Muncie
SANITARY DISTRICT

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# Bureau of Water Quality
# Annual Fish Community Report
# 2018

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# EXECUTIVE SUMMARY


- The objectives of this study are to assess the biological integrity of the fish communities within the West Fork White River (WFWR) and its tributaries within Delaware County in order to 1) evaluate the health of these aquatic communities, 2) supplement chemical assessments by evaluating overall water quality, and 3) report the results in a manner that is useful to both the public and professionals.

- Fish were collected with a Smith-Root backpack, tote-barge, or boat mounted electrofishing unit.

- Fish communities were evaluated for general health using the Index of Biotic Integrity (IBI).

- Habitat was evaluated with the Qualitative Habitat Evaluation Index (QHEI).

- A roving creel survey was implemented to monitor fishing and recreational activities done along the White River.

- Stream flashiness was calculated using USGS gage station data (1932-2018).

- IBI scores were found to be correlated with QHEI scores. High quality habitat promotes more resilient fish communities and habitat has a different affect on high quality, average quality, and low quality fish communities.

- IBI scores are generally lower in tributaries as opposed to White River.

- A shift from a fish community of pollution tolerant species to sensitive species was observed since the BWQ's creation 40+ years ago.

- Smallmouth Bass population estimates indicate that the population has many individuals that are of preferred size suggesting angling for this species will be above average for several years.

- Creel survey results show a majority of anglers fishing for Smallmouth Bass.

- Improvements in the fish community will likely occur with continued improvements in the Muncie Water Pollution Control Facility, reduction in Combined Sewer Overflow events, and improved land use practices at the headwaters of smaller tributaries.


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## INTRODUCTION

Delaware County encompasses nearly 250 miles of streams which provide habitat for 65 species of fish, 13 species of mussels, and numerous birds and mammals. This network of waterways offers recreational opportunities such as fishing and canoeing to Delaware County residents as well as residents of downstream cities such as Anderson and Indianapolis. Through the city of Muncie, the majority of the south bank riparian zone remains intact with woody vegetation. However, there are habitat alterations and potential sources of impairment brought on by urbanization, such as combined sewer overflows, low-head dams, and a variety of bank stabilization techniques.

Prior to passage of the Clean Water Act (CWA) in the early 1970s, White River was receiving unregulated industrial discharges from a variety of sources. Effluents from wastewater treatment facilities, battery and transmission plants, and tool and die shops along with combined sewer overflows (CSOs) were some of the main contributors. These point sources led to substantial amounts of pollutants entering the river and severely degrading water quality. Toxic pollutants including ammonia, cyanide, lead, zinc, and chromium eradicated all but the most tolerant species (Craddock 1975).

In addition to these point source pollutants, nonpoint source pollutants were also contributing to the impairment of water quality. Currently hydromodifications such as dredging, channelization, and impoundments by dam are listed as the main source of impairment accounting for over 60% of the reported impaired rivers and streams in the U.S. (U.S. EPA 2009). Originating from agriculture and urbanization, runoff (containing sediment, fertilizer, insecticides, and herbicides) is also listed as a source of waterway impairment.

Historically these threats to water quality have been evaluated with a single faceted approach. Chemical testing and bioassays provide empirical and legal validity to assessments but cannot accurately provide a holistic representation of water quality. The main deficiencies of this approach include 1) failure to account for naturally occurring differences in conventional water quality parameters, 2) failure to consider combined chemical effects, 3) failure to fully represent impacts to indigenous species or the most sensitive species, 4) the relatively high expense, and 5) failure to detect biological integrity impairments that are not the result of toxins (Hughes 1990).

Finally, a chemical representation of water quality by itself fails to meet all of the fundamental goals of the CWA. The CWA's principal objective is to restore and maintain the physical, chemical, biological, and radiological integrity of the nation's surface water. In response to the CWA, biological criteria have been incorporated into the monitoring programs of regulatory agencies to evaluate impaired waterways (Craddock 1975; OEPA 1989; Simon & Dufour 1997; Dufour 2000). The first quantitative measure of biological integrity to address the entire fish assemblage was developed by James Karr (Karr 1981). Karr's original Index of Biotic Integrity (IBI) was composed of 12 metrics that measure species richness, trophic composition, fish abundance, and condition.

Biological indicators provide many benefits to a water quality program. Biological communities reflect the cumulative impacts of the watershed condition. Fish are long-lived and disturbances in their environment can be reflected at the community or individual level (e.g. proportion of severe anomalies, proportion of tolerant species and age and growth). Freshwater fish species worldwide face accelerated extinction rates relative to most other wildlife taxa. Consequences of poor land management practices (siltation, excessive nutrients, and flow disruption) can negatively impact species that depend on these water sources for survival, reproduction, and/or development (Sayer 2012). Fish represent a variety of trophic levels; omnivores, herbivores, insectivores, planktivores, and piscivores. Fish are ubiquitous and found in even the smallest of streams. Biological sampling is also relatively inexpensive compared to chemical analysis. In addition, descriptors of the fish community are more easily related to the public.

While the benefits of biological criteria are widely known they are not intended to replace chemical sampling. It has been found that 91% of impaired streams in Ohio were detected by biological assessments, while 45% was found with chemical sampling (OEPA 1994) (Figure 1.) Implementation of the two in

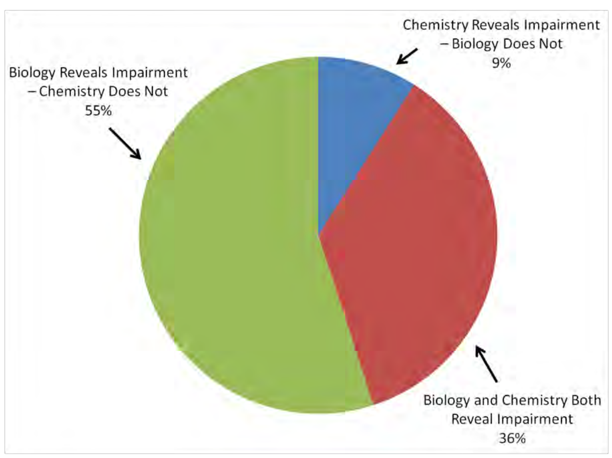


Figure 1.—Efficacy of chemical and biological assessments in detecting stream impairment.

concert provides the most holistic representation of water quality. In addition, chemical testing is sometimes necessary as a follow up to pinpoint the exact cause of the disturbances found by biological testing. A single approach or a single statistical analysis is insufficient at describing every variable that affects water quality. Multiple sampling approaches coupled with multiple analyses which take into account the distinction of the relationship at hand are necessary to see a grander picture of water quality.

The Bureau of Water Quality (BWQ) began supplementing its chemical sampling with biological assessments of fish and macroinvertebrates in 1973 (Craddock 1975). The combination of monitoring data along with the cooperative efforts of local industries has accounted for an enormous reduction of toxic pollutants in White River. However, it has also begun to highlight the extent of NPS stressors. Today, the unmasked effects of NPS pollution have become the leading cause of water quality impairment in the Midwest, demanding greater emphasis on the broad sensitivity of biological assessments (IDEM 1998; OEPA 2000).

The objectives of this study are to assess the biological integrity of the fish communities within WFWR and its tributaries within Delaware County in order to 1) evaluate the health of these aquatic communities, 2) supplement chemical assessments by evaluating overall water quality, and 3) report the results in a manner that is useful to both the public and professionals.

## METHODS

**Assessment of the Biological Integrity of the Fish Communities and Habitat of the WFWR and its Tributaries-Fish and Habitat Collection Methods-** Prior to 1990, fish sampling was sporadic and was conducted using a backpack electrofishing unit, electric seine, or kick seine. In 1990, the BWQ began a standardized annual sampling program. Variation in sampling design prior to 1990 precludes the use of some statistical analysis. Fish sampling methods were based on the electrofishing guidelines provided by Simon and Dufour (1997) and the Ohio Environmental Protection Agency for assessment of streams within the Eastern Corn Belt Plains ecoregion (OEPA 1989).

Beginning in 1990, fish were sampled using one of three types of Smith-Root Inc. electrofishing gear. Each unit emits a pulsed direct current of electricity that temporarily stuns fish so they can be netted and placed in a live well. Wadable sites were sampled with a fiberglass tote-barge electrofisher (TBS). In extremely small tributaries where a TBS unit was too large to be hauled by one person, a lightweight, battery-operated backpack unit (BPS) was used. At sample sites too deep to wade, a boat mounted electrofishing unit was used.

From 1980 through 2018, the BWQ has conducted 1,523 sampling events at 186 synoptically selected sites from the WFWR, its tributaries, and a handful of reference sites from the Mississinewa River drainage area. Annual stations were chosen based on historical baseline sample stations, presence of riffle-run-pool complex, proximity to potential stressors, and site accessibility. Variables that most significantly affect electrofishing efficiency and aquatic community conditions are measured at each sample location prior to sampling. Conductivity, water temperature, and dissolved oxygen were measured with a portable YSI Inc. meter following standard methods (4500-O G, 4500-H B, and 2510-B respectively).

Sample sites were classified as headwater (those with drainage areas < 20 mi.$^2$), wading (drainage areas > 20 mi.$^2$ and shallow enough to wade) and boat sites (those sites too deep to wade). Each stream category was evaluated with a unique set of metrics specifically calibrated by drainage area (Appendix B-1). Headwater and wading sites were sampled for distances of 50 to 200 m, and boat site lengths were sampled for distances of 450 to 1050 m.

Fish were processed according to Ohio EPA (1989) and Simon and Dufour (1997) methods for determination of IBI and MIwb scores at all sample sites from 1990 to 2018. Fish were sorted by species and measured in one of two ways. Game fish (ex. basses, bluegill, and catfish) were individually measured for a length (millimeters) and weight (grams). Non-game species (ex. minnows, suckers, and darters) were mass-weighed and measured for a single minimum and maximum length. Fish under 20 mm were not included to reduce the bias of young-of-the-year fish. Museum vouchers are kept of all the fish species collected by the BWQ. One representative of each species from each subwatershed is taken as a voucher every five years. Vouchered specimens are cataloged and maintained by the BWQ for identification and as a historical representative of species characteristics. All other fish are released.

The Index of Biotic Integrity (IBI), originally developed by James Karr, and the Modified Index of Well-being (MIwb) (Gammon 1976) provide sensitive and reproducible measurements of integrity of fish communities (OEPA 1989). These indices have been calibrated for use in specific ecoregions defined by the neutral presence of geographic variables pertinent to biological potential. Streams within the same ecoregion and with comparable drainage area will contain similar structural communities that have predictable and measurable responses to perturbation.

The IBI is composed of twelve metrics that measure functional aspects of fish communities including species composition, trophic composition, and fish condition. Each metric is scored according to the degree of deviation from a "healthy" or least impacted stream of comparable size (1 = severe deviation, 3 = moderate deviation, and 5 = little or no deviation). The total score of 12 to 60 is used to assign a narrative description of very poor, poor, fair, good, or excellent to the biological integrity of the community within the sampled stream segment (Appendix B-1). In 2009, the IBI score ranges used for narrative ratings were changed to match the ranges used by Indiana Department of Environmental Management (IDEM) for their Integrity Class ratings.

The MIwb, used primarily as a supplement to the IBI, consists of four measures of fish community structure based in part on the Shannon diversity index. Healthy communities are defined in part by the presence of diverse assemblages, making MIwb scores a reliable measure of general water quality. Scores of 0 to 12 reflect community descriptions of very poor to excellent are then assigned to stream segments (Appendix B-2).

Beginning in 2002, The Qualitative Habitat Evaluation Index (QHEI) measurements were taken in conjunction with each sampling event according to the guidelines provided by Rankin (1989). Habitat assessments allow a preliminary estimation of the potential contribution of habitat alterations (as opposed to chemical pollution) as the cause of impairment. The QHEI measures variables pertinent to biological potential including the quality of substrate, cover, channel morphology, riparian zone, and riffle-run-pool complexes. Habitat quality is scored from 0 (poor quality) to 100 (high quality).

**Smallmouth Bass Population Estimate-** In addition to yearly fish sampling events in 2017, all Smallmouth Bass *Micropterous dolomieu* sampled from the White River were aged using ctenoid scales. This non-lethal method of aging fish made the most sense for us at the Bureau of Water Quality and is the least intrusive for the fish. Scales collected from behind the left pectoral fin were pressed between two acetate slides using a Carver® Hydraulic Press (12 Ton 3912). Using a Ken-A-Vision® Microprojector the scales were magnified and annuli counted to determine the fishes age. Circuli rings form throughout the year on a fairly consistent basis. It isn't until the winter months when growth slows down that the circuli rings are spaced much closer together and an annulus forms. It is important to note that counting these annuli is not a fool proof method but still gives us reliable information on the Smallmouth Bass found in the White River without sacrificing the fish's life.

