

Elkhart Public Works & Utilities Fish Community Monitoring



**Annual Report
1999**

City of Elkhart 
The city with a heart

David L. Miller, Mayor

Cover Photo: Cobus Creek as it flows through the Elkhart Conservation Club's property.

ANNUAL REPORT

Fish Community Monitoring on the St. Joseph and Elkhart Rivers and Selected Tributaries in Elkhart County, 1999.



**Joseph Foy
Aquatic Biologist
Elkhart Public Works & Utilities**

INTRODUCTION

For many years municipalities such as Elkhart have been required, through their NPDES (National Pollutant Discharge Elimination System) permits, to monitor chemical and microbiological levels of the rivers and streams to which they have any regulated discharges. This is done in an effort to protect the public and the aquatic communities that inhabit these waters, to determine the water quality in these areas, and to document the chemical and microbial contributions these discharges make to these streams. While this conventional monitoring is good at identifying the chemical and microbial components of the water being tested and may help protect the public, it provides little information about the condition of the aquatic communities that it is also intended to protect. Alone, chemical and microbial monitoring is not an effective indicator of aquatic community health and provides limited insight to overall water quality.

To get a better idea of the impacts discharges may have on a stream, or what impact various land uses have in a stream's watershed, a two-tiered sampling approach has been found to be most effective in monitoring and determining water quality in aquatic systems and protecting aquatic communities (Craddock 1990, Ohio EPA 1988). These approaches use conventional monitoring coupled with biological monitoring, sampling of the actual aquatic communities. It is important to remember that conventional monitoring can only reveal the chemical and microbial levels of the water at the time the sample is collected. The sporadic presence of a biologically harmful substance could easily go undetected by conventional monitoring alone. Since the aquatic communities are present 24 hours a day, seven days a week, they are the overall product of the chemical and physical interactions in these aquatic systems and, hence, are the best indicators of the water quality in a given area. The drawback to biological monitoring, however, is it merely acts as a "red flag" when there is a problem. Since conventional monitoring can identify any problem chemical(s) and help pinpoint sources of contamination, it is best to use both monitoring strategies to provide the greatest amount of protection for the public and aquatic communities.

With this knowledge, the City of Elkhart began the second step in its monitoring activities by sampling the fish communities of the St. Joseph and Elkhart Rivers and their tributaries in and around Elkhart during the summer of 1998. In 1999, core (Index) stations were resampled in an effort to establish baseline information that will allow the City to document the condition of the fish communities over time. This baseline of information will also reveal what impact an urban environment like Elkhart has on the rivers and streams that flow through it, and should identify any problem areas. The tool that is used to assess the water quality using the fish community information is the Index of Biotic Integrity (IBI) as modified by Thomas Simon (1997). This index was developed by James Karr (1981), and is most useful in translating complex fish community information into a more

understandable format for non-biologists. In simplest terms, the IBI acts as a biological indicator much like the DOW Industrial Average acts as an economic indicator (Karr 1996) and it provides a method to track the trends in fish community condition over time. It is comprised of three broad categories (species composition, trophic composition, and fish condition) which are broken down into 12 individual metrics (Appendix A) to assess fish communities. These metrics are each given a score of 1 (low), 3, or 5 (high), and the total score for a site is in the range of 12 to 60. These scores can then be graphed and placed into one of five categories which describes the overall condition of the fish communities. Since it is assumed that the condition of the fish communities is a reflection of the water quality in a given area, Elkhart will be able to effectively track water quality conditions over time.

In addition to determining the water quality in a number of streams, sampling was also conducted to determine the overall diversity of the fish species in the Elkhart area. A fish tagging program that included smallmouth bass (*Micropterus dolomieu*), largemouth bass (*Micropterus salmoides*) and walleye (*Stizostedion vitreum*) that were collected during biological monitoring activities was also continued. This tagging effort will assist the Indiana Department of Natural Resources (IDNR) in determining the movement patterns of walleye and alert fishermen to the City's monitoring activities. Scale samples were also taken from all walleye, smallmouth and largemouth bass over 75 mm in length for age and growth analysis. The 1998 and 1999 scale data will be combined and made available as an additional report at a later date. Finally, tissue from nine species of fish was sampled and analyzed for mercury and PCB (polychlorinated biphenyl) content to compare to the state's fish consumption advisory for the St. Joseph and Elkhart Rivers. Presently several species are on this advisory in the Elkhart area (Table 1) and the City wants to verify the state's findings and contribute information to the existing state database so an accurate and thorough advisory can be issued.

METHODS

In 1999, sampling continued to identify the majority of fish species present and to determine water quality levels in the rivers and streams around Elkhart. Stream sites were sampled in one of two ways. Investigative sites were sampled only once and the length of the sample area was not measured. All fish collected at investigative sites were identified to species, the largest and smallest of each species were measured to the nearest millimeter (mm), the fish were counted, and then released. Index sites, on the other hand, were sampled twice at five-week intervals, and the length of the sample area was dependent on the stream's width. The length of these sites was 15 times the stream's width with a minimum length of 50 meters and a maximum length of 500 meters. Fish collected at index sites were studied more extensively. These fish were also identified to species and then processed in one of two ways. First, game fish (smallmouth bass, rock bass, bluegill, etc.) were measured by length to the nearest millimeter, individually weighed to the nearest gram (g), and then released. Non-game fish (suckers, darters, minnows, etc.) were counted, the largest and smallest of each species were measured to the nearest millimeter, species were mass weighed to the nearest gram, and then released. If a specimen of a species had not been previously retained from a site for the Public Works & Utilities specimen museum, then a single specimen of the smaller species was retained and larger specimens were photographed. This practice allows for the verification of the field and lab identifications if needed.

In 1999, the 17 index sites and 4 of the investigative that were sampled in 1998 were resampled. In addition 3 new index and 9 new investigative sites were sampled as well (Figures 1 & 2 & Table 2). This continued

Table 1. Fish consumption information taken from the 1999 Indiana Fish Consumption Advisory.

Location	Species	Fish Size (inches)	Contaminant	Group
Elkhart River	Rock Bass	7-9	Hg, PCB	3
		9+	Hg, PCB	4
	Smallmouth Bass	5-6	PCB	3
	White Sucker	8-13	PCB	3
13+		PCB	4	
St. Joseph River	Black Redhorse	13-17	Hg	2
		17+	Hg	3
	Channel Catfish	20-24	PCB	3
		25-26	PCB	4
		26+	PCB	5
	Golden Redhorse	13-25	PCB	3
		25+	PCB	4
	Largemouth Bass	11-12	Hg	2
		12+	Hg	3
	Rock Bass	7-9	PCB	3
		9+	PCB	4
	Shorthead Redhorse	14-17	Hg, PCB	3
		17+	Hg, PCB	4
	Smallmouth Bass	9-13	Hg	2
		13+	Hg	3
	Walleye	16-17	Hg	3
17+		Hg	4	

Hg = Mercury
PCB = PCBs

Group 2 = 1 meal/week
Group 3 = 1 meal/month

Group 4 = 1 meal/2 months
Group 5 = DO NOT EAT

(Special restrictions apply to women and children. See advisory.)

Elkhart's sampling strategy of surveying the maximum number of streams and sites in the limited amount of time available for sampling. Investigative sites were generally sampled for a shorter distance (less than 15 times the stream width) and game fish other than bass and walleye that were individually measured at index sites were not weighed at these sites. These two differences in sampling and processing allowed for two investigative sites to be sampled in a day versus one index site.

Figure 1: Fish sampling sites in Elkhart County, 1999.

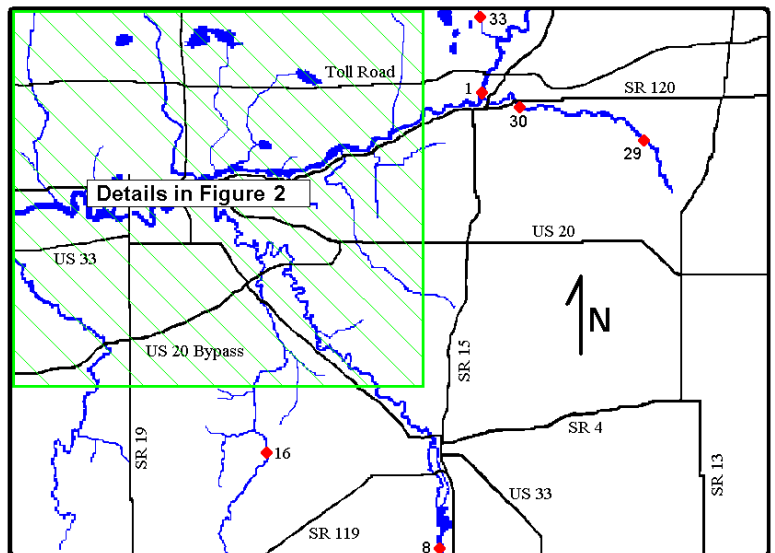


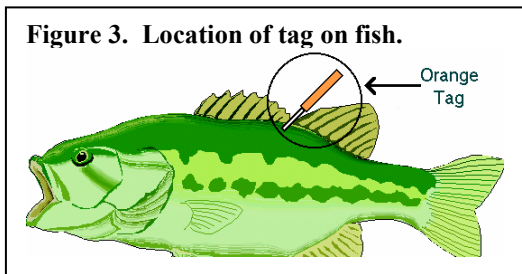
Table 2: Sites sampled, the method used to sample each, and their IBI score (Index sites only).

Site Number	Site Description	Type of Site (Index/Investigative)	Method	IBI Scores			
				1999 1st Pass	1999 2nd Pass	1999 Average	1998 Average
1	State Road 15 St. Joseph River	Index	Boat	58	56	57	53
2	County Road 17 St. Joseph River	Index	Boat	50	54	52	53
3	Mouth of Lily Creek St. Joseph River	Investigative	Boat	NA			
4	Sherman Street St. Joseph River	Index	Boat	50	48	49	46
5	Bridge Street St. Joseph River	Index	Boat	52	48	50	48
6	Nappanee Street St. Joseph River	Index	Boat	46	50	48	48
7	Ash Road St. Joseph River	Investigative	Boat	NA			
8	Violet Cemetery Elkhart River	Investigative	Boat	NA			
9	Oxbow Park Elkhart River	Index	Boat	54	54	54	52
10	County Road 18 Elkhart River	Index	Boat	56	48	52	52
11	Indiana Avenue Elkhart River	Index	Boat	50	44	47	45
12	Middlebury Street Elkhart River	Index	Boat	46	42	44	45
13	American Park Elkhart River	Index	Boat	48	42	45	48
14	County Road 4 Christiana Creek	Index	Tote Barge	46	48	47	45
15	Willowdale Park Christiana Creek	Index	Tote Barge	46	46	46	46
16	County Road 32 Yellow Creek	Index	Tote Barge	36	32	34	36
17	County Road 28 Yellow Creek	Investigative	Tote Barge	NA			
18	County Road 13 (S. crossing) Yellow Creek	Investigative	Tote Barge	NA			
19	US 20 Bypass Yellow Creek	Index	Tote Barge	44	42	43	44
20*	County Road 8 Puterbaugh Creek	Index	Tote Barge	42	40	41	38
21*	US 20 Bypass Pine Creek	Index	Tote Barge	30	40	35	31
22*	State Road 120 Pine Creek	Investigative	Tote Barge	NA			
23*	County Road 8 Cobus Creek	Index	Tote Barge	28	28	28	34
24*	Elkhart Conservation Club Cobus Creek	Investigative	Tote Barge	NA			
25	County Road 26 Baugo Creek	Investigative	Tote Barge	NA			
26*	County Road 6 Washington Township Ditch	Investigative	Tote Barge	NA			
27	Weaver Parkway Manning Ditch	Investigative	Tote Barge	NA			
28	Lexington Industrial Park Manning Ditch	Investigative	Tote Barge	NA			
29*	County Road 10 Little Elkhart River	Index	Tote Barge	44	42	43	NA
30*	State Road 120 Little Elkhart River	Investigative	Tote Barge	NA			
31	Reckell Avenue Lily Creek	Index	Tote Barge	32	32	32	NA
32	Greenleaf Boulevard Lily Creek	Investigative	Tote Barge	NA			
33	County Road 2 Trout Creek	Index	Tote Barge	46	56	51	NA

* - Denotes a cool/cold water stream

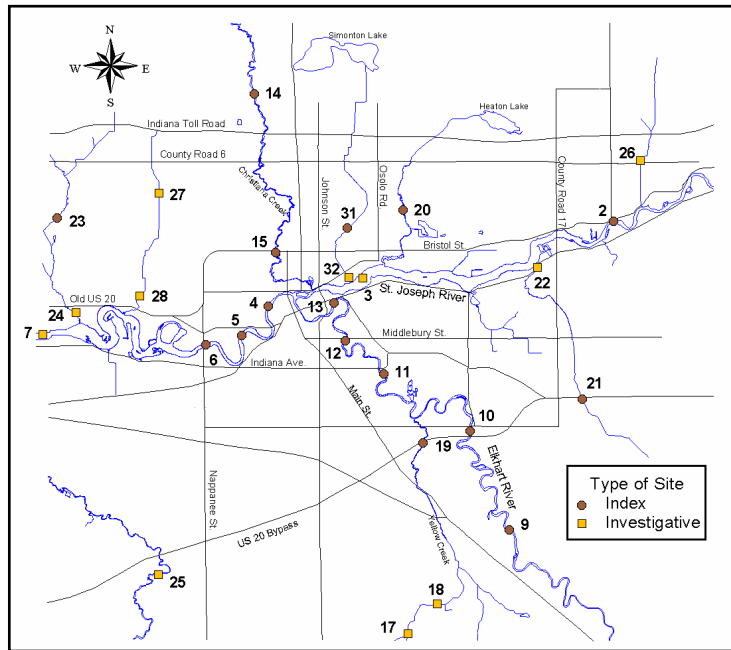
All sites were sampled utilizing either backpack, tote barge, or boat mounted electrofishing gear. The type of equipment used depended on the depth of the stream. For the smallest streams that would not accommodate the tote barge equipment, the battery powered backpack unit was used. If the stream was larger and wadeable for at least 80-90% of the area to be sampled, the tote barge equipment was used. All other areas were sampled utilizing the boat equipment. Power output of the three types of equipment varied. The backpack output was 0.5-1.5 amperes, the tote barge was 4-6 amperes, and the boat was 8-16 amperes.

