2023 Performance Monitoring WP for Selected Indiana Subwatersheds B-060-OWQ-WAP-XXX-23-W-R0

Author

Kayla Werbianskyj
Environmental Manager
Targeted Monitoring Section

Indiana Department of Environmental Management
Office of Water Quality
Watershed Assessment and Planning Branch
Targeted Monitoring Section
100 North Senate Avenue
MC 65-40-2 Shadeland
Indianapolis, Indiana 46204-2251

June 1, 2023

B-060-OWQ-WAP-XXX-23-W-R0

This page is intended to be blank.

Signature Page

Reviews and Approvals

Angela M Brown ______ 5/22/2023
Angie Brown, Section Chief Watershed Planning and Restoration — Date
Watershed Assessment and Planning Branch, OWQ

Paul McMurray ______ 5/23/2023
Paul McMurray, Integrated Report Coordinator — Date
Watershed Assessment and Planning Branch, OWQ

Stacey L. Sobat ______ May 18, 2023
Stacey Sobat, Section Chief — Date
Probabilistic Monitoring Section, Watershed Assessment and Planning Branch, OWQ

______ 5/18/2023
Ali Meils, Section Chief — Date
Targeted Monitoring Section, Watershed Assessment and Planning Branch, OWQ

Timothy Bowren ______ 5/23/2023
Timothy Bowren, Project Quality Assurance Officer — Date
Technical and Logistical Services Section, Watershed Assessment and Planning Branch, OWQ

Kristen Arnold ______ 5/23/2023
Kristen Arnold, Branch Chief — Date
Watershed Assessment and Planning Branch, OWQ

IDEM Quality Assurance Staff reviewed and approved this sampling and analysis work plan.

Patrick Colcord ______ 5/30/2023
Quality Assurance Staff, IDEM Office of Program Support — Date

This page is intended to be blank.

Work Plan Organization

This work plan details how sampling and data analysis for the 2023 Performance Monitoring project will occur by incorporating and referencing guidance set forth by the existing Watershed Assessment and Planning Branch (WAPB), March 2017, Quality Assurance Project Plan (QAPP) for Indiana Surface Water Programs (Surface Water QAPP) (IDEM 2017a) and October 2020 QAPP for Biological Community and Habitat Measurements (Biological and Habitat QAPP) (IDEM 2020a). Per the United States Environmental Protection Agency (U.S. EPA) 2006 Guidance on Systematic Planning Using the Data Quality Objectives (DQO) Process (U.S. EPA 2006) and the U.S. EPA 2002 Guidance for Quality Assurance Project Plans (U.S. EPA 2002), this work plan establishes criteria and specifications pertaining to a specific water quality monitoring project usually described in the following four groups or sections of a QAPP per Guidance for Quality Assurance Project Plans (U.S. EPA 2002).

Section A. Project Management

A.1 Title and Approval
A.2. Table of Contents
A.3. Distribution List
A.4. Project Organization
A.5 Problem Definition and Background
A.6. Project Description
A.7 Quality Objectives and Criteria for Measurement Data
A.8 Special Training or Certifications
A.9. Documents and Records

Section B. Data Generation and Acquisition

B.1 Sampling Process Design
B.2 Sampling Methods
B.3. Sample Handling and Custody
B.4 Analytical Methods
B.5 Quality Control
B.6. Instrument or Equipment Testing, Inspection, and Maintenance
B.7. Instrument or Equipment Calibration and Frequency
B.8. Inspection and Acceptance of Supplies and Consumables
B.9. Nondirect Measurements
B.10. Data Management

Section C. Assessment and Oversight

C.1 Assessments and Response Actions
C.2 Reports to Management

Section D. Data Validation and Usability

D.1 Data Review, Verification, and Validation

Table of Contents

List of Figures

List of Tables

List of Attachments

List of Appendices

List of Acronyms

AIMS	Assessment Information Management System
AUID	Assessment unit identification
CALM	Consolidated Assessment Listing Methodology
DO	Dissolved oxygen
DQO	Data quality objectives
IAC	Indiana Administrative Code
IBC	Impaired biotic community
IBI	Index of Biotic Integrity
mIBI	Macroinvertebrate Index of Biotic Integrity
MHAB	Multi-habitat
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source
OHEPA	Ohio Environmental Protection Agency
OWQ	Office of Water Quality
PFD	Personal floatation device
PPE	Personal protective equipment
QA/QC	Quality assurance and quality control
QAPP	Quality assurance project plan
QC	Quality control
QHEI	Qualitative Habitat Evaluation Index
SOP	Standard operating procedures
S.U.	Standard Units
TMDL	Total Maximum Daily Load
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WAPB	Watershed Assessment and Planning Branch

Definitions

Assessment unit (AU)	Individual segment of a stream or river (measured and reported in miles) used for assessing waters. Length of a stream AU can vary. A single AU may or may not represent the entire stream to which it is associated. Example: Large rivers are commonly broken into smaller, separate AUs. Smaller streams may be grouped together into a single, “catchment” AU based on hydrology and other factors which affect water quality.
Assessment unit identification (AUID)	Unique code used to identify each AU based on the 12-digit HUC in which it is located. Used for reporting biological, chemical, and bacteriological impairments of Indiana streams and rivers on the 303(d) List of Impaired Waterbodies.
Biotic community	A naturally occurring assemblage of plants and animals living in the same environment which are mutually sustaining and interdependent. (i.e., fish, macroinvertebrates)
Impaired biotic communities (IBC)	An IBC listing on Indiana’s 303(d) list or in a Total Maximum Daily Load (TMDL) means Indiana Department of Environmental Management) IDEM’s monitoring data show one or both aquatic communities [fish and aquatic invertebrates (e.g., insects)] are impaired for the Warmwater Aquatic Life Use criteria. IBC is not a source of impairment but a symptom of other sources. This indicates the cumulative effects of activities affecting water quality conditions over time.
Hydrologic Unit	Describes the area of land upstream from a specific point on the stream (generally the mouth of outlet) which contributes surface water runoff directly to this outlet point.
Hydrologic Unit Code (HUC)	A numeric U.S. Geological Survey code corresponding to a watershed area. Each area also has a text description associated with the numeric code.

Letter of intention	Letter sent to landowners stating staff will be sampling a stream accessed at a bridge near their property. If accessing through an individual's property is needed, approval from the landowner will be obtained.
National Hydrology Dataset (NHD)	The NHD is a database created by U.S. EPA and the United States Geological Survey (USGS) which provides a comprehensive coverage of hydrographic data for the United States. It uniquely identifies and interconnects the stream segments comprising the nation's surface water drainage system and contains information for other common surface waterbodies such as lakes, reservoirs, estuaries, and coastlines.
Perennial stream	A stream which flows throughout the year.
Reach	A segment of a stream used for fish community sampling, equal in length to 15 times the average wetted width of the stream, with a minimum length of 50 meters (m) and a maximum length 500 m.
Reach indexing	The process of using the NHD and geographic information systems software to delineate waterbody AUs for the purposes of applying and mapping quality assessment information.
Target	A sampling point which falls on a perennial stream within the basin of interest and the boundaries of Indiana.
Total Maximum Daily Load (TMDL)	The sum of the individual waste load allocations for point sources, load allocations for nonpoint sources, and natural background, plus a margin of safety. TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures which relate to a state's water quality standard. TMDLs are required for any impaired waters on the 303(d) List.

A. Project Management

A.1 Project Objective

The state of Indiana is tasked with restoring and maintaining the chemical, physical, and biological integrity of the waters of the state [327-IAC-2-1-1.5]. The IDEM Office of Water Quality (OWQ) is responsible for sampling and assessing Indiana's surface water quality pursuant to the Clean Water Act Section 305(b). According to Clean Water Act Section 303(d), Indiana must identify water bodies of the state which are impaired and require development of a TMDL to alleviate the impairments.

To that end, all states must submit a biennial Integrated Water Quality Monitoring and Assessment Report (Integrated Report) (IDEM 2022a) to the U.S. EPA. The Integrated Report encompasses the 305(b) assessment report and the 303(d) list of impaired water bodies (IDEM 2022a). Various WAPB programs facilitate assessments of the state's waters by involving probabilistic and targeted approaches through collection of biological, chemical, physical, and habitat data.

The objective of the Performance Monitoring program is to determine whether watershed restoration efforts resulted in water quality improvement; and subsequently, delisting of stream segments from the 303(d) list of impaired water bodies.

Additional sites outside of this project scope may be evaluated for improvements based on needs from other programs.

A.2 Project or Task Organization and Schedule

Sampling of waterbodies in the target subwatersheds will occur between April and October during the 2023 sampling season (Table 3). Project laboratory processing and data analysis will continue through spring of 2024.

Deadlines and Time Frames for Sampling Activities

1. **Site Reconnaissance**
   Complete reconnaissance activities for all watersheds in March 2023. Confirm landowner approval in March of 2023. Staff will seek landowner approval, if necessary, to safely access the original sampling location on the stream with the appropriate equipment. If staff cannot access the original location, then access sites at the nearest bridge crossing on the same AUID. If no bridge access, staff will try to find the easiest access through landowner approval in a different location on the same AUID. When unable to contact landowners, send a letter of intention with the project manager's contact information. Reject sites with no suitable access to a selected impaired segment. Conduct reconnaissance activities in the office and through physical site visits, if needed. Collect GPS coordinates and accuracy data at sites if necessary (IDEM 2022b 2023a, 2023b).

2. **Biological Sampling**
   Complete sampling of fish and macroinvertebrate communities for ten sites with impaired biotic communities (IBC). Table 3 contains the fish community and macroinvertebrate community sampling time frames and designated index period for each community. View dates specific to each community in the table footnotes. Use available historical biological community data to assess impairments for the impaired AUID segment. Report all data and results to U.S. EPA for a potential Success Story approval.

3. **In-situ Water Chemistry**
   Collect in-situ dissolved oxygen (DO), DO percent saturation, pH, temperature, specific conductance, and turbidity readings with all subwatershed sampling events using a data sonde which produces an instantaneous reading. Collect in-situ water chemistry parameters at the same time as biological samples. To assess a prior impairment for DO or pH, sample a site at least three times for the parameter (IDEM 2022c). Table 6 lists in-situ parameters and corresponding methods.

4. **Bacteriological Sampling (*E. coli*)**
   Conduct sampling during the recreational season of April to October 2023. Sample each site five times at equally spaced intervals over a 30-day period to determine a geometric mean. There will be two sites sampled to confirm *E. coli* delistings on the Indiana Harbor Canal and Lake Michigan shoreline, 23W011 and 23W012 respectively (Table 1, Table 2).

A.3 Background and Project or Task Description

Initiate performance monitoring, operated through the WAPB, to show improvements in water quality for waterbodies cited in Categories 4A or 5A of Indiana's Integrated Report's Consolidated List (IDEM 2022a). Improvements result from undergoing documented nonpoint source control, or watershed planning and restoration efforts. Report performance monitoring chemical, physical, biological, and bacteriological data to U.S. EPA Region 5's Nonpoint Source Program to show improvements in watersheds previously listed as impaired. The monitoring design for each waterbody reflects the original sampling effort. For this study, the Hydrologic Unit Code (HUC) 12 subwatersheds in Table 1 contain detailed site descriptions including latitude, longitude, waterbody, location, and county.

Table 1. 2023 Performance Monitoring Hydrologic Unit Code 12 subwatersheds and site descriptions

HUC 12	HUC 12 Name	Latitude	Longitude	Site	Event	Stream	Location	County
041000050104	Black Creek	41.1943284	-84.92703236	LEM-01-0012	23W001	Black Creek	Yellowstone Trail	Allen
040500011001	Pigeon Lake-Pigeon Creek	41.66919741	-84.91155355	LMJ-10-0093	23W002	Pigeon Creek	CR 200 North	Steuben
040500011105	Page Ditch	41.73882181	-85.58069621	LMJ-11-0021	23W003	Page Ditch	CR 800 West	Lagrange
071200020405	Hickory Branch-Iroquois River	40.87015	-87.306317	UMI-04-0019	23W004	Iroquois River	SR 55	Newton
051201080202	Headwaters Burnett Creek	40.50868309	-86.84485413	WLV010-0022	23W005	Burnett Creek	Prophet Street	Tippecanoe
051201080104	Elliott Ditch	40.37111111	-86.90472222	WLV020-0005	23W006	Elliott Ditch	SR 231	Tippecanoe
051201111511	Rogers Ditch	38.97413786	-87.4825249	WBU-15-0038	23W007	Rogers Ditch	CR 400 West	Sullivan
051201111504	Mud Creek-Big Branch	39.12078723	-87.3108456	WBU160-0050	23W008	Big Branch	CR 525 East	Sullivan
051201130706	Headwaters Little Creek	38.05456496	-87.66741773	WLW-07-0002	23W009	Little Creek	Number 6 School Road	Vanderburgh
051201130709	Indian Creek-Big Creek	38.01662135	-87.8892028	WLW-07-0005	23W010	Big Creek	Solitude Lane	Posey
040400010603	Calumet River-Frontal Lake Michigan	41.672642646	-87.44234612	LMM010-0001	23W011	Indiana Harbor Canal	Mouth at LTV Steel	Lake
040400010603	Calumet River-Frontal Lake Michigan	41.635371	-87.162205	LMG-06-0034	23W012	Lake Michigan	Lake Michigan - Burns Harbor	Porter

Use one or more of the following data types for assessment purposes: in-situ water chemistry (all sampling events), bacteriological, fish community and macroinvertebrate assemblages, and habitat evaluations at every sampling site. For biological community status, the community sampled will vary depending upon the available historical data. Use the historical biological community data (fish, macroinvertebrate, or both) which identified the impairment to show subsequent improvement. Table 2 contains site specific sampling information.

The Indiana Water Quality Monitoring Strategy: 2017–2021 (IDEM 2017b) facilitates accomplishing the Clean Water Act requirements, in addition to other IDEM-specific management goals. Following analysis of historical data and statewide restoration activities, select performance measures monitoring sites from AUIDs listed on the 303(d) List of Impaired Waters or in an approved TMDL in a watershed for which IDEM observed significant restoration activities. Following data collection, reassess sites to determine whether stream segments are supporting or nonsupporting for the designated use attainment status for parameters sampled. Sampling parameters may vary among sites. Determine the sampling parameters using the impairment indicated by the 303(d) listing or TMDL. Figures 1 and 2 depict impairments in subwatersheds.

Table 2. 2023 Performance monitoring sampling parameters and stream segment impairments for selected Indiana subwatersheds

AIMS site number	Project site number	Stream	Impairment	AUID
Black Creek (041000050104)				
LEM-01-0012	23W001	Black Creek	IBC	INA0514_02
Pigeon Lake-Pigeon Creek (040500011001)				
LMJ-10-0093	23W002	Pigeon Creek	IBC	INJ01A1_03
Page Ditch (040500011105)				
LMJ-11-0021	23W003	Page Ditch	IBC	INJ01B5_04
Hickory Branch-Iroquois River (071200020405)				
UMI-04-0019	23W004	Iroquois River	IBC	INK0245_02
Headwaters Burnett Creek (051201080202)				
WLV010-0022	23W005	Burnett Creek	IBC	INB0822_02
Elliott Ditch (051201080104)				
WLV020-0005	23W006	Elliott Ditch	IBC*	INB0814_04
Rogers Ditch (051201111511)				
WBU-15-0038	23W007	Rogers Ditch	IBC	INB11FB_01
Mud Creek-Big Branch (051201111504)				
WBU160-0050	23W008	Big Branch	IBC**	INB11F4_03
Headwaters Little Creek (051201130706)				
WLW-07-0002	23W009	Little Creek	IBC	INB1376_02
Indian Creek-Big Creek (051201130709)				
WLW-07-0005	23W010	Big Creek	IBC	INB1379_03
Calumet River-Frontal Lake Michigan (040400010603)				
LMM010-0001	23W011	Indiana Harbor Canal	*E. coli*	INC0163_G1078
LMG-06-0034	23W012	Lake Michigan	*E. coli*	INC0163_G1093

*IBC – sample macroinvertebrate community only
**IBC – sample fish community only

Figure 1. Location of 2023 Performance monitoring subwatersheds and impairments

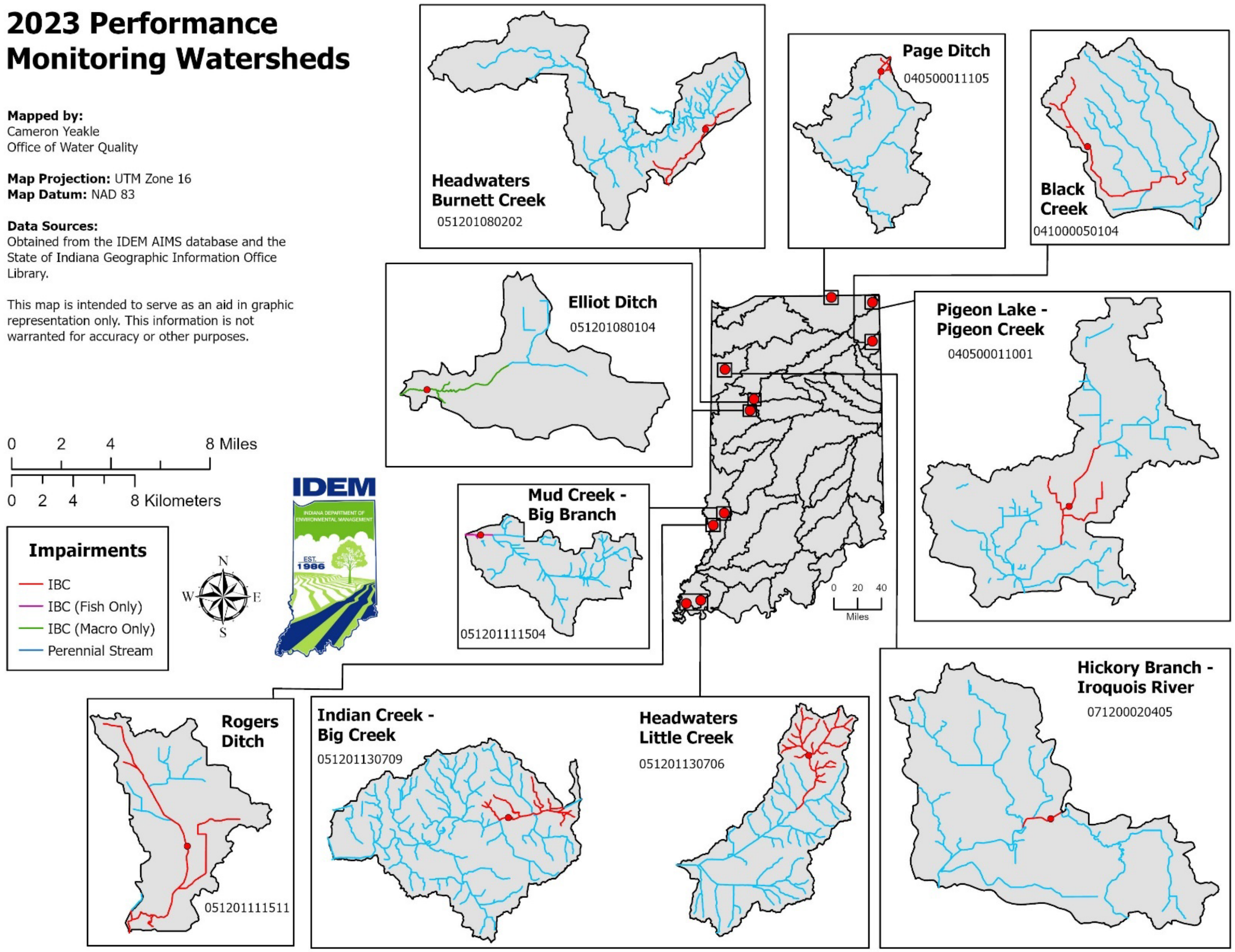

Figure 2. Location of 2023 performance monitoring subwatersheds and impairments (E. coli).

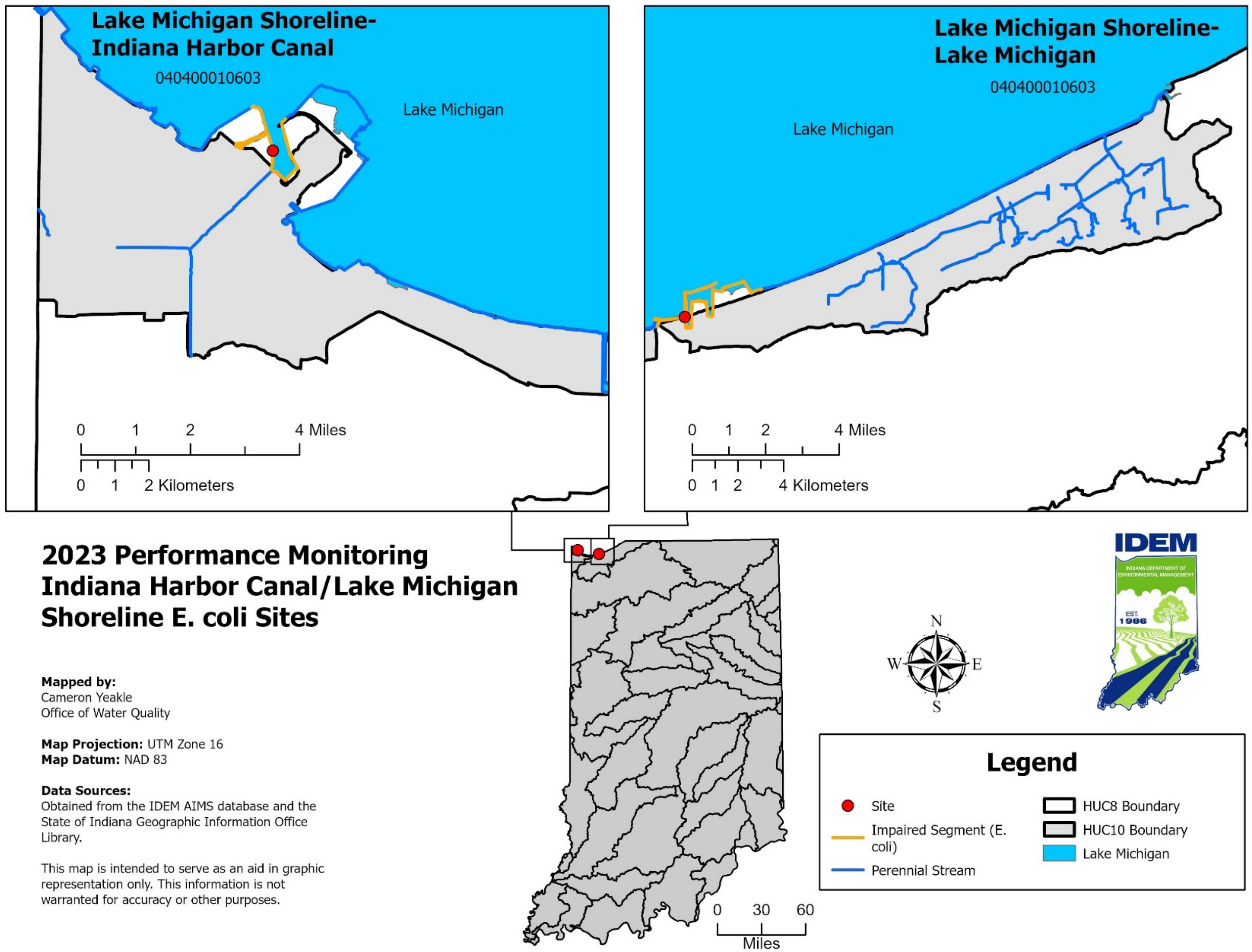

Table 3. Performance monitoring time frames for sampling activities relative to the cause of impairment per stream in selected subwatersheds in 2023

2023 Subwatershed	Recon	IBC[1]	In-situ Water Chemistry	*E. coli*
Black Creek	March	June 1–Oct 15	Every sampling event	N/A
Pigeon Lake-Pigeon Creek	March	June 1–Oct 15	Every sampling event	N/A
Page Ditch	March	June 1–Oct 15	Every sampling event	N/A
Hickory Branch-Iroquois River	March	June 1–Oct 15	Every sampling event	N/A
Headwaters Burnett Creek	March	June 1–Oct 15	Every sampling event	N/A
Elliott Ditch	March	July 15–Oct 15	Every sampling event	N/A
Rogers Ditch	March	June 1–Oct 15	Every sampling event	N/A
Mud Creek-Big Branch	March	June 1–Oct 15	Every sampling event	N/A
Headwaters Little Creek	March	June 1–Oct 15	Every sampling event	N/A
Indian Creek-Big Creek	March	June 1–Oct 15	Every sampling event	N/A
Calumet River-Frontal Lake Michigan	March	N/A	Every sampling event	April - Oct (Five-week Geomean)

[1] Sample fish and macroinvertebrate communities. Note: macroinvertebrate sampling index begins July 15.

A.4 Quality Objectives and Criteria

The DQO process (U.S. EPA 2006) is a planning tool for data collection activities. It provides a basis for balancing decision uncertainty with available resources. All significant data collection projects require the DQO process. It is a seven-step systematic planning process used to clarify study objectives, define the appropriate types of data, and establish decision criteria on which to base the final use of the data. The following seven steps identify the results of the DQO process for performance monitoring in selected Indiana subwatersheds.

1. **State the Problem**
   Indiana is required to assess all waters of the state to determine their designated use attainment status. “Surface waters of the state are designated for full body contact recreation” and “will be capable of supporting” a “well-balanced, warm water aquatic community” [327 IAC 2-1-3]. Performance monitoring gathers

biological (fish or macroinvertebrate), habitat, in-situ chemistry data, and *E. coli* for the purpose of assessing the designated use attainment status of the impaired AUID segments on waterbodies in the target subwatersheds. Table 2 lists the currently impaired AUID segments for improvement assessments in 2023.

2. **Identify the Goals of the Study**

   The goal of this study is to assess whether the 12 targeted waterbody segments in the target subwatersheds are “supporting” or “nonsupporting” for the designated use attainment related to each previously identified impairment (Table 2). Sample each AU at one or two sites per AUID stream segment, with one or more parameters per site. Compare the data with water quality criteria included in Table 4 or biological criteria following Indiana’s 2022 CALM (IDEM 2022c).

   Table 1 and Table 2 describe all sites; AUID stream segments, location, waterbodies, HUC 12 identification, and impairments for a total of 12 sites across 11 subwatersheds. Assess sites for one or more of the following parameters: biology (fish and macroinvertebrates) DO, or *E. coli*. Assess *E. coli* for improvement based on the Indiana narrative bacteria criteria (Table 4) and section 5 [327 IAC 2-1-3].