In addition to aging Smallmouth Bass, we also interpret the proportional stock density (PSD) and relative stock density (RSD) for these fish. Proportional stock density and RSD are used to describe the length frequency distribution of a fish population. PSD is the percent of individuals longer than stock size and longer than preferred size. Each fish species has a different stock size and preferred size designation. Smallmouth Bass stock size is 178 mm (7 inches) and preferred size is 279 mm (11 inches). For example, if there were 75 fish $\geq$ stock length and 25 fish $\geq$ preferred length then the PSD is 33 (25/75 *100 = 33). RSD is the percent of individuals longer than stock size and are also longer than a different specified length. Smallmouth Bass RSD is calculated with a specified length of 305 mm (12 inches) and 350 mm (14 inches) in this report.

**Richard-Baker Flashiness Index-** In an effort to better understand the stream hydrology of the West Fork White River throughout Muncie, daily discharge data from the USGS Gage Station #03347000 were used to establish Richard-Baker Flashiness Index values (R-B Values). The flashiness of a stream refers to the rapid changes in streamflow based on runoff events (Baker et al. 2004). These changes in flow can be measured temporally in various ways including; seasonally, hourly, daily and yearly.  Changes in stream flashiness can indicate land use alterations and potentially cause changes to the streams bank due to erosion (Frankenberger and Esman 2012). Changes in a streams sediment load can have a wide range of ecological effects on aquatic ecosystems. Increased turbidity and sediment deposits can cause shifts in fish community assemblages that feature fish species with specific guilds for feeding, reproduction, and habitat preference (Kemp et al.2011). Knowing that the USGS Gage Station located near Walnut St. in downtown Muncie has historical discharge data, 1932-present, made it an easy target for looking at the possible changes in discharge over time allowing us to calculate 80+ years of R-B Values.

Prior to calculation of R-B values, hourly discharge data were averaged to determine daily discharge. This daily discharge data are then used to calculate the R-B values for the flashiness of West Fork White River. The R-B values represent the day-to-day fluctuations observed in stream flow. The absolute value of these changes is divided by total discharge for the observed time interval. Our R-B values are calculated based on water year (October 1$^{st}$ through September 30$^{th}$). Water years are used to encompass an entire collection of the hydrological cycle. This would include seasonal rains and snow melt. Richard-Baker Flashiness Index values range from 0.00 to 2.00. These scores are dependent on watershed size, impervious surfaces, and other stream discharge factors which make it hard to compare them to other streams even if they are of similar size. Annual R-B values can be monitored over time to look for trends.

**White River Greenway Creel and Recreation Survey-** In 2015, the BWQ worked with the Natural Resources and Environmental Management Department (NREM) at Ball State University to conduct a creel and outdoor recreation survey along the White River Greenway. The White River can be accessed in various ways for recreational opportunities. Most notably of these access points is a 4.5-mile trail known as the White River Greenway. This multipurpose trail opened in 1999 and was completed in 2005. The White River Greenway follows the meandering curves of White River through various parks, overlooks and green spaces. In order to most accurately and efficiently sample the entire stretch of the White River Greenway a roving creel design was implemented. A roving creel is used when anglers can access the body of water from many points rather than a traditional creel survey method where clerks wait at specific access points. (Jones and Pollock 2012). A roving creel is also ideal for locations where streamside access is readily available and anglers can simply walk to the water's edge from multiple access points (Pollock et al. 1994). In order to get the most out of this study, recreational users were also counted based on recreational activities.

Prior to collection of any data, randomly selected dates, times, and sampling sections were determined. During each 4-hour time slot the creel clerk was instructed to walk one of the three 1.5-mile sections of the White River Greenway stopping to interview all anglers observed and also record the types of recreation users of the White River Greenway were taking part in. Notes on the weather, time of day, and other information pertinent to the survey were recorded as well. The goal of the greenway recreation counts was to establish a baseline for future studies along the White River Greenway.

The creel survey portion of this study replicated a creel survey done by the BWQ in 1983. Questions pertaining to fish species sought/caught, reason for visit, and demographics were asked. Their fishing location was recorded and matched to the 1983 survey for comparison. Fishing pressure, fish harvest rate, and angler fishing preferences were calculated. The goals of this creel survey are to 1) determine the amount of fishing pressure put on the West Fork of White River, 2) look for trends in the locations of anglers and species of fish sought/caught by these anglers, and 3) compare results to the 1983 creel survey.

Future creel and recreation surveys are being planned. In addition to angler interviews, a recreation based survey could be administered based on the baseline 2015 recreation counts.

RESULTS

Before getting to the results of the 2018 sampling season, it is important to note that Indiana experienced its second wettest June and July on record (Indiana State Climate Office) in 2015. When looking at the National Weather Service monthly Climatological Report for Muncie, IN, a total of 7.69 inches of rain fell throughout the month of June with the largest 24-hour total coming on June 19$^{th}$ (2.29 inches). July was not far behind with 6.86 inches of rain with the largest 24 hour total coming on July 8$^{th}$ (2.24 inches). These high precipitation totals can influence our sampling season in two ways: 1) dangerous sampling conditions, and 2) turbidity issues. Safety is always the number one priority when we are sampling. If the river is too high, the flow can make sampling challenging and unsafe while electrofishing. While there is not a specific river discharge or river depth regulation for sampling, there are turbidity standards that are strictly enforced. If the turbidity (cloudiness of a liquid) is above 40 Nephelometric Turbidity Units (NTU) we do not sample. The turbid water does not allow us to get a fair representation of the fish community present because we cannot see all of the fish as we are electrofishing. The above average rain totals for the 2015 sampling season caused us to lose 22 sampling days because of turbidity issues alone. There is also the potential for negative biological responses associated with heavy rains and these issues will be monitored in the upcoming sampling seasons.

**Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MIwb)-** In 2018, the BWQ sampled 61 sites (Figure 2.) from the WFWR and its surrounding tributaries in Delaware County to evaluate the health and integrity of fish communities. Complete lists of metric scores, sample collections, and precise site locations are available in the Appendices.

IBI scores for 2018 ranged from a low of 12 *very poor* at Jake's creek- Everett Rd. Lift Station (JAK-6.6) to a high of 58 *excellent* at White River- Main St. (WHI-314.4), White River – E. Jackson St. (B) (WHI-317.4) and White River- Camp Red Wing (B) (WHI-322.2). The mean IBI for all headwater sites sampled during the 2018 sampling period was 25 *poor.* The 2017 average headwater IBI score was 30 *poor.* The mean IBI score for White River wadable/boat sites in 2018 was 51 *good*. The 2017 yearly average was 51 *good* as well. Continued monitoring will be done to ensure the scores reflect an accurate depiction of the fish community.

Ohio EPA suggests MIwb scores should be used only when replicate samples are taken, therefore MIwb scores are reported in the appendices merely to supplement IBI scores. MIwb scores from 2017 ranged from a low of 5.8 *fair* at Buck Creek- Tillotson Ave. (BUC-6.9) to a high of 9.9 *excellent* at White River- High St. (B) (WHI-314.8). All sites with drainage areas <20 mi.$^2$ do not have MIwb scores. This includes all of our 2017 headwater sites.

**Qualitative Habitat Evaluation Index (QHEI)-** QHEI scores for 2018 ranged from a low of 43 *poor* at Muncie Creek- Yale Ave. (MUN-1.9) to a high of 76.5 *good* at Stoney Creek- Windsor Pike *(STN-1.0)*.

A slight correlation can be found between the IBI and QHEI scores. The correlation (r = 0.67) is *moderate*; a good indication of correlation that explains the strength of the relationship between IBI and QHEI scores. Both IBI and QHEI scores are lower in the surrounding tributaries (IBI average = 31 QHEI average= 56) due to agriculturally related hydromodifications. Channelization and riparian removal on these tributaries are the main reasons for low QHEI scores. White River sites had an average QHEI score of 64 *fair*.

**Electrofishing Yields and Observations-** Sampling events from 2018 yielded 11,245 fish representing 53 species (appendix A-1). Looking at the White River specifically, 48 species were harvested bringing in 7,450 fish. Some fish species are particularly sensitive to pollution and are not found in areas where water quality is poor. Golden Redhorse *Moxostoma erythrurum* is one of these pollution intolerant species. They also made up the largest proportion of sensitive species caught (9.14%) this year during summer sampling events. Other notable pollution intolerant species sampled this year included; Northern Hog Sucker *Hypentelium nigricans* (4.42%), Rock Bass *Ambloplites rupestris* (7.11%), Smallmouth Bass *Micropterus dolomieu* (4.51%), and Longear Sunfish *Lepomis megalotis* (5.51%). Sensitive species made up one third (42.12%) of this year's total White River catch. Pollution tolerant species are known to thrive in degraded waterways. Pollution tolerant species such as; Bluntnose Minnow *Pimephales notatus* (9.96%), Green Sunfish *Lepomis cyanellus* (4.26%), and White Sucker *Catostomus commersonii* (1.26%) made up 16.07% of the yearly catch. This leaves the remainder of the fish species caught in a moderately tolerant range.

Looking at species-specific data collected over the past 40 years there has been a notable shift from pollution tolerant species to sensitive species. It is not uncommon for fish communities to reflect environmental and historical changes. Fish communities act as an ecologically sensitive measure of environmental change (Philippi T.E. et. al. 1988). The early 1980's fish community was characterized by Common Carp *Cyprinus carpio* which are known to thrive in degraded habitat and are typically an indicator of poor water quality. The 1990's appeared to be a transition period where the fish community was comprised of both tolerant and sensitive species including; Spotfin Shiner *Cyprinella spiloptera*, Rock Bass *Ambloplites rupestris*, White Sucker *Catostomus commersonii*, and Spotted Sucker *Minytrema melanops*. The fish community has now shifted to one characterized by sensitive species such as Golden Redhorse *Moxostoma erythrurum* and Smallmouth Bass *Micropterus dolomieu*.

Historical data review of an easily recognized species known as the Common Carp *Cyprinus carpio* led to a statistical review of this pollution tolerant species. Carp impact streams by disturbing the sediment and uprooting plants while they feed on benthic invertebrates. High numbers reduce macrophyte density, increase turbidity, and reduce benthic invertebrates that are food for native species (Riera P. et al. 1991). There have been 3,282 Common Carp caught from 1983-2018 during boat electrofishing events done by the Bureau of Water Quality. The total weight of these fish was 6453.8kg (14,228.2 lbs). When looking at the total percent of biomass of Common Carp, decadal clusters were observed for the 1980's, 1990's, 2000's and 2010+ (Figure 3). The 1980's had the greatest percent of biomass at 62.40%. The 1990's percent of biomass lowered to 48.42%, the 2000's to 28.21% and from 2010 through 2018 total carp biomass dropped to 14.77%. Sampling protocol changes in the early 1990's allow for a better

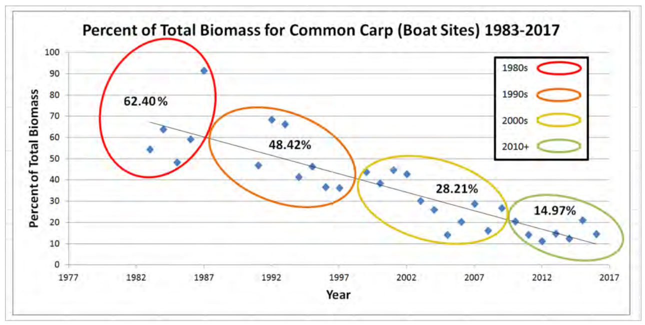


Figure 2.— Common carp yearly percent of biomass (boat sites).

understanding of the changes seen in the last 20 years as opposed to the sporadic sampling done in the late 1970's and early 1980's. Looking specifically at boat sites also allows for better conclusions to be made; most notably, the water quality improvements allowing for the return of pollution intolerant species putting pressure on the success of the Common Carp. Further research will continue to be done in order to fully grasp this change in species abundance.

**Smallmouth Bass Population Estimates—**In 2017, a total of 23 sites were sampled on the West Fork of White River and Smallmouth Bass scales were collected for each of the 194 specimen. These fish ranged anywhere from young of year (YOY) to a maximum of 12 years in age. Some of these fish were unable to be aged because of the regenerated condition of the scales collected. When YOY fish and regenerated scales were removed a total of 168 Smallmouth Bass were aged. Our results show that 51.20 % of our fish are between the ages of 1-3 while 37.5% are between the ages of 4-6 and the remaining 11.30% are greater than 6 years old. As Smallmouth Bass age their scales become more difficult to use for aging as their growth slows down. It is recommended to use additional methods to help strengthen the results of scale aging to better understand population estimates. We traditionally use PSD and RSD to elaborate on our Smallmouth Bass populations.

The total PSD for all of our WFWR sites sampled in 2017 was 49.06. This is interpreted as 49.06% of the fish that were longer than 178 mm (stock size) and also longer than 279 mm (preferred size). The RSD-305 was 38 and the RSD-350 was 18. These values indicate there is a relatively high abundance of fish in the 279 to 305 mm (11 to 12 in) length range. White River supports a large population of Smallmouth Bass. Additionally, the population has many individuals of preferred size suggesting angling for this species will be above average for several years.