Smallmouth bass greater than 10 inches, walleye greater than 12 inches and largemouth bass greater than 16 inches in length also had an anchor tag applied under the left anterior edge of the dorsal fin (Figure 3). This tag was orange in color and contained Elkhart Public Works &



Utilities' phone number and a unique tag number. In addition to being tagged, the right pectoral fin of these fish was clipped to alert Public Works personnel to fish that had been tagged, but had shed the tag. The biggest advantage of this tagging study is its ability to reveal important movement patterns of these fish and help the

Figure 2: Fish sampling sites in and around Elkhart, IN, 1999.



IDNR in its walleye stocking efforts on the St. Joseph River. If the success of this stocking program continues and grows, it could provide the Elkhart economy with additional revenue from non-local sport fishermen pursuing walleye in the Elkhart area.

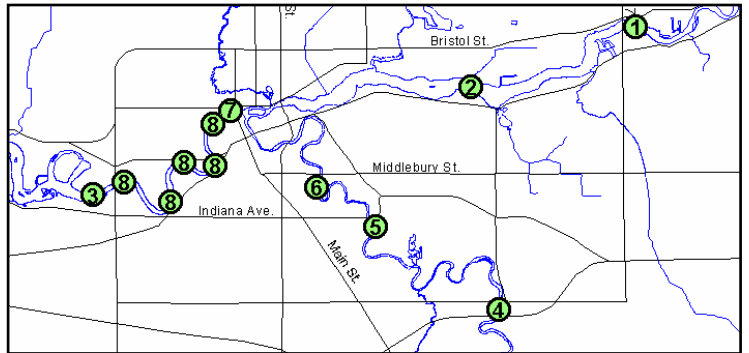
Lastly, tissue in the form of fillets, was collected from common carp (*Cyprinus carpio*),

smallmouth bass, largemouth bass, rock bass (*Ambloplites rupestris*), walleye, channel catfish (*Ictalurus punctatus*), golden redbreast (*Moxostoma erythrurum*), shorthead redbreast (*M. macrolepidotum*), and white sucker (*Catostomus commersoni*) in July. The tissue samples were collected from three sites on the Elkhart River and five areas on the St. Joseph River (Table 3 & Figure 4). Lack of a sufficient sample of fish at the Jackson Boulevard site necessitated expanding the sampling area of this site. Due to the presence of an impassable dam just upstream of this site, the sampling area was expanded into the St. Joseph River until a sufficient sample was collected. This modification was acceptable because fish from this site had previously been treated as St. Joseph River due to the presence of the dam on the Elkhart River. Also, due to the difficulty of collecting an adequate sample of walleye from any given site, a larger area of the lower St. Joseph River was specifically sampled for the collection of these fish. Each tissue sample was a composite of tissue from three fish of the same species at the given site or area. 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).

Table 3: Fish tissue sites.

Site Number	River	Station
1	St. Joseph	Six-Span (CR 17)
2	St. Joseph	Bulldog Crossing (CR13)
3	St. Joseph	Below Nappanee St.
4	Elkhart	Hively Ave. (CR 18)
5	Elkhart	Indiana Ave.
6	Elkhart	Middlebury St.
7	Elkhart/ St. Joseph	Jackson Blvd.- Lexington Ave.
8	St. Joseph	Sherman St.-Lexington Landing

Figure 4: Location of fish tissue sites on the St. Joseph and Elkhart Rivers.



RESULTS & DISCUSSION

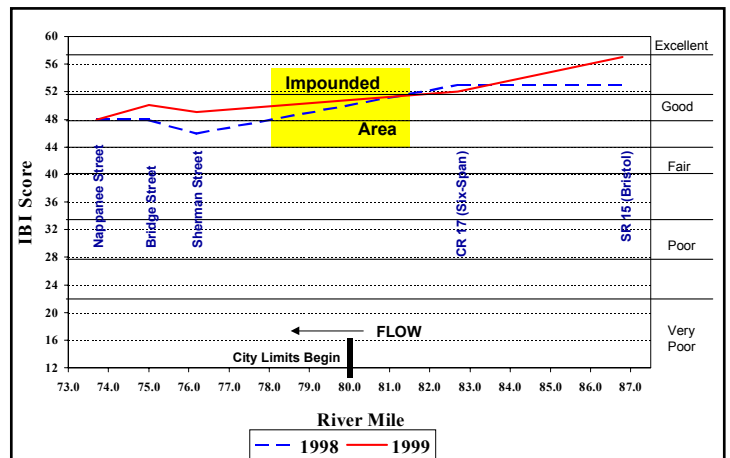
In 1999, 20,279 fish were collected from the index and investigative sites representing 72 species and 16 families (Tables 4 & 5). This was an increase of four species from 1998 and brings the number of species found for the last two years to 76. Greater redhorse (*Moxostoma valenciennesi* - state endangered) and river redhorse (*Moxostoma carinatum* - species of special concern) also continued to be represented in the samples. The top three species collected were mimic shiner (*Notropis volucellus*), creek chub (*Semotilus atromaculatus*), and white sucker while the top three families represented were Cyprinidae (minnows and shiners), Catostomidae (suckers and redhorse), and Centrarchidae (sunfish and black bass). A summary of the species collected at each site is presented in Appendix C.

INDICES

The IBI scores ranged from a low of 28 (poor) at County Road 8 on Cobus Creek to a high of 57 (excellent-good) at State Road 15 (Bristol) on the St. Joseph River (Table 2). A longitudinal comparison of the 1998 and 1999 scores for the St. Joseph and Elkhart Rivers and Christiana and Yellow Creeks is presented in Graphs 1-3. It is important to remember that the IBI scores for the St. Joseph River (drainage basin >2,000 square miles) are only approximate because the metrics that were used were developed for rivers and streams in this area that have a drainage basin <1,000 square miles. When metrics are developed for the St. Joseph River, all previously collected information will be used to recalculate a more accurate IBI score. Index sites also could

not be established in the impounded area of the St. Joseph River because the metrics were developed for flowing waters. The make-up of the fish community is greatly different in impounded areas due to the differences in habitats that are available. The fluctuations in IBI scores for all of the rivers and streams sampled are normal and reflect the natural variability of these systems.

Graph 1: IBI scores for the St. Joseph River, Elkhart County.



The 1998 IBI scores have undergone a slight correction since the release of that report. All 1998 scores in this report reflect the correction.

The trend of higher IBI scores upstream of Elkhart versus downstream on the St. Joseph River continued from 1998 (Graph 1). This trend is normal and, for now, expected. The multitude of impacts (ie. bridges, street run-off, combined sewer overflows, seawalls, lawn fertilizers, etc.) that are found in an urban area like Elkhart creates this trend in IBI scores. As improvements are made in adjacent land-use practices by all people, and new technologies allow for cleaner effluents from all sources, this trend will ideally become less exaggerated in

Table 4: Summary of species captured at index sites.

Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Mimic Shiner	2,018	12.56	2,522	5.56	0.12
Creek Chub	1,709	10.63	17,221	37.93	0.79
White Sucker	1,306	8.13	180,128	396.76	8.22
Smallmouth Bass	1,136	7.07	155,514	342.54	7.10
Golden Redhorse	1,117	6.95	550,166	1,211.82	25.12
Bluegill	995	6.19	26,515	58.40	1.21
Striped Shiner	711	4.42	10,070	22.18	0.46
Northern Hog Sucker	666	4.14	122,374	269.55	5.59
Rock Bass	613	3.81	53,297	117.39	2.43
Blacknose Dace	534	3.32	2,047	4.51	0.09
Spotfin Shiner	513	3.19	1,358	2.99	0.06
Common Shiner	482	3.00	6,668	14.69	0.30
Bluntnose Minnow	449	2.79	1,242	2.74	0.06
Hornyhead Chub	372	2.31	5,428	11.96	0.25
Stoneroller, Central	346	2.15	1,658	3.65	0.08
Mottled Sculpin	341	2.12	1,618	3.56	0.07
Sand Shiner	307	1.91	456	1.00	0.02
Logperch	304	1.89	2,518	5.55	0.11
Green Sunfish	184	1.14	3,347	7.37	0.15
Shorthead Redhorse	153	0.95	86,039	189.51	3.93
Johnny Darter	150	0.93	248	0.55	0.01
Rainbow Darter	144	0.90	233	0.51	0.01
Largemouth Bass	135	0.84	22,781	50.18	1.04
River Redhorse	121	0.75	222,509	490.11	10.16
Common Carp	94	0.58	369,804	814.55	16.89
Yellow Bullhead	85	0.53	8,331	18.35	0.38
Fathead Minnow	78	0.49	192	0.42	0.01
Silverjaw Minnow	78	0.49	280	0.62	0.01
Silver Redhorse	70	0.44	101,482	223.53	4.63
Tadpole Madtom	63	0.39	387	0.85	0.02
Grass Pickerel	48	0.30	1,305	2.87	0.06
Orangethroat Darter	48	0.30	53	0.12	0.00
Pumpkinseed	48	0.30	1,780	3.92	0.08
Yellow Perch	44	0.27	1,574	3.47	0.07
Channel Catfish	43	0.27	50,908	112.13	2.32
Chestnut Lamprey	43	0.27	402	0.89	0.02
Spotted Sucker	41	0.26	16,492	36.33	0.75
Brown Trout	39	0.24	4,968	10.94	0.23
Greater Redhorse	39	0.24	56,695	124.88	2.59
Blackside Darter	38	0.24	209	0.46	0.01
Rosyface Shiner	34	0.21	78	0.17	0.00
Longear Sunfish	33	0.21	1,107	2.44	0.05
Walleye	33	0.21	6,616	14.57	0.30
Central Mudminnow	31	0.19	175	0.39	0.01
Black Crappie	23	0.14	2,020	4.45	0.09
Bowfin	23	0.14	33,896	74.66	1.55
Hybrid Sunfish	23	0.14	1,776	3.91	0.08
Steelcolor Shiner	22	0.14	49	0.11	0.00
Longnose Gar	17	0.11	10,425	22.96	0.48
Redear Sunfish	17	0.11	763	1.68	0.03
Northern Pike	16	0.10	8,683	19.13	0.40
River Chub	16	0.10	292	0.64	0.01
Brook Silverside	11	0.07	19	0.04	0.00
Black Redhorse	10	0.06	8,094	17.83	0.37
Quillback	9	0.06	14,159	31.19	0.65
Black Bullhead	6	0.04	1,174	2.59	0.05
Brook Stickleback	6	0.04	6	0.01	0.00
Spottail Shiner	6	0.04	12	0.03	0.00
Stonecat	6	0.04	295	0.65	0.01
American Brook Lamprey	5	0.03	26	0.06	0.00
Brown Bullhead	4	0.02	3,194	7.04	0.15
Rainbow Trout	4	0.02	1,301	2.87	0.06
Warmouth	3	0.02	156	0.34	0.01
Blackstripe Topminnow	2	0.01	2	0.00	0.00
Goldfish	2	0.01	8	0.02	0.00
Blacknose Shiner	1	0.01	1	0.00	0.00

Table 4 (continued)

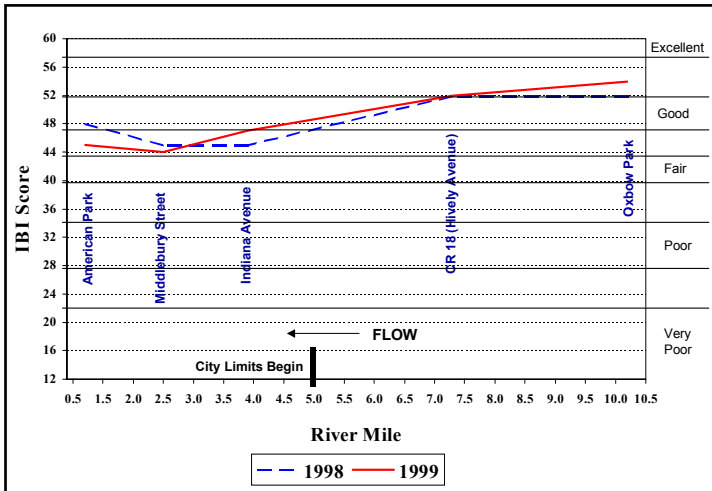
Common Name	Total Number	% by Number	Total Weight (g)	Total Weight (lbs)	% by Weight
Grass Carp	1	0.01	4,500	9.91	0.21
Pirate Perch	1	0.01	9	0.02	0.00
Spotted Gar	1	0.01	325	0.72	0.01
White Crappie	1	0.01	105	0.23	0.00
TOTAL	16,072	100.00	2,190,085	4,823.98	100.00

Table 5: Summary of species captured at investigative sites.

