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Addendum

INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
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Eric J. Holcomb — *Governor*
Brian C. Rockensuess — *Commissioner*

Memorandum

TO: Interested Parties

FROM: Michael Schneider
Environmental Manager 2
Probabilistic Monitoring Section
Watershed Assessment and Planning Branch
Office of Water Quality

DATE: March 24, 2023

SUBJECT: Amendment to 2019 Lake and Reservoir Monitoring Work Plan

This memorandum serves as an amendment to the 2019 Lake and Reservoir Monitoring Work Plan B-047-OWQ-WAP-XXX-19-W-R0. The purpose of this amendment is to provide a list of potential lakes for sampling in 2023 if IDEM sampling crews cannot perform monitoring activities in rivers and streams. These locations have been selected to reflect lakes being sampled in 2023 as part of the Indiana Clean Lakes Program. The information collected will serve to provide additional data for the refinement of the Index of Biotic Sustainability (IBS) and lead to the development of multi-metric indices for aquatic macroinvertebrate and aquatic macrophyte communities in Indiana's lakes and reservoirs. The ultimate goal of this program is to provide a comprehensive, unbiased assessment of the ability of Indiana's lentic systems (i.e., lakes and reservoirs) to support aquatic life.

Table 1. Potential Sampling Locations for 2023 Lake and Reservoir Monitoring

Lake Name	County	Location	Lake Type	Size Category
Ferdinand State Forest	Dubois	in Ferdinand St. Forest	Impoundment	Small
Deam	Clark	In Clark Co. State Forest	Impoundment	Small
Bixler	Noble	E. edge of Kendallville	Natural Lake	Small
Eagle	Noble	2 mi N. of Kimmel	Natural Lake	Small
Smalley	Noble	3.5 mi E. of Wilmot	Natural Lake	Small
Sand	Noble	Chain 'O Lakes State Park	Natural Lake	Small
Shipshewana	LaGrange	1 mi W. of Shipshewana	Natural Lake	Small
Appleman	LaGrange	2.5 mi N. of Elmira	Natural Lake	Small
Emma	LaGrange	S. edge of Emma	Natural Lake	Small
Center	Kosciusko	Warsaw	Natural Lake	Small
Summit Lake	Henry	Summit Lake State Park	Impoundment	Medium
Westwood Park Reservoir	Henry	2.5 mi W. of New Castle	Impoundment	Small

2019 Lake and Reservoir Monitoring Work Plan

PREPARED BY

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December 5, 2019

B-047-OWQ-WAP-XXX-19-W-R0

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SIGNATURE PAGE

2019 Lake and Reservoir Monitoring Work Plan

Indiana Department of Environmental Management
Office of Water Quality
Watershed Assessment and Planning Branch
Indianapolis, Indiana

B-047-OWQ-WAP-XXX-19-W-R0

Reviews and Approvals

Stacey Sobat Date 11-18-2019
Stacey Sobat, Section Chief Probabilistic Monitoring Section

Cynthia Wagner Date 11-18-19
Cynthia Wagner, Section Chief Targeted Monitoring Section

Timothy Bowren Date 11-14-2019
Timothy Bowren, Project Quality Assurance Officer, Technical and Logistical Services Section

Marylou Renshaw Date 11-18-19
Marylou Renshaw, Branch Chief, Branch Quality Assurance Coordinator

IDEM Quality Assurance Staff reviewed and approves this Sampling and Analysis Work Plan.

James E. Bailey Date 20Nov2019
Quality Assurance Staff
IDEM Office of Program Support

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WORK PLAN ORGANIZATION

This Sampling and Analysis Work Plan is an extension of the existing WAPB, March 2017 Quality Assurance Project Plan (QAPP) for Indiana Surface Water Program (Surface Water QAPP) (IDEM 2017) and serves as a link to the existing QAPP as well as an independent QAPP of the project. Per the United States Environmental Protection Agency (U.S. EPA) 2006 Guidance on Systemic Planning Using the Data Quality Objectives (DQO) Process (U.S. EPA 2006), this work plan establishes criteria and specifications pertaining to a specific water quality monitoring project that are usually described in the following four groups (phases) or sections as QAPP elements:

Section I. Project Management

- Project Objective
- Project/Task Organization and Schedule
- Background and Project/Task Description
- Data Quality Objectives (DQOs)
- Training and Staffing Requirements

Section II. Data Generation and Acquisition

- Sampling Procedures
- Analytical Methods
- Sample and Data Acquisition Requirements
- Quality Control (QC) Measures Specific to the Project

Section III. Assessment/Oversight

- External and Internal Checks
- Audits
- Data Quality Assessments (DQAs)
- Quality Assurance/Quality Control (QA/QC) Review Reports

Section IV. Data Validation and Usability

- Data Handling and associated QA/QC activities
- QA/QC Review Reports

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LIST OF ACRONYMS

AIMS	Assessment Information Management System
DO	Dissolved Oxygen
DQO	Data Quality Objective
IAC	Indiana Administrative Code
IBS	Index of Biotic Sustainability
IDEM	Indiana Department of Environmental Management
NLA	National Lakes Assessment
OWQ	Office of Water Quality
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
QHEI	Qualitative Habitat Evaluation Index
SOP	Standard Operating Procedure
U.S. EPA	United States Environmental Protection Agency
WAPB	Watershed Assessment and Planning Branch

DEFINITIONS

Elutriate	To purify, separate, or remove lighter or finer particles by washing, decanting, and settling.
Impoundment	A body of water confined within an enclosure, such as a reservoir.
Lentic	Referring to a waterbody type -stationary or relatively still water.
Macroinvertebrate	Aquatic animals which lack a backbone, are visible without a microscope, and spend some period of their lives in or around water.
Macrophyte	Plants which are visible without a microscope, and occur in or around water.

I. PROJECT MANAGEMENT

Project Objective

The main objectives of the lake and reservoir monitoring project are the collection of water quality and biological data. Data collected further refines the Index of Biotic Sustainability (IBS); and leads to the development of multi-metric indices for aquatic macroinvertebrate and aquatic macrophyte communities in Indiana's lakes and reservoirs. The final goal is to provide a comprehensive, unbiased assessment of the ability of Indiana's lentic systems (i.e., lakes and reservoirs) to support aquatic life. Sampling for the project begins in June and continues through August of the sampling year. Chemical, physical, and biological parameters are collected. Laboratory processing and data analysis for the project continues through the following spring of the sampling year. Data collected during lake and reservoir monitoring supports the following purposes:

- Provide water quality and biological data useful for municipal, industrial, agricultural, and recreational decision making processes, including TMDL decisions and National Pollutant Discharge Elimination System (NPDES) permit waste load allocations modeling.
- Compile water quality and biological data for trend analyses.
- Aid in the development of narrative biological water quality criteria for lentic systems.

Project/Task Organization and Schedule

Sampling will be conducted in conjunction with, or near the time of water chemistry sampling performed by the Indiana Clean Lakes Program (CLP). The CLP is a statewide water monitoring and education program created through a partnership with Indiana University.all waterbody sampling (fish, macroinvertebrate, and macrophyte) will be conducted within a two week timeframe after a CLP sampling event between June and August. However, all sampling may not necessarily occur within the same week. This workplan serves any waterbody locations (Tables 1 and 2) selected for monitoring in any given year by the WAPB.

Each waterbody fish community sampling period occurs once for one or two consecutive nights. Fish community sampling occurs within multiple 500 meter stations, determined by the surface hectares of the waterbody, randomly picked along the shoreline. Sampling occurs no earlier than one half hour after sunset and lasts no longer than one half hour prior to sunrise. At each station, record the following characteristics for each species:

- Counts,
- Length, and weight measurements, and
- Condition of fish observations (deformity, eroded fin, lesion and tumor (DELT) anomalies).

Determine Qualitative Habitat Evaluation Index (QHEI) scoring of each station's fish communities for a maximum of six scores.

Each waterbody macroinvertebrate community sampling period occurs once for one or two consecutive days during daylight hours. Collect a composite sample for each waterbody. Each composite sample consists of samples taken from ten evenly distributed sampling points along the shoreline of the waterbody.

Each waterbody macrophyte community sampling period occurs once, during daylight hours,whenfive composite samples are collected. Sampling transects occur at every other macroinvertebrate community sampling site perpendicular from the shoreline.

Collect water quality measurements (dissolved oxygen (DO), % DO saturation, water temperature, pH, specific conductance, and turbidity) at the beginning and end points of each 500 meter station for fish community sampling and at each of the ten macroinvertebrate/macrophyte sampling sites.

Conduct sampling activities in the following timeframes:

- Complete site reconnaissance in March or April of the sampling year. Conduct reconnaissance activities in the office and through physical site visits.
- Schedule fish, macroinvertebrate, and macrophyte community sampling during the months of June through August, at up to three lakes or reservoirs per year, depending on IDEM-OWQ staff availability.
- Complete chemical measurements and habitat evaluations during each fish and macroinvertebrate community sampling event.

Background and Project/Task Description

WAPB, OWQ, IDEM operates the Lake and Reservoir Monitoring Project. Other organizations assisting with data preparation, collection, and analysis include the CLP and the Indiana Department of Natural Resources.

The Lake and Reservoir Monitoring Project provides physical, chemical, and biological data used to calibrate the IBS for fish community samples. Data collected from this project may be usedto create a multimetric index for aquatic macroinvertebrates, after multiple years of sampling. Calibration is accomplished by sampling lakes and reservoirs over several years to characterize overall water quality and biological sustainability. Data from the following parameters are investigated and utilized for IBS and biological criteria refinement: water chemistry; fish, macroinvertebrate, and macrophyte assemblages; and habitat evaluations.

Data Quality Objectives (DQOs)

The DQO process (U.S. EPA 2006) is a data collection activities planning tool. The following seven steps identify the DQO planning process for the Lake and Reservoir Monitoring Project:

1. State the Problem

Assessments: 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 Indiana Administrative Code (IAC) 2-1-3]. This project gathers physical field parameters (water temperatures, DO, and other characteristics); CLP’s collected chemical data; fish community data, macroinvertebrate community

data, macrophyte community data, and habitat evaluation data for the purpose of assessing the designated use attainment status of lakes and impoundments.

2. Identify the Goals of the Study

The primary objectives of this study are:

- Gather aquatic macroinvertebrate and macrophyte biological data and additional fish community data, chemical data, and physical habitat evaluations to add to the existing fish community IBS
- Construct multimetric indices for aquatic macroinvertebrates and aquatic macrophytes.

  Indiana narrative biological criteria [327 IAC 2-1-3] states that "all waters, except as described in subdivision (5)," (i.e., limited use waters) "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 that: (A) is diverse in species composition; (B) contains several different trophic levels; and (C) is not composed mainly of pollution tolerant species" [327 IAC 2-1-9]. The work plan data collected will assist with IBS calibration so future waterbodies can be assessed for aquatic life use support and eventually be included in future updates of Indiana's Integrated Water Monitoring and Assessment Report to U.S. EPA.

3. Identify Information Inputs

Biological community sampling (fish, macroinvertebrate, and macrophyte communities); instantaneous field parameters (DO, % DO saturation, water temperature, pH, specific conductance, and turbidity); and QHEI scoring occur as one-time sampling events at stations within the potential waterbodies listed in Tables 1 and 2. Water chemistry data is collected by the CLP as a one-time sampling event following the CLP standard operating procedure (SOP) (IU SPEA 1989). All information collected assists with the recalibration of the IBS with the use of new and existing data and future development of multimetric indices for aquatic macroinvertebrate and aquatic macrophyte communities. Collection procedures for field measurements, biological, and habitat data are described in detail under Section II. DATA GENERATION AND ACQUISITION.

4. Define the Boundaries of the Study

See Tables 1 and 2 for the list of potential sampling locations. See Figures 1 and 2 for detailed maps of a representative fish community sampling effort. See Figure 3 for a detailed map of a representative aquatic macroinvertebrates and macrophytes sampling effort.

5. Develop the Analytical Approach

Water Quality Data: Collect water quality field measurements (DO, % DO saturation, temperature, pH, specific conductance, and turbidity) at a depth of 0.5 meters below the surface of the water at:

- Both the beginning and end of each 500 meter fish community station sampled within the lake or impoundment.
- With each macroinvertebrate community sample.

Fish community census occurs in multiple 500 meter stations across the waterbody for a maximum total shoreline sampled up to 3000 meters. Compile a waterbody macroinvertebrate community census from a composite sample consisting of samples from ten evenly spaced shoreline plots measuring 10 meters by 15 meters. Macrophyte community census occurs at five evenly spaced transects perpendicular to the shoreline. CLP water chemistry samples are collected during a one-time sampling event.

For assessment purposes, evaluate the fish assemblage at each site using the IBS (Simon 2004). For each waterbody station sampled, examining the IBS score determines the fish community's assessment. Evaluate macroinvertebrate communities using the U.S. EPA National Lakes Assessment (NLA) macroinvertebrate multimetric index (MMI) (U.S. EPA 2017). Evaluate all data meeting IDEM's data quality requirements for a lake for potential use in assessments (IDEM 2018b).

6. Specify Performance or Acceptance Criteria

Good quality data are essential for minimizing decision error. By minimizing errors in the sampling design; measurement; and laboratory for physical, chemical, and biological parameters; more confidence can be placed in aquatic life use assessments.

Site specific aquatic life use assessments include program specific controls to minimize the introduction of errors. These controls include data sonde calibrations, field equipment checks, biological site revisits or duplicates, and laboratory controls through verification of species identifications as described in Field Procedure Manuals (IDEM 2002; IDEM 2018a) and SOP (IDEM 1992a, 1992b, 1992c, 2018, IU SPEA 1989, U.S. EPA 2012a, 2012b).

The QA/QC process detects deficiencies in the data collection as set forth in the Surface Water QAPP (IDEM 2017). Precision and accuracy goals with acceptance limits for applicable field measurements are provided in the Surface Water QAPP, Table B2-2: Field Parameters page 81. Criteria for acceptance or rejection of results as well as application of data quality flags is presented in the Surface Water QAPP (IDEM 2017). Field techniques used during sample collection, along with laboratory procedures are subject to periodic evaluation by both WAPB QA and field staff.

7. Optimize the Plan for Obtaining Data

Sampling locations in this project have been selected based on the waterbodies that will be sampled by the CLP . The CLP selects their sites randomly from a list comprised of approximately 400 waterbodies with depth greater than a meter and public access across Indiana. As the WAPB is trying to coordinate its sampling events with the CLP , the sampling location priority could change within a few weeks of actual sampling events. WAPB staff flexibility is pertinent to adjusting sampling locations in concert with the CLP 's sampling schedule.

Table 1 Potential Sampling Locations for 2019 Lake and Reservoir Monitoring

LAKE NAME	COUNTY	LOCATION	LAKE TYPE	SIZE CATEGORY
Deam	Clark	in Clark Co. State Forest	Impoundment	SMALL
Huntingburg City	Dubois	1.5 mi. W of Huntingburg	Impoundment	SMALL
Patoka Res.	Dubois	3 mi. N of Birdseye	Impoundment	LARGE
Nyona	Fulton	4 mi. N.E. of Fulton	Natural Lake	SMALL
South Mud	Fulton	4 mi. N.E. of Fulton	Natural Lake	SMALL
Starve Hollow	Jackson	in Jackson State Forest	Impoundment	SMALL
Brush Creek Res.	Jennings	1 mi. N. Butlerville	Impoundment	SMALL
Center	Kosciusko	At Warsaw	Natural Lake	SMALL
James	Kosciusko	1 1/2 mi. W. of North Webster	Natural Lake	MEDIUM
Kuhn	Kosciusko	3 mi. SW of North Webster	Natural Lake	SMALL
Little Chapman	Kosciusko	3 mi NE of Warsaw	Natural Lake	SMALL
Palestine	Kosciusko	1/2 mi. E. of Palestine	Impoundment	SMALL
Silver	Kosciusko	N.W. edge of Silver Lake	Natural Lake	SMALL
Winona	Kosciusko	1 mi. SE of Warsaw	Natural Lake	MEDIUM
Big Long	LaGrange	3 mi. N.E. of South Milford	Natural Lake	MEDIUM
North Twin	LaGrange	1 1/2 mi. N.W. of Howe	Natural Lake	SMALL
Oliver	LaGrange	2 1/2 mi. N.W. of Wolcottville	Natural Lake	MEDIUM
Royer	LaGrange	2 mi. S. of Plato	Natural Lake	SMALL
Shipshewana	LaGrange	1 mi. W. of Shipshewana	Natural Lake	SMALL
Lake George (Hobart)	Lake	W. of Hobart in city limits	Impoundment	MEDIUM
Hog	LaPorte	2.5 mi. N of Rolling Prairie	Natural Lake	SMALL
Lake Lemon	Monroe	6 mi. W. of Bean Blossom	Impoundment	MEDIUM
Bixler	Noble	E. edge of Kendallville	Natural Lake	SMALL
Knapp	Noble	3.5 mi. NE of Wilmot	Natural Lake	SMALL
Mansfield Res (Hardin)	Parke	Raccoon State Park	Impoundment	MEDIUM
Spectacle	Porter	in Valparaiso	Natural Lake	SMALL
Lake Lincoln	Spencer	Lincoln State Park	Impoundment	SMALL
Potato Cr. (Worster)	St. Joseph	2 mi E of North Liberty		MEDIUM
Ball	Steuben	1 1/2 mi. N.W. Hamilton	Natural Lake	SMALL
Crooked	Steuben	5 mi. N.W. Angola	Natural Lake	MEDIUM
Fox	Steuben	1 mi. S.W. of Angola	Natural Lake	SMALL
Pigeon	Steuben	3 mi. E. of Angola	Natural Lake	SMALL
Sullivan	Sullivan	at Sullivan	Impoundment	MEDIUM
Goose	Whitley	3.5 mi. SE of Etna	Natural Lake	SMALL

Table 2 Potential Sampling Locations for 2020 Lake and Reservoir Monitoring

LAKE NAME	COUNTY	LOCATION	LAKE TYPE	SIZE CATERGORY
Yellowwood	Brown	5 mi. W. of Nashville	Impoundment	SMALL
Deam	Clark	in Clark Co. State Forest	Impoundment	SMALL
Huntingburg City	Dubois	1.5 mi. W of Huntingburg	Impoundment	SMALL
Huntington Res.	Huntington		Impoundment	MEDIUM
Little Chapman	Kosciusko	3 mi NE of Warsaw	Natural Lake	SMALL
Palestine	Kosciusko	1/2 mi. E. of Palestine	Impoundment	SMALL
Winona	Kosciusko	1 mi. SE of Warsaw	Natural Lake	MEDIUM
Tippecanoe	Kosciusko	at Oswego	Natural Lake	MEDIUM
Wawasee	Kosciusko	at Syracuse	Natural Lake	LARGE
Fish Lake (Plato)	LaGrange	1 mi. S. of Plato	Natural Lake	SMALL
Cedar	LaGrange	4 mi. E.N.E. of Howe	Natural Lake	SMALL
Big Long	LaGrange	3 mi. N.E. of South Milford	Natural Lake	MEDIUM
Hog	LaPorte	2.5 mi. N of Rolling Prairie	Natural Lake	SMALL
Clear (LaPorte)	LaPorte	N. edge of LaPorte in city limits	Natural Lake	SMALL
Pine	LaPorte	in LaPorte	Natural Lake	MEDIUM
Eagle Creek Res.	Marion	NW edge of Indianapolis	Impoundment	MEDIUM
Mill Pond (Zehner)	Marshall	5 mi. S.W. Plymouth	Natural Lake	SMALL
Lake Lemon	Monroe	6 mi. W. of Bean Blossom	Impoundment	MEDIUM
Monroe Res. (lower basin)	Monroe	1 1/2 mi. E. of Harrodsburg	Impoundment	LARGE
Tamarack (Rome City)	Noble	2 1/2 mi. S.W. of Rome City	Natural Lake	SMALL
Bear Lake	Noble	1 1/2 mi. S.W. Wolfe Lake	Natural Lake	SMALL
Glen Flint	Putnam	1 mi. E of Clinton Falls	Impoundment	MEDIUM
Versailles	Ripley	in Versailles State Park	Impoundment	SMALL
Potato Cr. (Worster)	St. Joseph	2 mi E of North Liberty	Impoundment	MEDIUM
Little Turkey	Steuben	1 1/2 mi. W. Hudson	Natural Lake	SMALL
Pigeon	Steuben	3 mi. E. of Angola	Natural Lake	SMALL
Ball	Steuben	1 1/2 mi. N.W. Hamilton	Natural Lake	SMALL
Barton	Steuben	5 1/2 mi. N.E. of Orland	Natural Lake	SMALL
Snow	Steuben	6 mi. N. of Angola	Natural Lake	MEDIUM
Hamilton	Steuben	at Hamilton	Natural Lake	MEDIUM
Sullivan	Sullivan	at Sullivan	Impoundment	MEDIUM
Whitewater	Union	1 1/2 mi. S. of Liberty in Whitewater SP	Impoundment	SMALL
John Hay	Washington	at Salem	Impoundment	SMALL
Robinson	Whitley	4 mi. NW of Larwill	Natural Lake	SMALL
Goose	Whitley	3.5 mi. SE of Etna	Natural Lake	SMALL
Big Cedar	Whitley	8 mi. NE of Columbia City	Natural Lake	SMALL

Figure 1 Example of a waterbody shoreline divided into 500 meter stations for fish community sampling

Figure 2 Example of selected stations for fish community sampling

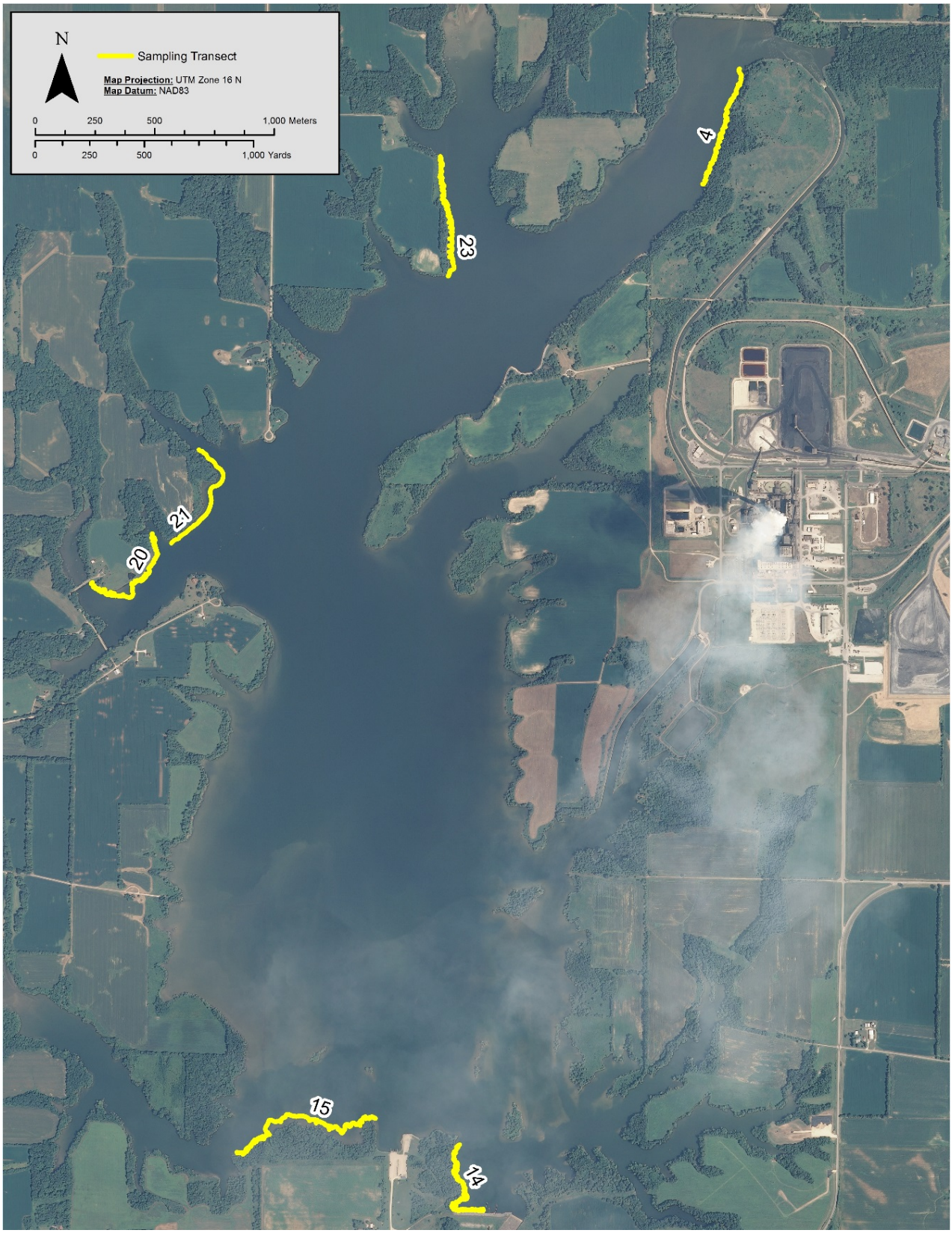

Figure 3 Example site location for macroinvertebrate and macrophyte sampling

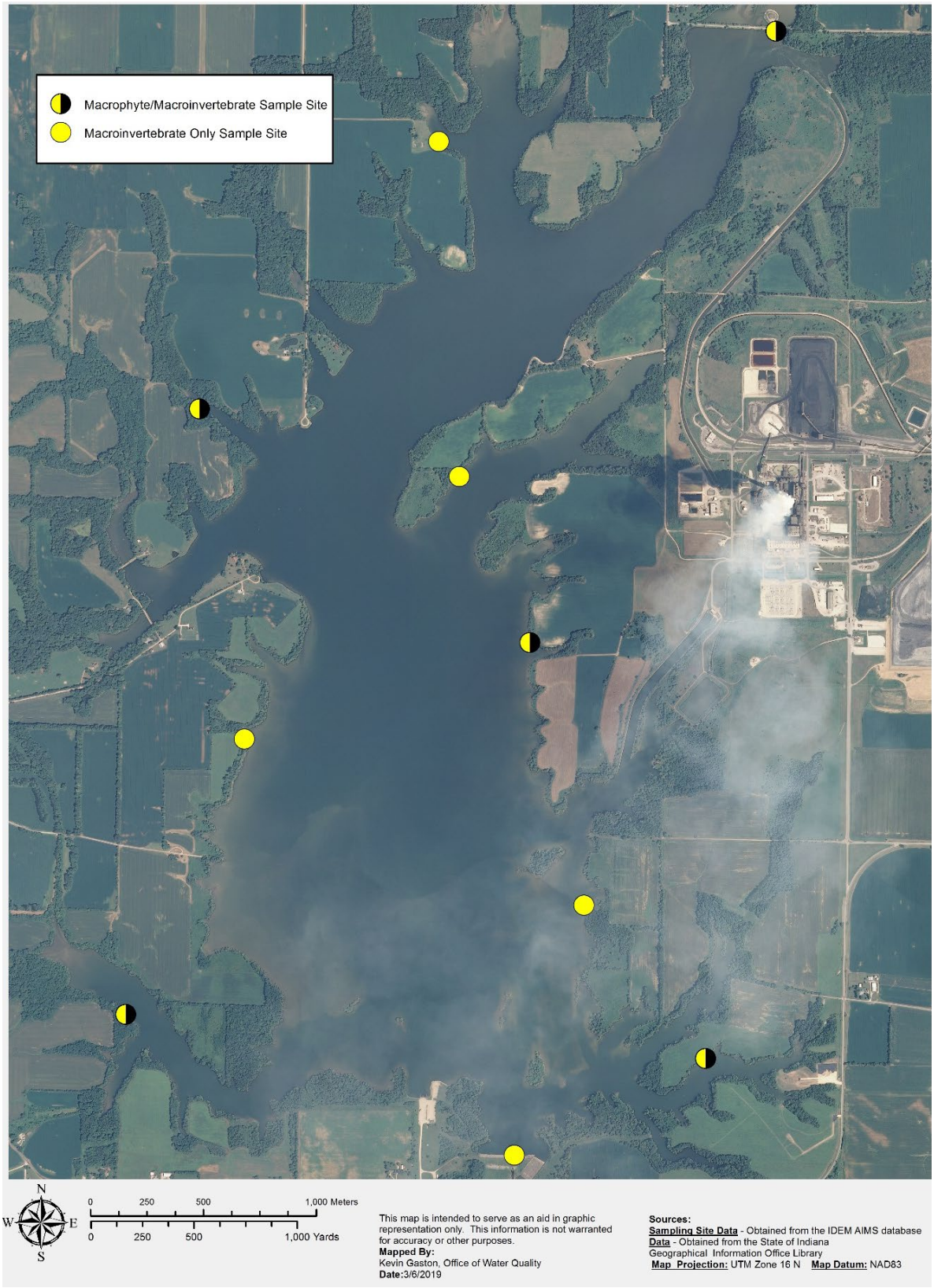

Table 3 Training and Staffing Requirements

Role	Required Training/Experience	Responsibilities	Training References
Project Manager	-Database experience -Demonstrated experience in project management and QA/QC procedures	-Establish Project in the Assessment Information Management System (AIMS) II database -Oversee development of Project Work Plan -Oversee entry and QC of field data -Querying data from AIMS II to determine results not meeting Water Quality Criteria	-AIMS II Database User Guide -U.S. EPA 2006 Quality Assurance (QA) Documents on developing Work Plans (QAPPs)
Field Crew Chief-Biological Community Sampling	-At least one year of experience in sampling methodology and taxonomy of aquatic communities in the region -Annually review the Principles and Techniques of Electrofishing -Review the National Lab Assessment Field Manual -Annually review relevant safety procedures -Annually review relevant SOP documents for field operations	-Completion of field data sheets -Taxonomic accuracy -Sampling efficiency and representation -Voucher specimen tracking -Overall operation of the field crew when remote from central office -Adherence to safety and field SOP procedures by crew members -Ensure that multi-probe analyzers are calibrated weekly prior to field sampling activities -Ensure that field sampling equipment is functioning properly and loaded into field vehicles prior to field sampling activities	-IDEM 1992a, 1992b, 1992c, 2002, 2010a, 2010b, 2015, 2018, 2018 -Simon 2001, 2004, 2005 -Simon and Dufour 2005 -U.S. EPA 2012a, 2012b -YSI 2006, 2014
Field Crew members-Biological Community Sampling	-Complete hands-on training for sampling methodology prior to participation in field sampling activities -Review the Principles and Techniques of Electrofishing -Review the National Lab Assessment Field Manual -Review relevant safety procedures -Review relevant SOP documents for field operations	-Follow all safety and SOP procedures while engaged in field sampling activities -Follow direction of Field Crew Chief while engaged in field sampling activities	-IDEM 1992a, 1992b, 1992c, 2002, 2010a, 2010b, 2015, 2018, 2018 -U.S. EPA 2012a, 2012b -YSI 2006, 2014
Laboratory Supervisor Biological	- -At least one year of experience in taxonomy of	-Identification of fish specimens collected during field sampling	-IDEM, 2010a, 2010b -AIMS II Database User Guide

Role	Required Training/Experience	Responsibilities	Training References
Community Sample Processing	aquatic communities in the region -Review the National Lab Assessment Field Manual-Annually review relevant safety procedures -Annually review relevant SOP documents for laboratory operations	-Completion of laboratory data sheets -Verify taxonomic accuracy of processed samples -Voucher specimen tracking -Adherence to safety and SOP procedures by laboratory staff -Check data for completeness -Perform all necessary calculations on the data -Ensure that data are entered into the AIMS Data Base -Ensure that required QA/QC are performed on the data -Querying data from AIMS II to determine results not meeting Water Quality Criteria	
Laboratory Staff – Biological Community Sample Processing	-Complete hands-on training for laboratory sample processing methodology prior to participation in laboratory sample processing activities -Review the National Lab Assessment Field Manual -Annually review relevant safety procedures -Annually review relevant SOP documents for laboratory operations	-Adhere to safety and SOP procedures -Follow Laboratory Supervisor direction while processing samples -Identification of fish specimens collected during field sampling -Completion of laboratory data sheets, perform necessary calculations on data, enter field sheets	-IDEM 1992a, 2010a, 2010b -AIMS II Database User Guide
Quality Assurance Officer	- -Familiarity with QA/QC practices and methodologies -Familiarity with the Surface Water QAPP and data qualification methodologies	-Ensure adherence to QA/QC requirements of Surface Water 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	-IDEM 2017 -U.S. EPA 2006 documentation on QAPP development and data qualification -AIMS II Database User Guide

Role	Required Training/Experience	Responsibilities	Training References
		based on the data quality analysis -Import data into the AIMS data base -Ensure that field sampling methodology audits are completed according to WAPB procedures	

II. DATA GENERATION AND ACQUISITION

Sampling Sites/Sampling Design

The sampling sites proposed in this project are a subset that is selected from a larger pool of sites scheduled for water chemistry and algae sampling by the CLP. Sites are selected by the CLP based on the following criteria:

- A minimum surface area of 5 acres
- A usable boat ramp

Public lakes are generally the waterbodies that are targeted in this program as they have public access. This results in a list of 401 lakes and impoundments (IU SPEA 2012). Since 2010, the list of lakes that fulfill the above criteria are randomized and sampled over the course of a 2-year cycle resulting in 160 lakes being sampled (IU SPEA 2012). Sampling in conjunction with the CLP allows for potential analysis of relationships between chemical and physical parameters, and biotic communities.

Site reconnaissance activities are conducted in-house and through physical site visits. In-house 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. All information is recorded on the IDEM Site Reconnaissance Form (Attachment 1) and entered into the AIMS II database. Final coordinates for each site are determined during the physical site visits or at the beginning of the sampling phase of this project using a Trimble Juno ™ 3D Global Positioning System (GPS), with an accuracy of one to three meters (IDEM 2015). Final coordinates are entered into the AIMS II database.

Table 1 and 2 provide a list of the possible lakes and impoundments scheduled for sampling by the CLP in 2019 and 2020, respectively. Figures 1 and 3 provide an example overview of the various sampling site locations and sampling points within each waterbody.

Sampling Methods and Sample Handling

Field Parameters Measurements

Data sonde measurements of DO, pH, water temperature, specific conductance, and DO percent saturation are taken during each sampling event, regardless of the media type collected. The field parameters, respective test methods, and sensitivity limits are identified in Table 3. Field parameter measurements are collected at the beginning and

end of each 500 meter fish community station; and at each macroinvertebrate only or macroinvertebrate/macrophyte sampling point.

Measurement procedures and operation of the data sonde shall be performed according to the manufacturers' manuals (YSI 2006, 2014). Turbidity is measured with a Hach™ turbidity kit, and the meter number written in the comments under the field parameter measurements. If a Hach™ turbidity kit is not available, record the data sonde turbidity measurement. Record all field parameter measurements and weather codes on the IDEM Stream Sampling Field Data Sheet (Attachment 2) along with other sampling observations. Take a digital photo of the site (e.g., each 500 meter fish community station, macroinvertebrate/macrophyte sampling point), during each sampling event.

Table 4 Field Parameters showing method and IDEM quantification limits

Parameters	Method (SM=Standard Method)	IDEM Quantification Limit
DO (data sonde optical)	ASTM[1] D888-09	0.05 mg/L
DO (data sonde)	SM 4500-OG	0.03 mg/L
DO (Winkler Titration)	SM 4500-OC [2]	0.20 mg/L
DO % Saturation (data sonde optical)	ASTM[1] D888-09	0.05 %
DO % Saturation (data sonde)	SM 4500-OG	0.01 %
pH (data sonde)	U.S. EPA 150.2	0.10 S.U.
pH (field pH meter)	SM 4500H-B [2]	0.10 S.U.
Specific Conductance (data sonde)	SM 2510B	1.00 µmhos/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 (data sonde)	SM 2130B	0.02 NTU [3]
Turbidity (Hach™ turbidity kit)	U.S. EPA 180.1	0.05 NTU [3]

[1] American Society for Testing and Materials (ASTM)
[2] Method used for Field Calibration Check
[3] NTU = Nephelometric Turbidity Unit(s)

Fish Community Measurements

Perform fish community sampling using boat-based electrofishing equipment. Perform fish assemblage assessments at stations consisting of 500 meters of shoreline or a maximum of 30 minutes whichever comes first. For each 500 meter station, maintain all fish counts for each segment on a separate data sheet. Fish community sampling occurs no earlier than, 30 minutes after sunset and no later than 30 minutes before

sunrise as determined by the National Oceanic and Atmospheric Administration (NOAA) Earth System Research Laboratory (ESRL) Sunrise/Sunset Calculator (https://www.esrl.noaa.gov/gmd/grad/solcalc/sunrise.html)

Make an attempt to sample all available habitat types within the station to ensure adequate representation of the fish community present at the time of the sampling event. The list of electrofishers possibly utilized include: the Smith-Root Type 6A electrofisher assembled in a 16 foot Jon boat with a spherical dropper anode or with two array dropper anodes, or the Midwest Lake Electrofishing System (MLES) Infinity Box assembled in a 16 foot jon boat with two array dropper anodes (IDEM 1992a, 1992b, 1992c, 2018).

Sample collections during high water levels or turbid conditions will be avoided due to 1) low collection rates which result in non-representative samples and 2) safety considerations for the sampling team. Sample collections during late autumn and seasonal cold temperatures will be avoided due to the lack of responsiveness to the electrical field by some species that can also result in samples not representative of the lakes fish assemblage (IDEM 2018a).

Fish are collected using dip nets with fiberglass handles and netting of 1/8-inch bag mesh. Fish collected in the sampling reach are sorted by species into baskets and buckets. Larval and young-of-the year fish less than 20 millimeters (mm) total length will not be retained in the community sample (IDEM 2018a).

Prior to processing fish specimens and completion of the fish community datasheet, one to two individuals per species may be preserved in 3.7% formaldehyde solution for future reference if there are more than 10 individuals for that species collected in the sampling reach, the specimens can be positively identified, the individuals for preservation are small enough to fit in a 2000 mL jar, and it is the first time that the species has been collected by the crew leader. If however, few individuals are captured or the specimens are too large to preserve, a photo of key characteristics is taken for later examination. Also, should a crew chief collect a species for the first time during the field season, a photo is taken for later verification. Taxonomic characteristics for possible species encountered in the basin of interest are reviewed prior to field work. Fish specimens should also be preserved if individuals cannot be positively identified in the field (especially those that co-occur like the Striped and Common Shiners); appear to be hybrids; have unusual anomalies; are dead specimens that are taxonomically valuable for undescribed taxa (like the Red Shiner or Jade Darter); life history studies; or research projects.

Data for nonpreserved fish is recorded on the Fish Collection Data Sheet (Attachment 4) consisting of the following: number of individuals, minimum and maximum total length (mm), mass weight (g), and number of individuals with deformities, eroded fins, lesions, tumors, and other anomalies (DELTs). Once the data are recorded, specimens are released within the sampling reach, if possible. The OWQ Chain of Custody Form (Attachment 3) is completed for preserved fish specimens. Data is recorded for preserved fish specimens following taxonomic identification in the laboratory.

Macroinvertebrate Community Measurements

Macroinvertebrate community sampling occurs at ten evenly spaced points along the shoreline (Figure 3). At each sampling point, a 10m x 15m plot is established. Within each plot, the most dominant substrate such as rocky; cobble; large woody debris; macrophyte beds; fines – including mud, sand, or silt; and leaf pack will be recorded on the NLA 2012 Littoral Sample Collection Form (Attachment 5), The plot is sampled following methods presented in the 2012 NLA Field Operations Manual (U.S. EPA 2012a).

Once the dominate substrate type has been identified, a D-frame net with 500 µm mesh is used to sample the dominate substrate. Sampling consists of a sweep through one linear meter of the dominant substrate at a single location within the designated plot, ensuring disturbance of the substrate to dislodge organisms. If the substrate is rocky, cobble, or large woody debris, the sample collector may need to exit the boat and using feet to disturb the substrate. After the sample is collected, all organisms and debris is removed from the D-frame net and placed into a bucket (U.S. EPA 2012a).

After all ten sampling points have been collected, the contents of all the buckets are combined to create a composite sample for the waterbody. The composite sample is then be elutriated into a sieve with 500 µm mesh using clean lake water. Remove any large objects, and the remaining contents washed into a large jar. Completely fill the jar with 95% ethanol in order to properly preserve the organisms (U.S. EPA 2012a). Place a waterproof label containing site information (i.e., site ID, collector's initials, waterbody name, date collected, number of stations sampled, etc.) into the jar prior to replacing the cap. Once collected process each sample in a laboratory setting.

Samples from each waterbody will be subsampled in-house following procedures presented in the 2012 NLA Laboratory Operations Manual (U.S. EPA 2012b). Subsampling will consist of placing the sample on a gridded tray and processing at least 10% of the grids or until 500 organisms have been collected (U.S. EPA 2012b). Organisms collected will then be identified to lowest possible taxonomic level.

Macrophyte Community Measurements

Macrophyte community sampling will occur at five evenly distributed transects perpendicular from the shoreline and ending halfway across the waterbody. A minimum of six points within each transect stratified by water depth (e.g., 0.5m, 1m, 2m, etc.) will be sampled moving away from the shoreline at one meter intervals. Sampling continues for each transect until one of the following conditions occur:

1) Field crew have sampled halfway across the waterbody
2) The depth of the waterbody reaches levels where aquatic vegetation cannot grow
3) Nine minutes have passed at no-wake speeds with no additional samples taken due to a consistent water depth. This can occur in large lakes with large shallow areas near the shoreline. Travelling for nine minutes at a no-wake speed will result in approximately 1000 meters being sampled.

If a minimum of six points have not been sampled and conditions 1 or 2 are met, samplers must turn the boat around 180 degrees and distribute the remaining number of points evenly while heading back towards the shoreline (U.S. EPA 2012a).

During sampling at each point, a "rake-on-a-rope" sampler will be lowered down to the sediment surface. One linear meter will be sampled by dragging the sampler with short tugs on the rope. Once completed, the sampler will be raised to the surface in one continuous motion until back onto the boat. At each sampling point within a transect, depth, density of plants on the rake, density of filamentous algae on the rake, and plant growth forms will be recorded on the "NLA 2012 Macrophyte Assemblage Characterization Form" (Attachment 6, U.S. EPA 2012a). Any invasive plants collected during sampling with be noted on the "NLA 2012 Invasive Plants and Invertebrates Checklist" (Attachment 7, U.S. EPA 2012a)

Habitat Assessments

Habitat assessments will be completed immediately following fish community sample collections for each 500 meter station using the Ohio EPA Lake/Lacustuary (Lentic) QHEI (Ohio EPA 2010, Attachment 8).

Quality Control and Custody Requirements

Quality assurance protocols will follow part B5 of the Surface Water QAPP (IDEM 2017).

Fish Community Data

The IDEM OWQ Chain of Custody Form is used to track samples from the field to the laboratory (Attachment 3). Fish taxonomic identifications made by IDEM staff in the laboratory may be verified by regionally recognized non-IDEM freshwater fish taxonomists (e.g., Brant Fisher, Nongame Aquatic Biologist, Indiana Department of Natural Resources). All raw data are: 1) checked for completeness; 2) utilized to calculate derived data (i.e., total weight of all specimens of a taxon), which is entered into the AIMS II database; and 3) checked again for data entry errors.

Field Instrument Testing and Calibrations

The data sonde will be calibrated immediately prior to each week's sampling (IDEM 2002). Calibration results and drift values are recorded and stored in log books 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 (Hydrolab Corporation 2002; YSI 2006, 2014). The DO component of the calibration procedure is conducted using the air calibration method (IDEM 2002). The unit is field checked for accuracy once during the week by comparison with a Winkler DO test, as well as Hach™ turbidity, pH, and temperature meters. Weekly calibration verification results will be recorded on the stream sampling field data sheets (Attachment 2) and entered into the AIMS II database. A Winkler DO test will also be conducted at sites where the DO concentration is 4.0 mg/L or less.

Field Measurement Data

In-situ water chemistry field data is collected at a depth of 0.5 meters (i.e., surface of the water) in the field using calibrated or standardized equipment. During collection, the depth at which the field data is collected is noted on the field data sheet (Attachment 2). Calculations may be done in the field or later at the office. Analytical results, which have limited QC checks, are included in this category. Detection limits have been set for each

analysis (Table 3). QC checks (such as duplicate measurements, measurements of a secondary standard, or measurements using a different test method or instrument) which are performed on field or laboratory data are usable for estimating precision, accuracy, and completeness for the project.

III. ASSESSMENT AND OVERSIGHT

Field and laboratory performance and system audits will be conducted to ensure good quality data. The field and laboratory performance checks include precision measurements by relative percent difference (RPD) of field and laboratory duplicate (IDEM 2017, pp. 56, 61–63), accuracy measurements by percent of recovery of MS/MSD samples analyzed in the laboratory (IDEM 2017, pp. 58, 61–63), and completeness measurements by the percent of planned samples that are actually collected, analyzed, reported, and usable for the project (IDEM 2017, p. 58).

Field audits will be conducted biannually by staff of the IDEM WAPB to ensure that sampling activities adhere to approved SOPs. Audits are systematically conducted by WAPB QA staff to include all WAPB personnel that engage in field sampling activities. WAPB field staff involved with sample collection and preparation will be evaluated by QA staff trained in the associated sampling SOPs, and in the processes related to conducting an audit. QA staff will produce an evaluation report documenting each audit for review by those field staff audited, as well as WAPB management. Corrective actions will be communicated to, and implemented by, field staff as a result of the audit process (IDEM 2017a, p. 176–177).

Data Quality Assessment Levels

The samples and various types of data collected by this program are intended to meet the quality assurance criteria and DQA Levels as described in the Surface Water QAPP (IDEM 2017, pp 182-183).

IV. DATA VALIDATION AND USABILITY

QA reports to management and data validation and usability are also important components of the QAPP which ensures good quality data for this project. A QA audit report will be submitted to the QA Manager and Project Manager for review for this project should problems arise and need to be investigated and corrected. 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 to ensure it meets the project data quality objectives.

Quality Assurance/Data Qualifiers and Flags

The various data qualifiers and flags that will be used for quality assurance and validation of the data are found on page 184 of the Surface Water QAPP (IDEM 2017).

Data Usability

The environmental data collected and its usability are qualified and classified into one or more of the four categories: Acceptable Data, Enforcement Capable Results, Estimated Data, and Rejected Data as described on page 130 of the Surface Water QAPP (IDEM 2017).

Information, Data, and Reports

Data collected will be recorded in the AIMSII database. All data and reports will be made available to public and private entities which may find the data useful for municipal, industrial, agricultural, and recreational decision making processes (i.e. 303(b) & (d) assessments, TMDL development, NPDES permit modeling, watershed restoration projects, water quality criteria refinement, etc.).

Laboratory and Estimated Cost

All fish, macroinvertebrate, and macrophyte samples will be collected and analyzed by IDEM staff.

Table 5 Personal Safety and Reference Manuals

Role	Required Training/Experience	Training References	Training Notes
All Staff that Participate 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 -February 29, 2000 WAPB internal memorandum regarding use of approved PFDs	-Staff lacking 4 hours of in-service training or appropriate certification will be accompanied in the field at all times by WAPB staff that meet health and safety training requirements -When working on boundary waters (defined by Indiana Code IC 14-8-2-27) or between sunset and sunrise on any waters of the state, all personnel in watercraft must wear a high intensity whistle and Safety of Life at Sea certified strobe light.

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

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Attachment 1 IDEM Site Reconnaissance Form

IDEM

Site Reconnaissance Form

EPA Site Identifier	Rank
Recon #: Trip #:	

Site Number: Stream: County:

Location Description:

Reconnaissance Data Collected

Recon Date | Crew Members

Avg. Width (m) | Avg. Depth (m) | Max. Depth (m) | Nearest Town

Water Present? ☐ | Site Wadeable? ☐ | Riffle/Run Present? ☐ | Road/Public Access Possible? ☐

Site Impacted by Livestock? ☐ | Collect Sediment? ☐ | Gauge Present? ☐

Landowner/Contact Information

First Name | Last Name

Street Address

City | State | Zip

Telephone | E-Mail Address

Pamphlet Distributed? ☐ | Please Call in Advance? ☐ | Results Requested? ☐

Rating, Results, Comments, and Planning

Site Rating By Category (1=easy, 10=difficult)
Access Route
Safety Factor
Sampling Effort

Reconnaissance Decision

Pre-Recon
Recon in process
Approved Site
No, Landowner denied access
No, Dry
No, Stream channel missing
No, Physical barriers
No, Impounded stream
No, Marsh/Wetland
No, Bridge gone or not accessible
No, Unsafe due to traffic or location
No, Site impacted by backwater
No, Other

Equipment Selected

Circle Equipment Needed

Backpack
Boat
Towbarge
Longline
Scanoe
Seine
Weighted Handline
Waders
Gill Net

Comments

Sketch of Stream & Access Route – Indicate Flow, Direction, Obstacles, & Land Use (Use Back of Page, if Necessary)

Attachment 2 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 ☐ All-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
Nu	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	Chromium VI(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 3 IDEM OWQ Chain of Custody Form

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

Attachment 4 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 4 (cont.) 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 5 NLA 2012 Littoral Sample Collection Form

NLA 2012 LITTORAL SAMPLE COLLECTION Reviewed by (initial): _____

Site ID: _____ Date: ___ / ___ / _____

BENTHIC MACROINVERTEBRATES (BENT) No SampleCollected ○

Sample ID	Number of jars	Preserved (ETOH)	Comments
		○	

STATIONS

SUBSTRATE CODES: R - Rocky/Cobble/Woody debris; M - Macrophyte beds; F - Fines (sand, mud, organic); L - Leaf Pack; O - Other (Flag and explain in comments)
COLLECTION CODES: B - Boat; W - Wading

A	B	C	D	E		G	H	I	J		
Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O	Sub ○R ○M ○ ○L ○O
Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W	Coll ○B ○W
Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag	Flag

Flag	Comments

CHLOROPHYLL-a (CHLL)
(Target Volume = 1000mL; max vol = 2000 mL) No SampleCollected ○

Sample ID	Volume filtered (ml)	Comments

PHYTOPLANKTON (PHYL)
(Target Volume = 1000mL) No SampleCollected ○

Sample ID	Lugols	Comments
	○	

ALGAL TOXIN (Microcystin) (MICL)
(Target Volume = 500mL) No SampleCollected ○

Sample ID	Comments

Use comment section to explain: Suspect measurement, observations or no measurements taken.

04/16/2012 NLA Littoral Sample Collection 4553059090

Attachment 6 NLA 2012 Macrophyte Assemblage Characterization (front)

Reviewed by (initial): ______

NLA 2012 MACROPHYTE ASSEMBLAGE CHARACTERIZATION (Front)

Site ID: ____________________ **Date:** ___ / ___ / ______

Phab Plot	Point	Depth	Plant Rake Density	Fil. Algae Density	Macrophyte Growth Form E	FL	FF	SB	SC	SF	SW	Fill if MDC reached	Comments
	1		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	2		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	3		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	4		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	5		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	6		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	7		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	8		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	9		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	10		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	11		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	12		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	1		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	2		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	3		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	4		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	5		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	6		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	7		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	8		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	9		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	10		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	11		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	12		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	1		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	2		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	3		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	4		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	5		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	6		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	7		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	8		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	9		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	10		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	11		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	12		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	

04/16/2012 NLA Macrophyte Assemblage Characterization

2132293877

Attachment 6 (cont.) NLA 2012 Macrophyte Assemblage Characterization (back)

Reviewed by (initial): ____

NLA 2012 MACROPHYTE ASSEMBLAGE CHARACTERIZATION (Back)

Site ID: _____ Date: ____ / ____ / ____

Phab Plot	Point	Depth	Plant Rake Density	Fil. Algae Density	Macrophyte Growth Form E	FL	FF	SB	SC	SF	SW	Fill if MDC reached	Comments
	1		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	2		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	3		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	4		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	5		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	6		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	7		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	8		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	9		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	10		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	11		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	12		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	1		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	2		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	3		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	4		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	5		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	6		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	7		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	8		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	9		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	10		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	11		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	
	12		0 1 2 3	0 1 2 3	O	O	O	O	O	O	O	O	

Deepest Partof Lake: _____ (m)

Plants observed O Y O N
If Yes, stop, lake is 100% littoral

	Depth at which plants observed	Direction:
MDC 1		
MDC 2		
MDC 3		
MDC 4		
MDC 5		

04/16/2012 NLA Macrophyte Assemblage Characterization

8704293878

Attachment 7 NLA 2012 Invasive Plants and Invertebrates Checklist (front)

NLA 2012 INVASIVE PLANTS AND INVERTEBRATES (Front) Reviewed by (initial): _____

Site ID: _____ Date: ____ / ____ / _____

STATIONS	A		B		C		D		E		F	
SPECIES	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG
NONE OBSERVED	O		O		O		O		O		O	
Curlyleaf pondweed	O		O		O		O		O		O	
Common reed	O		O		O		O		O		O	
Eurasian watermilfoil	O		O		O		O		O		O	
Purple loosestrife	O		O		O		O		O		O	
Russian-olive	O		O		O		O		O		O	
Reed canarygrass	O		O		O		O		O		O	
Canada thistle	O		O		O		O		O		O	
Multiflora rose	O		O		O		O		O		O	
Narrowleaf cattail	O		O		O		O		O		O	
Brazilian waterweed	O		O		O		O		O		O	
Brittleleaf naiad	O		O		O		O		O		O	
Parrot feather milfoil	O		O		O		O		O		O	
Mimosa	O		O		O		O		O		O	
Hydrilla	O		O		O		O		O		O	
Water starwort	O		O		O		O		O		O	
Water hyacinth	O		O		O		O		O		O	
Yellow floatingheart	O		O		O		O		O		O	
European pepperwort	O		O		O		O		O		O	
Alligatorweed	O		O		O		O		O		O	
European waterstarwort	O		O		O		O		O		O	
Giant salvinia	O		O		O		O		O		O	
Water fern	O		O		O		O		O		O	
Water-chestnut (European)	O		O		O		O		O		O	
Tamarisk	O		O		O		O		O		O	
Deeprooted sedge	O		O		O		O		O		O	
Japanese or giant knotweed	O		O		O		O		O		O	
Miramar weed	O		O		O		O		O		O	
Brazilian peppertree	O		O		O		O		O		O	
Zebra or quagga mussel	O		O		O		O		O		O	
Asian clam	O		O		O		O		O		O	
Rusty crayfish	O		O		O		O		O		O	
OTHER (Note in comments)	O		O		O		O		O		O	

Flag	Comments

Flag codes: U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comments section.

04/16/2012 NLA Invasive Plants and Invertebrates 8998518154

Attachment 7 (cont.) NLA 2012 Invasive Plants and Invertebrates Checklist (back)

NLA 2012 INVASIVE PLANTS AND INVERTEBRATES (Back) Reviewed by (initial): _____

Site ID: _____ Date: ___ / ___ / _____

STATIONS	G		H		I		J					
SPECIES	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG	Mark if observed	FLAG
NONE OBSERVED	O		O		O		O		O		O	
Curlyleaf pondweed	O		O		O		O		O		O	
Common reed	O		O		O		O		O		O	
Eurasian watermilfoil	O		O		O		O		O		O	
Purple loosestrife	O		O		O		O		O		O	
Russian-olive	O		O		O		O		O		O	
Reed canarygrass	O		O		O		O		O		O	
Canada thistle	O		O		O		O		O		O	
Multiflora rose	O		O		O		O		O		O	
Narrowleaf cattail	O		O		O		O		O		O	
Brazilian waterweed	O		O		O		O		O		O	
Brittleleaf naiad	O		O		O		O		O		O	
Parrot feather milfoil	O		O		O		O		O		O	
Mimosa	O		O		O		O		O		O	
Hydrilla	O		O		O		O		O		O	
Water starwort	O		O		O		O		O		O	
Water hyacinth	O		O		O		O		O		O	
Yellow floatingheart	O		O		O		O		O		O	
European pepperwort	O		O		O		O		O		O	
Alligatorweed	O		O		O		O		O		O	
European waterstarwort	O		O		O		O		O		O	
Giant salvinia	O		O		O		O		O		O	
Water fern	O		O		O		O		O		O	
Water-chestnut (European)	O		O		O		O		O		O	
Tamarisk	O		O		O		O		O		O	
Deeprooted sedge	O		O		O		O		O		O	
Japanese or giant knotweed	O		O		O		O		O		O	
Miramar weed	O		O		O		O		O		O	
Brazilian peppertree	O		O		O		O		O		O	
Zebra or quagga mussel	O		O		O		O		O		O	
Asian clam	O		O		O		O		O		O	
Rusty crayfish	O		O		O		O		O		O	
OTHER (Note in comments)	O		O		O		O		O		O	

Flag	Comments

Flag codes: U = Suspect measurement or observation; F1, F2, etc. = misc. flags assigned by field crew. Explain all flags in comments section.

04/16/2012 NLA Invasive Plants and Invertebrates 8578518158

Attachment 8 Ohio EPA Lake/Lacustuary (Lentic) QHEI Field Sheet (front)

Lake / Lacustuary (Lentic) QHEI Field Sheet

Ohio Environmental Protection Agency QHEI Score: ☐

RIVERCODE_____ RIVERMILE _____WATERBODY _____ DISTANCE ASSESSED (m): _____
DATE _____LOCATION _____
SCORER_____ LAT. _____ LONG. _____ COMMENT _____

1] SUBSTRATE (Check *ONLY* Two Substrate TYPE BOXES; Estimate % or note every type present); LAKE:_____LACUSTUARY:_____

TYPE	SHORE	BOTTOM		SHORE	BOTTOM
☐☐-BLDR/SLABS [7]			☐☐-HARDPAN [4]		
☐☐- BOULDER [10]			☐☐- BEDROCK [3]		
☐☐- COBBLE [8]			☐☐- DETRITUS [3]		
☐☐- GRAVEL [7]			☐☐- SILT [2]		
☐☐- SAND [6]			☐☐- MUCK [2]		

NOTE: Ignore sludge that originates from point-sources; score on natural substrates
NUMBER OF SUBSTRATE TYPES: ☐- 5 or More [2] ☐- 4 or Less [0]

SUBSTRATE ORIGIN Check ONE (or 2 & *AVERAGE*)
☐-LIMESTONE [1] ☐-TILLS [1] ☐-WETLANDS [1] ☐-LACUSTUARINE [1] ☐-SANDSTONE [1] ☐-RIP/RAP [1] ☐-HARDPAN [0] ☐-SHALE [-1] ☐-COAL/ORE [-2]

SILT ORIGIN:

SUBSTRATE QUALITY Check ONE (or 2 & *AVERAGE*)
SILT: ☐-SILT HEAVY [-2] ☐-SILT MODERATE [-1] ☐-SILT NORMAL [0] ☐-SILT FREE [1]
SILT ORIGIN: ☐-CLAY [-2] ☐-INDUSTRIAL [-1] ☐-ORGANIC [1] ☐-NONE [1]

Substrate ☐ Max 20

COMMENTS: _____

2] COVER TYPES **TYPE:** (Check All That Apply)

☐-OFF-SHORE SAND BARS [4]	☐-DEEPWATER > 1 M [1]	☐-WETLAND POOLS [1]
☐-OVERHANGING VEGETATION [1]	☐-ROOTWADS [1]	☐-SUBMERGED AQUATIC VEG. [4]
☐-SHALLOWS (ON BEACH) [1]	☐-BOULDERS [1]	☐-LOGS OR WOODY DEBRIS [1]
☐-ROOTMATS [1]	☐-SAND BEACH [1]	☐-GRAVEL BEACH [1]

AMOUNT (Check *ONLY* One or check2 and AVERAGE)
☐-EXTENSIVE > 75% [9] ☐-MODERATE 25-75% [7] ☐-SPARSE 5-25% [3] ☐-NEARLY ABSENT < 5% [1]

Cover ☐ Max 20

COMMENTS: _____

3] SHORELINE MORPHOLOGY (Check *ONLY* one PER category or check 2 and *AVERAGE*)

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

DEVELOPMENT
☐-EXCELLENT [6] ☐-GOOD [5] ☐-FAIR [3] ☐-POOR [1]

MODIFICATION
☐-NONE [7] ☐-RECOVERED [5] ☐-RECOVERING [3] ☐-RECENT OR NO RECOVERY [1]

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

SHORE to BOTTOM SLOPE MORPHOLOGIES
☐-SLOPE < 15 deg. [0] ☐-SLOPE > 45 deg. [2] ☐-SLOPE < 25 deg. [1] ☐-SLOPE 90 deg. [0] ☐-SLOPE > 25 deg. [3]

AVERAGE DEPTH (of 5 measures)
☐- < 50 cm [0] ☐- > 400 – 500 cm [4] ☐- 50 - <100 cm [1] ☐- > 500 - 900 cm [2] ☐- ≥100 - 200 cm [2] ☐- >900 cm [1] ☐- >200 -4 00 cm [3]

MODIFICATIONS OF SAMPLED SHORELINE
☐- CEMENTED [-1] ☐- STEEL BULKHEADS [-2] ☐-RIP RAPPED [1] ☐-ISLANDS [1] ☐-RAILROAD TIES [-1] ☐-DIKES [-1] ☐-DREDGED [-1] ☐-BANK SHAPING [-1] ☐-TWO SIDE CHANNEL MODIFICATIONS [-1] ☐-WOOD PILINGS [1] ☐-SHIP CHANNEL [-2]

Shore Line ☐ Max 20

COMMENTS: _____

★ Shore Right Looking East or South on Lake ★
★ Shore Right Looking Toward Lake in Lacustuary ★

4] RIPARIAN ZONE AND BANK EROSION (Check *ONE* box PER bank or 2 and *AVERAGE*)

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

SHORE LINE QUALITY (PAST 100 FOOT RIPARIAN) L R (Most Predominant Per Bank)
☐☐-FOREST, WETLAND, LAKE [3] ☐☐- SHRUB OR OLD FIELD [2] ☐☐-VINEYARD, ORCHARD [2] ☐☐-FENCED PASTURE [1] ☐☐-RESIDENTIAL, PARK, NEW FIELD [1]
☐☐-CONSERVATION TILLIAGE [1] ☐☐-URBAN OR INDUSTRIAL [0] ☐☐-OPEN PASUTRE, ROWCROP [0] ☐☐-MINING/CONSTRUCTION [0] ☐☐- DIKED WETLAND [0]

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

Riparian ☐ Max 10

COMMENTS: _____

5] AQUATIC VEGETATION QUALITY: PLANT SPECIES OBSERVED (Sum All Scores)
(Score all for observed abundance: ABUNDANT = [3]; COMMON = [5]; FEW = [1]; UNCOMMON = [0]) _____NO AQUATIC VEGETATION = 0

____-Pond Lilies (NYMPHAEA) ____-Sedge (CYPERACEAE) ____-Wild Celery (VALLISNERIA)
____-Pond Weed (POTAMOGETON) ____-Bulrush (SCIRPUS) ____-Waterweed (ELODEA) ____-Wild Rice (ZIZANIA)

(Score all for observed abundance: ABUNDANT = [-2]; COMMON = [-1]; FEW = [0])

____-Purple Loosestrife ____-Reed Grass ____-Eurasian Milfoil ____-Cattails ____-Algae (mats) ____-Algae (planktonic)

Vegetation ☐ Max 30

COMMENTS: _____

June 2010

Attachment 8 (cont.) Ohio EPA Lake/Lacustuary (Lentic) QHEI Field Sheet (back)

Is the Sampling Reach Representative of Area Habitat? (Y/N)____ If Not, Explain: _____

Depth measures: | | | | | |

Zebra Mussel/Quagga Mussel Coverage ☐-->60% ☐-60-->25% ☐-25-->10% ☐-<10-->1% ