
Boyeria vinosa	0	+	Gyraulus (Torquis) parvus	0	+
Plathemis lydia	0	+	Planorbella (Pierosoma) trivolvis	0	+
Acroneuria internata	5		Ferrissia sp	4	
Sialis sp	6	+	Corbicula fluminea	0	+
Neureclipsis sp	6	+	Pisidium sp	0	+
Cheumatopsyche sp	45	+	Sphaerium sp	0	+
Ceratopsyche morosa group	0	+			
Hydropsyche depravata group	3	+			
Hydropsyche phalerata	34	+	No. Quantitative Taxa:	34	
Hydropsyche venularis	0	+	No. Qualitative Taxa:	56	
Neophylax sp	0	+	Total Taxa:	72	
Helicopsyche borealis	14	+	Number of Organisms:	1247	
Mystacides sp	0	+	Qual EPT:	26	
Nectopsyche diarina	0	+	**ICI:**	**46**	
Oecetis sp	0	+			
Triaenodes sp	0	+			

Site: Christiana Creek High Dive Below

Date Collected: 08/27/13 Site #: 9

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Turbellaria	1	+	Optioservus sp	0	+
Nemertea	24		Stenelmis sp	2	+
Oligochaeta	2376		Simulium sp	58	+
Helobdella stagnalis	0	+	Conchapelopia sp	29	
Crangonyx sp	0	+	Rheopelopia paramaculipennis	15	
Gammarus fasciatus	5		Cardiocladius obscurus	15	
Cambaridae	0	+	Corynoneura sp	0	+
Hydrachnidia	8	+	Cricotopus (C.) sp	160	
Plauditus dubius or P. virilis	5		Cricotopus (C.) bicinctus	204	
Baetis flavistriga	63	+	Nanocladius (N.) crassicornus	0	+
Baetis intercalaris	639	+	Parametriocnemus sp	15	
Iswaeon anoka	66		Paratrichocladius sp	248	
Isonychia sp	42	+	Rheocricotopus robacki	29	
Stenacron sp	0	+	Thienemanniella taurocapita	15	
Maccaffertium exiguum	90	+	Thienemanniella xena	29	
Maccaffertium mediopunctatum	150	+	Cryptochironomus sp	0	+
Maccaffertium terminatum	0	+	Dicrotendipes neomodestus	15	
Teloganopsis sp	29	+	Microtendipes "caelum"	44	
Tricorythodes sp	262	+	Microtendipes pedellus group	0	+
Caenis sp	8		Paralauterborniella nigrohalteralis	0	+
Hetaerina sp	0	+	Polypedilum scalaenum group	0	+
Coenagrionidae	0	+	Cladotanytarsus sp	0	+
Argia sp	0	+	Rheotanytarsus pellucidus	29	
Boyeria vinosa	0	+	Rheotanytarsus sp	204	+
Corydalus cornutus	1		Tanytarsus sp	0	+
Chimarra obscura	2		Tanytarsus glabrescens group sp 7	102	
Psychomyia flavida	6		Hemerodromia sp	170	
Neureclipsis sp	1	+	Elimia sp	14	+
Cheumatopsyche sp	41		Physella sp	0	+
Ceratopsyche morosa group	31		Ferrissia sp	25	
Ceratopsyche sparna	19		Corbicula fluminea	0	+
Hydropsyche depravata group	176	+	Fusconaia flava	0	+
Hydroptila sp	65	+			
Ochrotrichia sp	0	+	No. Quantitative Taxa:	47	
Brachycentrus numerosus	5	+	No. Qualitative Taxa:	44	
Neophylax sp	0	+	Total Taxa:	73	
Mystacides sp	0	+	Number of Organisms:	5613	
Oecetis persimilis	34		Qual EPT:	16	
Petrophila sp	0	+	**ICI:**	**36***	
Psephenus herricki	0	+	*Quantitative sample is not valid		
Macronychus glabratus	42	+			

Site: Elkhart River Oxbow Park

Date Collected: 08/27/13 Site #: 10

Taxa Name	Quantitative	Qualitative
Spongillidae	0	+
Hydra sp	1	
Turbellaria	18	
Caecidotea sp	0	+
Orconectes rusticus	0	+
Hydrachnidia	4	+
Plauditus dubius or P. virilis	13	+
Baetis flavistriga	51	+
Baetis intercalaris	230	+
Labiobaetis propinquus	0	+
Iswaeon anoka	13	+
Isonychia sp	9	+
Leucrocuta sp	27	
Stenacron sp	20	+
Maccaffertium exiguum	27	+
Maccaffertium mediopunctatum	1	
Maccaffertium mexicanum integrum	1	
Maccaffertium pulchellum	39	+
Tricorythodes sp	15	+
Calopteryx sp	0	+
Hetaerina sp	0	+
Coenagrionidae	0	+
Argia sp	8	+
Dromogomphus sp	0	+
Pteronarcys sp	0	+
Agnetina capitata complex	0	+
Belostoma sp	0	+
Corydalus cornutus	10	
Cheumatopsyche sp	156	+
Ceratopsyche morosa group	83	+
Ceratopsyche sparna	11	+
Hydropsyche depravata group	5	+
Hydroptila sp	4	
Brachycentrus numerosus	6	+
Neophylax sp	0	+
Pycnopsyche sp	0	+
Ceraclea sp	0	+
Triaenodes sp	0	+
Haliplus sp	0	+
Ancyronyx variegata	5	
Dubiraphia bivittata	0	+
Macronychus glabratus	2	+
Stenelmis sp	0	+
Simulium sp	5	+
Tanypodinae	2	
Ablabesmyia mallochi	4	
Hayesomyia senata	2	
Nilotanypus fimbriatus	3	
Cardiocladius obscurus	4	
Corynoneura lobata	13	
Rheocricotopus robacki	13	+
Tvetenia discoloripes group	11	
Chironominae	2	
Paratendipes albimanus	0	+
Polypedilum flavum	29	
Polypedilum scalaenum group	2	+
Rheotanytarsus pellucidus	2	
Rheotanytarsus sp	65	+
Hydrobiidae	0	+
Elimia sp	66	+
Physella sp	0	+
Ferrissia sp	2	
Corbicula fluminea	0	+
Dreissena polymorpha	0	+
Sphaerium sp	0	+
Fusconaia flava	0	+

No. Quantitative Taxa:	41
No. Qualitative Taxa:	47
Total Taxa:	66
Number of Organisms:	984
Qual EPT:	21
ICI:	**54**

Site: Elkhart River Middlebury

Date Collected: 08/15/13 Site #: 11

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Spongillidae	0	+	Dubiraphia vittata group	0	+
Turbellaria	25	+	Macronychus glabratus	9	+
Oligochaeta	2	+	Stenelmis sp	8	+
Placobdella ornata	0	+	Simulium sp	35	+
Hyalella azteca	0	+	Hayesomyia senata	12	
Crangonyx sp	8		Nilotanypus fimbriatus	12	
Gammarus fasciatus	13	+	Procladius (Holotanypus) sp	0	+
Gammarus pseudolimnaeus	18	+	Rheopelopia paramaculipennis	22	
Hydrachnidia	0	+	Cardiocladius obscurus	4	+
Plauditus dubius	13		Corynoneura sp	2	
Plauditus dubius or P. virilis	12	+	Corynoneura lobata	82	
Baetis flavistriga	452	+	Cricotopus sp	4	
Baetis intercalaris	702	+	Cricotopus (C.) bicinctus	56	+
Labiobaetis propinquus	0	+	Cricotopus (C.) trifascia	12	
Iswaeon anoka	70	+	Rheocricotopus robacki	8	
Paracloeodes minutus	0	+	Thienemanniella taurocapita	10	
Procloeon viridoculare	0	+	Thienemanniella xena	28	
Isonychia sp	181	+	Tvetenia discoloripes group	30	
Leucrocuta sp	52	+	Xylotopus par	0	+
Stenacron sp	21	+	Chironominae	8	
Maccaffertium exiguum	41	+	Chironomus sp	0	+
Maccaffertium pulchellum	53	+	Dicrotendipes neomodestus	4	+
Maccaffertium terminatum	16		Microtendipes "caelum"	18	+
Eurylophella sp	16		Phaenopsectra sp or Tribelos sp	4	+
Teloganopsis sp	22		Polypedilum (Uresipedilum) flavum	52	
Tricorythodes sp	144	+	Polypedilum (P.) fallax group	4	
Caenis sp	16		Polypedilum (P.) illinoense	4	+
Calopteryx sp	0	+	Polypedilum scalaenum group	0	+
Coenagrionidae	0	+	Cladotanytarsus vanderwulpi group	0	+
Argia sp	8	+	Rheotanytarsus pellucidus	12	
Pteronarcys sp	0	+	Rheotanytarsus sp	115	+
Sialis sp	0	+	Tanytarsus sp	0	+
Corydalus cornutus	6		Tanytarsus glabrescens group sp 7	4	
Cheumatopsyche sp	235		Tanytarsus sepp	4	
Ceratopsyche morosa group	430	+	Hemerodromia sp	16	
Ceratopsyche sparna	39		Elimia sp	54	+
Hydropsyche depravata group	31		Fossaria sp	0	+
Hydropsyche phalerata	79	+	Corbicula fluminea	0	+
Hydropsyche venularis	27		Sphaerium sp	0	+
Hydroptila sp	81				
Brachycentrus numerosus	2	+	No. Quantitative Taxa:	59	
Pycnopsyche sp	0	+	No. Qualitative Taxa:	56	
Helicopsyche borealis	0	+	Total Taxa:	86	
Mystacides sepulchralis	0	+	Number of Organisms:	3448	
Nectopsyche sp	0	+	Qual EPT:	23	
Nectopsyche diarina	0	+	**ICI:**	**54**	
Oecetis sp	0	+			
Dubiraphia vittata group	0	+			

Site: Cobus Creek CR 8

Date Collected: 08/25/13 Site #: 12

Taxa Name	Quantitative	Qualitative
Turbellaria	0	+
Nemertea	0	+
Caecidotea sp	0	+
Orconectes propinquus	0	+
Hydrachnidia	0	+
Baetis tricaudatus	0	+
Baetis flavistriga	0	+
Iswaeon anoka	0	+
Leucrocuta sp	0	+
Stenacron sp	0	+
Maccaffertium exiguum	0	+
Maccaffertium pulchellum	0	+
Maccaffertium vicarium	0	+
Eurylophella sp	0	+
Boyeria vinosa	0	+
Notonecta sp	0	+
Cheumatopsyche sp	0	+
Ceratopsyche sparna	0	+
Hydropsyche depravata group	0	+
Brachycentrus numerosus	0	+
Neophylax sp	0	+
Pycnopsyche sp	0	+
Helicopsyche borealis	0	+
Mystacides sepulchralis	0	+
Nectopsyche diarina	0	+
Oecetis persimilis	0	+
Macronychus glabratus	0	+
Optioservus sp	0	+
Stenelmis sp	0	+
Antocha sp	0	+
Anopheles sp	0	+
Simulium sp	0	+
Tanypodinae	0	+
Tvetenia bavarica group	0	+
Paratendipes albimanus	0	+
Stictochironomus sp	0	+
Rheotanytarsus pellucidus	0	+
Rheotanytarsus sp	0	+
Corbicula fluminea	0	+

No. Quantitative Taxa:	0
No. Qualitative Taxa:	39
Total Taxa:	39
Number of Organisms:	367
Qual EPT:	19
ICI:	**VG***

*Qualitative rating

Site: Baugo Creek CR 3 (N)

Date Collected: 08/27/13 Site #: 13

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Spongillidae	0	+	Cryptotendipes pseudotener	0	+
Hydra sp	80		Dicrotendipes neomodestus	107	+
Turbellaria	30	+	Microtendipes "caelum"	107	
Fredericella sp	0	+	Microtendipes pedellus group	133	+
Plumatella sp	8	+	Parachironomus frequens	27	
Oligochaeta	0	+	Paratendipes albimanus	0	+
Erpobdella punctata punctata	0	+	Phaenopsectra obediens group	214	+
Gammarus pseudolimnaeus	0	+	Polypedilum (Uresipedilum) flavum	534	+
Hydrachnidia	8		Polypedilum (P.) fallax group	27	
Baetis tricaudatus	0	+	Polypedilum (P.) illinoense	0	+
Plauditus dubius or P. virilis	0	+	Polypedilum scalaenum group	0	+
Baetis flavistriga	0	+	Cladotanytarsus vanderwulpi	27	+
Labiobaetis frondalis	0	+	Paratanytarsus sp	133	
Baetis intercalaris	8		Rheotanytarsus sp	27	+
Stenacron sp	16	+	Tanytarsus sp	160	+
Tricorythodes sp	0	+	Tanytarsus glabrescens group sp 7	374	
Calopteryx sp	0	+	Tanytarsus sepp	214	+
Hetaerina sp	0	+	Hemerodromia sp	24	
Coenagrionidae	0	+	Elimia sp	11	+
Belostoma sp	0	+	Fossaria sp	4	
Cheumatopsyche sp	41	+	Physella sp	90	+
Ceratopsyche morosa group	143	+	Helisoma anceps anceps	10	+
Hydropsyche depravata group	12	+	Menetus (Micromenetus) dilatatus	16	
Hydroptila sp	16	+	Ferrissia sp	66	+
Ptilostomis sp	0	+	Sphaerium sp	0	+
Lepidoptera	0	+			
Stenelmis sp	0	+			
Antocha sp	17		No. Quantitative Taxa:	41	
Limonia sp	0	+	No. Qualitative Taxa:	47	
Anopheles sp	0	+	Total Taxa:	66	
Simulium sp	0	+	Number of Organisms:	3298	
Ablabesmyia mallochi	187	+	Qual EPT:	11	
Conchapelopia sp	133	+	**ICI:**	**34**	
Hayesomyia senata	53				
Helopelopia sp	53				
Labrundinia pilosella	53				
Nilotanypus fimbriatus	27				
Cricotopus (C.) sp	27				
Cricotopus (C.) bicinctus	27	+			
Nanocladius (N.) crassicornus	27				
Nanocladius (N.) spiniplenus	27				

Site: Juday Creek SR 23

Date Collected: 08/25/13 Site #: 14

Taxa Name	Quantitative	Qualitative	Taxa Name	Quantitative	Qualitative
Hydra sp	8		Nilotanypus fimbriatus	14	
Turbellaria	52	+	Procladius (Holotanypus) sp	0	+
Oligochaeta	73		Corynoneura floridaensis	8	
Helobdella elongata	0	+	Corynoneura lobata	38	
Caecidotea sp	0	+	Cricotopus (C.) bicinctus	0	+
Crangonyx sp	24	+	Orthocladius (O.) sp	21	
Gammarus pseudolimnaeus	2	+	Parakiefferiella n.sp 2	21	
Orconectes sanbornii sanbornii	0	+	Parametriocnemus sp	166	+
Hydrachnidia	32	+	Rheocricotopus robacki	62	
Baetis tricaudatus	1		Thienemanniella xena	14	
Baetis flavistriga	8	+	Tvetenia bavarica group	41	
Callibaetis sp	0	+	Cryptochironomus sp	0	+
Stenacron sp	99	+	Cryptotendipes pseudotener	0	+
Maccaffertium exiguum	2	+	Dicrotendipes modestus	0	+
Maccaffertium pulchellum	0	+	Microtendipes "caelum"	83	+
Maccaffertium terminatum	0	+	Microtendipes pedellus group	249	+
Tricorythodes sp	8	+	Paratendipes albimanus	0	+
Caenis sp	9	+	Phaenopsectra obediens group	0	+
Coenagrionidae	0	+	Polypedilum aviceps	41	
Boyeria vinosa	0	+	Polypedilum flavum	62	
Polycentropus sp	10	+	Polypedilum halterale group	0	+
Cheumatopsyche sp	421	+	Tribelos jucundum	21	
Ceratopsyche morosa group	147	+	Paratanytarsus sp	83	
Hydropsyche depravata group	246	+	Rheotanytarsus pellucidus	21	
Hydroptila sp	27	+	Rheotanytarsus sp	581	+
Brachycentrus numerosus	8	+	Tanytarsus sp	41	
Pycnopsyche sp	0	+	Tanytarsus sepp	21	
Mystacides sepulchralis	1	+	Physella sp	1	+
Nectopsyche diarina	1	+	Gyraulus sp	2	
Oecetis persimilis	4	+	Ferrissia sp	9	
Triaenodes sp	0	+	Corbicula fluminea	0	+
Peltodytes sp	0	+			
Dubiraphia sp	8				
Dubiraphia quadrinotata	0	+	No. Quantitative Taxa:	51	
Macronychus glabratus	16		No. Qualitative Taxa:	47	
Stenelmis sp	1	+	Total Taxa:	72	
Tanypodinae	21		Number of Organisms:	3327	
Ablabesmyia mallochi	21		Qual EPT:	19	
Conchapelopia sp	269	+	**ICI:**	**48**	
Hayesomyia senata	187				
Helopelopia sp	21	+			

Appendix F

Aerial Site Location Maps

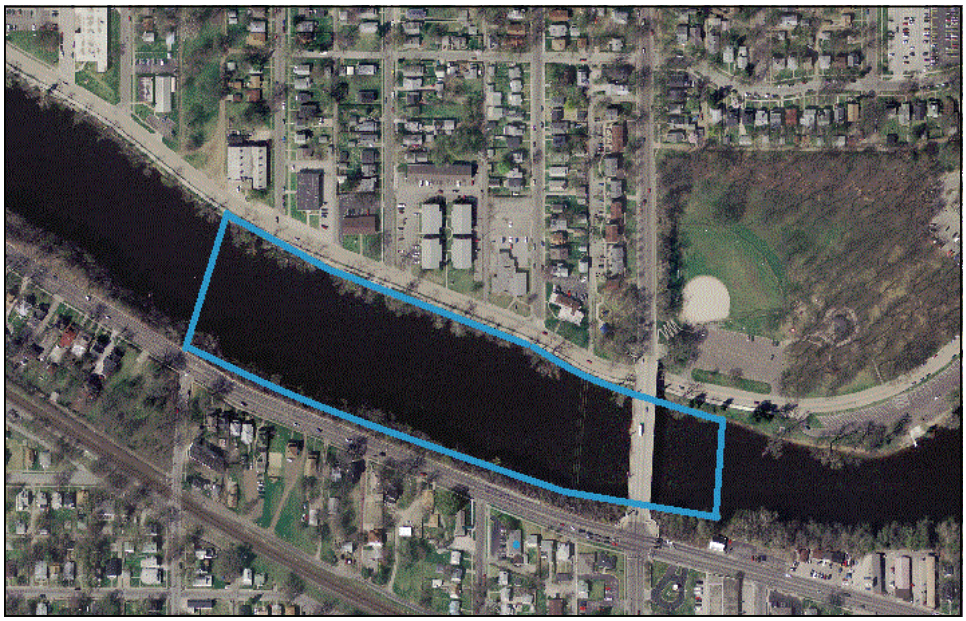
Site #1: St. Joseph River SR 15 (Bristol)

Site #2: St. Joseph River Homan Avenue

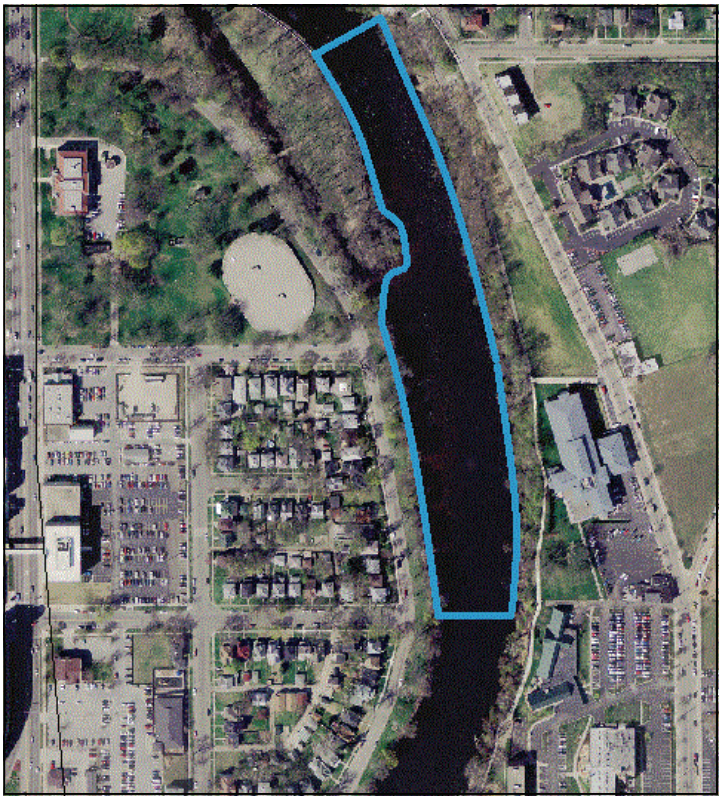
Site #3: St. Joseph River Sherman Street

Site #4: St. Joseph River Nappanee Street

Site #5: St. Joseph River Capital Avenue

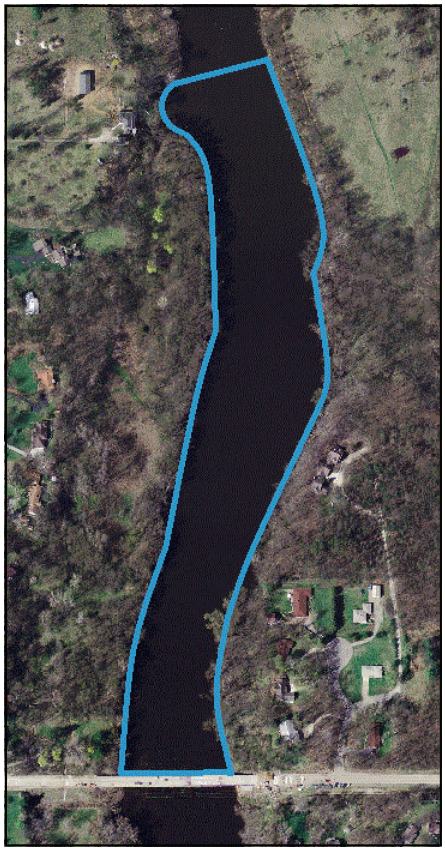


Site #6: St. Joseph River Sample Street



Site #7: St. Joseph River Michigan Street

Site #8: St. Joseph River Pinhook Park (B)



Site #9: St. Joseph River Auten Road

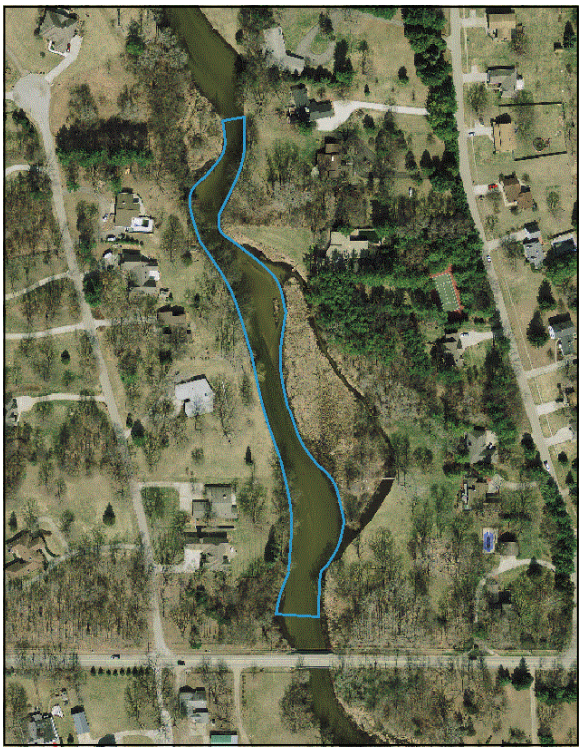
Site #10: Little Elkhart River CR 10

Site #11: Puterbaugh Creek CR 8

Site #12: Lily Creek Reckell Avenue

Site #14: Christiana Creek
Willowdale Park

Site #13: Christiana Creek CR4

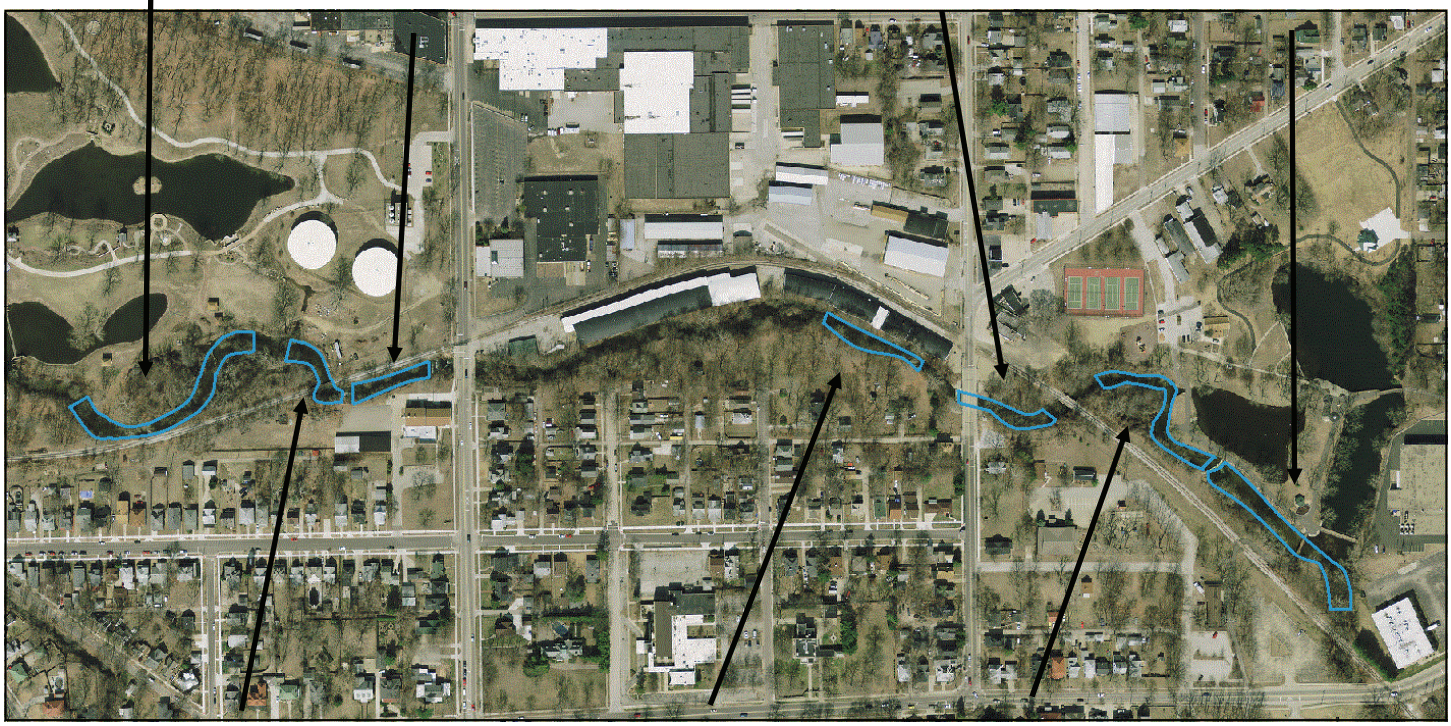


Site #15: North Main Wellfield

Site #17: Main Street (Above)

Site #19: Cassopolis (Below)

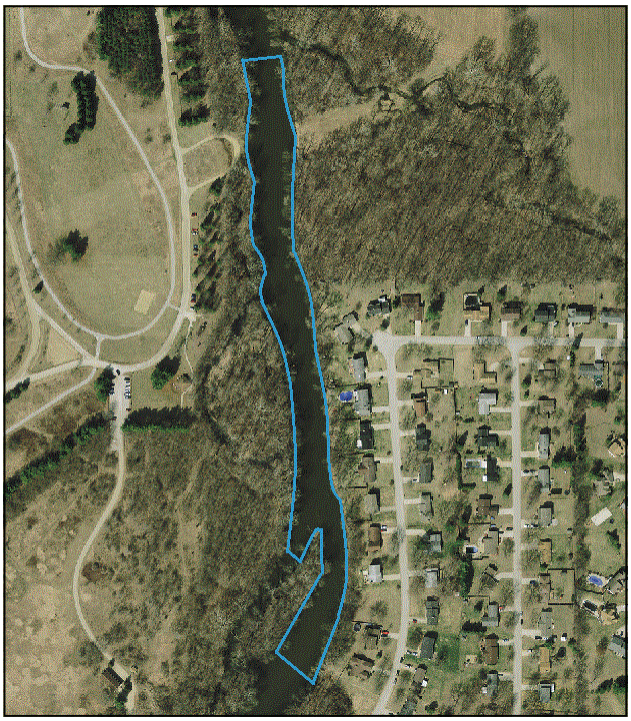
Site #21: High Dive (Below Dam)



Site #16: Wellfield Below

Site #18: Cassopolis (Above)

Site #20: High Dive (Above Dam)



Site #22: Elkhart River Oxbow Park

Site #23: Elkhart River Indiana Avenue

Site #24: Elkhart River Middlebury Street

Site #25: Yellow Creek CR 32

Site #26: Cobus Creek CR 8

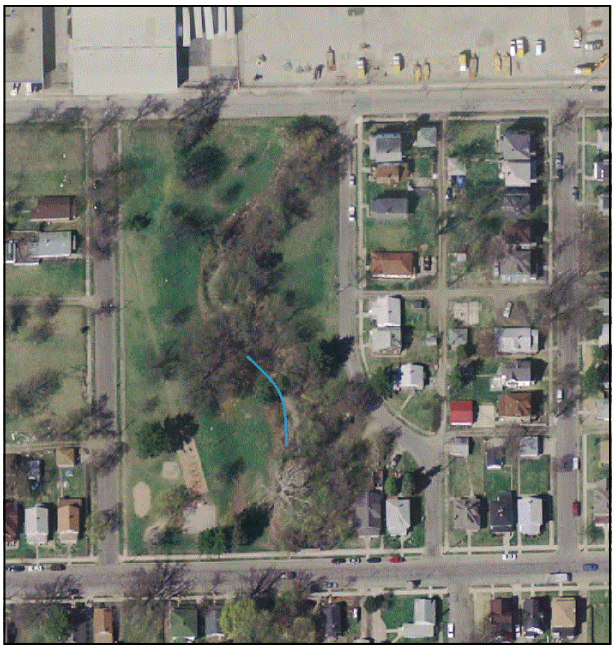
Site #27: Baugo Creek CR 1 (S)

Site #28: Baugo Creek CR 3 (N)

Site #29: Bowman Creek AM General (North)

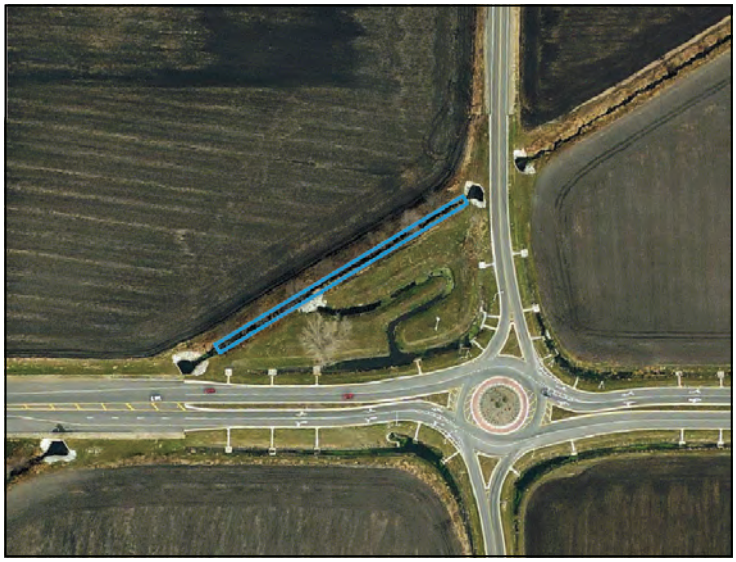
Site #30: Bowman Creek AM General (South)

Site #32 Auten Ditch Locust Road (South)



Site #31: Bowman Creek, Ravina Park

Site #33: Auten Ditch Gertrude



Site #34: Juday Creek Bittersweet Road

Site #35: Juday Creek State Road 23

Site #36: Juday Creek Warren Golf Course