Common Name	Total Number	% by Number
Bluntnose Minnow	409	9.72
White Sucker	368	8.75
Smallmouth Bass	365	8.68
Blacknose Dace	363	8.63
Common Shiner	324	7.70
Creek Chub	318	7.56
Bluegill	298	7.08
Golden Redhorse	187	4.44
Johnny Darter	157	3.73
Brown Trout	141	3.35
Logperch	97	2.31
Spotted Sucker	91	2.16
Largemouth Bass	77	1.83
Rock Bass	76	1.81
Mottled Sculpin	70	1.66
Spottail Shiner	70	1.66
Stoneroller	70	1.66
Striped Shiner	69	1.64
Common Carp	58	1.38
Sand Shiner	50	1.19
Rainbow Darter	45	1.07
Spotfin Shiner	41	0.97
Walleye	36	0.86
Grass Pickerel	33	0.78
Silver Redhorse	33	0.78
Blackside Darter	32	0.76
Green Sunfish	31	0.74
Longnose Dace	28	0.67
Silverjaw Minnow	26	0.62
Hornyhead Chub	24	0.57
Pumpkinseed	22	0.52
Brook Silverside	20	0.48
Mimic Shiner	20	0.48
Northern Hog Sucker	16	0.38
Central Mudminnow	14	0.33
Yellow Perch	14	0.33
Fathead Minnow	11	0.26
Hybrid Sunfish	9	0.21
Steelcolor Shiner	9	0.21
Bowfin	8	0.19
Shorthead Redhorse	8	0.19
American Brook Lamprey	7	0.17
River Redhorse	7	0.17
Longear Sunfish	6	0.14
Black Crappie	5	0.12
Black Redhorse	5	0.12
Northern Pike	5	0.12
Pirate Perch	5	0.12
Longnose Gar	4	0.10
Yellow Bullhead	4	0.10
Blackchin Shiner	3	0.07
Orangethroat Darter	3	0.07
Redear Sunfish	3	0.07
Blackstripe Topminnow	2	0.05
Quillback	2	0.05
Rainbow Trout	2	0.05
Redfin Shiner	2	0.05
Rosyface Shiner	2	0.05
Channel Catfish	1	0.02
Chestnut Lamprey	1	0.02
TOTAL	4,214	100.00

time. With all of the disturbances and impacts that this river receives, however, the condition of the fish community as reflected by the IBI scores remains above average for an urban area the size of Elkhart.

Graph 2: IBI scores for the Elkhart River, Elkhart County.



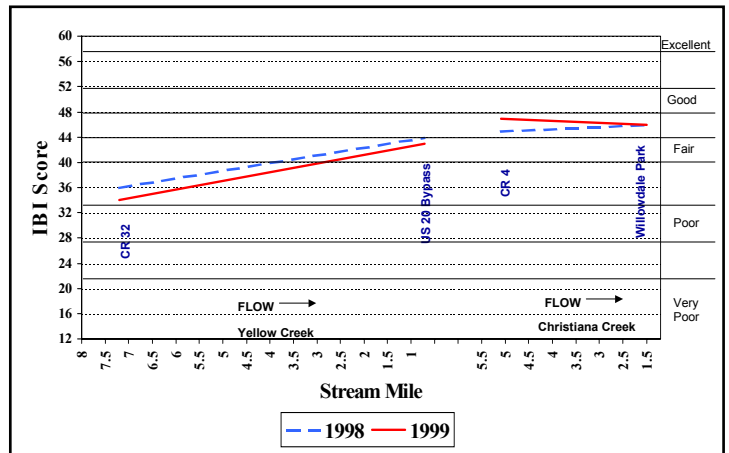
The trend of the Elkhart River IBI scores closely followed that of the St. Joseph River. Scores were higher above versus within Elkhart, and were very similar to 1998's. A few sites had a slight decrease in scores, while a few others showed a slight increase. The trend for both the Elkhart and St. Joseph Rivers does not reflect that the fish communities are in trouble, but does reveal that there is room for improvement through advances in technology and better stewardship activities.

Yellow Creek (tributary of the Elkhart River) and Christiana Creek (tributary of the St. Joseph River) were two of the largest tributaries sampled and each had two index sites. The County Road 32 site on Yellow Creek continued to reflect the poor water quality that is common in streams impacted by agricultural runoff and stream channel modifications (ie. snagging and dredging). This site and the area upstream of it have tall, steep slopes and very little overhanging vegetation. These characteristics contribute to the high amount of sediments this stream moves after a hard rain, and decreases the amount and types of habitats available to fish. In contrast, the US 20 Bypass site reveals how a fish community can recover from most impacts if left undisturbed. This site and the immediate areas

up and downstream of it have a great deal of overhead canopy and the stream channel has not been modified. Both of these stream characteristics allow for a more diversified fish assemblage due to an increase in the amounts and types of habitats available.

Christiana Creek flows through less agricultural land, but more residential areas than Yellow Creek. This trade-off has problems of its own, however. Since Christiana Creek does not fall under the jurisdiction of the county drainage board, it is not regularly dredged nor are trees removed from its banks on a regular basis. It is impacted, though, by the presence of seawalls and septic systems, absence of buffer zones (unmowed grass), and application of lawn fertilizers up to the stream's edge. The residential development along this stream could greatly decrease the effects of these impacts by simply building fewer or no seawalls, leaving more buffer zones, dealing with problem or failing septic systems, and using little or no lawn chemicals near the stream's edge. While the IBI scores for this stream are good, they could still be improved.

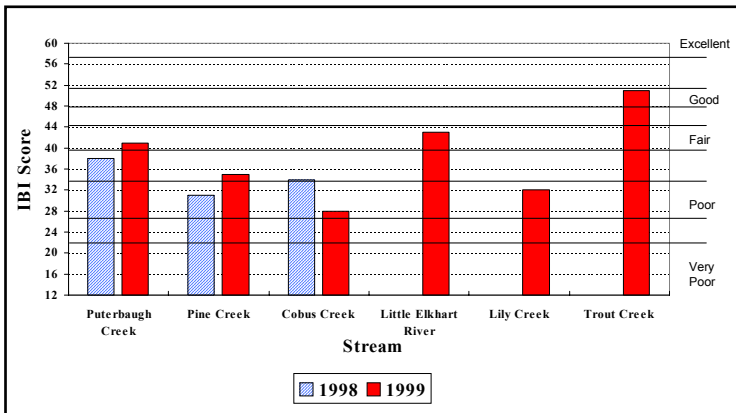
Graph 3: IBI scores for Yellow & Christiana Creeks, Elkhart County.



The IBI scores for the six remaining streams that had an index site are displayed in Graph 4. The Little Elkhart River, Lily Creek and Trout Creek were not sampled in 1998 so there is no past score to compare.

Puterbaugh, Pine and Cobus Creeks as well as the Little Elkhart River all had a good variety of

Graph 4: IBI scores for various streams, Elkhart County.



habitats available. The one limiting factor of these streams is they maintain water temperatures that classify them as cool/cold water streams. This is important to know because the IBI was developed and modified for use on warmwater streams. Cool/cold water streams tend to have fewer species and not as many fish as warmwater streams. When the IBI is used to assess cool/cold water streams, it generally scores them lower. To have the best understanding of the integrity of these stream resources, the IBI metrics would need to be modified for scoring these types of streams. For now, the present IBI modification will suffice to reveal any drastic changes over time until the cool/cold water metrics can be completed.

Lily Creek and Trout Creek are warmwater streams that both drain lakes, but are maintained quite differently. Lily Creek is a regulated drain that has recently (1997) been dredged. This dredging activity is done in an effort to decrease flooding impacts to neighboring landowners. Streams of this type may never support a biologically diverse fish community, but that is to be expected due to the main function (agricultural drainage) of the stream. Trout Creek, however, is a naturally flowing stream that has not been impacted by dredging activities. The IBI scores for both sites quickly reveal that streams with few or no disturbances support a more diverse fish community.

TAGGING & MOVEMENT

Tagging activities continued from 1998 with the addition of largemouth bass greater than 14

inches in total length. A total of 379 fish were tagged (Table 6) and 46 fish were recaptured. The 17 fish recaptured in 1998 coupled with the 46 in 1999 produced a recapture rate of 9.5% for all fish tagged to date. This recapture rate is good and reflects a slight increase in fishermen reporting recaptures, and a large increase in the number of smallmouth bass recaptured by Public Works.

This year only about half of the recaptured fish were recaptured in the area from which they were released. Fourteen smallmouth bass and 2 walleye moved upstream before being recaptured. These smallmouth bass, however, were following the pattern that was observed in 1998 and merely returning to the area from which they were captured. Keep in mind at certain sampling sites

Table 6: Summary of tagged and recaptured fish

Species	Number Tagged		Recaptures (fishermen)		Recaptures PW&U	
	1998	1999	1998	1999	1998	1999
Smallmouth Bass	245	321	8	12	5	30
Walleye	37	41	4	4	0	0
Largemouth Bass	NA	17	NA	0	NA	0

no shoreline area is available to process the catch. In these instances, the fish are transported to a different location for processing and then released. The walleye that moved upstream were recaptured by fishermen below two impassable structures, the Mottville Dam and the Elkhart Dam. The fish recaptured in Mottville moved 13.6 miles.

No walleye and only 5 smallmouth bass moved in a downstream direction. There was no pattern to why these fish moved in the direction that they did, and one smallmouth bass had an interesting journey. It was captured and released near Martin's Landing above the Elkhart dam and recaptured 3.3 miles downstream at McNaughton Park (below the Elkhart dam). This fish either went through the turbines at the dam, over the dam, or was transported by a fisherman.

Table 7: Fish tissue comparison.

Stream	Species	Fish size (inches)	State Results		PW & U Results			
			Contaminant	Advisory Group	Contaminant		Advisory Group	
					1998	1999	1998	1999
Elkhart River	Rock Bass	7-9	Hg, PCB	3	PCB	PCB	2	2
	Smallmouth Bass	12+	NA	NA	Hg, PCB	Hg, PCB	2	2
	White Sucker	13+	PCB	4	Hg, PCB	Hg, PCB	2	2
St. Joseph River	Channel Catfish	<20	NA	NA	PCB	PCB	2	2
	Common Carp	25+	Hg, PCB	5	Hg, PCB	Hg, PCB	3	3
	Golden Redhorse	13-25	PCB	3	PCB	Hg, PCB	2	2
	Largemouth Bass	12+	Hg	3	Hg	Hg	2	2
	Shorthead Redhorse	14-17	Hg, PCB	3	PCB	PCB	2	3
	Smallmouth Bass	9-13	Hg	2	Hg, PCB	PCB	2	3
	Walleye	<16	NA	NA	NA	Hg, PCB	NA	2

Hg = Mercury

PCB = PCBs

Group 2 = 1 meal/week

Group 3 = 1 meal/month

Group 4 = 1 meal/2 months

Group 5 = DO NOT EAT

(Special restrictions apply to women and children. See advisory.)

FISH TISSUE

The fish tissue results from 1998 and 1999 reveal that a modification of the fish consumption advisory is warranted in Elkhart County (Table 7). Many of the species tested had lower levels of PCBs and mercury than the state had found, while a few species had the same levels and one species had higher levels. Detailed results can be found in Appendix B.

Smallmouth bass larger than the advisory group were again sampled on the Elkhart River, and the test results confirmed that these larger fish should be placed on the advisory as well. In 2000, tissue from 5 to 6 inch smallmouth bass will be sampled to compare the mercury and PCB levels to the state's findings from 1988. Rock bass tissue from the Elkhart River continued to have PCB levels that placed it in a group 2 advisory, and the white sucker tissue had group 2 mercury and PCB levels.

The St. Joseph River tissue results varied, but still generally revealed lower mercury and PCB levels than had been previously found by the state. Carp and largemouth bass tissue results from 1998 and 1999 were almost identical and both reveal that the advisory could be lowered for these two species. Channel catfish and walleye tissue was taken from fish smaller than those on the advisory, and both had mercury and/or PCB levels that would qualify them for the advisory. Golden redhorse, shorthead redhorse, and smallmouth bass results varied from 1998 to 1999. Golden redhorse tissue had lower

PCB levels than the state found, but also had mercury in high enough concentrations to qualify it for the advisory for that contaminant as well. The shorthead redhorse results have found no mercury levels high enough to qualify for the advisory, but have found PCB levels at or below the state's findings. Smallmouth bass tissue generally had mercury levels below the advisory limits, but also had PCB levels that would qualify it for the advisory.

CONCLUSION

After two years of biological monitoring, the fish communities of the Elkhart and St. Joseph Rivers near Elkhart continue to exhibit good biological integrity. This in turn indicates that the water quality of these rivers is acceptable for these organisms, but as Graphs 1 & 2 quickly point out, some improvements could still be made. The fish communities of Christiana and Trout Creeks also reflect good water quality, while Yellow and Puterbaugh Creeks as well as the Little Elkhart River have poor to fair water quality. Pine, Cobus and Lily Creeks continue to have poor water quality. The lower water quality of Lily and Yellow Creeks may be due to their primary use as agricultural drainage. The fish communities that were found may be the best that this type of stream can support. The fish communities found at the cool/cold water streams (Puterbaugh, Pine and Cobus Creeks and the Little Elkhart River) indicate lower water quality as determined by warmwater stream standards. Once the IBI

metrics are developed and calibrated for the cool/cold water streams in this area, a more accurate assessment will be available.

The second year of tagging efforts confirmed the 1998 findings, smallmouth bass tend to like certain areas of the stream and will return there if moved, and walleye are highly migratory and will go as far as impediments like dams will allow them to go. This movement information, as well as the fish community information that is gathered, is helping the IDNR assess its stocking strategy for walleye. Elkhart looks forward to the continued stocking of walleye and its associated economic benefit due to monies spent by fishermen while fishing for this prized fish. The reporting of recaptured fish by fishermen has also given Elkhart the opportunity to inform people of the biological monitoring program.

Elkhart's tissue sampling has shown that the fish consumption advisory for some species of fish in Elkhart County should be modified. The data collected could greatly contribute to the state's database for Elkhart County and provide citizens with the most accurate consumption advisory possible.

The City of Elkhart will continue its stewardship role in helping to preserve and protect the aquatic resources in its area. Through continued monitoring activities, these rivers and streams and their biological communities will be observed in an effort to reduce human disturbances to them and ensure their viability as a productive resource for the future.

REFERENCES

- Craddock, J.M. Bureau of Water Quality annual fish population report. Muncie, Indiana. Loose-leaf pub. n.p.
- Indiana State Department of Health, Indiana Department of Environmental Management, Indiana Department of Natural Resources. 1999. 1999 Indiana Fish Consumption Advisory. Indianapolis, Indiana.
- Karr, J.R. 1981. Assessment of biotic integrity using fish communities. *Fisheries* 6 (6): 21-27.
- Karr, J.R. 1996. Going beyond water quality to protect fish and aquatic ecosystems. 126th Annual Meeting of the American Fisheries Society. (Abstract)
- Ohio Environmental Protection Agency. 1988. Biological criteria for the protection of aquatic life. Volumes I, II, III. Division of Water Quality Monitoring and Assessment. Columbus, Ohio.
- Simon, T.P. 1997. Development of Index of Biotic Integrity expectations for the Ecoregions of Indiana. III. Northern Indiana Till Plain. U.S. Environmental Protection Agency, Region V, Water Division, Watershed and Non-Point Source Branch, Chicago, IL. EPA 905/R-96/002.

Appendix A

Index of Biotic Integrity metrics

Appendix A

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. % Headwater species
4. Number of minnow species
5. Number of sensitive species
6. % Tolerant
7. % Omnivores
8. % Insectivores
9. % Pioneer species (individuals)
10. Number of fish collected
11. % Simple lithophils
12. % DELT anomalies

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. % Tolerant
7. % Omnivores
8. % Insectivores
9. % Carnivores
10. Number of fish collected
11. % Simple lithophils
12. % DELT anomalies

Appendix B

Fish tissue preparation and results

Appendix B

Fish tissue preparation for PCB and metals analysis.

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
- scalars
- ice
- cooler

A group of three fish per species was selected based on size. In every case but one, the smallest fish in a group was greater than or equal to 90% of the length of the largest fish in that group. In the one instance the smallest fish was greater than 75% of the length of the largest fish as called for in the "Protocol for a Uniform Great Lakes Sport Fish Consumption Advisory"(1993). 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, except for a few carp and redhorse groups, had skin-on fillets taken. The few exceptions had skin-on fillets taken from one side of each fish and skin-off fillets taken from the opposite side. These skin-on composites were analyzed separate from the skin-off composites to note the differences that may occur due to the different preparations.

Before the tissue was removed, the fillet knives, scalars and skinners were cleaned and rinsed with DI water, and freezer wrap was placed where the fish were to be processed. The knives, scalars 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. For skin-off samples, the skin was scored around the edge of the fillet and then 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.

Appendix B

Tissue results and comparison.

Stream	Species	Station	Length Range (PW&U)	Advisory Length Range (State)	Mercury Group (PW&U)		Advisory Mercury Group (State)	PCB Group (PW&U)		Advisory PCB Group (State)
					1998	1999		1998	1999	
Elkhart River										
Rock Bass										
		Hively Ave. (CR 18)	7.0-7.3	7-9	1	1	2	2	2	3
		Indiana Ave.	6.9-7.3	7-9	1	1	2	1	1	3
		Middlebury St.	7.2-7.6	7-9	1	1	2	1	2	3
Smallmouth Bass										
		Hively Ave. (CR 18)	15.0-15.6	5-6	2	1	1	2	2	3
		Indiana Ave.	11.9-14.0	5-6	2	2	1	2	2	3
		Middlebury St.	15.6-16.7	5-6	2	2	1	2	1	3
White Sucker										
		Hively Ave. (CR 18)	15.0-15.6	13+	1	1	1	2	2	4
		Indiana Ave.	15.2-15.6	13+	1	1	1	2	2	4
		Middlebury St.	14.1-14.7	13+	2	2	1	2	2	4
St. Joseph River										
Channel Catfish										
		Jackson St.	16.3-17.7	20-24	1	1	1	2	2	3
Common Carp										
		Six-Span (CR 17)	31.1-32.1	25+	2	2	5	2	3	5
		Bulldog Crossing (CR 13)	27.6-29.5	25+	2	2	5	3	3	5
		Jackson St.	25.6-26.1	25+	1	1	5	3	3	5
		Nappanee St.	26.2-27.1	25+	1	1	5	3	3	5
Golden Redhorse										
		Six-Span (CR 17)	15.6-15.9	13-25	1	2	1	1	1	3
		Bulldog Crossing (CR 13)	16.1-16.8	13-25	1	2	1	1	1	3
		Nappanee St.	15.2-15.7	13-25	1	1	1	2	2	3
Largemouth Bass										
		Six-Span (CR 17)	12.9-13.2	12+	2	2	3	1	1	1
Shorthead Redhorse										
		Jackson St.	15.5-16.9	14-17	1	1	2	2	3	3
Smallmouth Bass										
		Bulldog Crossing (CR 13)	10.7-10.8	9-13	1	1	2	1	3	1
		Jackson St.	10.0-10.2	9-13	1	1	2	2	2	1
		Nappanee St.	11.2-11.6	9-13	2	1	2	1	1	1
Walleye										
		Main St. to Lexington Landing	14.8-15.6	16-17	NA	2	3	NA	2	1

Appendix C

Location and species of fish caught at all sites in Elkhart County, 1998

Appendix C

Stream Site Number	St. Joseph River													
	1		2			3		4		5		6		7
	1st Pass	2nd Pass	1st Pass	2nd Pass	Night	Day	Night	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
Chestnut Lamprey	X		X		X									
Spotted Gar								X						
Longnose Gar	X		X		X	X	X	X	X	X	X	X	X	
Bowfin	X	X	X	X		X	X						X	
Central Mudminnow														
Grass Pickerel	X	X					X							X
Northern Pike		X	X		X	X	X		X					
Common Carp	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Grass Carp	X													
Hornyhead Chub												X		
Rosyface Shiner	X	X	X											
Striped Shiner	X			X					X					
Common Shiner												X	X	
Spottail Shiner				X		X	X				X			X
Steelcolor Shiner		X									X	X		
Spotfin Shiner	X	X	X	X				X	X	X	X	X	X	X
Sand Shiner	X	X	X		X		X	X		X		X		X
Mimic Shiner	X	X	X	X				X	X	X	X	X	X	X
Bluntnose Minnow	X	X	X	X		X	X		X	X		X	X	X
Quillback								X		X		X		X
Silver Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Black Redhorse		X	X	X	X				X	X	X			
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Shorthead Redhorse	X	X	X	X	X			X		X	X	X	X	X
Greater Redhorse		X	X	X				X	X		X			
River Redhorse	X	X	X	X	X			X	X	X	X		X	
Northern Hog Sucker	X	X	X	X	X		X	X	X	X	X	X		
White Sucker	X	X			X	X	X	X	X	X	X	X	X	X
Spotted Sucker	X	X	X	X		X	X				X	X	X	X
Channel Catfish	X	X		X				X	X	X	X		X	
Yellow Bullhead	X	X			X	X	X							
Brown Bullhead	X	X												
Black Bullhead													X	
Brook Silverside				X			X				X		X	
Black Crappie		X	X				X						X	X
Rock Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Largemouth Bass		X	X	X	X	X	X	X		X	X	X	X	X
Warmouth											X			
Green Sunfish							X			X	X			
Hybrid Sunfish		X					X		X				X	X
Bluegill	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Longear Sunfish	X	X	X	X			X			X	X	X	X	
Redear Sunfish		X			X	X			X	X	X		X	X
Pumpkinseed		X	X	X		X	X	X	X	X	X	X	X	X
Walleye	X		X	X	X		X	X	X	X	X	X	X	
Yellow Perch	X	X	X	X	X	X	X				X			
Blackside Darter		X	X	X	X		X		X		X			
Logperch	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Johnny Darter	X						X							
Rainbow Darter				X										
Orangethroat Darter				X										

Appendix C

Stream Site Number	Elkhart River										
	8	9		10		11		12		13	
		1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass
Chestnut Lamprey		X	X	X	X	X				X	
Bowfin	X										
Grass Pickerel	X	X		X	X						
Northern Pike	X	X	X	X			X	X	X		X
Common Carp	X		X								
Hornyhead Chub		X	X	X	X	X	X	X	X	X	
Rosyface Shiner		X		X		X		X		X	
Redfin Shiner	X										
Striped Shiner		X	X	X	X	X	X	X	X		X
Common Shiner		X				X		X			
Spotfin Shiner		X				X		X	X		
Mimic Shiner	X										
Bluntnose Minnow	X	X	X	X	X	X		X	X		
Stoneroller		X									
Golden Redhorse	X	X	X	X	X	X	X	X	X	X	X
Shorthead Redhorse											
Greater Redhorse		X	X	X	X	X					
River Redhorse		X		X						X	X
Northern Hog Sucker		X	X	X	X	X	X	X	X	X	X
White Sucker	X	X	X	X	X	X	X	X	X	X	X
Spotted Sucker	X	X	X	X	X	X	X	X		X	
Yellow Bullhead			X	X	X		X		X		
Stonecat			X			X					
Pirate Perch	X										
Blackstripe Topminnow	X										
Black Crappie	X	X	X	X		X					
Rock Bass	X	X	X	X	X	X	X	X	X	X	X
Smallmouth Bass	X	X	X	X	X	X	X	X	X	X	X
Largemouth Bass	X	X	X	X	X	X			X		X
Warmouth				X				X			
Green Sunfish		X	X	X	X	X	X		X	X	X
Hybrid Sunfish		X	X	X	X		X				
Bluegill	X	X	X	X	X	X	X	X	X	X	X
Longear Sunfish	X		X	X	X					X	X
Redear Sunfish				X							X
Pumpkinseed	X	X	X	X			X	X			X
Blackside Darter		X	X	X		X	X	X	X		X

Appendix C

Stream Site Number	Christiana Creek				Yellow Creek						Puterbaugh Creek		Pine Creek		
	14		15		16		17	18	19		20		21		22
	1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass			1st Pass	2nd Pass	1st Pass	2nd Pass	1st Pass	2nd Pass	
Chestnut Lamprey	X	X	X						X						
American Brook Lamprey											X			X	
Bowfin		X	X												
Brown Trout														X	
Central Mudminnow	X	X								X			X	X	X
Grass Pickerel	X	X	X	X	X	X			X			X	X	X	X
Common Carp	X	X	X	X											
Hornyhead Chub	X	X	X	X	X	X	X	X	X	X					
River Chub	X	X													
Creek Chub					X	X	X	X	X	X	X	X	X	X	X
Blacknose Dace					X	X	X	X	X				X	X	X
Striped Shiner	X	X		X	X			X		X					
Common Shiner					X	X	X	X	X	X					
Silverjaw Minnow					X	X	X	X							
Fathead Minnow					X	X		X	X						
Bluntnose Minnow	X	X			X	X	X	X	X	X					
Stoneroller					X	X		X			X	X		X	X
Golden Redhorse	X	X	X						X	X					
Shorthead Redhorse			X												
Northern Hog Sucker	X	X	X	X					X						
White Sucker	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Channel Catfish	X														
Yellow Bullhead	X	X	X		X	X						X			
Brown Bullhead					X										
Black Bullhead						X									
Stonecat	X	X	X	X											
Tadpole Madtom	X	X													
Pirate Perch										X					
Brook Silverside											X				
Brook Stickleback						X									
White Crappie									X						
Black Crappie									X	X					
Rock Bass	X	X	X	X											
Smallmouth Bass	X	X	X	X					X					X	
Largemouth Bass		X			X	X		X	X	X	X	X	X		
Green Sunfish				X	X	X			X	X		X		X	
Hybrid Sunfish				X					X	X				X	
Bluegill			X	X	X	X			X	X	X	X		X	X
Pumpkinseed				X	X	X								X	
Yellow Perch										X					
Blackside Darter									X		X			X	
Logperch			X	X							X	X		X	X
Johnny Darter					X	X	X	X	X	X	X	X	X	X	X
Rainbow Darter	X	X	X	X							X	X			X
Orangethroat Darter	X	X		X								X			X
Mottled Sculpin											X	X	X	X	X

Appendix C

Stream	Cobus Creek			Baugo Creek	Washington Twnshp. Ditch	Manning Ditch		Little Elkhart River			Lily Creek			Trout Creek	
	23		24	25	26	27	28	29		30	31		32	33	
	1st Pass	2nd Pass						1st Pass	2nd Pass		1st Pass	2nd Pass		1st Pass	2nd Pass
American Brook Lamprey		X	X												
Chestnut Lamprey								X							
Bowfin														X	X
Brown Trout	X	X	X		X			X	X						
Rainbow Trout			X					X	X	X					
Central Mudminnow		X						X	X	X					
Grass Pickerel	X	X	X	X	X	X	X			X					
Common Carp				X				X							
Goldfish		X													
Hornyhead Chub														X	
Creek Chub	X	X	X	X	X	X	X	X	X		X	X	X		
Blacknose Dace	X	X	X	X		X	X	X	X			X			
Longnose Dace				X											
Rosyface Shiner										X				X	
Striped Shiner			X							X				X	X
Common Shiner			X	X				X	X			X			
Blackchin Shiner			X												
Steelcolor Shiner			X												
Spotfin Shiner			X	X									X		
Sand Shiner			X	X							X	X			
Mimic Shiner			X								X	X			X
Blacknose Shiner															X
Silverjaw Minnow			X	X											
Bluntnose Minnow			X	X					X		X	X		X	X
Stoneroller				X			X				X	X			
Black Redhorse										X					
Golden Redhorse										X				X	X
Northern Hog Sucker			X					X	X	X					X
White Sucker	X	X	X	X	X		X	X	X	X	X	X			X
Spotted Sucker															X
Channel Catfish				X											
Yellow Bullhead										X	X	X		X	X
Tadpole Madtom														X	
Pirate Perch				X											
Blackstripe Topminnow															X
Brook Silverside										X					
Rock Bass			X	X				X	X	X				X	X
Smallmouth Bass			X	X				X		X			X	X	X
Largemouth Bass	X	X	X					X	X					X	X
Green Sunfish	X	X	X	X	X			X	X		X	X			
Hybrid Sunfish									X						
Bluegill				X			X	X	X		X	X	X	X	X
Longear Sunfish															X
Pumpkinseed								X	X	X					
Yellow Perch											X	X		X	X
Blackside Darter			X							X					
Logperch			X							X		X	X	X	X
Johnny Darter			X	X				X	X		X	X	X		X
Rainbow Darter			X										X	X	X
Orangethroat Darter														X	X
Mottled Sculpin		X	X					X	X	X					