In the future, studies will continue to be done to help strengthen the results of the previous population estimates done by the BWQ. Recently, studies have been conducted in regards to the effects of multi-pass electrofishing on specific fish species. A majority of these studies focus on rare or endangered species, but the same principals still apply. Fish responses to electrofishing can be categorized as behavioral (reactive movements), trauma resulting from stress (physiological changes), injuries (mechanical damage to tissue), or all three. These traumas can lead to death (Reynolds and Kolz 2012). Altered feeding habits, activity levels, mechanical injury, and temporary cardiac arrest have also been observed (Mesa and Schreck 1986; Pasnik et al. 2003; Dalbey et al. 1996; Panek and Densmore 2013; Schreer et al. 2004). Electrofishing is important to fisheries professionals, and when done properly minimal harm to the fish occurs. The above mentioned studies and also the work done by C.L. Densmore and L.A. Panek (2013) have led us to alter our sampling protocol for yearly Smallmouth Bass and population estimates in the future.

**Richard-Baker Flashiness Index Results-** Over the past 87 years, R-B values on the West Fork of White River have ranged from low 0.32 (1988) to a high of 0.57 (1963). The average R-B value for our entire data set was 0.45. The 2018 water year R-B value was 0.55. When graphically represented (FigureXX) yearly oscillations can be seen and some changes can be attributed to stream modifications. Located roughly half a mile upstream of the USGS gage is the George R. Dale Dam in McCulloch Park. This dam was built in 1948 with collapsible wooden gates. It wasn't until after a large flood in 1964, yearly R-B value 0.57, damaged the gates that permanent upright gates were installed in 1966. The impounded water behind this dam has had effects on the flashiness of WFWR. Prior to the installation of the permanent dam structures, R-B values averaged 0.47 and after 0.44. Another impoundment located downstream (0.80 mi), The Pauline St. Dam (High Street Dam), also has the potential to affect the flashiness of West Fork White River. Yearly R-B Values will continue to be monitored and interpreted for further reference.

**White River Greenway Creel Survey-** During the recreation season of 2015 angler interviewers were conducted along the White River Greenway (Map xx). A total of 79 interviews were conducted. These interviews included seventy-three males and six females. Angler ages varied with our youngest being 13 and our oldest 79. Traditional age classes were used to classify our interviewees. Our most abundant age class was 45-54 with 20 anglers total. Our second largest age group was the 18-24 year olds with 15. The ethnicity of our interviewees was also documented (12- African Americans and 67- Caucasian). The last demographics question asked was the angler's zip code. While a majority of our interviewees were from Muncie (64) we had fifteen commuter anglers from seven different zip codes.

Anglers were also asked about their mode of transportation to the White River Greenway and reason for the visit. Although the greenway does connect to Ball State University and the Cardinal Greenway,

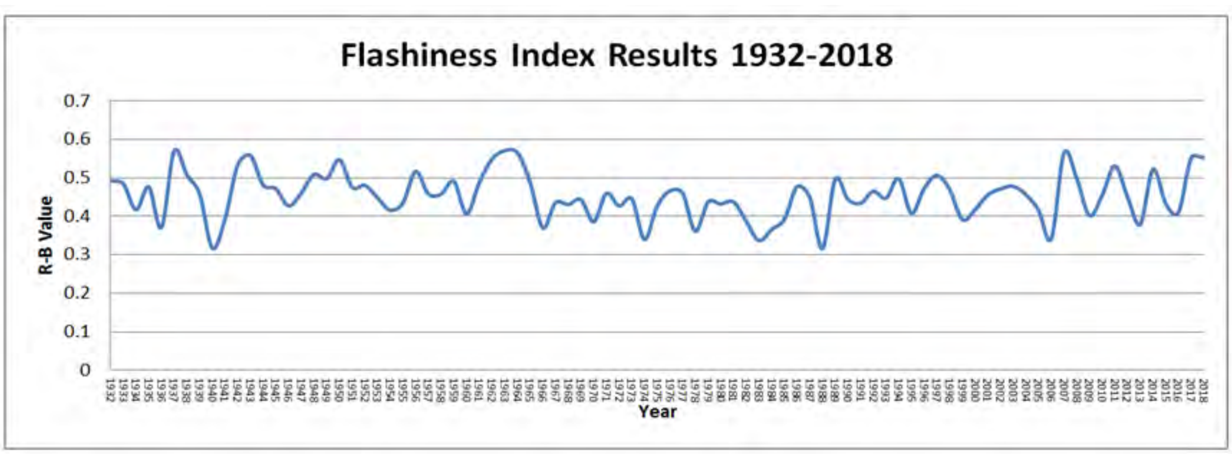


Figure 3.— Richard-Baker Flashiness Index Results 1932-2018.

86.07% of our anglers arrived by car. The remaining eleven anglers rode their bikes to get to their favorite fishing location. When asked about their reason for visiting all anglers were given the same four options: fishing reputation (43), close to home (18), public access (5) and other (13). If an angler responded “other” they were asked to explain. Some answers included: “They Love it!”, catching a meal, family fun, and nice weather.

The first question asked to the angler in regard to fishing was what species they were hoping to catch. When looking at the anglers who had a preference in a specific species the numbers were heavily lopsided. Smallmouth bass (68%) were the most sought after species. All other species were sought less than 10% each. The results of 1983 creel survey numbers were much different. Smallmouth Bass were only sought after by 12% of the 105 anglers who had a preference. The biggest difference came in the number of anglers fishing for Common Carp (1983= 34% and 2015= 4.8%).

If you were to ask any angler, there is a big difference between what species they want to catch and what they actually catch. Although Smallmouth Bass were the most sought after species they were the second most caught (n=56). Rock Bass (n=104) were the most caught. During the 1983 creel survey anglers caught 67 Common Carp. This creel survey did not interview any anglers who had caught a Common Carp even though three anglers were specifically fishing for carp.

A common measurement often calculated as a result of a creel survey is the Catch Per Unit Effort (CPUE). The CPUE in a creel survey is the total number of fish caught per hour during a fishing trip. Since this was a roving creel, we interviewed anglers who were actively fishing or completing their fishing trips. For this reason we calculated a complete and incomplete trip CPUE. The incomplete CPUE was determined by the number of fish caught at the time of the interview while the complete CPUE was calculated based on the amount of fish caught during the entire trip. A total of 35 fish were caught during 19.75 hours of completed fishing trip interviews. This made our completed trip CPUE 1.77. The incomplete trips account for the remaining 137 fish caught. The amount of time spent prior to interviews for these trips was 75.84 hours making our incomplete CPUE 1.81. Unreliable and incomplete data does not allow us to make an accurate comparison of CPUEs when looking at the 1983 creel results.

Another valuable piece of information obtained from the creel survey was the harvest rate or the number of fish kept for eating. In the 1983 creel survey nearly 40% of all fish caught were kept. This year’s creel had only 14 total fish kept or 7.29%. Multiple factors could be attributed to the dramatic drop in the number of fish harvested and will be continually monitored in future creel surveys.

As previously mentioned, the anglers fishing location was recorded using the same segments as the 1983 creel survey (Map xx). These twenty-four sections were split evenly amongst the three greenway sections. Section 1 had the most activity with 44 anglers interviewed. Our fishing segment (15) located directly above the Water Pollution Control Facility Dam was our most popular fishing location. The thirteen anglers interviewed had caught 43 total fish including 31 Rock Bass

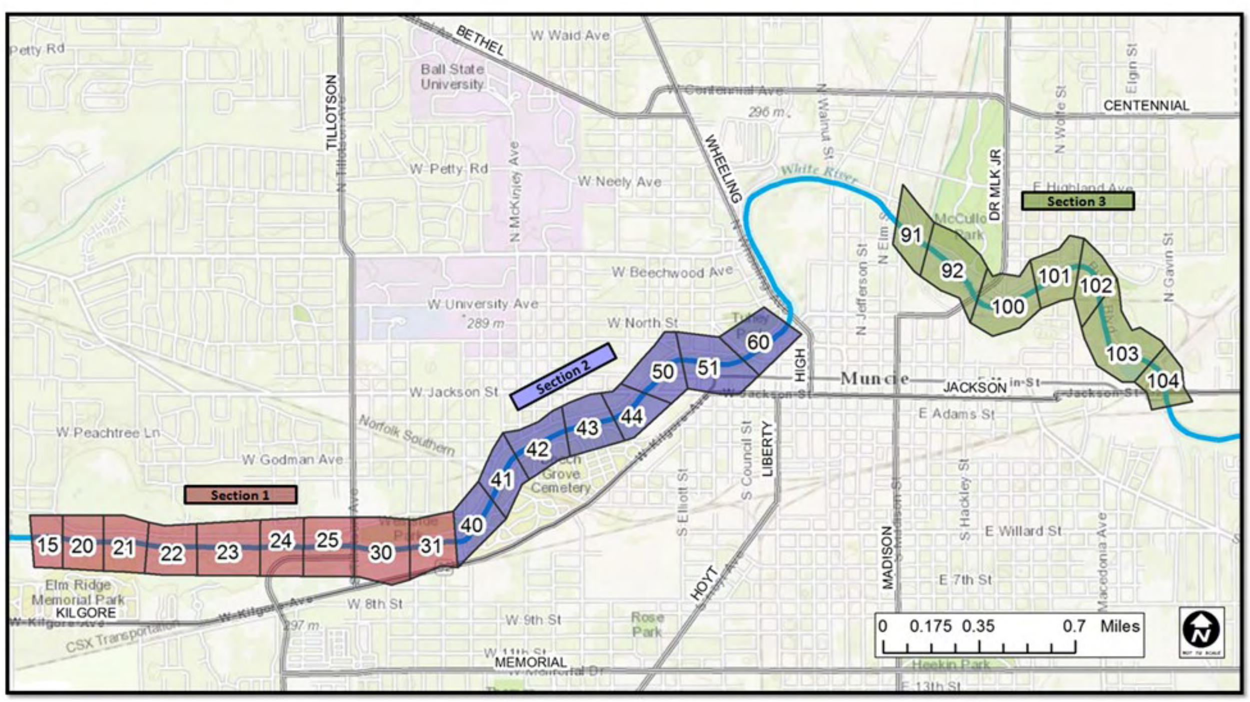


Figure 4.— Map of White River Greenway creel sections and fishing segments.

and eight Smallmouth Bass. The most popular fishing segments in Section 2 were number 50 and 51. A total of six anglers caught four Smallmouth Bass. These segments are located on a stretch of White River characterized by slow moving water with large pools and runs. Traditionally known as one of our better scoring IBI electrofishing sites, segment 101 was the most fished segment in Section 3. While only three Smallmouth Bass were caught by the five anglers, just downstream in segment 100 anglers caught seven Smallmouth Bass.

**A complete summary of all creel angler interviews can be located in the appendix of this report. **

**White River Greenway Recreation Survey-** As previously mentioned, a recreation count survey was added to the creel survey to get a better understanding of the types of activities the White River Greenway is being used for. Because 2015 was the first year for the recreation survey, all information will be used as a baseline and various projects will potentially be explored because of the results.

Very similar to the results found in the Indiana Statewide Outdoor Recreation Plan (SCORP), the number-one activity in which White River Greenway users participated was walking/running. According the SCORP, 46% of all respondents said they had participated in walking for exercise or pleasure more than once a week. During the White River Greenway recreation survey, 279 of our observed 474 greenway users were actively walking/running. Cycling was the second most observed with 150 users. The only other types of activities recorded were rollerblading (2) and skateboarding (2).

One of the more interesting observations during the recreation counts was the amount of users walking their dogs along the greenway. There are leash and pet nuisance laws punishable by fine for any pet owner who does not restrain or clean up after their pet. However, there is not any sort of dog waste station available for users to clean up after their pet along the White River Greenway. Dog waste has been shown to contain high levels of fecal coliform bacteria (Van Der Wel 1995) and the proximity of the White River Greenway in relationship to the White River could cause potential stormwater runoff issues. In order to combat this, the Muncie Sanitary District Stormwater Management Department decided to fund the addition of three dog waste stations along the White River Greenway at public access points. These locations we chosen because of their proximity to the White River Greenway and the availability of city maintained trash receptacles. A map of these locations can be found in the appendix. A total of 1300 dog waste bags have been used since installation on May 12, 2016. These first-year dog waste bag totals have further strengthened the results of our creel recreation counts showing us that the trail is heavily used for walking pets.

## DISCUSSION

Despite the presence of a wide range of negative human impacts, the overall health of the fish communities within the West Fork White River in and around Muncie is *good*. While some minor differences were identified, namely the drop in IBI scores downstream of Muncie, White River meets the goal of maintaining good biological integrity (Figure 4.). These lower IBI scores could potentially be caused by urban stormwater runoff, combined sewer overflows, and a general increase in urbanization. The stability of the White River fish community is due in large part to the strict permitting efforts of point source outfalls through the National Pollution Discharge Elimination Systems. Muncie's Long Term Control Plan (MLTCP) has a goal of a reduction in CSO discharge events and the eventual consolidation/removal of unnecessary combined sewers. This, together with the enhanced efficiency of industrial pretreatment facilities and the improvement of Water Pollution Control Facilities processes will continue to improve biological integrity within White River.

The presence of dams or impoundments typically has noticeable negative effects on water quality (Santucci et al. 2005); however, the five dams located along White River maintain uncommonly high IBI scores. Dams have a tendency to trap sediment, increase water temperatures, decrease dissolved oxygen, and inhibit breakdown of background pollutants such as ammonia (Baxter 1977). Their presence block fish passage and creates lentic habitats unsuitable for rheophilic species (Beasley & Hightower 2000). In spite of these chemical and physical changes, integrity of fish communities above Muncie's dams remains strong.

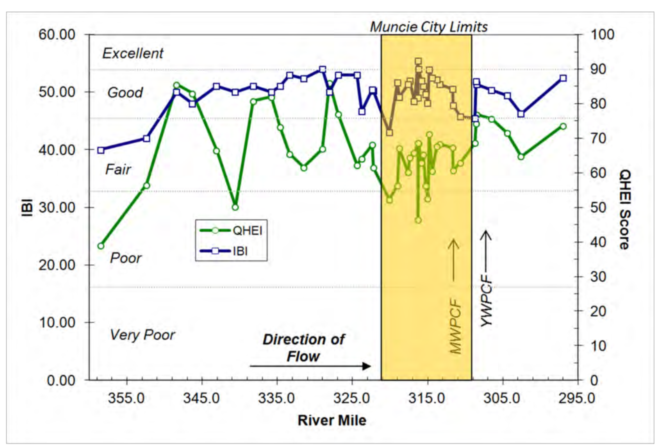


Figure 5.—Average IBI and QHEI scores from WFWR (2004-2018).

In contrast to White River, its tributaries within Delaware County have consistently *poor* biological integrity ratings. Often, small streams and creeks are not maintained with the consideration to water quality and aquatic life. Channelized, dredged, and denuded of riparian vegetation, they have been engineered for the sole purpose of rapidly draining water. Fish communities within these types of streams are dominated by pollution tolerant species. Under these conditions, biological integrity is often irretrievable (Yoder et al. 2000)

The watersheds in Delaware County (Figure 5) show distinct differences in the fish community. As found in previous years, JCEP and WRYPC watersheds are the most impaired both biologically and physically. In contrast the three least impaired watersheds also contained predominantly White River sites and few tributary sites. Urbanization pressures appear to be having the most negative impact on the fish communities in the watersheds analyzed. While both Jake's Creek and York Prairie Creek are in the most impaired watersheds, IBI scores on both creeks increase downstream and outside of city limits.

Underlying ecoregion characteristics have led to a differentiation in habitat and fish communities. The Clayey High Lime Till Plains (CHLTP) is described as having less productive soil with turbid, low gradient streams. These characteristics have led to more artificial drainage and clear cutting of the stream riparian zone to increase drainage efficiency, compounding anthropogenic influences on the fish communities. In contrast, the Loamy High Lime Till Plains (LHLTP) are inherently more efficient in natural drainage reducing the amount of channelization and clear cutting that has been necessary to increase drainage. Lastly, the WIA contains distinctly cool water that is predominantly fed by groundwater. The unique thermal regime has led to a fish community that includes mottled sculpin, several species of dace, and native lampreys. When attempting to compare fish communities from these three ecoregions (Figure 5) it is important to take into consideration the unique characteristics beyond the control of managers and inherently promote different fish communities.

Over the last forty years, fish communities within White River in Muncie have dramatically improved; however, future improvements may depend on our ability to effect change in the tributaries which supply its water. In addition to efficiently conveying water, tributaries simultaneously transport myriad nonpoint pollutants such as silt, fertilizers, pesticides, and many others which are discharged directly into White River.

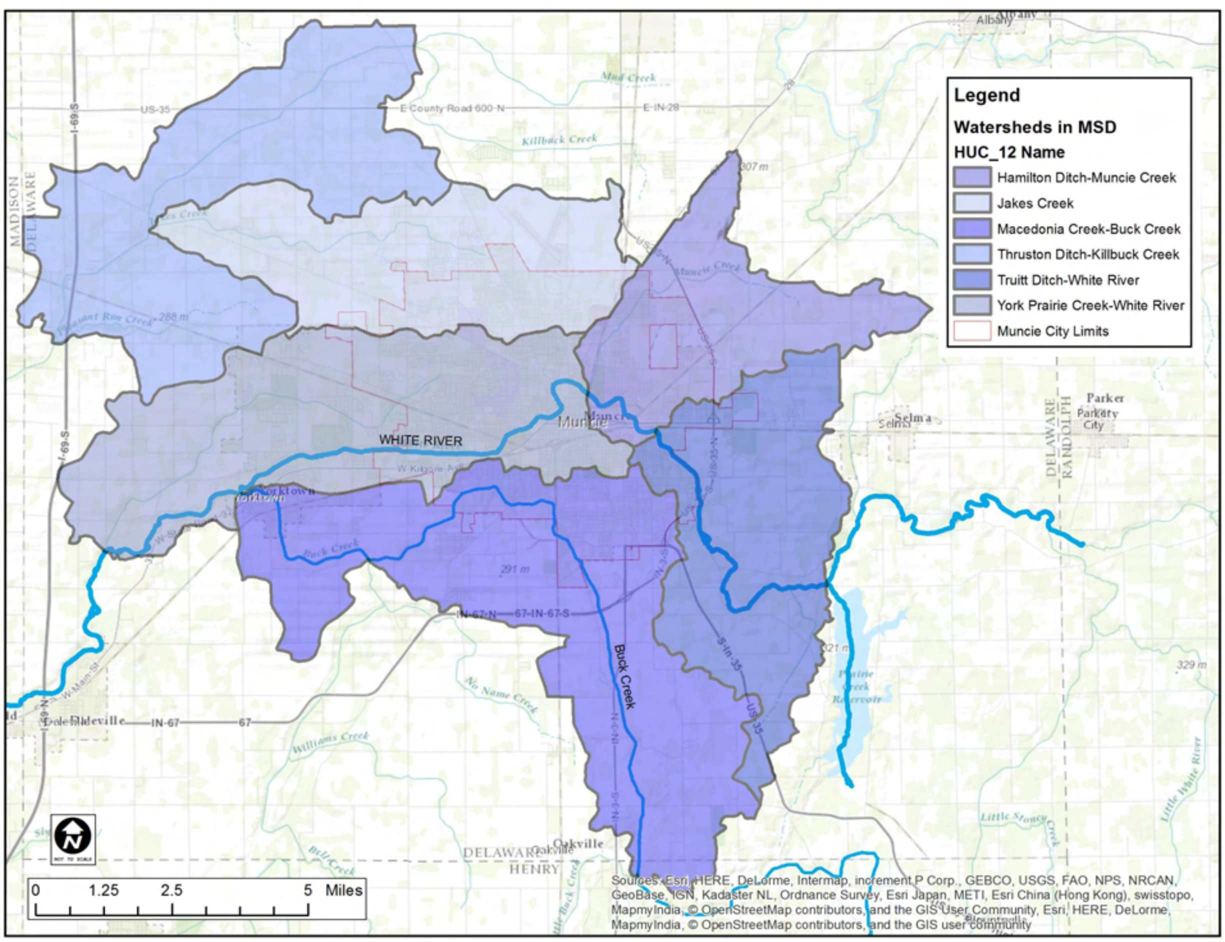

Figure 6.—Map of HUC_12 Watersheds located within the Muncie Sanitary District.

In Delaware County, these small streams account for greater than 80% of the county's stream miles and are capable of having a significant impact on water quality of White River (Lowe & Likens 2005; Alexander et al. 2007). Often, the use of streams as drainage ditches is viewed as directly conflicting with the ability to support ecological integrity, but simple methods exist which can have dramatic improvements on water quality while still preserving the primary function of the stream. Streams bordered by a woody buffer strip 10 m wide may reduce

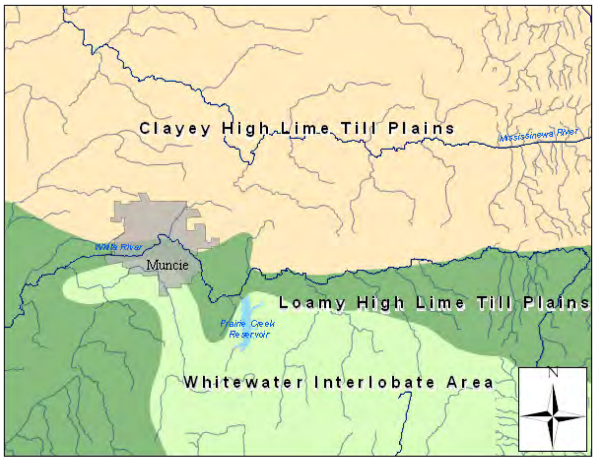

Figure 7.—Level IV ecoregions of Delaware County (usgs 2007).

the phosphorous load by 95% (Vought et al. 1995). Simpler vegetated borders such as filter strips and grassed waterways also provide significant benefits to water quality. They trap soil that would otherwise suffocate aquatic life and protect the natural structure and function of fish habitats. In addition to benefiting water quality, they can also increase farming profits by diverting efforts away from the naturally low-yield areas of buffer zones. Filter strips also supply increased access to fields, more forage for cattle, and improved aesthetics.

Landowners that wish to implement riparian buffer strips can acquire funding through various programs from the Natural Resources Conservation Service (NRCS). The Farm Bill which funds these projects has been highly successful. For example, the Wetlands Reserve Program alone has resulted in a total of 9,951 projects protecting 1,899,979 acres (NRCS 2004). Landowners are encouraged to contact their local NRCS office for more details on each program and information on how to apply. Additionally, state allocated 319 grants award money to counties to educate and involve local citizens in improving their watersheds containing tributaries of White River. Future integrity of the fish community could be drastically affected by how we address these issues.

In 2019, the BWQ plans to continue sampling baseline sites to assess habitat and biological integrity of White River and its surrounding tributaries. As it has for the last forty-seven years, the BWQ will continue to work with industries and private citizens to see that Muncie Continues to remain healthy for the people of Muncie and Indiana.

## AMERICAN EEL

While conducting annual fish sampling events, the 2013 fish crew came across a rarity. An American Eel *Anguilla rostrata* was sampled below High St. dam in Muncie, IN. The specimen was 762 mm (30 in.) long and weighted 1360 g (3 lbs.). This was only the second American Eel to be sampled by the BWQ. The first came in the summer of 1986. While water quality assumptions cannot be made regarding this species, it is always a positive to find a species that hasn't been seen in over 25 years.


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# Appendix A-1: List of Species Collected From 2004-2018

**Petromyzontidae (lampreys)**

| | |
|---|---|
| *Lampetra aepyptera* | least brook lamprey |

**Clupeidae (herrings)**

| | |
|---|---|
| *Dorosoma cepedianum* | gizzard shad |

**Cyprinidae (minnows)**

| | |
|---|---|
| *Pimephales notatus* | bluntnose minnow |
| *Campostoma anomalum* | central stoneroller |
| *Semotilus atromaculatus* | creek chub |
| *Notropis ludibundus* | sand shiner |
| *Notropis rubellus* | rosyface shiner |
| *Ericymba buccata* | silverjaw minnow |
| *Cyprinella spiloptera* | spotfin shiner |
| *Luxilus chrysocephalus* | striped shiner |
| *Rhinichthys atratulus* | blacknose dace |
| *Notropis photogenis* | silver shiner |
| *Notropis volucellus* | mimic shiner |
| *Cyprinus carpio* | common carp |
| *Lythrurus umbratilis* | redfin shiner |
| *Cyprinella whipplei* | steelcolor shiner |
| *Phenacobius mirabilis* | suckermouth minnow |
| *Nocomis biguttatus* | hornyhead chub |
| *Nocomis micropogon* | river chub |
| *Carassius auratus* | goldfish |
| *Pimephales promelas* | fathead minnow |
| *Phoxinus erythrogaster* | southern redbelly dace |
| *Notemigonus crysoleucas* | golden shiner |
| *Hybopsis amblops* | bigeye chub |
| *Notropis blennius* | river shiner |
| *Ctenopharyngodon idella* | grass carp |

**Catostomidae (suckers)**

| | |
|---|---|
| *Moxostoma erythrurum* | golden redhorse |
| *Catostomus commersonii* | white sucker |
| *Hypentelium nigricans* | northern hog sucker |
| *Minytrema melanops* | spotted sucker |
| *Carpiodes cyprinus* | quillback carpsucker |
| *Moxostoma duquesnei* | black redhorse |
| *Carpiodes velifer* | highfin carpsucker |
| *Erimyzon oblongus* | creek chubsucker |
| *Ictiobus bubalus* | smallmouth buffalo |

**Esocidae (pikes)**

| | |
|---|---|
| *Esox americanus* | redfin pickerel |

**Aphredoderidae (pirate perches)**

| | |
|---|---|
| *Aphredoderus sayanus* | pirate perch |

**Fundulidae (killfishes)**

| | |
|---|---|
| *Fundulus notatus* | blackstripe topmin. |

**Percopsidae (trout-perch)**

| | |
|---|---|
| *Umbra limi* | central mudminnow |

**Ictaluridae (catfishes and bullheads)**

| | |
|---|---|
| *Ameiurus natalis* | yellow bullhead |
| *Noturus gyrinus* | tadpole madtom |
| *Noturus flavus* | stonecat |
| *Ictalurus punctatus* | channel catfish |
| *Ameiurus melas* | black bullhead |
| *Ameiurus nebulosus* | brown bullhead |
| *Noturus miurus* | brindled madtom |
| *Pylodictis olivaris* | flathead catfish |

**Peociliidae (livebearers)**

| | |
|---|---|
| *Gambusia affinis* | mosquitofish |

**Atherinidae (silversides)**

| | |
|---|---|
| *Labidesthes sicculus* | brook silverside |

**Cottidae (sculpins)**

| | |
|---|---|
| *Cottus bairdi* | mottled sculpin |

**Percichthyidae (temperate basses)**

| | |
|---|---|
| *Morone chrysops* | white bass |

**Centrarchidae (sunfishes)**

| | |
|---|---|
| *Lepomis cyanellus* | green sunfish |
| *Ambloplites rupestris* | rock bass |
| *Lepomis megalotis* | longear sunfish |
| *Lepomis macrochirus* | bluegill |
| *Micropterus dolomieu* | smallmouth bass |
| *Micropterus salmoides* | largemouth bass |
| *Pomoxis nigromaculatus* | black crappie |
| *Lepomis microlophus* | redear sunfish |
| *Pomoxis annularis* | white crappie |
| *Lepomis humilis* | orangespotted sunfish |
| *Lepomis gibbosus* | pumpkinseed |
| *Lepomis gulosus* | warmouth sunfish |
| *Lepomis spp.* | hybrid sunfish |
| *Centrarchidae* | sunfish Family |
| *Micropterus punctatus* | spotted bass |

**Percidae (perches)**

| | |
|---|---|
| *Etheostoma nigrum* | johnny darter |
| *Etheostoma blennioides* | greenside darter |
| *Etheostoma spectabile* | orangethroat darter |
| *Etheostoma caeruleum* | rainbow darter |
| *Percina caprodes* | logperch |
| *Percina maculata* | blackside darter |
| *Percina phoxocephala* | slenderhead darter |
| *Etheostoma flabellare* | fantail darter |
| *Perca flavescens* | yellow perch |
| *Sander vitreus* | walleye |

**Sciaenidae (drums)**

| | |
|---|---|
| *Aplodinotus grunniens* | freshwater drum |

**Anguillidae (American eel)**

| | |
|---|---|
| *Anguilla rostrata* | american eel |

# Appendix B-1: IBI Metrics

| Site Type | | Abbreviated in summary sheets as: |
|---|---|---|
| Wading Site Metrics: | | |
| One: | Total number of species | # Total Species |
| Two: | Total number of darter species | # Darter Species |
| Three: | Number of sunfish species | # Sunfish Species |
| Four: | Number of sucker species | # Sucker Species |
| Five: | Number of sensitive species | # Sensitive Species |
| Six: | Percent of individual tolerants | % Tolerant |
| Seven: | Percent of individual omnivores | % Omnivores |
| Eight: | Percent of individual insectivores | % Insectivores |
| Nine: | Percent of individual top carnivores | % Top Carnivores |
| Ten: | Percent of individual simple lithophils | % Simple Lithophils |
| Eleven: | Percent of individuals with deformities, eroded fins, lesions, or tumors | % DELT |
| Twelve: | Relative number of individual fish per 15 times the wetted width | Relative Number |

| Headwater Site Metrics: | | |
|---|---|---|
| One: | Total number of species | # Total Species |
| Two: | Total number of darter, madtom, and sculpin species | # Darter/Madtom/ Sculpin |
| Three: | Percent of headwater species | % Headwater Species |
| Four: | Number of minnow species | # Minnow Species |
| Five: | Number of sensitive species | # Sensitive Species |
| Six: | Percent of individual tolerants | % Tolerant |
| Seven: | Percent of individual omnivores | % Omnivores |
| Eight: | Percent of individual insectivores | % Insectivores |
| Nine: | Percent of individual pioneering | % Pioneering |
| Ten: | Percent of Simple Lithophil Species | % Simple Lithophils |
| Eleven: | Percent of individuals with deformities, eroded fins, lesions, or tumors | % DELT |
| Twelve: | Relative number of individual fish per 15 times the wetted width | Relative Number |

[NOTE: Refer to Simon and Dufour (1997) for exact calculation of metrics and description of guilds]

## Appendix B-2: IBI, MIwb, and QHEI Ratings

| Wading Sites: | | | |
|---|---|---|---|
| IBI Score | MIwb Score | QHEI Score | Rating |
| 53-60 | > 9.4 | 90-100 | Excellent |
| 45-52 | 8.3-9.3 | 71-89.9 | Good |
| 35-44 | 5.9-8.2 | 52-70.9 | Fair |
| 23-34 | 4.5-5.8 | 27-51.9 | Poor |
| 12-22 | < 4.5 | 0-26.9 | Very poor |
| <12 | 0 | | NO FISH FOUND |

| Headwater Sites: | | | |
|---|---|---|---|
| IBI Score | MIwb Score | QHEI Score | Rating |
| 53-60 | Not applicable to headwater sites | 90-100 | Excellent |
| 45-52 | | 71-89.9 | Good |
| 35-44 | | 52-70.9 | Fair |
| 23-34 | | 27-51.9 | Poor |
| 12-22 | | 0-26.9 | Very poor |
| <12 | | | NO FISH FOUND |

## Appendix B-3: Pollution Tolerant and Pollution Intolerant Species

| Pollution Tolerant | | | |
|---|---|---|---|
| Bluntnose Minnow | *Pimephales notatus* | Golden Shiner | *Notemigonus crysoleucas* |
| Brown Bullhead | *Ameiurus nebulosus* | Green Sunfish | *Lepomis cyanellus* |
| Common Carp | *Cyprinus carpio* | White Sucker | *Catostomus commersonii* |
| Creek Chub | *Semotilus atromaculatus* | Yellow Bullhead | *Ameiurus natalis* |

| Sensitive Species | | | |
|---|---|---|---|
| Golden Redhorse | *Moxostoma erythrurum* | Northern Hog Sucker | *Hypentelium nigricans* |
| Greenside Darter | *Etheostoma blennioides* | Rock Bass | *Ambloplites rupestris* |
| Least Brook Lamprey | *Lampetra aepyptera* | Smallmouth Bass | *Micropterus dolomieu* |
| Logperch | *Percina caprodes* | Sand Shiner | *Notropis ludibundus* |
| Longear Sunfish | *Lepomis megalotis* | Silver Shiner | *Notropis photogenis* |

Appendix B-4: Breakdown of Index Scores from 2018

| Sample Site | River Mile | Date Sampled | | IBI METRICS - HEADWATER SITES: # Total Species | # Darter/ Madtom/ Sculpin | % Head-water Sp. | # Minnow Species | # Sensitive Species | % Tolerant | % Omni-vores | % Insecti-vores | % Pioneer-ing | % Simple Lithophils | % DELT | Relative Number | IBI Score | QHEI Score | MIwb Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cabin Creek** | 0.5 | 7/19/18 | Calc. | 22 | 5 | 3.30 | 7 | 11 | 49.85 | 32.21 | 33.43 | 61.70 | 15.81 | 0.00 | 329.00 | 42 | 64.0 | N/A |
| Windsor Pike | | | Score | 5 | 5 | 1 | 5 | 5 | 3 | 3 | 3 | 1 | 1 | 5 | 5 | | | |
| **Greenfarm Ditch** | 0.3 | 5/18/18 | Calc. | 7 | 2 | 0 | 3 | 0 | 48.14815 | 35.18518519 | 48.14815 | 77.7778 | 57.40740741 | 0 | 54 | 34 | 57.0 | N/A |
| W. Riggin Rd. | | | Score | 3 | 5 | 1 | 3 | 1 | 3 | 3 | 3 | 1 | 5 | 5 | 1 | | | |
| **Holt Ditch** | 0.1 | 7/6/18 | Calc. | 7 | 1 | 52.38 | 1 | 1 | 38.10 | 4.76 | 71.43 | 28.57 | 4.76 | 0 | 21.00 | 20 | 55.0 | N/A |
| Ball Rd. | | | Score | 3 | 1 | 5 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **Huffman Creek** | 0.2 | 6/25/18 | Calc. | 11 | 3 | 23.71 | 3 | 1 | 42.27 | 10.82 | 25.77 | 56.19 | 57.73 | 0 | 97.00 | 44 | 57.0 | N/A |
| C.R. 600 S. | | | Score | 5 | 5 | 5 | 3 | 1 | 3 | 5 | 3 | 1 | 5 | 5 | 3 | | | |
| **Jakes Creek** | 0.7 | 6/13/18 | Calc. | 7 | 4 | 47.50 | 3 | 2 | 5.00 | 2.50 | 90.00 | 27.50 | 35.00 | 0 | 48.00 | 24 | 59.5 | N/A |
| C.R. 700 W. | | | Score | 1 | 5 | 5 | 1 | 1 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **Jakes Creek** | 6.6 | 5/18/18 | Calc. | 4 | 0 | 0.00 | 0 | 1 | 85.71 | 0.00 | 100.00 | 78.57 | 0.00 | 0 | 16.33 | 12 | 54.5 | N/A |
| Everett Rd. Lift Station (A) | | | Score | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **Killbuck Creek** | 20.1 | 6/13/18 | Calc. | 12 | 4 | 28.17 | 5 | 2 | 57.75 | 8.45 | 36.62 | 56.34 | 18.31 | 0 | 53.25 | 32 | 50.0 | N/A |
| Wheeling Ave. | | | Score | 3 | 5 | 3 | 3 | 1 | 1 | 5 | 3 | 1 | 1 | 5 | 1 | | | |
| **Muncie Creek** | 0.1 | 6/29/18 | Calc. | 5 | 2 | 0.00 | 1 | 2 | 11.11 | 0.00 | 88.89 | 22.22 | 0.00 | 0 | 9.00 | 18 | 51.0 | N/A |
| McCulloch Park | | | Score | 1 | 3 | 1 | 1 | 1 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **Muncie Creek** | 0.3 | 5/17/18 | Calc. | 6 | 1 | 0.00 | 3 | 1 | 53.85 | 46.15 | 23.08 | 26.92 | 30.77 | 0 | 26.00 | 14 | 47.0 | N/A |
| Highland Ave. | | | Score | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **Muncie Creek** | 0.6 | 6/29/18 | Calc. | 10 | 1 | 0.00 | 5 | 1 | 58.70 | 56.52 | 34.78 | 36.96 | 32.61 | 0 | 46.00 | 16 | 49.0 | N/A |
| Wade St. | | | Score | 3 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **Muncie Creek** | 1.4 | 6/29/18 | Calc. | 7 | 1 | 0.00 | 2 | 2 | 68.97 | 37.93 | 31.03 | 48.28 | 55.17 | 0 | 29.00 | 20 | 47.0 | N/A |
| McGalliard Rd. | | | Score | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 3 | 3 | 1 | 1 | 1 | | | |
| **Muncie Creek** | 1.9 | 6/29/18 | Calc. | 8 | 2 | 7.69 | 3 | 1 | 76.92 | 23.08 | 26.92 | 69.23 | 42.31 | 0 | 26.00 | 20 | 43.0 | N/A |
| Yale Ave. | | | Score | 3 | 3 | 1 | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | | | |
| **No Name Creek** | 1.1 | 6/25/18 | Calc. | 6 | 2 | 82.69 | 3 | 0 | 50.00 | 1.92 | 42.31 | 15.38 | 46.15 | 0 | 26.00 | 18 | 62.0 | N/A |
| S.R. 67 S. | | | Score | 1 | 3 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **No Name Creek** | 2.0 | 7/6/18 | Calc. | 10 | 3 | 46.05 | 4 | 1 | 43.42 | 6.58 | 61.84 | 44.74 | 15.79 | 5.26 | 76.00 | 26 | 43.5 | N/A |
| C.R. 400 S. | | | Score | 1 | 3 | 5 | 3 | 1 | 3 | 1 | 1 | 5 | 1 | 1 | 1 | | | |
| **Truitt Ditch** | 0.8 | 5/18/18 | Calc. | 6 | 3 | 38.89 | 3 | 0 | 36.11 | 25.00 | 63.89 | 52.78 | 13.89 | 0 | 36.00 | 24 | 59.5 | N/A |
| Butterfield Rd. | | | Score | 1 | 5 | 5 | 3 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **Truitt Ditch** | 1.3 | 6/26/18 | Calc. | 9 | 2 | 41.18 | 3 | 0 | 35.29 | 20.59 | 50.00 | 41.18 | 14.71 | 0 | 34.00 | 26 | 50.0 | N/A |
| Highway 3 | | | Score | 3 | 3 | 5 | 3 | 1 | 3 | 1 | 1 | 3 | 1 | 1 | 1 | | | |
| **Truitt Ditch** | 1.6 | 6/26/18 | Calc. | 5 | 2 | 18.18 | 1 | 0 | 31.82 | 4.55 | 95.45 | 36.36 | 4.55 | 0 | 22.00 | 20 | 54.0 | N/A |
| C.R. 300 E. | | | Score | 1 | 5 | 3 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | |

Appendix B-4 cont'd:

| Sample Site | River | Date | | # Total | # Darter/ | % Head- | # Minnow | # | % Tolerant | % Omni-vores | % Insecti- | % | % Simple | % DELT | Relative | IBI | QHEI | MIwb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | IBI METRICS - HEADWATER SITES | | | | | | | | | | | | | | |
| **York Praire Creek** C.R. 750 W. | 1.7 | 6/15/18 | Calc. | 18 | 5 | 0.59 | 7 | 3 | 21.76 | 14.12 | 19.12 | 77.65 | 13.24 | 0 | 340.00 | 42 | 55.0 | N/A |
| | | | Score | 5 | 5 | 1 | 5 | 3 | 5 | 5 | 1 | 1 | 1 | 5 | 5 | | | |
| **York Praire Creek** C.R. 50 S. | 2.8 | 6/15/18 | Calc. | 13 | 4 | 1.76 | 5 | 2 | 17.65 | 5.00 | 13.24 | 90.59 | 8.53 | 0 | 340.00 | 36 | 49.0 | N/A |
| | | | Score | 3 | 5 | 1 | 3 | 1 | 5 | 5 | 1 | 1 | 1 | 5 | 5 | | | |
| **York Praire Creek** C.R. 600 W. | 4.0 | 7/6/18 | Calc. | 7 | 4 | 7.69 | 1 | 1 | 30.77 | 7.69 | 76.92 | 69.23 | 53.85 | 0 | 13.00 | 20 | 53.5 | N/A |
| | | | Score | 3 | 5 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **York Praire Creek** C.R. 400 W. | 6.3 | 6/25/18 | Calc. | 9 | 3 | 22.00 | 2 | 1 | 42.00 | 8.00 | 58.00 | 62.00 | 26.00 | 0 | 50.00 | 24 | 53.5 | N/A |
| | | | Score | 3 | 5 | 5 | 1 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| **York Praire Creek** N. Winthrop Rd | 8.0 | 5/17/18 | Calc. | 7 | 2 | 0.00 | 2 | 0 | 29.58 | 0.00 | 91.55 | 95.77 | 39.44 | 0 | 71.00 | 34 | 49.0 | N/A |
| | | | Score | 3 | 5 | 1 | 1 | 1 | 3 | 5 | 5 | 1 | 3 | 5 | 1 | | | |
| **York Praire Creek** Maddox Dr. | 9.0 | 5/17/18 | Calc. | 4 | 2 | 0.00 | 0 | 0 | 3.85 | 0.00 | 100.00 | 88.46 | 80.77 | 0 | 26.00 | 20 | 51.0 | N/A |
| | | | Score | 1 | 5 | 1 | 1 | 1 | 5 | 1 | 1 | 1 | 1 | 1 | 1 | | | |

Appendix B-4 cont'd:

| Sample Site | River Mile | Date Sampled | | # Total Species | # Darter Species | # Sunfish Species | # Sucker Species | # Sensitive Species | % Tolerant | % Omni-vores | % Insecti-vores | % Top Carni-vores | % Simple Lithophils | % DELT | Relative Number | IBI Score | QHEI Score | MIwb Score |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | IBI METRICS - WADING SITES | | | | | | | | | | | | | | |
| **Buck Creek** | 0.2 | 6/6/18 | Calc. | 20 | 4 | 3.00 | 2 | 11 | 13.72 | 11.06 | 74.78 | 4.42 | 50.44 | 0 | 244.08 | 50 | 67.0 | 8.0 |
| Morrow's Meadow | | | Score | 5 | 5 | 3 | 3 | 5 | 5 | 5 | 5 | 1 | 5 | 5 | 3 | | | |
| **Buck Creek** | 0.5 | 6/6/18 | Calc. | 18 | 4 | 2.00 | 4 | 11 | 16.26 | 11.04 | 75.46 | 2.45 | 38.34 | 0 | 352.08 | 48 | 63.0 | 8.6 |
| S.R. 32 | | | Score | 3 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 1 | 3 | 5 | 3 | | | |
| **Buck Creek** | 0.9 | 7/3/18 | Calc. | 16 | 4 | 3.00 | 4 | 10 | 28.99 | 11.83 | 78.70 | 8.28 | 46.15 | 0 | 182.52 | 50 | 62.0 | 7.7 |
| Yorktown Lions Club | | | Score | 3 | 5 | 3 | 5 | 5 | 3 | 5 | 5 | 3 | 5 | 5 | 3 | | | |
| **Buck Creek** | 4.0 | 7/18/18 | Calc. | 17 | 5 | 2.00 | 3 | 7 | 43.79 | 29.41 | 61.44 | 3.27 | 48.37 | 0 | 153.00 | 44 | 61.5 | 6.9 |
| C.R. 325 W. | | | Score | 5 | 5 | 3 | 3 | 5 | 3 | 3 | 5 | 1 | 5 | 5 | 1 | | | |
| **Buck Creek** | 5.9 | 7/3/18 | Calc. | 19 | 5 | 2.00 | 2 | 6 | 36.80 | 20.00 | 64.80 | 0.80 | 35.20 | 0 | 125.00 | 42 | 65.5 | 6.4 |
| Tilliotson Ave. | | | Score | 5 | 5 | 3 | 3 | 3 | 3 | 5 | 5 | 1 | 3 | 5 | 1 | | | |
| **Buck Creek** | 7.0 | 7/18/18 | Calc. | 12 | 2 | 2.00 | 3 | 4 | 37.93 | 16.55 | 70.34 | 0.00 | 38.62 | 0 | 310.71 | 40 | 52.5 | 7.5 |
| C.R. 100 W. | | | Score | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 5 | 1 | 3 | 5 | 3 | | | |
| **Buck Creek** | 8.0 | 7/2/18 | Calc. | 14 | 4 | 1.00 | 3 | 6 | 28.40 | 8.02 | 66.05 | 0.62 | 29.63 | 0 | 162.00 | 40 | 64.5 | 6.7 |
| 23rd Street | | | Score | 3 | 5 | 1 | 3 | 3 | 3 | 5 | 5 | 1 | 3 | 5 | 3 | | | |
| **Buck Creek** | 11.3 | 7/2/18 | Calc. | 12 | 2 | 1.00 | 2 | 4 | 40.86 | 13.44 | 32.26 | 0.54 | 15.59 | 0 | 186.00 | 36 | 59.0 | 6.0 |
| S.R. 3 | | | Score | 3 | 3 | 3 | 3 | 3 | 3 | 5 | 3 | 1 | 1 | 5 | 3 | | | |
| **Mississinewa River** | 88.6 | 5/30/18 | Calc. | 26 | 5 | 5.00 | 6 | 12 | 35.14 | 28.11 | 68.92 | 2.97 | 28.92 | 0 | 532.80 | 50 | 61.0 | 8.8 |
| S.R. 1 | | | Score | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 5 | 1 | 3 | 5 | 5 | | | |
| **Stoney Creek** | 1.0 | 7/5/18 | Calc. | 10 | 3 | 2.00 | 0 | 6 | 0.00 | 0.00 | 80.00 | 2.86 | 31.43 | 0 | 70.00 | 40 | 76.5 | N/A |
| Windsor Pike | | | Score | 3 | 5 | 3 | 1 | 3 | 5 | 5 | 5 | 1 | 3 | 5 | 1 | | | |
| **White River** | 297.0 | 6/4/18 | Calc. | 18 | 4 | 4.00 | 2 | 12 | 32.89 | 23.03 | 63.82 | 12.50 | 24.34 | 0 | 383.04 | 48 | 73.0 | 7.3 |
| Mounds State Park | | | Score | 3 | 3 | 5 | 3 | 5 | 3 | 5 | 5 | 5 | 3 | 5 | 3 | | | |
| **White River** | 302.6 | 5/25/18 | Calc. | 19 | 4 | 4.00 | 3 | 12 | 32.16 | 10.05 | 81.91 | 8.04 | 20.10 | 0 | 429.84 | 46 | 62.0 | 7.8 |
| C.R. 900 W. | | | Score | 3 | 3 | 5 | 3 | 5 | 3 | 5 | 5 | 3 | 3 | 5 | 3 | | | |
| **White River** | 304.4 | 6/5/18 | Calc. | 20 | 3 | 4.00 | 4 | 12 | 13.82 | 1.63 | 59.35 | 36.59 | 28.46 | 0 | 184.50 | 48 | 70.0 | 8.2 |
| C.R. 300 S. | | | Score | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 5 | 1 | | | |
| **White River** | 306.5 | 7/12/18 | Calc. | 20 | 4 | 4.00 | 3 | 11 | 34.25 | 17.68 | 56.35 | 14.36 | 18.23 | 0 | 369.24 | 46 | 73.0 | 7.8 |
| C.R. 750 W. | | | Score | 3 | 3 | 5 | 3 | 5 | 3 | 5 | 5 | 5 | 1 | 5 | 3 | | | |
| **White River** | 308.5 | 5/21/18 | Calc. | 18 | 2 | 4.00 | 5 | 10 | 4.83 | 1.38 | 84.14 | 14.48 | 65.52 | 0 | 165.30 | 52 | 70.5 | 8.2 |
| C.R. 575 W. (B) | | | Score | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 1 | | | |
| **White River** | 308.6 | 5/22/18 | Calc. | 19 | 4 | 4.00 | 4 | 10 | 9.90 | 2.97 | 72.28 | 24.75 | 30.69 | 0 | 193.92 | 52 | 67.5 | 7.9 |
| C.R. 575 W. ( C ) | | | Score | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 1 | | | |
| **White River** | 310.7 | 6/1/18 | Calc. | 19 | 2 | 6.00 | 5 | 7 | 32.17 | 15.65 | 59.13 | 22.61 | 19.13 | 0 | 234.60 | 46 | 65.5 | 8.1 |
| C.R. 400 W. | | | Score | 3 | 3 | 5 | 5 | 3 | 3 | 5 | 5 | 5 | 1 | 5 | 3 | | | |
| **White River** | 311.6 | 7/9/18 | Calc. | 24 | 4 | 5.00 | 4 | 12 | 17.37 | 12.21 | 70.42 | 16.90 | 32.39 | 0 | 408.96 | 56 | 67.5 | 9.2 |
| MWPCF (B) | | | Score | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 3 | | | |

Appendix B-4 cont'd:

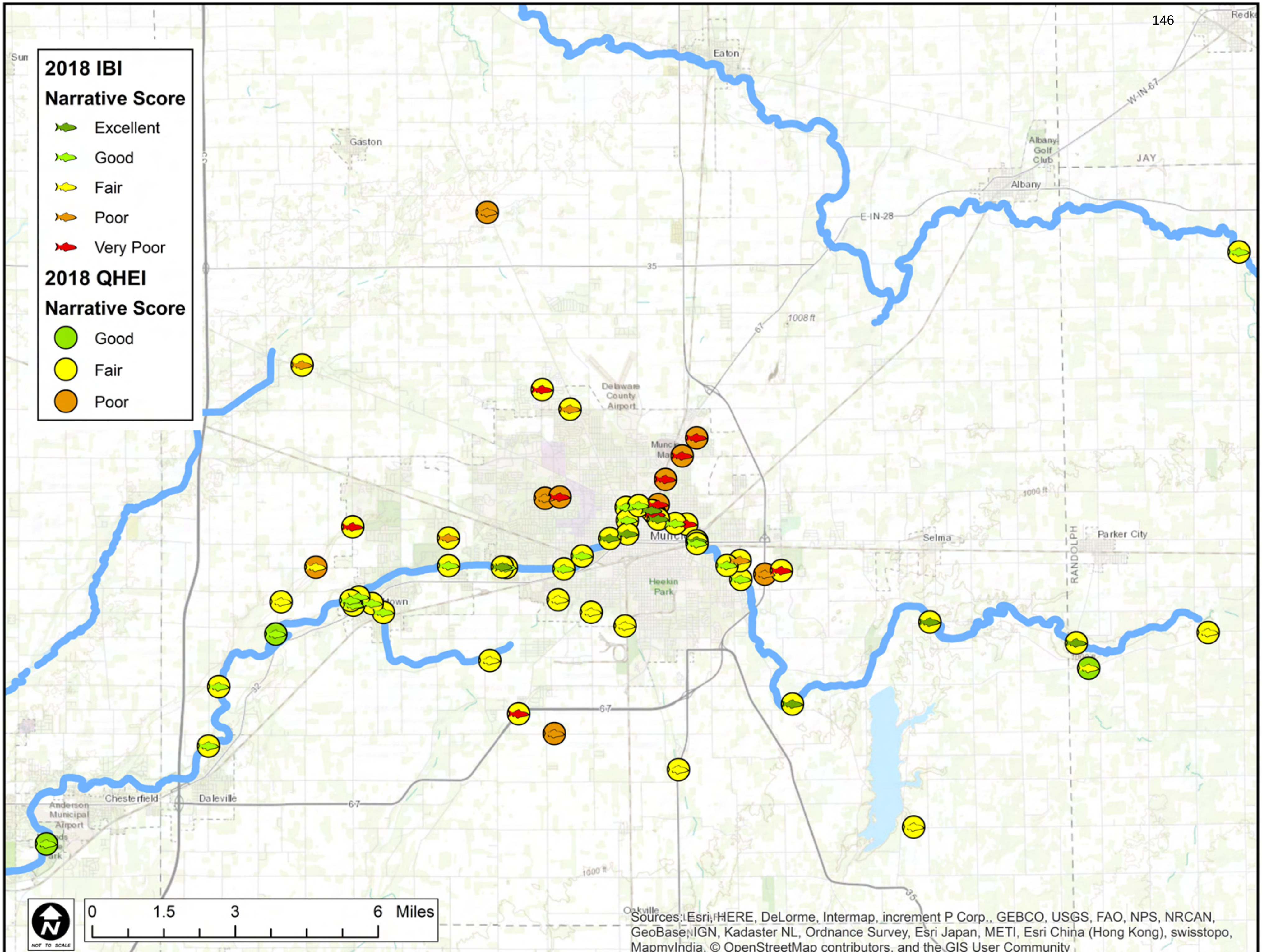
| Sample Site | River | Date | | # Total | # Darter | # Sunfish | # Sucker | # | % Tolerant | % Omni-vores | % Insecti- | % Top | % Simple | % DELT | Relative | IBI | QHEI | MIwb |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | IBI METRICS - WADING SITES | | | | | | | | | | | | | | | |
| White River | 311.7 | 5/24/18 | Calc. | 17 | 3 | 3.00 | 5 | 11 | 5.98 | 3.42 | 74.36 | 19.66 | 54.70 | 0 | 238.68 | 52 | 65.5 | 7.9 |
| MWPCF (A) | | | Score | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | | | |
| White River | 313.4 | 5/22/18 | Calc. | 14 | 4 | 3.00 | 3 | 10 | 6.52 | 0.72 | 53.62 | 45.65 | 14.49 | 0 | 248.40 | 46 | 67.0 | 7.1 |
| West Side Park | | | Score | 3 | 5 | 3 | 3 | 5 | 5 | 5 | 5 | 3 | 1 | 5 | 3 | | | |
| White River | 313.8 | 5/23/18 | Calc. | 20 | 3 | 5.00 | 4 | 12 | 12.50 | 2.84 | 72.73 | 22.73 | 38.64 | 0 | 411.84 | 52 | 60.5 | 8.2 |
| Godman Ave. | | | Score | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 3 | | | |
| White River | 314.4 | 5/23/18 | Calc. | 24 | 4 | 4.00 | 4 | 15 | 13.19 | 3.40 | 81.28 | 14.47 | 42.13 | 0 | 296.10 | 58 | 67.5 | 8.9 |
| Main St. | | | Score | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | | | |
| White River | 314.8 | 5/23/18 | Calc. | 29 | 4 | 5.00 | 4 | 14 | 19.63 | 14.95 | 69.16 | 13.08 | 26.17 | 0 | 372.36 | 56 | 64.5 | 9.0 |
| High St. (B) | | | Score | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 3 | | | |
| White River | 315.0 | 5/31/18 | Calc. | 20 | 3 | 3.00 | 5 | 10 | 7.95 | 15.23 | 75.50 | 9.27 | 58.28 | 0 | 115.52 | 48 | 59.5 | 7.8 |
| High St. ( C ) | | | Score | 3 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | 1 | | | |
| White River | 315.3 | 8/6/18 | Calc. | 17 | 1 | 3.00 | 5 | 9 | 4.86 | 6.94 | 82.64 | 10.42 | 75.69 | 0 | 110.16 | 48 | 57.0 | 7.1 |
| High St. (A) | | | Score | 3 | 1 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 1 | | | |
| White River | 315.6 | 5/23/18 | Calc. | 15 | 4 | 3.00 | 4 | 9 | 9.41 | 7.65 | 73.53 | 18.82 | 25.88 | 0 | 367.20 | 52 | 65.0 | 8.0 |
| Walnut St. | | | Score | 3 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 3 | | | |
| White River | 315.8 | 5/29/18 | Calc. | 21 | 3 | 3.00 | 5 | 12 | 10.42 | 9.23 | 78.87 | 6.25 | 60.71 | 0 | 866.88 | 54 | 59.0 | 9.0 |
| Elm St. | | | Score | 5 | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | 5 | | | |
| White River | 316.3 | 5/19/18 | Calc. | 18 | 3 | 4.00 | 5 | 9 | 10.05 | 15.98 | 59.82 | 24.20 | 32.88 | 0 | 680.46 | 54 | 69.0 | 9.6 |
| McCulloch Park (B) | | | Score | 3 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | | | |
| White River | 316.3 | 8/14/18 | Calc. | 13 | 1 | 2.00 | 6 | 6 | 1.70 | 4.55 | 85.23 | 10.23 | 76.70 | 0 | 316.80 | 48 | 57.0 | 7.3 |
| McCulloch Park (A) | | | Score | 3 | 1 | 3 | 5 | 3 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | | | |
| White River | 317.4 | 5/25/18 | Calc. | 25 | 5 | 4.00 | 6 | 13 | 11.76 | 9.36 | 72.46 | 17.91 | 27.81 | 0 | 762.96 | 58 | 60.0 | 9.3 |
| Ball Rd. | | | Score | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | | | |
| White River | 317.6 | 5/31/18 | Calc. | 21 | 4 | 4.00 | 5 | 9 | 49.67 | 48.36 | 36.84 | 14.14 | 16.78 | 0 | 775.20 | 50 | 62.0 | 8.8 |
| E. Jackson St. (B) | | | Score | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 3 | 5 | 1 | 5 | 5 | | | |
| White River | 318.8 | 7/25/18 | Calc. | 25 | 5 | 4.00 | 3 | 15 | 25.87 | 25.46 | 59.06 | 13.24 | 20.57 | 0 | 795.42 | 52 | 61.0 | 9.2 |
| Water Co. (B) | | | Score | 5 | 5 | 5 | 3 | 5 | 3 | 3 | 5 | 5 | 3 | 5 | 5 | | | |
| White River | 319.0 | 8/14/18 | Calc. | 13 | 2 | 3.00 | 5 | 8 | 5.11 | 5.11 | 86.36 | 8.52 | 88.07 | 0 | 121.13 | 46 | 57.0 | 6.4 |
| Water Co (A) | | | Score | 3 | 3 | 3 | 5 | 3 | 5 | 5 | 5 | 3 | 5 | 5 | 1 | | | |
| White River | 322.2 | 7/11/18 | Calc. | 25 | 5 | 4.00 | 4 | 13 | 8.26 | 5.50 | 78.90 | 14.22 | 27.52 | 0 | 444.72 | 58 | 67.5 | 8.7 |
| Camp Red Wing (B) | | | Score | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 5 | 5 | | | |
| White River | 236.9 | 7/26/18 | Calc. | 28 | 5 | 4.00 | 4 | 15 | 18.44 | 9.02 | 73.36 | 7.99 | 31.76 | 0 | 527.04 | 56 | 62.5 | 9.5 |
| Smithfield Rd. | | | Score | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 3 | 3 | 5 | 5 | | | |
| White River | 331.5 | 7/19/18 | Calc. | 24 | 4 | 5.00 | 4 | 11 | 6.14 | 4.94 | 84.64 | 2.77 | 71.39 | 0 | 2483.10 | 56 | 59.5 | 8.8 |
| C.R. 1275 W. (Rand Co.) | | | Score | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 1 | 5 | 5 | 5 | | | |

Section 1

| Interview # | (I/C) Trip | Start Time | Interview Time | Projected End | Fish Caught @ Time of Interview | Total time | Species Sought | Fish Caught | | | Reason for Visit | Mode of Travel | Fishing Section | Demographics | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Species | Total | # Kept | | | | Sex | Age | Ethnicity | Zip Code |
| 2 | I | 1:00 | 1:30 | 3:00 | 0.5 | 2 | SMB | SMB<br>ROB | 1<br>3 | 0<br>0 | 1 | 1 | 15 | M | 52 | 2 | 47396 |
| 5 | I | 2:00 | 2:30 | 3:30 | 0.5 | 1.5 | SMB | NONE | 0 | 0 | 1 | 1 | 15 | M | 48 | 2 | 47302 |
| 10 | I | 12:00 | 2:00 | 3:00 | 2 | 3 | SMB | NONE | 0 | 0 | 4 | 1 | 15 | M | 49 | 2 | 47303 |
| 14 | I | 4:00 | 5:15 | 5:45 | 1.25 | 1.75 | SMB | SMB | 3 | 0 | 4 | 1 | 15 | M | 22 | 2 | 47305 |
| 18 | C | 4:00 | 6:45 | 6:45 | 2.75 | 2.75 | SMB | ROB<br>SMB<br>BLG | 2<br>1<br>1 | 0<br>0<br>0 | 4 | 1 | 15 | M | 37 | 2 | 47304 |
| 19 | C | 3:00 | 4:30 | 4:30 | 1.5 | 1.5 | ANY | BLC | 3 | 0 | 4 | 1 | 15 | M | 22 | 2 | 47305 |
| 23 | I | 6:00 | 6:30 | 7:30 | 0.5 | 1.5 | NONE | NONE | 0 | 0 | 1 | 1 | 15 | M | 20 | 2 | 47302 |
| 24 | I | 2:00 | 2:30 | 4:00 | 0.5 | 1.5 | SMB<br>BLG | SMB<br>ROB | 2<br>6 | 1<br>2 | 3 | 1 | 15 | M | 77 | 2 | 47304 |
| 25 | I | 12:00 | 12:10 | 12:30 | 0.2 | 0.5 | SMB | NONE | 0 | 0 | 3 | 1 | 15 | M | 49 | 2 | 47302 |
| 28 | I | 2:15 | 2:45 | 3:15 | 0.5 | 1 | ANY | NONE | 0 | 0 | 1 | 1 | 15 | M | 25 | 2 | 47304 |
| 33 | C | 12:00 | 2:00 | 2:00 | 2 | 2 | SMB | ROB | 10 | 0 | 3 | 1 | 15 | M | 19 | 2 | 47396 |
| 34 | C | 12:00 | 2:00 | 2:00 | 2 | 2 | SMB | ROB | 10 | 0 | 3 | 1 | 15 | M | 19 | 2 | 47396 |
| 42 | I | 9:30 | 11:00 | 11:30 | 1.5 | 2 | ANY | SMB | 1 | 0 | 3 | 1 | 15 | F | 79 | 1 | 47302 |
| 17 | I | 6:30 | 6:45 | 8:30 | 0.25 | 2 | SMB | ROB | 1 | 0 | 1 | 1 | 20 | M | 39 | 2 | 47303 |
| 20 | I | 4:30 | 5:30 | 5:45 | 1 | 1.25 | SMB<br>ROB | ROB<br>SMB | 20<br>1 | 0<br>0 | 4 | 1 | 20 | M | 35 | 2 | 47302 |
| 29 | I | 12:45 | 2:45 | 3:00 | 2 | 2.25 | ANY | SMB<br>ROB<br>BLG | 2<br>2<br>1 | 0<br>0<br>0 | 3 | 1 | 20 | M | 77 | 2 | 47304 |
| 43 | I | 10:00 | 11:00 | 12:00 | 1 | 2 | ANY | SMB | 2 | 0 | 2 | 1 | 20 | M | 58 | 2 | 47302 |
| 6 | C | 11:30 | 12:00 | 12:00 | 0.5 | 0.5 | SMB | SMB<br>ROB | 1<br>1 | 0<br>0 | 1 | 1 | 21 | M | 40 | 2 | 47302 |
| 11 | I | 1:00 | 2:00 | 5:00 | 1 | 4 | ANY | SMB | 1 | 0 | 4 | 1 | 21 | M | 47 | 2 | 47302 |
| 21 | I | 5:15 | 5:45 | 6:30 | 0.5 | 1.25 | SMB | SMB | 1 | 0 | 4 | 1 | 21 | M | 20 | 2 | 47303 |
| 26 | I | 11:00 | 12:15 | 1:00 | 1.25 | 2 | ANY | NONE | 0 | 0 | 3 | 1 | 21 | M | 56 | 2 | 47302 |
| 35 | I | 1:30 | 2:30 | 3:30 | 1 | 2 | SMB | NONE | 0 | 0 | 3 | 1 | 21 | M | 69 | 2 | 47304 |
| 36 | I | 1:45 | 2:00 | 3:00 | 0.25 | 1.25 | SMB | SMB | 1 | 0 | 3 | 1 | 21 | M | 17 | 2 | 47304 |
| 70 | I | 11:00 | 1:30 | 3:30 | 2.5 | 4.5 | ANY | ROB | 1 | 0 | 3 | 1 | 21 | F | 31 | 2 | 47304 |
| 71 | I | 11:00 | 1:30 | 3:30 | 2.5 | 4.5 | ANY | NONE | 0 | 0 | 3 | 1 | 21 | M | 38 | 2 | 47356 |
| 27 | I | 11:30 | 12:20 | 1:30 | 0.83 | 2 | ANY | NONE | 0 | 0 | 3 | 1 | 22 | M | 23 | 2 | 47302 |
| 30 | I | 2:30 | 2:55 | 5:00 | 0.41 | 2.5 | SMB | NONE | 0 | 0 | 2 | 1 | 22 | M | 49 | 2 | 47302 |
| 48 | I | 7:00 | 10:45 | 12:00 | 3.75 | 5 | SMB | ROB<br>SMB | 12<br>1 | 0<br>0 | 3 | 1 | 22 | M | 40 | 2 | 47362 |
| 49 | I | 7:00 | 10:45 | 12:00 | 3.75 | 5 | SMB | ROB<br>SMB | 12<br>1 | 0<br>0 | 3 | 1 | 22 | M | 37 | 2 | 73012 |
| 61 | I | 1:00 | 2:30 | 3:00 | 1.5 | 2 | SMB/LMB | LMB | 1 | 0 | 3 | 1 | 22 | M | 22 | 2 | 47304 |
| 75 | I | 2:15 | 2:30 | 4:30 | 0.25 | 2.25 | SMB | NONE | 0 | 0 | 3 | 1 | 22 | M | 71 | 2 | 47304 |
| 76 | I | 9:00 | 9:20 | 10:00 | 0.33 | 1 | ANY | NONE | 0 | 0 | 3 | 1 | 22 | M | 36 | 2 | 47302 |
| 77 | I | 9:00 | 9:20 | 10:30 | 0.33 | 1.5 | ANY | NONE | 0 | 0 | 3 | 1 | 22 | M | 51 | 1 | 47304 |
| 16 | I | 5:00 | 6:30 | 8:30 | 1.5 | 3.5 | SMB | NONE | 0 | 0 | 1 | 1 | 23 | M | 28 | 2 | 47304 |
| 15 | I | 3:30 | 5:30 | 6:00 | 2 | 2.5 | ANY | ROB | 2 | 0 | 4 | 2 | 24 | F | 17 | 2 | 47305 |
| 72 | I | 1:00 | 1:40 | 3:00 | 0.66 | 2 | ANY | NONE | 0 | 0 | 3 | 2 | 24 | M | 29 | 2 | 47304 |
| 13 | I | 4:45 | 4:45 | 5:45 | 0 | 1 | SMB | NONE | 0 | 0 | 1 | 2 | 30 | M | 33 | 1 | 47303 |
| 32 | I | 9:00 | 10:30 | 11:00 | 1.5 | 2 | COC | NONE | 0 | 0 | 3 | 1 | 30 | M | 44 | 2 | 47303 |
| 37 | I | 1:00 | 2:00 | 5:00 | 1 | 4 | ANY | NONE | 0 | 0 | 4 | 1 | 30 | M | 26 | 1 | 47303 |
| 78 | I | 8:30 | 9:30 | 10:30 | 1 | 2 | SMB | NONE | 0 | 0 | 3 | 1 | 30 | M | 53 | 2 | 47368 |
| 7 | I | 10:30 | 10:50 | 11:30 | 0.33 | 1 | SMB/CAT | NONE | 0 | 0 | 3 | 1 | 31 | M | 57 | 2 | 37066 |
| 12 | I | 4:00 | 4:40 | 5:30 | 0.66 | 1.5 | ANY | NONE | 0 | 0 | 1 | 1 | 31 | M | 34 | 2 | 47303 |
| 40 | I | 1:00 | 2:00 | 3:00 | 1 | 2 | ANY | BLC | 2 | 0 | 4 | 1 | 31 | M | 28 | 2 | 47303 |
| 79 | I | 9:30 | 9:30 | 11:00 | 0 | 1.5 | ANY | NONE | 0 | 0 | 1 | 2 | 31 | M | 33 | 2 | 47302 |

Appendix E-1. Cont'd

| Section | Interview # | (I/C) Trip | Start Time | Interview Time | Projected End | Fish Caught @ Time of Interview | Total time | Species Sought | Fish Caught | | | Reason for Visit | Mode of Travel | Fishing Section | Demographics | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Species | Total | # Kept | | | | Sex | Age | Ethnicity | Zip Code |
| Section 2 | 52 | I | 1:15 | 1:20 | 3:15 | 0.08 | 2 | SMB | NONE | 0 | 0 | 3 | 1 | 40 | M | 52 | 2 | 47396 |
| | 8 | I | 11:00 | 12:00 | 1:00 | 1 | 2 | LMB/SMB | SMB | 2 | 0 | 1 | 2 | 41 | M | 19 | 2 | 47306 |
| | 9 | I | 10:45 | 12:00 | 1:00 | 1.25 | 2 | LMB/COC | NONE | 0 | 0 | 1 | 2 | 41 | M | 24 | 2 | 46772 |
| | 31 | I | 2:45 | 3:45 | 4:00 | 1 | 1.25 | ANY | SMB | 1 | 0 | 3 | 1 | 43 | M | 60 | 2 | 47302 |
| | 44 | I | 12:00 | 12:45 | 1:15 | 0.75 | 1.25 | SMB | SMB | 3 | 0 | 3 | 1 | 43 | M | 24 | 2 | 47304 |
| | 1 | I | 9:30 | 12:15 | 12:30 | 2.75 | 3 | LMB | SMB | 3 | 0 | 4 | 1 | 44 | M | 24 | 2 | 47303 |
| | 58 | I | 11:30 | 2:00 | 2:30 | 2.5 | 3 | SMB | ROB<br>SMB | 9<br>1 | 0<br>1 | 4 | 1 | 44 | M | 54 | 2 | 47302 |
| | 38 | I | 12:00 | 2:15 | 4:00 | 2.25 | 4 | COC | SMB | 1 | 0 | 3 | 1 | 50 | M | 54 | 2 | 47304 |
| | 57 | I | 11:30 | 2:00 | 3:30 | 2.5 | 4 | SMB | SMB | 3 | 0 | 1 | 2 | 50 | M | 22 | 2 | 47305 |
| | 60 | I | 1:30 | 2:00 | 3:00 | 0.5 | 1.5 | SMB/ROB | NONE | 0 | 0 | 2 | 2 | 50 | M | 22 | 2 | 47305 |
| | 54 | I | 1:30 | 2:00 | 8:00 | 0.5 | 6.5 | ANY | NONE | 0 | 0 | 3 | 1 | 51 | M | 64 | 1 | 47303 |
| | 55 | I | 1:30 | 2:00 | 8:00 | 0.5 | 6.5 | ANY | NONE | 0 | 0 | 3 | 1 | 51 | F | 52 | 1 | 47303 |
| | 56 | I | 1:30 | 2:00 | 8:00 | 0.5 | 6.5 | ANY | NONE | 0 | 0 | 3 | 1 | 51 | M | 13 | 1 | 47303 |
| | 3 | I | 12:30 | 1:45 | 5:00 | 1.25 | 4.5 | SMB | SMB | 4 | 0 | 3 | 1 | 60 | M | 54 | 2 | 47302 |
| | 74 | I | 2:00 | 2:15 | 2:30 | 0.25 | 0.5 | ANY | Crappie<br>SMB | 5<br>3 | 0<br>0 | 1 | 1 | 60 | M | 42 | 2 | 47302 |
| Section 3 | 69 | C | 11:30 | 2:00 | 2:00 | 2.5 | 2.5 | SMB | NONE | 0 | 0 | 2 | 1 | 90 | M | 31 | 2 | 47304 |
| | 50 | C | 10:00 | 11:30 | 11:30 | 1.5 | 1.5 | Sunfish | NONE | 0 | 0 | 1 | 1 | 91 | M | 53 | 2 | 47304 |
| | 39 | I | 12:00 | 2:00 | 3:00 | 2 | 3 | LMB/CHC | NONE | 0 | 0 | 3 | 2 | 92 | M | 31 | 2 | 47305 |
| | 66 | C | 8:15 | 8:45 | 8:45 | 0.5 | 0.5 | SMB | NONE | 0 | 0 | 3 | 1 | 92 | M | 51 | 2 | 47362 |
| | 67 | I | 8:45 | 8:50 | 10:45 | 0.08 | 2 | SMB/ROB | SMB | 1 | 0 | 3 | 1 | 92 | M | 59 | 2 | 47304 |
| | 62 | I | 7:30 | 8:00 | 9:30 | 0.5 | 2 | SMB | SMB | 4 | 0 | 4 | 1 | 100 | M | 56 | 2 | 47303 |
| | 63 | I | 7:30 | 8:00 | 9:30 | 0.5 | 2 | SMB | SMB | 3 | 0 | 3 | 1 | 100 | M | 48 | 2 | 47302 |
| | 45 | I | 7:00 | 9:00 | 12:00 | 2 | 5 | SMB/ROB | NONE | 0 | 0 | 3 | 1 | 101 | M | 40 | 2 | 47362 |
| | 46 | I | 7:00 | 9:00 | 12:00 | 2 | 5 | SMB | NONE | 0 | 0 | 3 | 1 | 101 | M | 37 | 2 | 73012 |
| | 51 | I | 1:30 | 1:40 | 3:30 | 0.1 | 2 | BLG/WAE | NONE | 0 | 0 | 3 | 2 | 101 | F | 15 | 1 | 47302 |
| | 64 | I | 12:00 | 2:25 | 2:30 | 2.42 | 2.5 | SMB/Crapie | SMB | 3 | 0 | 3 | 1 | 101 | M | 68 | 2 | 47302 |
| | 65 | I | 12:00 | 2:25 | 2:30 | 2.42 | 2.5 | SMB/BLG | NONE | 0 | 0 | 3 | 1 | 101 | M | 53 | 1 | 47303 |
| | 41 | C | 8:00 | 1:15 | 1:15 | 5.25 | 5.25 | ROB | ROB | 10 | 10 | 3 | 1 | 102 | F | 53 | 1 | 47305 |
| | 53 | I | 12:45 | 1:50 | 5:00 | 1.08 | 4.25 | FHC | NONE | 0 | 0 | 3 | 1 | 102 | M | 58 | 2 | 47302 |
| | 68 | I | 12:00 | 12:30 | 2:00 | 0.5 | 2 | ANY | NONE | 0 | 0 | 1 | 2 | 102 | M | 52 | 2 | 47303 |
| | 73 | I | 11:00 | 11:30 | 12:00 | 0.5 | 1 | ANY | ROB | 1 | 0 | 1 | 1 | 102 | M | 68 | 2 | 47368 |
| | 4 | I | 12:00 | 2:00 | 2:30 | 2 | 2.5 | SMB | SMB<br>ROB | 5<br>2 | 0<br>0 | 1 | 1 | 103 | M | 62 | 2 | 47302 |
| | 22 | I | 7:20 | 7:30 | 8:30 | 0.16 | 1 | SMB | NONE | 0 | 0 | 3 | 1 | 103 | M | 53 | 1 | 47354 |
| | 47 | C | 8:30 | 9:45 | 9:45 | 1.25 | 1.25 | SMB | NONE | 0 | 0 | 3 | 1 | 103 | M | 59 | 1 | 47304 |
| | 59 | I | 1:30 | 2:00 | 2:30 | 0.5 | 1 | SMB | NONE | 0 | 0 | 2 | 1 | 104 | M | 24 | 2 | 47302 |


2018 IBI
Narrative Score
Excellent
Good
Fair
Poor
Very Poor
2018 QHEI
Narrative Score
Good
Fair
Poor
Eaton
Gaston
Albany Golf Club
Albany
JAY
W-IN-67
E-IN-28
1008 ft
Delaware County Airport
Selma
Parker City
RANDOLPH
Heekin Park
Chesterfield
Daleville
Anderson Municipal Airport
1000 ft
Oakville
0
1.5
3
6
Miles
NOT TO SCALE
Sources: Esri, HERE, DeLorme, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community