Table 4. Water Quality Criteria [327 IAC 2-1.5-8 and 327 IAC 2-1-6-b-3 (page 15)] – Modified to sampling parameters in 2023 Performance Monitoring

Parameter	Level	Criterion
E. coli (April-October recreational season)	≤125 MPN/100 milliliter (mL)	Five-sample geometric mean
	≤235 MPN/100 mL	Single sample maximum
pH	6.0 – 9.0 S.U. except for daily fluctuations which exceed 9.0 due to photosynthetic activity	Single reading
DO	At least 5.0 milligram per Liter (mg/L) (warm waters) At least 6.0 mg/L (cold waters*) At least 7.0 mg/L (salmonids spawning and imprinting areas)	Daily average
	Not less than 4.0 mg/L at any time (warm waters) Not less than 6.0 mg/L at any time (cold water) Not less than 7.0 mg/L (during spawning season and time of imprinting)	Single reading

*Waters protected for cold-water fish include those waters designated by the Indiana Department of Natural Resources for put-and-take trout fishing, as well as salmonid waters listed in 327 IAC 2-1.5-5.

MPN = Most Probable Number, CAC = Chronic Aquatic Criterion, S.U. = Standard Units

3. **Identify Information Inputs**
   Field monitoring activities must collect physical, chemical, biological, and habitat data. These data address the necessary decisions previously described. Monitoring activities will take place at previously sampled sites for which permission to access is granted by the necessary landowners or property managers. Section B. Measurement and Data Acquisition describes in detail collection procedures for in-situ water chemistry measurements, biological, and habitat data.

4. **Define the Boundaries of the Study**
   Collect samples for physical in-situ chemistry, bacteriological, and biological communities. Tables 1 and 2; Figures 1 and 2 provide HUC 12, AUID, and site descriptions or location information.

   Postpone sampling when the stream flow is dangerous for staff to enter, any hazardous weather conditions exist, or unexpected physical barriers prevent site access. Unexpected physical barriers could include an impassable log jam, fence, or physical installations, and domestic and wildlife dangers. Flow is considered dangerous at flood stages, so staff will use best professional judgement following or during a high-water event. Staff will use current USGS website water data, and daily streamflow condition readings to determine whether the discharge rate is elevated too far from median flow to sample. Typically, streamflow discharge in the 75th percentile or greater would be considered too high to sample. Since stream gaging stations are not on all streams and rivers, especially headwater streams, staff may travel to sites and use best professional judgement to determine whether sample collection at the site will occur. Even if weather conditions and stream flows are safe, sample collections for biological communities may be postponed at least one week due to scouring of the stream substrate or instream cover following a high-water event resulting in nonrepresentative samples.

5. **Develop the Analytical Approach**
Report assessment decisions (305(b) and 303(d)) in the 2026 Indiana Integrated Report. Aquatic life use support decisions will include independent evaluations of biological and chemical data as outlined in Indiana's 2022 CALM (IDEM 2022c) and based on water quality criteria expressed in Indiana's Water Quality Standards [327 IAC 2-1-6 and 327 IAC 2-1.5-8]. *E. coli* bacteria assessments will follow the water quality criteria mentioned in section B.2(1).

Evaluate fish and macroinvertebrate assemblages at selected sites using the appropriate Index of Biotic Integrity (IBI) (Simon 1991; Simon 1994; Simon 1997; Simon 1997, DRAFT; Simon and Dufour 1998) and Macroinvertebrate Index of Biotic Integrity (mIBI) (Appendix 1 and Appendix 2 provide more details). Evaluate MHAB macroinvertebrate samples using the mIBI developed for lowest practical taxonomic level identifications (Appendix 2 contains more details). For fish, IBI scores range from 0 (minimum) to 60 (maximum). For macroinvertebrates, the mIBI scores range from 12 (minimum) to 60 (maximum). Determine a site nonsupporting for aquatic life use when one or both biological communities score less than or equal to 35.

6. **Specify Performance of Acceptance Criteria**
Acceptable data are essential for minimizing decision error. Identifying errors in physical, chemical, and biological parameter sampling design, in-situ measurements, and laboratory measurements results in more confidence in IBI calibrations, biological threshold determinations, and aquatic life use assessment decisions.

Site specific aquatic life use and recreational use assessments include program specific controls to identify the introduction of errors. Controls include bacteriological blanks and duplicates; biological site revisits or duplicates; and laboratory controls through verification of species identifications as described in

IDEM QAPPs and standard operating procedures (SOPs) (IDEM 2017a, 2019a, 2020a, 2020b, 2020c, 2021, 2022a, 2023b, 2023c, 2023d, 2023e, 2023f).

Indiana narrative biological criteria [327 IAC 2-1-3] states “(2) All waters, except [limited use waters] will be capable of supporting: (A) a well-balanced, warm water aquatic community.” The water quality standard definition of a “well-balanced aquatic community” is “[327 IAC 2-1-9 (59)] An aquatic community which: (A) is diverse in species composition; (B) contains several different trophic levels; and (C) is not composed mainly of pollution tolerant species.” An interpretation or translation of narrative biological criteria into numeric criteria would be as follows: A stream segment is nonsupporting for aquatic life use when the monitored fish or macroinvertebrate community receives an IBI score of less than 36 (on a scale of 0-60 for fish and 12-60 for macroinvertebrate communities), which is considered “Poor” or “Very Poor” (IDEM 2022c).

Report assessment of each site sampled to U.S. EPA in the 2026 update of Indiana’s Integrated Report. Use site-specific data to classify associated AUs into one of five major categories in the state’s Consolidated 303(d) list. Category definitions are available in Indiana’s CALM (IDEM 2022c pp G-33 to G-34).

The quality assurance and quality control (QA/QC) process detects deficiencies in the data collection as set forth in the Surface Water QAPP (IDEM 2017a) and Biological and Habitat QAPP (2020a). Chemists within the WAPB review the laboratory analytical results for quality assurance (QA). Compare lab QA/QC for each data set against acceptance limits specified in the laboratory methods, the laboratory’s QA Manual, the Surface Water QAPP Section B5.3 Laboratory Quality Control Checks, and the Surface Water QAPP Section D3 Reconciliation with DQO. Validate data based on the QA/QC review. Do not use any data which is “Rejected” due to analytical problems or errors for water quality assessment decisions. Use of data flagged “Estimated” on a case-by-case basis and note in the QA/QC report. The Surface Water QAPP (IDEM 2017a Table D3-1: Data Qualifiers and Flags p 184) and Biological and Habitat QAPP (IDEM 2020a pp 32–36) present criteria for acceptance or rejection of results as well as application of data quality flags. The Surface Water QAPP (IDEM 2017a Table A7-1: Precision and Accuracy Goals for Data Acceptability by Matrix; and Table B2.1.1.8-2 Field Parameters pp 61–63 and p 117) provide precision and accuracy goals with acceptance limits for applicable analytical methods.

In response to data consistently flagged “Rejected”, conduct further investigation to determine the source of error. The WAPB QA manager and project manager may troubleshoot error introduced throughout the entire data collection process using evaluation of field sample collection and preparation techniques, and laboratory procedures employed. Implement corrective actions upon determination of the source of error per the Surface Water QAPP (IDEM 2017a) and Biological and Habitat QAPP (IDEM 2020a).

7. Develop the Plan for Obtaining Data

This study targets 11 Indiana subwatersheds (12 AUID stream segments) previously sampled and cited as AUID segments on the 303(d) list for impairment(s) or in an approved TMDL; and have undergone restoration activities. AUIDs in the watershed with historically documented impairments were chosen as sampling sites. For sites 23W001-23W010, these activities will be discussed in a write-up to U.S. EPA in a Success Story Document. For the two *E. coli* sites, 23W011-23W012, AUIDs will be assessed to confirm a delisting from the 303(d) List of Impaired Waters.

A.5 Training and Staffing Requirements

Table 5. Project Roles, Experience, and Training

Role	Required Training and Experience	Responsibilities	Training References
Project manager	-Database experience -Experience in project management and QA/QC procedures -An annual review relevant SOP documents for field operations	-Establish projects in the AIMS II database. -Oversee development of project work plan. -Oversee entry and quality control (QC) of field data. -Oversee querying of data from AIMS II database to determine results not meeting aquatic life use water quality criteria. -Send sample shipments to contract laboratory.	-IDEM 2017a, 2018, 2020a, 2020c, 2022d -U.S. EPA 2006
Field crew chief – biological community sampling	-At least one year of experience in sampling methodology and taxonomy of aquatic communities in the region -An annual review of the Principles and Techniques of Electrofishing -An annual review of relevant safety procedures -An annual review of relevant SOP documents for field operations	-Complete field data sheets. -Ensure taxonomic accuracy. -Ensure sampling efficiency and representation. - Operate overall field crew when remote from central office. -Ensure crew members adhere to safety and field SOP procedures. -Ensure weekly data sondes' calibration, field sampling equipment functions properly, and all equipment is loaded into vehicles prior to field sampling activities. -Maintain proper preservation of samples. -Hold an active First Aid and CPR certification.	-IDEM 2008, 2010a, 2010b, 2017a, 2019b, 2020a, 2020c, 2021, 2022a, 2023b, 2023c, 2023d, 2023f -Simon 1991 -Simon 1994 -Simon 1997 -Simon 1997, DRAFT -Simon and Dufour 1998 -Appendix 1 and 2 -Attachments 1-4 for field data sheets -Xylem Inc. 2017,2018
Field crew members – biological	-At least one year of experience in sampling methodology and	-Follow all safety and SOP procedures while engaged in field sampling	-Xylem Inc. 2017; Xylem Inc. 2018 -IDEM 2008, 2010a,

Role	Required Training and Experience	Responsibilities	Training References
community sampling	taxonomy of aquatic communities in the region -A review of the Principles and Techniques of Electrofishing -A review of relevant safety procedures -A review of relevant SOP documents for field and sample processing operations	activities. -Follow direction of field crew chief while conducting field sampling activities. -Hold an active First Aid and CPR certification.	2010b, 2016, 2017a, 2019a, 2020a, 2020c, 2021, 2022a, 2023b, 2023c, 2023d, 2023f
Field crew chief – water chemistry or bacteriological sampling	-At least one year of experience in sampling methodology -An annual review of relevant safety procedures -An annual review of relevant field operations' SOP's	-Complete field data sheets. -Ensure sampling efficiency and representativeness. -Operate overall field crew, when remote from central office. -Ensure crew members adhere to safety and field SOPs. -Ensure weekly calibrations of data sondes, proper functioning of field sampling equipment, and all equipment is loaded into vehicles prior to field sampling activities.	-IDEM 2008, 2010a, 2010b, 2017a, 2020b, 2020c, 2022a, 2023b, 2023e -Xylem Inc. 2017,2018
Field crew members – water chemistry or bacteriological sampling	-Hands-on training for sampling methodology prior to field sampling activities -A review of relevant safety procedures and field operation SOPs	-Follow all safety procedures and SOPs while conducting field sampling activities. -Follow direction of field crew chief while conducting field sampling activities.	-IDEM 2008, 2010a, 2010b, 2017a, 2019b, 2020b, 2020c, 2022a, 2023b, 2023e -Xylem Inc. 2017,2018
Laboratory supervisor – fish or macroinvertebrate community sample processing	-At least one year of experience in taxonomy of aquatic communities in the region -An annual review of relevant safety procedures	-Ensure laboratory staff adheres to safety and SOP procedures. -Assist with identification of fish and macroinvertebrate specimens.	-IDEM 2008, 2010a, 2010b, 2017b, 2019a, 2019b 2020a, 2021, 2023f

Role	Required Training and Experience	Responsibilities	Training References
	-An annual review of relevant laboratory operations' SOPs	-Verify samples' taxonomic accuracy. -Track voucher specimens. -Check QC calculations' completeness on data sheets. -Ensure correct data entry into AIMS II.	
Laboratory supervisor – water chemistry or bacteriological sample processing	-An annual review of relevant safety procedures -An annual review of relevant field operations' SOPs	-Ensure laboratory staff adheres to safety procedures and SOPs. -Complete laboratory data sheets. -Check data for completeness. -Perform all necessary calculations on the data. -Ensure data entry into the AIMS II database.	-IDEM 1997, 2008, 2010a, 2010b, 2017a, 2017b, 2019b, 2023e
Quality assurance officer	-Familiarity with QA/QC practices and methodologies -Familiarity with the WAPB QAPP and data qualification methodologies	-Ensure adherence to QA/QC requirements of WAPB QAPP. -Evaluate data collected by sampling crews for adherence to project work plan. -Review data collected by field sampling crews for completeness and accuracy. -Perform a data quality analysis of data generated by the project. -Assign data quality levels based on the data quality analysis. -Import data into the AIMS II database. -Ensure field sampling methodology audits are completed according to WAPB procedures.	-IDEM 2017a, 2017b, 2018 -U.S. EPA 2006

B. Data Generation and Acquisition

B.1 Sampling Sites and Sampling Design

A.1 to A.4 Objectives of this work plan describes the 12 targeted AUIDs sampled previously and cited on the 303(d) List of Impaired Waters or an approved TMDL.

Conduct site reconnaissance activities through physical site visits. Activities include preparation and review of site maps and aerial photographs. Physical site visits include verification of accessibility, safety considerations, equipment needed to properly sample the site, and property owner consultations, if required. Confirm final coordinates for each site using an agency approved handheld Global Positioning System (GPS) unit which can verify horizontal precision within five meters or less (IDEM 2022b, 2023b) during the reconnaissance activities. Assess whether current conditions have not significantly changed. Also confirm the coordinates in the AIMS II database.

Table 1 provides a list of the selected sampling sites with the Site Number, AIMS Site Number, 12-digit HUC name and code, Stream Name, Location, County, and the Latitude and Longitude of each site. Figures 1 and 2 depict the various sampling site locations for this project.

B.2 Sampling Methods and Sample Handling

Take a photo upstream and downstream of the site during every sampling event for a visual aid in assessments. No analytical data is derived from the upstream and downstream photographs of each site.

1. **Bacteriological Sampling**
   Conduct bacteriological sampling (IDEM 2023e) using one team consisting of one or two staff. The work effort requires an average of one hour per site per week, not including drive time to the site. Analyze samples in an IDEM *E. coli* Mobile Laboratory equipped with all materials and equipment necessary for the Colilert® *E. coli* Test Method. Collect five samples from each site, 2 sites total, at equally spaced intervals over a thirty-day period. Staff will collect the samples in a 120 mL presterilized wide mouth container from the center of flow, if stream is wadeable, or from the shoreline using a pole sampler, if not wadeable. This is subject to field staff determination based on available personal protective equipment, turbidity, and other factors. However, streams waist deep or shallower are generally considered wadeable. Consistently label, cool, and hold in a cooler with ice at a temperature less than 10ºC all samples during transport. Preserve samples with 0.0008% $Na_2S_2O_3$ for CL_2 (this preservative is already pre-measured into the 120 mL presterilized wide mouth container by IDEXX). Collect all *E. coli* samples on a schedule which allows any sampling crew to deliver them to the IDEM *E. coli* Laboratory for analyses within the bacteriological

holding time of six hours (Table 7). All samples will be processed in the IDEM laboratory, Room 118. Obtain all supplies from IDEXX Laboratories, Inc., Westbrook, Maine.

Due to supply order issues, E. coli samples will be analyzed using U.S. EPA approved SM9223B IDEXX Colilert Enzyme Substrate Standard Method per E. coli Field Sampling and Analysis standard operating procedures (IDEM 2023) with one exception, an 18-hour incubation period instead 24-hours; thus, altering field and laboratory logistics for incubation period and time to read/quantify results.

2. **In-situ Water Chemistry Measurements**
   Measure DO, pH, water temperature, specific conductance, and DO percent saturation with a data sonde during each sampling event, regardless of the sample type collected (Table 6 and 7). Perform measurement procedures and operation of the data sonde according to the manufacturers' manuals (IDEM 2020b, 2020c; YSI Incorporated 2020). Measure turbidity with a Hach™ turbidity kit. Record all in-situ measurements taken from the data sonde, Hach™, and weather codes at each site on the IDEM Stream Sampling Field Data Sheet (Attachment 1). Use the same protocol with all calibration equipment (temperature and pH probe, YSI ProSolo DO meter, Hach™, pre-calibrated gels) at one site, once per week.

Table 6. In-situ Water Chemistry Field Parameters Test Methods

Parameters	Method (SM = Standard Method)	Sensitivity Limit with Units
DO (data sonde optical)	ASTM[1] D888-09(C)	0.01 mg/L
DO % Saturation (data sonde optical)	ASTM[1] D888-09(C)	0.01 %
DO (field meter)	ASTM[1] D888-09(C)[2]	0.01 mg/L
pH (data sonde)	EPA 150.2	0.01 S.U.
pH (field pH meter)	SM 4500-HB[2]	0.01 S.U.
Specific Conductance (data sonde)	SM 2510B	1.0 μS/cm
Temperature (data sonde)	SM 2550B(2)	0.1 Degrees Celsius (°C)
Temperature (field meter)	SM 2550B(2)[2]	0.1 Degrees Celsius (°C)
Turbidity (Hach™ turbidity kit)	EPA 180.1[2]	0.01 NTU[3]

[1]American Society for Testing and Materials

[2]Method used for field calibration check

[3]NTU = Nephelometric Turbidity Unit(s)

3. **Fish Community Sampling**
   Conduct fish community sampling at nine sites historically impaired for IBC. Perform sampling using standardized electrofishing methodologies depending on stream size and site accessibility. Perform fish assemblage assessments in a

sampling reach of 15 times the average wetted width, with a minimum reach of 50 m and a maximum reach of 500 m (IDEM 2023f). Attempt to sample all habitat types available (i.e., pools, shallows) within the sample reach to ensure adequate representation of the fish community present at the time of the sampling event. Procedures for Completing the Qualitative Habitat Evaluation Index (IDEM 2023d pp 10–11) provides more potential habitat types. Utilize an electrofisher from this list:

- Midwest Lake Electrofishing Systems (MLES) Infinity XStream, Smith-Root LR-24 or LR-20B Series backpack electrofishers
- MLES Infinity Control Box with MLES junction box and rat-tail cathode cable, assembled in a canoe (if parts of the stream are not wadeable, the system may require the use of a dropper boom array outfitted in a canoe or possibly a 12- or 14- foot Loweline boat) for nonwadeable sites.
- Smith-Root Type VI-A electrofisher or MLES Infinity Control Box assembled in a 16-foot Loweline or Blazer boat (IDEM 2021, 2020a, 2019a, 2023f).

Avoid sample collections during high flow or turbid conditions due to 1) low collection rates which result in nonrepresentative samples and 2) safety considerations for the sampling team. Avoid sample collection during late autumn due to the cooling of water temperature, which may affect the responsiveness of some species to the generated electric field. This lack of responsiveness can result in nonrepresentative samples of the stream’s fish assemblage (IDEM 2023f).

Prior to field work, review taxonomic characteristics for possible species encountered in the basin of interest. Prior to sampling, randomly select 10% of the sites for revisits.

See the Fish Community Collection Procedures SOP for collection procedures (2023f.)

Record data for nonpreserved fish on the IDEM Fish Collection Data Sheet (Attachment 2) consisting of the following: number of individuals, minimum and maximum total length (mm), mass weight in grams (g), and number of individuals with deformities, eroded fins, lesions, tumors, and other anomalies (DELTs). After recording the data, release specimens within the sampling reach from which they were collected. Record data for preserved fish specimens following taxonomic identification in the laboratory (IDEM 2023f).

4. Macroinvertebrate Sampling

Conduct macroinvertebrate sampling at nine sites impaired for IBC. In determining the scope of this project, confirmation of improvement or success is only through analysis of parameters previously sampled and which initially identified the impairment at the site. Use MHAB sampling methodology to collect all macroinvertebrate samples (IDEM 2023c).

Possibly conduct macroinvertebrate community sampling immediately following the fish community sampling event or on a different date by crews of two to three staff members. Evaluate sites using the MHAB macroinvertebrate IBI (Appendix 2).

5. **Habitat Assessments**
   Complete habitat assessments immediately following macroinvertebrate and fish community sample collections at each site using a slightly modified version of the Ohio Environmental Protections Agency (OHEPA 2006) Procedures for Completing the Qualitative Habitat Evaluation Index, 2006 edition (OHEPA 2006, Rankin 1995). Complete a separate Qualitative Habitat Evaluation Index (QHEI) (Attachment 3) for each sample type, since the sampling reach length may differ (i.e., 50 m for macroinvertebrates and between 50 and 500 m for fish). Procedures for Completing the Qualitative Habitat Evaluation Index (IDEM 2023d) describes the method used in completing the QHEI.

B.3 Analytical Methods

1. **Laboratory Procedures for *E. coli* Measurements:**
   Process and analyze all waters sampled for *E. coli* in the IDEM *E. coli* mobile laboratory or IDEM Shadeland laboratory, which is equipped with required materials and equipment necessary for the Idexx™ Coliert Test. The Coliert Test is a multiple-tube enzyme substrate Standard Method (SM) 9223B (Colilert-18) Enzyme Substrate Coliform Test Method (Lipps et al., 2023). Table 7 contains quantification limits and holding times.

Table 7. *E. coli* and General Chemistry Parameters Test Methods[1] and holding times.

Parameter	Method	Limits of Quantification	Units	Preservative	Holding Times
E. coli	SM-9223B Enzyme Substrate Test	1.0	MPN/100 mL	Ice, 0.0008% $Na_2S_2O_3$	6-8 hours

[1]Methods accredited by EPA (State of Illinois, 2018)

3. **In-situ Water Chemistry Field Parameter Measurements**
   Collect in-situ water chemistry field parameters at all 12 sites. The field staff member collecting the sample shall wait for all readings to stabilize before recording the readings on the IDEM Stream Sampling Field Data Sheet (Attachment 1). Table 6 lists the in-situ water chemistry field parameters with

their respective test method and sensitivity limits. During each sampling event note the field observations from each site, ambient weather conditions at the time of sampling, and document on the IDEM Stream Sampling Field Data Sheet (Attachment 1).

B.4 Quality Control and Custody Requirements

QA protocols will follow the Surface Water QAPP (IDEM 2017a part B5 p 170) and the Biological and Habitat QAPP (IDEM 2020a part B.5. p 27).

1. **Field Instrument Testing and Calibrations**
   Calibrate the data sonde prior to each week's sampling (IDEM 2020c). Record, maintain, store, and archive calibration results and drift values in logbooks located in the calibration laboratories at the Shadeland facility. The drift value is the difference between two successive calibrations. Field parameter calibrations will conform to the procedures as described in the instrument users' manuals (Xylem 2017; Xylem 2018). Field check the unit for accuracy once during the week by comparison with a YSI EcoSense DO200A DO Probe (IDEM 2020b, p 24), Hach™ turbidity, and an Oaktown Series 5 pH meter. Record weekly calibration verification results on the field calibrations portion of the IDEM OWQ Stream Sampling Field Data Sheets (Attachment 1) and input into the AIMS II database. At field sites where the DO concentration is 4.0 mg/L or less, use the YSI ProSolo DO meter.

2. **Field Measurement Data**
   Collect in-situ water chemistry field data in the field using calibrated or standardized equipment and record on the IDEM OWQ Stream Sampling Field Data Sheet (Attachment 1). Perform calculations either in the field or later at the office. Include analytical results, which have limited QC checks, in this category. Table 6 contains detection limits and ranges for each analysis. Quality control checks (i.e., duplicate measurements, measurements of a secondary standard, measurements using a different test method or instrument) performed on field or laboratory data, are usable for estimating precision, accuracy, and completeness for the project, as described in the Surface Water QAPP (IDEM 2017a Section C1.1 p 176 and Section A7.2 p 56).

3. **Bacteriological Measurement Data**
   Analytical results from an IDEM fixed or mobile *E. coli* laboratory include QC check sample. The results can determine precision, accuracy, and completeness for each batch of samples. Archive raw data by analytical batch for easy retrieval and review. Follow COC procedures, including time of collection, time of setup, time of reading the results, and time and method of disposal (IDEM 2023e). The field staff member collecting the samples signs the COC form upon delivery of samples to the laboratory (Attachment 4). Thoroughly document any method

deviations in the raw data. Collect all QA/QC samples according to the following guidelines:

Field Duplicate:	Collect and test at a frequency of one per batch or at least one for every 20 samples collected (≥ 5%).
Field Blank:	Collect and test at a frequency of one per batch or at least one for every 20 samples collected (≥ 5%).
Laboratory Blank:	Test at a frequency of one per day.
Positive Control:	Test each lot of media for performance using *E. coli* bacterial cultures.
Negative Controls:	Test each lot of media for performance using non-*E. coli* and non-coliform bacterial cultures.

4. **Fish Community Measurement Data**
Perform fish community sampling revisits at a rate of 10 percent of the total fish community sites sampled, approximately one across all sampled sites (IDEM 2023f). Perform revisit sampling with at least two weeks of recovery between the initial and revisit sampling events. Perform the fish community revisit sampling and habitat assessment with either a partial or complete change in field team members (IDEM 2023f). Use the resulting IBI and QHEI total score between the initial visit and the revisit to evaluate precision, as described in the Biological and Habitat QAPP (IDEM 2020a). Use the IDEM OWQ Chain of Custody Form to track samples from the field to the laboratory (Attachment 4). A field staff member from the crew signs the COC form after sampling is complete and relinquishes the samples and COC form to a lab custodian to verify the sampling information is accurate. For all raw data: 1) check for completeness; 2) utilize to calculate derived data (i.e., total weight of all specimens of a taxon), which is input into the AIMS II database; and 3) check again for data entry errors.

5. **Macroinvertebrate Community Measurement Data**
Randomly select 10 percent of the total macroinvertebrate community sites prior to the beginning of the field season for duplicate macroinvertebrate field sample collection, approximately one sample site. Perform the macroinvertebrate community duplicate sample and corresponding habitat assessment using the same team member collecting the original sample. Duplicate samples are chosen before sampling begins. Collect the duplicate sample immediately after the initial sample. The result is a precision evaluation based on a 10% duplicate of samples collected, as described in the Biological and Habitat QAPP (IDEM 2020a). Use the IDEM OWQ Chain of Custody Form to track samples from the field to the laboratory (Attachment 4). A field staff member from the crew completes the OWQ COC form after completion of sampling. After completion of weekly field sampling activities, the laboratory custodian uses the OWQ COC form to check in samples prior to long-term storage. The IDEM Probabilistic

Monitoring Section laboratory supervisor maintains laboratory identifications and QA/QC of taxonomic work.

C. Assessment and Oversight

C.1 Field and laboratory performance and system audits

Conduct field and laboratory performance and system audits to ensure good quality data. The field and laboratory performance checks include precision measurements by relative percent difference (RPD) of field and laboratory duplicate samples (IDEM 2017a pp 56, 61–63) analyzed in the laboratory and completeness measurements by the percent of planned samples versus the actual number collected, analyzed, reported, and usable for the project (IDEM 2017a p 58).

Biological and habitat measurements, field performance measurements include:

- Completeness (IDEM 2020a pp 10-11, 14)
- Examination of fish IBI score differences and the RPD for number of fish species at the revisit sites (IDEM 2020a pp 9-10)
- RPD for number of taxa for macroinvertebrate duplicate samples (IDEM 2020a p 13)
- RPD between the two total QHEI scores (IDEM 2020a p 18)

Lab performance measurements include:

- Percent taxonomic difference for fish (IDEM 2020a p 12)
- Percent taxonomic difference for macroinvertebrates (IDEM 2020a pp 15-16)
- Percent difference in enumeration and percent sorting efficiency for macroinvertebrates (IDEM 2020a pp 14-16)

Regionally recognized non-IDEM freshwater fish taxonomists may verify fish taxonomic identifications made by IDEM staff in the laboratory. Send ten percent of macroinvertebrate samples, the initial samples taken at sites where duplicate samples were collected, to a contractor with certified macroinvertebrate taxonomists for verification by an outside taxonomist (IDEM 2023c) For macroinvertebrate verifications by an external lab, the lab’s taxonomists must maintain Society for Freshwater Science taxonomic certifications. Genus level taxonomic certifications are required for (1) Eastern General Arthropods; (2) Eastern Ephemeroptera, Plecoptera, and Trichoptera; (3) Chironomidae; and (4) Oligochaeta.

IDEM WAPB staff conducts biannual field audits to ensure sampling activities adhere to approved SOPs. WAPB QA staff conducts systematic audits to include all WAPB staff engaging in field sampling activities. Managers trained in the associated sampling SOPs, and in the processes related to conducting an audit evaluate WAPB field staff involved with sample collection and preparation. Managers will produce an evaluation report documenting each audit for review by the field staff audited, and WAPB management. Communicate corrective actions to field staff, which implement the corrective action, resulting from the audit process (IDEM 2017a p 176–177; IDEM 2020a p 31).

The QA officer submits QA reports upon completion of a dataset's data validation to the program manager or WAPB branch chief. The QA manager, relevant section chief, project manager, any technical staff working on corrective actions, and QA staff receives copies of the progress reports when new developments arise. The section chief, project officer, or QA officer is responsible for working with relevant staff members to develop corrective actions and notify the QA manager of corrective action progress. Depending on the associated corrective actions, either the section chief or the QA officer approves the final corrective action (IDEM 2017a p 179).

C.2 Data Quality Assessment Levels

The samples and various types of data collected should meet the QA criteria and Data Quality Assessment Level 3 rating, as described in the Surface Water QAPP (IDEM 2017a p 182) and the Biological and Habitat QAPP (IDEM 2020a pp 34-35).

D. Data Validation and Usability

Quality Assurance reports to management and data validation and usability are also important components of the Indiana Surface Water QAPP which ensure good quality data for this project. The QA officer submits quality assurance reports upon completion of a dataset's validation to the program manager or WAPB branch chief. This ensures investigation and correction of problems arising during the sampling and analysis phases of the project (IDEM 2017a, p 179). As described in the Surface water QAPP (IDEM 2017a, section D), data are reduced (converted from raw analytical data into final results in proper reporting units); validated (qualified based on the performance of field and laboratory QC measures incorporated into the sampling and analysis procedures); and reported (described so as to completely document the calibration, analysis, QC measures, and calculations). These steps allow users to assess the data ensuring the project DQOs are met.

D.1 Quality Assurance, Data Qualifiers, and Flags

Use the various data qualifiers and flags for QA and validation of the data found in the Surface Water QAPP (IDEM 2017a pp 184–185) and the Biological and Habitat QAPP (IDEM 2020a pp 33-34).

D.2 Data Usability

Qualify the environmental data's collection and usability per each lab or field result obtained and classify into one or more of the four categories: Acceptable Data, Enforcement Capable Results, Estimated Data, and Rejected Data as described in the Surface Water QAPP (IDEM 2017a p 184) and in the Biological and Habitat QAPP (IDEM 2020a, pp 35-36).

D.3 Information, Data, and Reports

To enter Success Stories into U.S. EPA's Success Stories database for approval (U.S. EPA 2017 a and b), use performance monitoring data indicating water quality improvement as defined by U.S. EPA's Office of Water's Nonpoint Source Section 319 Program Guidance. Include sites assessed to evaluate whether restoration activities improved the water quality on individual AUID stream segments in Success Story reports. Additionally, record the data in the AIMS II database and use in the Indiana Integrated Water Monitoring and Assessment Report. Make all data and reports available to public and private entities which may find the data useful for municipal, industrial, agricultural, and recreational decision-making processes (TMDL, National Pollutant Discharge Elimination System (NPDES) permit modeling, watershed restoration projects, water quality criteria refinement, etc.,). (U.S. EPA 2005)

Record data collected in 2023 in the AIMS II database and present in two compilation summaries. The first summary is a general compilation of the watershed *in situ* field chemistry data prepared for use in the 2026 Indiana Integrated Report. The second summary is in database report format containing biological results and habitat evaluations, produced for inclusion in the Integrated Report as well as individual site folders. Maintain all site folders at the WAPB facility. All data and reports are available to public and private entities, which may find the data useful for municipal, industrial, agricultural, and recreational decision-making processes (TMDL, NPDES permit modeling, watershed restoration projects, water quality criteria refinement, etc.,). Upload the work plan into the virtual file cabinet. Store all field sheets in the AIMS II database. Upload results to U.S. EPA's Water Quality Portal via the Water Quality Exchange (formerly STORET). The Water Quality Exchange is a framework which allows states, tribes, and other data partners to submit and share water quality monitoring data via the web to the Water Quality Portal.

D.4. Laboratory and Estimated Cost

Laboratory analysis and data reporting for this project complies with the Surface Water QAPP (IDEM 2017a); Biological and Habitat QAPP (IDEM 2020a); and the IDEM QMP (IDEM 2018). IDEXX Laboratories, Inc., Westbrook, Maine supplies the bacteriological sampling supplies, with a total estimated cost of $136. IDEM staff will test and analyze bacteriological samples. IDEM staff will collect and analyze all fish and macroinvertebrate samples. A contractor with certified macroinvertebrate taxonomists

(IDEM 2020a) will verify ten percent of macroinvertebrate samples with a total estimated cost of $230. The anticipated total budget for laboratory costs for the project is $330.

D.5 Reference Manuals and Personnel Safety

Table 8. Personnel Safety and Reference Manuals

Role	Required Training or Experience	Training References	Training Notes
All staff participating in field activities	-Basic first aid and cardio-pulmonary resuscitation (CPR) -Personal Protective Equipment (PPE) Policy -Personal flotation devices (PFD)	-A minimum of 4 hours of in-service training provided by WAPB (IDEM 2010a) -IDEM 2008 -IDEM 2019b -February 29, 2000, WAPB Internal memorandum regarding use of approved Personal Flotation Devices	- WAPB staff meeting health and safety training requirements will accompany staff lacking 4 hours of in-service training or appropriate certification in the field at all times. -When working on boundary waters as defined by Indiana Code (IC) 14-8-2-27 or between sunset and sunrise on any waters of the state, all personnel in the watercraft must wear a high intensity whistle and Safety of Life at Sea certified strobe light.

E. References

(40 CFR 136) Code of Federal Regulations (CFR). 40 CFR Part 136, Appendix B, pp 343–346

(U.S. EPA 2002) Guidance for Quality Assurance Project Plans EPA QA/G-5, EPA/240R02/009 U.S. EPA, Office of Environmental Information, Washington D.C.

(U.S. EPA 2005) Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act, Washington, D.C., U.S. Environmental Protection Agency

(U.S. EPA 2006) Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4 EPA/240/B-06/001, U.S. EPA, Office of Environmental Information, Washington D.C. 20460

(U.S. EPA 2017a) FY16 NWPG Water Quality Measure Definitions, WQ-SP10.N11

(U.S. EPA 2017b) U.S. EPA's Office of Water's Nonpoint Source Section 319 Program Guidance, Last updated October 5, 2022

[IC 14-8 1] Indiana Code, Title 14 Natural and Cultural Resources, Article 8 General Provisions and Definitions, Chapter 1 General Provisions,

[IAC 327-2] Indiana Administrative Code, Title 327 Water Pollution Control Division, Article 2. Water Quality Standards. Last updated March 14, 2018

(IDEM 2008) IDEM policy, Personal Protective Equipment Policy, revised May 1, 2008, A-059-OEA-08-P-R0, Office of Program Support Health and Safety Director, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2010a) IDEM policy, Health and Safety Training Policy, revised October 1 2010, A-030-OEA-10-P-R2, Office of Program Support Health and Safety Director, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2010b) IDEM policy Injury and Illness Resulting from Occupational Exposure Policy, revised February 12, 2016, A-034-AW-16-P-R3, Office of Program Support Health and Safety Director, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2017a) Quality Assurance Project Plan for Indiana Surface Water Programs, Revision 4, B-001-OWQ-WAP-XX-17-Q-R4, Indiana Department of Environmental Management, OWQ, WAPB, Indianapolis, Indiana

(IDEM 2017b) Indiana Water Quality Monitoring Strategy 2017-2021, WAPB, OWQ, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2018) IDEM 2018 Quality Management Plan, IDEM, Indiana Government Center North, 100 N. Senate Ave., Indianapolis, Indiana

(IDEM 2019a) IDEM Hazard Communication (HazCom) Plan, IDEM, Office of Program Support, Indianapolis, Indiana

(IDEM 2019b) IDEM Health and Safety Manual, IDEM, Office of Program Support, Indianapolis, Indiana

(IDEM 2020a) Quality Assurance Project Plan for Biological Community and Habitat Measurements, B-003-OWQ-WAP-XXX-20-Q-R0, Indiana Department of Environmental Management, Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana

(IDEM 2020b) Water Chemistry Field Sampling Procedures, B-015-OWQ-WAP-XXX-20-T-R0, Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana

(IDEM 2020c) Calibration of YSI Multiparameter Data Sondes, B-014-OWQ-WAP-XXX-20-T-R0, IDEM, Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana

(IDEM 2021) Office of Water Quality Watershed Assessment and Planning Branch Laboratory Safety Plan, Office of Program Support, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2022a) Indiana Integrated Water Monitoring and Assessment Report 2022, IDEM, Office of Water Quality, Indianapolis, Indiana

(IDEM 2022b) Global Positioning System (GPS) Data Creation TSOP, B-001-OWQ-WAP-XXX-22-T-R0, OWQ, WAPB, Indianapolis, Indiana

(IDEM 2022c) Indiana's 2022 Consolidated Assessment and Listing Methodology (CALM), IDEM, Office of Water Quality, Indianapolis, Indiana

(IDEM 2022d) AIMS II Database User Guide, IDEM, Office of Water Quality, Watershed Assessment and Planning Branch, Indianapolis, Indiana*

(IDEM 2023a) Site Reconnaissance Procedure, B-002-OWQ-WAP-PRB-23-S-R1, OWQ, WAPB, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2023b) Global Navigational Satellite System (GNSS) R1 Unit User Instructions TSOP, B-055-OWQ-WAP-XXX-23-T-R0, OWQ, WAPB, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2023c) Multi-habitat (MHAB) Macroinvertebrate Collection Procedure, B-011-OWQ-WAP-XXX-23-T-R1, OWQ, WAPB, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2023d) Procedures for Completing the Qualitative Habitat Evaluation Index, B-003-OWQ-WAP-XX-23-T-R2, OWQ, WAPB, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2023e) E. coli Field Sampling and Analysis, B-013-OWQ-WAP-XXX-23-T-R1, OWQ, WAPB, Indiana Department of Environmental Management, Indianapolis, Indiana

(IDEM 2023f) Fish Community Field Collection Procedures, B-009-OWQ-WAP-XXX-23-T-R1, OWQ, WAPB, Indianapolis, Indiana

(Lipps, WC et al, 2023), Standard Methods for the Examination of Water and Wastewater, 24th edition, Washington DC, APHA Press*

(OHEPA 2006) Ohio Environmental Protection Agency (OHEPA) 2006, Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI), OHIO EPA Technical Bulletin EAS/2006-06-1, Revised by the Midwest Biodiversity Institute for State of Ohio Environmental Protection Agency, Division of Surface Water, Ecological Assessment Section, Groveport, Ohio

(Simon, T.P. 1991) Development of Index of Biotic Integrity expectations for the Ecoregions of Indiana I, Central Corn Belt Plain, EPA 905/R-91/025 U.S. Environmental Protection Agency, Region 5, Water Division, Watershed and Non-Point Source Branch, Chicago, IL

(Simon, T.P. 1994) Development of Index of Biotic Integrity expectations for the Ecoregions of Indiana II, Huron-Erie Lake Plain, EPA 905/R-92/007 U.S. Environmental Protection Agency, Region 5, Water Division, Watershed and Non-Point Source Branch, Chicago, IL

(Simon, T.P 1997) Development of Index of Biotic Integrity expectations for the Ecoregions of Indiana 111. Northern Indiana Till Plain, EPA 905/R-6/002, Water Division, Watershed and Non-Point Source Branch, U.S. Environmental Protection Agency Region V, Chicago, Illinois

(Simon DRAFT 1997) Simon Thomas P. DRAFT, 1997 Development of Index of Biotic Integrity Expectations for the Ecoregions of Indiana, Interior River Lowland*

(Simon, T.P. and R.L. Dufour, 1998) Development of Index of Biotic Integrity Expectations for the Ecoregions of Indiana V: Eastern Corn Belt Plains EPA 905/R-96/004s Water Division, Watershed and Non-Point Branch, U.S. Environmental Protection Agency Region V, Chicago, Illinois

(Xylem Incorporated 2017) Revision G, EXO User Manual, EXO User Manual, revision g, Yellow Springs, Ohio.

(YSI Incoporated 2020). ProDigital User Manual, revision H,Yellow Springs, Ohio.

*This document may be inspected at the Watershed and Assessment Branch office, located at 2525 North Shadeland Avenue, Indianapolis, IN.

F. Distribution List

Electronic Distribution Only:

Name	**Organization**
Kristen Arnold	IDEM, OWQ, WAPB, Branch Chief
Timothy Bowren	IDEM, OWQ, WAPB, Technical and Logistical Services Section
Angie Brown	IDEM, OWQ, WAPB, Watershed Planning and Restoration Section Chief
Dylan Brown	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
McKenzie Bruder	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Pat Colcord	IDEM, Office of Program Support, Quality Assurance Section
Alan Cooper	IDEM, OWQ, WAPB, Technical and Logistical Services Section
Marissa Cubbage	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Alan Cooper	IDEM, OWQ, WAPB, Targeted Monitoring Section
Kevin Gaston	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Paul Higginbotham	IDEM, OWQ, Deputy Assistant Commissioner
Charles Hostetter	IDEM, OWQ, WAPB, Technical and Logistical Services Section
David Jordan	IDEM, OWQ, WAPB, Technical and Logistical Services Section
Paula Kaszynski	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Paul McMurray	IDEM, OWQ, WAPB, Technical E7
Ali Meils	IDEM, OWQ, WAPB, Targeted Monitoring Section Chief
Martha Clark Mettler	IDEM, OWQ, Assistant Commissioner
Mitchell Owens	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Caleb Rennaker	IDEM, OWQ, WAPB, Technical and Logistical Services Section Chief
Michael Schneider	IDEM, OWQ, WAPB, Probabilistic Monitoring Section
Stacey Sobat	IDEM, OWQ, WAPB, Probabilistic Monitoring Section Chief
John Sparks	IDEM, OWQ, WAPB, Watershed Planning and Restoration
Jessica Weir	IDEM, OWQ, WAPB, Technical E7
Cameron Yeakle	IDEM, OWQ, WAPB, Targeted Monitoring Section

Attachment 1. IDEM Stream Sampling Field Data Sheet

IDEM **Stream Sampling Field Data Sheet**

Analysis Set #	EPA Site ID	Rank

Sample #	Site #	Sample Medium	Sample Type	Duplicate Sample #

Stream Name:		River Mile:		County:	
Site Description:					

Survey Crew Chief	Sample Collectors 1	2	3	4	Sample Collected Date	Time	Hydrolab #	Water Depth/Gage Ht (ft)	Water Flow (cf/sec)	Flow Estimated?	Algae?	Aquatic Life?
										☐	☐	☐

Sample Taken?	Aliquots	Water Flow Type	Water Appearance	Canopy Closed %
☐ Yes ☐ No; Frozen	☐ 1 ☐ 2 ☐ 3 ☐ 4	☐ Riffle ☐ Dry ☐ Stagnant	☐ Clear ☐ Green ☐ Sheen	☐ 0-20% ☐ 60-80%
☐ No; Stream Dry ☐ No; Other	☐ 6 ☐ 8 ☐ 12 ☐ 24	☐ Pool ☐ Run ☐ Flood	☐ Murky ☐ Black ☐ Other	☐ 20-40% ☐ 80-100%
☐ No; Owner refused Access	☐ 48 ☐ 72 ☐ AS-Flow	☐ Glide ☐ Eddy ☐ Other	☐ Brown ☐ Gray (Septic/Sewage)	☐ 40-60%

Special Notes:	

Field Data:

Date (m/d/yy)	24-hr Time (hh:mm)	D.O. (mg/l)	pH	Water Temp (°C)	Spec Cond (µohms/cm)	Turbidity (NTU)	% Sat.	Chlorine (mg/l)	Chloride (mg/l)	Chlorophyll (mg/l)	Weather Codes SC	WD	WS	AT
Comments														
Comments														
Comments														
Comments														
Comments														
Comments														

Measurement Flags		
	<	< Min. Meter Measurement
	>	> Max. Meter Measurement
	E	Estimated (See Comments)
	R	Rejected (See Comments)

Weather Code Definitions

SC Sky Conditions		WD Wind Direction	WS Wind Strength	AT Air Temp
1 Clear	8 Rain	00 North (0 degrees)	0 Calm	1 < 32
2 Scattered	9 Snow	09 East (90 degrees)	1 Light	2 33-45
3 Partly	10 Sleet	18 South (180 degrees)	2 Mod./Light	3 46-60
4 Cloudy		27 West (270 degrees)	3 Moderate	4 61-75
5 Mist			4 Mod./Strong	5 76-85
6 Fog			5 Strong	6 > 86
7 Shower			6 Gale	

Field Calibrations:

Date (m/d/yy)	Time (hh:mm)	Calibrator Initials	Calibrations Type	Meter #	Value	Units

Calibration Type	
	pH
	DO
	Turbidity

Preservatives/Bottle Lots:

Group: Preservative	Preservative Lot #	Bottle Type	Bottle Lot #

Groups: Preservatives		Bottle Types	
GC	General Chemistry: Ice	2000P	2000mL Plastic, Narrow Mouth
Nx	Nutrients: H2SO4	1000P	1000mL Plastic, Narrow Mouth
Metals	Metals: HNO3	500P	500mL Plastic, Narrow Mouth
CN	Cyanide: NaOH	250P	250mL Plastic, Narrow Mouth
O&G	Oil & Grease: H2SO4	1000G	1000mL Glass, Narrow Mouth
Toxics	Toxics: Ice	500G	500mL Glass, Wide Mouth
Ecoli	Bacteriology: Ice	250G	250mL Glass, Wide Mouth
VOA	Volatile Organics: HCl & Thiosulfate	125G	125mL Glass, Wide Mouth
Pest	Pesticides: Ice	40GV	40mL Glass Vial
Phen	Phenols: H2SO4	120PB	120ml Plastic (Bacteria Only)
Sed	Sediment: Ice	1000PF	1000mL Plastic, Corning Filter
Gly	Glyphosate: Thiosulfate	500PF	500mL Plastic, Corning Filter
Hg	Mercury(1631): HCl	60P	60mL Plastic
Cr6	ChromiumVI(1636): NaOH	250T	250mL Teflon
MeHg	Methyl Mercury(1630): HCl	500T	500mL Teflon
		125T	125mL Teflon

Data Entered By: ________________ QC1: ________________
QC2: ________________

Stream Sampling Field Data Sheet

Attachment 2. IDEM Fish Collection Data Sheet (front)

IDEM
OWQ-WATERSHED ASSESSMENT AND PLANNING BRANCH

Event ID_______________ Voucher jars________ Unknown jars_________ Equipment_________________ Page ______of _______
Voltage________ Time fished (sec)_________ Distance fished (m)__________ Max. depth (m)__________ Avg. depth (m)_________
Avg. width (m)_______ Bridge in reach______ Is reach representative______ If no, why_______________________________________
Elapsed time at site (hh:mm)____:_____ Comments____

Museum data: Initials___________ ID date___________ Jar count___________ Fish Total___________

Coding for Anomalies: D – deformities E – eroded fins L – lesions T – tumor M – multiple DELT anomalies O – other (A – anchor worm C – leeches W – swirled scales Y – popeye S – emaciated F – fungus P – parasites) H – heavy L – light (these codes may be combined with above codes)

TOTAL # OF FISH				WEIGHT (s) (mass g)				(length mm)	ANOMALIES					
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												

KRW: Rev/09.26.18 Calculation:_________ QC1 + Entry_________ QC 1 _________ QC 2_________

Attachment 2. (continued) IDEM Fish Collection Data Sheet (back)

Event ID______________ Page _____ of ______

								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												
								Min length	D	E	L	T	M	O
								Max length						
V		P												

KRW: Rev/09.26.18

Attachment 3. IDEM OWQ Biological Qualitative Habitat Evaluation Index (front).

IDEM

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

Sample #	bioSample #	Stream Name	Location

Surveyor	Sample Date	County	Macro Sample Type	☐ Habitat Complete	QHEI Score:

1] *SUBSTRATE* Check ONLY Two predominant substrate TYPE BOXES and check every type present

BEST TYPES (PREDOMINANT / PRESENT P/G R/R)
- ☐☐ BLDR/SLABS [10] ☐☐
- ☐☐ BOULDER [9] ☐☐
- ☐☐ COBBLE [8] ☐☐
- ☐☐ GRAVEL [7] ☐☐
- ☐☐ SAND [6] ☐☐
- ☐☐ BEDROCK [5] ☐☐

OTHER TYPES (PREDOMINANT / PRESENT P/G R/R)
- ☐☐ HARDPAN [4] ☐☐
- ☐☐ DETRITUS [3] ☐☐
- ☐☐ MUCK [2] ☐☐
- ☐☐ SILT [2] ☐☐
- ☐☐ ARTIFICIAL [0] ☐☐

(Score natural substrates; ignore sludge from point-sources)

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0]

Check ONE (Or 2 & average)

ORIGIN
- ☐ LIMESTONE [1]
- ☐ TILLS [1]
- ☐ WETLANDS [0]
- ☐ HARDPAN [0]
- ☐ SANDSTONE [0]
- ☐ RIP/RAP [0]
- ☐ LACUSTRINE [0]
- ☐ SHALE [-1]
- ☐ COAL FINES [-2]

QUALITY

SILT
- ☐ HEAVY [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ FREE [1]

EMBEDDEDNESS
- ☐ EXTENSIVE [-2]
- ☐ MODERATE [-1]
- ☐ NORMAL [0]
- ☐ NONE [1]

Substrate ☐ Maximum 20

Comments

2] *INSTREAM COVER* Indicate presence 0 to 3: 0–Absent; 1–Very small amounts or if more common of marginal quality; 2–Moderate amounts, but not of highest quality or in small amounts of highest quality; 3–Highest quality in moderate or greater amounts (e.g., very large boulders in deep or fast water, large diameter log that is stable, well developed root wad in deep/fast water, or deep, well-defined, functional pools.)

- ___ UNDERCUT BANKS [1]
- ___ OVERHANGING VEGETATION [1]
- ___ SHALLOWS (IN SLOW WATER) [1]
- ___ ROOTMATS [1]
- ___ POOLS > 70cm [2]
- ___ ROOTWADS [1]
- ___ BOULDERS [1]
- ___ OXBOWS, BACKWATERS [1]
- ___ AQUATIC MACROPHYTES [1]
- ___ LOGS OR WOODY DEBRIS [1]

AMOUNT
Check ONE (Or 2 & average)
- ☐ EXTENSIVE > 75% [11]
- ☐ MODERATE 25 - 75% [7]
- ☐ SPARSE 5 - < 25% [3]
- ☐ NEARLY ABSENT < 5% [1]

Cover ☐ Maximum 20

Comments

3] *CHANNEL MORPHOLOGY* Check ONE in each category (Or 2 & average)

SINUOSITY
- ☐ HIGH [4]
- ☐ MODERATE [3]
- ☐ LOW [2]
- ☐ NONE [1]

DEVELOPMENT
- ☐ EXCELLENT [7]
- ☐ GOOD [5]
- ☐ FAIR [3]
- ☐ POOR [1]

CHANNELIZATION
- ☐ NONE [6]
- ☐ RECOVERED [4]
- ☐ RECOVERING [3]
- ☐ RECENT OR NO RECOVERY [1]

STABILITY
- ☐ HIGH [3]
- ☐ MODERATE [2]
- ☐ LOW [1]

Channel ☐ Maximum 20

Comments

4] *BANK EROSION AND RIPARIAN ZONE* Check ONE in each category for EACH BANK (Or 2 per bank & average)

River right looking downstream

EROSION (L R)
- ☐☐ NONE/LITTLE [3]
- ☐☐ MODERATE [2]
- ☐☐ HEAVY/SEVERE [1]

RIPARIAN WIDTH (L R)
- ☐☐ WIDE > 50m [4]
- ☐☐ MODERATE 10-50m [3]
- ☐☐ NARROW 5-10m [2]
- ☐☐ VERY NARROW [1]
- ☐☐ NONE [0]

FLOOD PLAIN QUALITY (L R)
- ☐☐ FOREST, SWAMP [3]
- ☐☐ SHRUB OR OLD FIELD [2]
- ☐☐ RESIDENTIAL, PARK, NEW FIELD [1]
- ☐☐ FENCED PASTURE [1]
- ☐☐ OPEN PASTURE, ROWCROP [0]
- ☐☐ CONSERVATION TILLAGE [1]
- ☐☐ URBAN OR INDUSTRIAL [0]
- ☐☐ MINING /CONSTRUCTION [0]

Indicate predominant land use(s) past 100m riparian.

Riparian ☐ Maximum 10

Comments

5] *POOL/GLIDE AND RIFFLE/RUN QUALITY*

MAXIMUM DEPTH
Check ONE (ONLY!)
- ☐ > 1m [6]
- ☐ 0.7 - < 1m [4]
- ☐ 0.4 - < 0.7m [2]
- ☐ 0.2 - < 0.4m [1]
- ☐ < 0.2m [0] [metric = 0]

CHANNEL WIDTH
Check ONE (Or 2 & average)
- ☐ POOL WIDTH > RIFFLE WIDTH [2]
- ☐ POOL WIDTH = RIFFLE WIDTH [1]
- ☐ POOL WIDTH < RIFFLE WIDTH [0]

CURRENT VELOCITY
Check ALL that apply
- ☐ TORRENTIAL [-1]
- ☐ VERY FAST [1]
- ☐ FAST [1]
- ☐ MODERATE [1]
- ☐ SLOW [1]
- ☐ INTERSTITIAL [-1]
- ☐ INTERMITTENT [-2]
- ☐ EDDIES [1]

Indicate for reach – pools and riffles.

Recreation Potential
(Check one and comment on back)
- ☐ Primary Contact
- ☐ Secondary Contact

Pool/Current ☐ Maximum 12

Comments

Indicate for functional riffles; Best areas must be large enough to support a population of riffle-obligate species:

Check ONE (Or 2 & average) ☐ NO RIFFLE [metric = 0]

RIFFLE DEPTH
- ☐ BEST AREAS > 10cm [2]
- ☐ BEST AREAS 5 - 10cm [1]
- ☐ BEST AREAS < 5 cm [metric = 0]

RUN DEPTH
- ☐ MAXIMUM > 50cm [2]
- ☐ MAXIMUM < 50cm [1]

RIFFLE/RUN SUBSTRATE
- ☐ STABLE (e.g., Cobble, Boulder) [2]
- ☐ MOD. STABLE (e.g., Large Gravel) [1]
- ☐ UNSTABLE (e.g., Fine Gravel, Sand) [0]

RIFFLE/RUN EMBEDDEDNESS
- ☐ NONE [2]
- ☐ LOW [1]
- ☐ MODERATE [0]
- ☐ EXTENSIVE [-1]

Riffle/Run ☐ Maximum 8

Comments

6] *GRADIENT* (ft/mi)

DRAINAGE AREA (mi²)

- ☐ VERY LOW - LOW [2 – 4]
- ☐ MODERATE [6 - 10]
- ☐ HIGH - VERY HIGH [10 - 6]

%POOL: ☐ **%GLIDE:** ☐

%RUN: ☐ **%RIFFLE:** ☐

Gradient ☐ Maximum 10

Entered ______________ QC1 ______________ QC2 ______________ IDEM 02/01/2023

Attachment 3 (continued). IDEM OWQ Biological QHEI (back)

IDEM

OWQ Biological QHEI (Qualitative Habitat Evaluation Index)

COMMENT ______________________

A-CANOPY
- ☐ >85%-Open
- ☐ 55%-<85%
- ☐ 30%-<55%
- ☐ 10%-<30%
- ☐ <10%-Closed

B-AESTHETICS
- ☐ Nuisance algae
- ☐ Invasive macrophytes
- ☐ Excess turbidity
- ☐ Discoloration
- ☐ Foam/Scum
- ☐ Oil sheen
- ☐ Trash/Litter
- ☐ Nuisance odor
- ☐ Sludge deposits
- ☐ CSOs/SSOs/Outfalls

C-RECREATION

Area: Pool: ☐ > 100 ft^2 Depth: ☐ > 3 ft

D-MAINTENANCE
- ☐ Public ☐ Private
- ☐ Active ☐ Historic
- Succession: ☐ Young ☐ Old
- ☐ Spray ☐ Islands ☐ Scoured
- Snag: ☐ Removed ☐ Modified
- Leveed: ☐ One sided ☐ Both banks
- ☐ Relocated ☐ Cutoffs
- Bedload: ☐ Moving ☐ Stable
- ☐ Armoured ☐ Slumps
- ☐ Impounded ☐ Desiccated
- ☐ Flood control ☐ Drainage

E-ISSUES
- ☐ WWTP ☐ CSO ☐ NPDES
- ☐ Industry ☐ Urban
- ☐ Hardened ☐ Dirt & Grime
- ☐ Contaminated ☐ Landfill
- BMPs: ☐ Construction ☐ Sediment
- ☐ Logging ☐ Irrigation ☐ Cooling
- Erosion: ☐ Bank ☐ Surface
- ☐ False bank ☐ Manure ☐ Lagoon
- ☐ Wash H_2O ☐ Tile ☐ H_2O Table
- Mine: ☐ Acid ☐ Quarry
- Flow: ☐ Natural ☐ Stagnant
- ☐ Wetland ☐ Park ☐ Golf
- ☐ Lawn ☐ Home
- ☐ Atmospheric deposition
- ☐ Agriculture ☐ Livestock

Looking upstream (> 10m, 3 readings; ≤ 10m, 1 reading in middle); Round to the nearest whole percent

	Right	Middle	Left	Total Average
% open	___ %	___ %	___ %	___ %

Stream Width (m):

Stream Drawing:

IDEM 02/01/2023

Attachment 4. IDEM Field Chain of Custody Form

IDEM

Indiana Department of Environmental Management

OWQ Chain of Custody Form

Project:
OWQ Sample Set or Trip #:

I Certify that the sample(s) listed below was/were collected by me, or in my presence. Date:____________________

Signature:____ Section:____________________

Sample Media (☐ Water, ☐ Algae, ☐ Fish, ☐ Macro, ☐ Cyanobacteria/Microcystin, ☐ Sediment)

Lab Assigned Number / Event ID	IDEM Control Number	Sample Type	ID	1000 ml P.N.M.	1000 ml G.N.M.	40 ml Vial	120 ml P (Bact)	2000 ml Nalgene	250 ml Nalgene	125 ml Glass	Date and Time Collected		One check per bottle present
											Date	Time	

P = Plastic	G = Glass	N.M. = Narrow Mouth	Bact = Bacteriological Only	Should samples be iced?	Y	N
M = MS/MSD	B = Blank	D = Duplicate	R = Revisit			

Carriers

I certify that I have received the above sample(s).

Signature	Date	Time	Seals Intact		Comments
Relinquished By:			Y	N	
Received By:					
Relinquished By:			Y	N	
Received By:					
Relinquished By:			Y	N	
Received By:					
IDEM Storage Room #					

Lab Custodian

I certify that I have received the above sample(s), which has/have been recorded in the official record book. The same sample(s) will be in the custody of competent laboratory personnel at all times, or locked in a secured area.

Signature:______________________________ Date:______________ Time:______________

Lab:______________________________ Address:______________________________

Revision Date: 4/27/2016

Appendix 1. IDEM Fish Community Assessments for Aquatic Life Use

IDEM collects fish along with other data (chemical parameters, nutrients, macroinvertebrate, and habitat) to monitor the health of streams and rivers in Indiana. There are many advantages of using fish for monitoring stream health:

- Many fish have life spans of greater than 3 years allowing detection of degradation in habitat or water chemistry over time (which will alter the expected fish community structure).
- The knowledge of fish life history, feeding, and reproductive behavior is well known and can be used to detect changes in water chemistry or habitat alterations.
- Identification of fish species can usually be made in the field so that fish are returned to the stream and time for laboratory identifications kept minimal.

The IAC [327 IAC 2-1.5-3(2)] has narrative biological criteria that states “all waters, except those designated as limited use, will be capable of supporting a well-balanced, warm water aquatic community.” The water quality standard definition of a “well-balanced aquatic community” is “an aquatic community which is diverse in species composition, contains several different trophic levels, and is not composed mainly of pollution tolerant species” [327 IAC 2-1.5-9(59)]. To measure whether or not the fish community is meeting this definition, IDEM uses an IBI which is composed of 12 fish community characteristics chosen based on what part of the state you are sampling (ecoregion) and size of stream (drainage area). The 12 different characteristics can each score a 0, 1, 3, or 5, which represents the deviation from expected fish community structure (i.e., 5 = no deviation from expectations, 1 = severe deviation from expected fish community structure). The total score can range from 0 (no fish) to 60 (excellent, comparable to “least impacted” conditions). Indiana expects streams to score at least 36 (the minimum score required for a “fair” stream integrity classification) out of 60 to meet aquatic life use water quality standards. The chart below, modified from a table developed by Karr et al. 1986, uses total IBI score, integrity class, and attributes to define the fish community characteristics in Indiana streams and rivers.

Total IBI Score	Integrity Class	Attributes
53-60	Excellent	Comparable to “least impacted” conditions, exceptional assemblage of species.
45-52	Good	Decreased species richness (intolerant species in particular), sensitive species present.
36-44	Fair	Intolerant and sensitive species absent, skewed trophic structure.
23-35	Poor	Top carnivores and many expected species absent or rare, omnivores and tolerant species dominant.
12-22	Very Poor	Few species and individuals present, tolerant species dominant, diseased fish frequent.
<12	No Fish	No fish captured during sampling.

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J Schlosser. 1986. Assessing biological integrity in running waters: a method and its rationale. Illinois Natural History Survey Special Publication 5. 28 pages.

Some examples of metrics and fish specimens for the IBI looking at species composition, trophic levels, and tolerance to water pollution or habitat disturbance.

1. *Number of Species* (generally more species = better quality stream)
2. *Number of Darter, Madtom, Sculpin Species* (species require high DO and clean, rocky substrates so higher number = better quality stream)
   - Examples: rainbow darter, brindled madtom, mottled sculpin

   % Large River Individuals (species require habitats typical in great rivers in terms of bottom substrates, current velocity, backwater areas, etc. so higher percentage = better quality river)
   - Examples: chestnut lamprey, channel catfish, bullhead minnow, silver chub
3. *% Headwater Individuals* (species in small streams occupying permanent habitat with low environmental stress so greater percentage = better quality stream)
   - Examples: western blacknose dace, southern redbelly dace, fantail darter

   Number of Sunfish or Centrarchidae Species (species occupy pools which act as “sinks” for potential pollutants and silt so fewer number of these species = low quality stream)
   - Examples: rock bass, bluegill, largemouth bass
4. *Number of Sucker or Round Body Sucker Species* (species do not tolerate habitat and water quality degradation so more = better quality stream)
   - Examples: black redhorse, northern hog sucker

   Number of Minnow Species (generally more minnow species = better quality stream)
   - Examples: spotfin shiner, silverjaw minnow, hornyhead chub
5. *Number of Sensitive Species* (species sensitive to pollution so more species = better quality stream)
   - Examples: greenside darter, smallmouth bass, longear sunfish
6. *% Tolerant Individuals* (species tolerant to pollution so greater percentage = low quality stream)
   - Examples: yellow bullhead, green sunfish, central mudminnow
7. *% Omnivore/Detritivore Individuals* (species that consume at least 25% plant and 25% animal material which makes them opportunistic feeders when other food sources are scarce: thus, greater percentage = lower quality stream)
   - Examples: bluntnose minnow, white sucker, gizzard shad
8. *% Insectivore/Invertivore Individuals* (species whose diet is mainly benthic insects, so the metric is a reflection of the food source; thus, lower percentage = lower quality stream)
   - Examples: blackstripe topminnow, emerald shiner, logperch
9. *% Carnivore Individuals* (species whose diet is carnivorous and also reflects the availability of the food source; too high or too low percentage of carnivores = lower quality stream and imbalance of trophic levels)
   - Examples: spotted bass, grass pickerel

   % Pioneer Individuals (species that are first to colonize a stream after environmental disturbance so higher percentage of pioneer individuals = lower quality stream)
   - Examples: creek chub, central stoneroller, johnny darter
10. *Number of Individuals* (generally more individuals = better quality stream)
11. *% Simple Lithophilic Individuals* (species that require clean gravel or cobble for successful reproduction since they simply broadcast their eggs on the substrate, fertilize, and provide no parental care; thus, heavy siltation or environmental disturbance will result in a lower percentage of simple lithophilic species = lower quality stream)
    - Examples: bigeye chub, striped shiner, orangethroat darter
12. *% Individuals with Deformities, Eroded Fins, Lesions, and Tumors (DELT’s)* (diseased individuals with external anomalies as a result of bacterial, fungal, viral, and parasitic infections, chemical pollutants, overcrowding, improper diet, and other environmental degradation. Percentages should be absent or very low naturally so higher percentage = low quality stream)
    - Examples: deformed blackstripe topminnow, creek chub with tumors

Appendix 2. Calculating IDEM Macroinvertebrate Index of Biotic Integrity

The purpose of this document is to describe the laboratory processing and data analysis procedures used by the IDEM to calculate the mIBI. SOPs are being developed to describe these processes, but it may be some time before they are finalized.

An SOP describing the methods used by IDEM to collect macroinvertebrate samples with a MHAB sampling method is available at http://monitoringprotocols.pbworks.com/f/S-001-OWQ-W-BS-10-S-R0.pdf. The index period for collection of macroinvertebrate samples with the MHAB sampling method is July 15 to October 30. The entire sample is processed in the laboratory as subsampling has already been performed in the field. All macroinvertebrate individuals are counted with the exception of empty snail and clam shells, microcrustaceans (Ostracoda, Branchiopoda, Copepoda), larval and pupal insect exuviae, and terrestrial insects (including the terrestrial adults of aquatic insect larvae); invertebrate specimens missing their head are also excluded. The level of taxonomic resolution used in the identification of macroinvertebrates may depend in large part on the condition (instar and physical condition) of the specimens and the availability of taxonomic resources that are comprehensive and appropriate for Indiana's fauna. Specimens are generally identified to the "lowest practical" taxonomic level. Oligochaeta (aquatic worms, Hirudinea and Branchiobdellida), Planaria and Acari are only identified to family or a higher level; freshwater snails and clams are identified to genus; freshwater crustacea are identified to genus (Amphipoda and Isopoda) or species (Decapoda); aquatic insects are identified to family (Collembola and several Dipteran families) or genus and species (all other insects). The following table lists insect genera that are often identified to species (and may contain multiple species in a sample) and taxonomic resources commonly used by IDEM biologists for their identification (full citations for these resources are listed in the Taxonomic References at the end of this document.

Ephemeroptera:
Baetidae: *Baetis* (leave everything *Baetis*, except separate*)*
B. intercalaris
B. flavistriga, Moriharra and McCafferty 1979
Caenidae: *Caenis:* Provonsha 1990
Heptageniidae: *Mccaffertium* (formerly *Stenonema* subgenus *Mccaffertium*): Bednarik and McCafferty 1979
Odonata:
Gomphidae: *Dromogomphus*: Westfall and Tennessen 1979
Coenagrionidae: *Argia* and *Enallagma*: Westfall and May 1996
Hemiptera:
Corixidae: *Trichocorixa* and *Palmacorixa*: Hungerford 1948, Hilsenhoff 1984
Megaloptera:
Corydalidae: *Chauliodes* and *Nigronia*: Rasmussen and Pescador 2002
Coleoptera:
Haliplidae: *Peltodytes*: Brigham 1996
Dytiscidae: *Neoporus*, *Heterosternuta*, *Laccophilus*, *Coptotomus*: Larson et al. 2000.
Hydrophilidae: *Tropisternus*, *Berosus*, *Enochrus*: Hilsenhoff 1995A and 1995B.
Elmidae: *Stenelmis*, *Dubiraphia*, *Optioservus*: Hilsenhoff and Schmude, Hilsenhoff 1982
Trichoptera:
Philopotamidae: *Chimarra*: Hilsenhoff 1982
Leptoceridae: *Nectopsyche*: Glover and Floyd 2004
Hydropsychidae: *Hydropsyche*: Schuster and Etnier 1978
Diptera:
Chironomidae: *Ablabesmyia*: Roback 1985 (subgenus and species group)
Polypedilum: Maschwitz and Cook 2000 (subgenus and species group)
Cricotopus/Orthocladius: Merritt et al 2007 (subgenus and species group)

After all organisms in the sample have been identified to the lowest practical taxon, those taxa are then associated with their corresponding tolerance, functional feeding group, and habit values (found in the spreadsheet "Indiana Macroinvertebrate Attributes"). Organisms without a tolerance value, functional feeding group or habit are not included in the calculations for those specific metrics (this may become more evident while looking at the metric example on page 3). For taxa metrics, all of the taxa listed for a specific group (EPT, Diptera) are counted, regardless of level of identification (i.e., if there were 4 taxa under the Chironomidae family (1 family level ID, 1 *Cricotopus* genus level ID, and 2 distinct species level IDs under the *Cricotopus* genus) this would be considered 4 taxa).

The metrics are then calculated as follows:

1 - Total Number of Taxa: Numerical count of all identified taxa in the sample

2 - Total Number of Individuals: Numerical count of the number of individual specimens in the sample

3 - Total Number of EPT Taxa: Numerical count of all Ephemeroptera, Plecoptera and Trichoptera taxa in the sample

4 - Total Number of Diptera Taxa: Numerical count of all Diptera taxa in the sample

5 - % Orthocladiinae + Tanytarsini of Chironomidae: Number of individuals in the chironomid subfamily Orthocladiinae and tribe Tanytarsini divided by the total number of Chironomidae in the sample

6 - % Noninsect (minus crayfish): Number of individuals, except for crayfish, which are not in the Class Insecta (Isopoda, Amphipoda, Acari, snails, freshwater clams, Oligochaeta, Nematoda, Nematomorpha) divided by the total number of individuals in the sample

7 - % Intolerant: Number of individuals with a tolerance value of 0-3 divided by the total number of individuals in the sample

8 - % Tolerant: Number of individuals with a tolerance value of 8-10 divided by the total number of individuals in the sample

9 - % Predators: Number of individuals with a functional feeding group designation of "Predator" divided by the total number of individuals in the sample

10 - % Shredders + Scrapers: Combined number of individuals in the functional feeding groups "Shredder" and "Scraper" divided by the total number of individuals in the sample

11 - % Collector-Filterers: Number of individuals in the functional feeding group "Collector-Filterer" divided by the total number of individuals in the sample

12 - % Sprawlers: Number of individuals with a habit specificity of "Sprawler" divided by the total number of individuals in the sample

These metric values are then scored as a 1, 3, or 5 according to the criteria in the following table:

Metric	1	3	5
Number of Taxa	< 21	≥ 21 and <41	≥ 41
Number of Individuals	< 129	≥ 129 and < 258	≥ 258
Number of EPT Taxa			
Drainage Area: < 5 mi^2	< 2	≥ 2 and < 4	≥ 4
Drainage Area: ≥ 5 and < 50 mi^2	< 4	≥ 4 and < 8	≥ 8
Drainage Area: ≥ 50 mi^2	< 6	≥ 6 and < 12	≥ 12
% Orthocladiinae + Tanytarsini of Chironomidae	≥ 47	≥ 24 and < 47	< 24
% Noninsects Minus Crayfish	≥ 35	≥ 18 and < 35	< 18
Number of Diptera Taxa	< 7	≥ 7 and < 14	≥ 14
% Intolerant	< 15.9	≥ 15.9 and < 31.8	≥ 31.8
% Tolerant	≥ 25.3	≥ 12.6 and < 25.3	< 12.6
% Predators	< 18	≥ 18 and < 36	≥ 36
% Shredders + Scrapers	< 10	≥ 10 and < 20	≥ 20
% Collector-Filterers	≥ 20	≥ 10 and < 20	< 10
% Sprawlers	< 3	≥ 3 and < 6	≥ 6

Most scoring classifications are the same regardless of stream drainage area; the exception is the "Number of EPT Taxa" metric which increases with increasing drainage area. After all metrics have been scored, the individual metric scores are summed, and the total is the mIBI score for that particular site. Scores less than 36 are considered impaired while those greater than or equal to 36 are unimpaired.

Example of Derivation of Metric Scores for the Macroinvertebrate Index of Biotic Integrity

TAXA NAME	FEED GRP	TOL	HAB/BHV	# OF IND
Heptagenia	SC	3		1
Leucrocuta	SC	2	cn	1
Acerpenna pygmaea	OM	2	sw	1
Baetis flavistriga	GC	3	sw	1
Callibaetis	GC	6	sw	1
Ephemera simulans				1
Ischnura verticalis	PR			1
Berosus peregrinus	SH	6	sw	1
Dubiraphia	GC	5	cn	1
Macronychus glabratus	OM	3	cn	1
Ceratopsyche bronta		5		1
Pycnopsyche	SH	3	sp	1
Chrysops	GC	5		1
Procladius	PR	7	sp	1
Paraphaenocladius	GC		sp	1
Lirceus	GC	8	cr	1
Ferrissia rivularis	SC	6		1
Physella	SC	8		1
Corbicula fluminea	FC	6		1
NAIDIDAE	GC	8		1
Acariformes		4		1
Maccaffertium pulchellum	SC	2		2
Tricorythodes	GC	3	sw	2
Boyeria vinosa	PR	4	cb	2
Rheumatobates	PR		sk	2
Trepobates	PR			2
Stenelmis	SC	5	cn	2
Polypedilum flavum				2
Stictochironomus	OM	4	bu	2
Caenis latipennis	GC			3
Palmacorixa nana	PI	4	sw	3
Cheumatopsyche	FC	3	cn	3
Orconectes	GC	4		3
Hetaerina americana	PR			4
Ancyronyx variegatus	OM	4		5
Baetis intercalaris	OM	3	sw	6
Peltodytes duodecimpunctata				6
Trepobates inermis				7
Dubiraphia minima				7
Hyalella azteca	GC	8	cr	9
Polypedilum illinoense		7		16
Stenelmis sexlineata				**18**
Grand Total				127
Metrics	**Metric Values**	**Metric Scores**		

Total Number of Taxa	42	**3**
Total Abundance of Individuals	127	**1**
Number of EPT Taxa	13	**5**
% Orthocladinae + Tanytarsinii of Chironomidae	4.55	**5**
% NonInsects - Crayfish	11.81	**5**
Number of Diptera Taxa	6	**1**
% Intolerant Taxa (Score 0 - 3)	14.96	**1**
% Tolerant Taxa (Score 8 - 10)	9.45	**5**
% Predators	9.45	**1**
% Shredders + Scrapers	7.87	**1**
% Collector-Filterers	3.15	**5**
% Sprawlers	2.36	**1**
MIBI Score		**34**

Taxonomic References

Bednarik A.F. and W.P. McCafferty. 1979. Biosystematic revision of the genus *Stenonema* Ephemeroptera: Heptageniidae). Canadian Bulletin of Fisheries and Aquatic Sciences 201: 1-73.

Brigham, W.L. 1996. Key to adult *Peltodytes* of the U.S. and Canada (Coleoptera: Haliplidae).

Glover, J.B. and M. A. Floyd. 2004. Larvae of the genus *Nectopsyche* (Trichoptera:Leptoceridae) in eastern North America, including a new species from North Carolina. Journal of the North American Benthological Society 23(3) 526-541.

Hilsenhoff WL. 1982. Using a biotic index to evaluate water quality in streams. Department of Natural Resources, Technical Bulletin 132, Madison, Wisconsin.

Hilsenhoff, W.L. 1984. Aquatic Hemiptera of Wisconsin. Great Lakes Entomologist 17: 29-50.

Hilsenhoff, W.L. 1995. Aquatic Hydrophilidae and Hydraenidae of Wisconsin (Coleoptera). I. Introduction, key to genera of adults, and distribution, habitat, life cycle, and identification of species of *Helophorus* Fabricius, *Hydrochus* Leach, and *Berosus* Leach (Hydrophilidae), and Hydraenidae. The Great Lakes Entomologist 28(1): 25-53.

Hilsenhoff, W.L. 1995. Aquatic Hydrophilidae and Hydraenidae of Wisconsin (Coleoptera). II. Introduction, key to genera of adults, and distribution, habitat, life cycle, and identification of species of Hydrobini and Hydrophili (Hydrophilidae: Hydrohilinae). The Great Lakes Entomologist 28(2): 97-126.

Hilsenhoff, W.L. and K.L. Schmude. 1992. Riffle beetles of Wisconsin (Coleoptera: Dryopidae, Elmidae, Lutrochidae, Psepheniidae) with notes on distribution, habitat, and identification. The Great Lakes Entomologist 25(3): 191-213.

Hungerford H.B. 1948. The Corixidae of the Western Hemisphere (Hemiptera). Reprint of The University of Kansas Science Bulletin 32:1-827, reprinted (1977) by Entomological Reprint Specialists: Los Angeles, California.

Larson, D.J., Y. Alarie, and R.E. Roughley. 2000. Predaceous Diving Beetles (Coleoptera: Dytiscidae) of the Nearctic Region, with emphasis on the fauna of Canada and Alaska. NRC Research Press, Ottawa.

Maschwitz, D.E. and E. F. Cook. 2000. Revision of the Nearctic Species of the Genus *Polypedilum* Kieffer (Diptera: Chironomidae) in the Subgenera *P*. (*Polypedilum*) Kieffer and *P*. (*Urespedilum*) Oyewo and Saether. Ohio Biological Survey Bulletin (New Series) 12(3). 135 pp

Morihara D.K. and McCafferty W.P. 1979. The *Baetis* larvae of North America (Ephemeroptera: Baetidae). Transactions of the American Entomological Society 105:139-221.

Provonsha A.V. 1990. A revision of the genus *Caenis* in North America (Ephemeroptera: Caenidae). Transactions of the American Entomological Society 116:801-884.

Rasmussen, A.K. and M.L. Pescador. 2002. A Guide to the Megaloptera and Aquatic Neuroptera of Florida. http://publicfiles.dep.state.fl.us/dear/labs/biology/biokeys/megaloptera.pdf

Roback, S.S. 1985. The immature chironomids of the eastern United States VI - genus *Ablabesmyia*. Proceedings of the Academy of Natural Sciences of Philadelphia 137(2): 153-212.

Schuster, G.A. and D.A. Etnier. 1978. Manual for the Identification of the Larvae of the Caddisfly Genera *Hydropsyche* Pictet and *Symphitopsyche* Ulmer in Eastern and Central North America (Trichoptera:Hydropsychidae) EPA/600/4-78/060.

Westfall, M.J., Jr. and M.L. May. 2006. Damselflies of North America (Revised Edition).

Westfall, M.J. Jr. and K.J. Tennessen. 1979. Taxonomic clarification within the genus *Dromogomphus* Selys (Odonata: Gomphidae). Florida Entomologist 62(3). 266-273.

If you have further questions regarding the IDEM mIBI please contact:

Mitchell Owens
Environmental Manager
Indiana Department of Environmental Management
Office of Water Quality, Watershed Assessment and Planning Branch
Probabilistic Monitoring Section

100 N. Senate Ave.
MC65-40-2 Shadeland
Indianapolis, IN 46204-2251
317-308-3135

mcowens@idem.in.gov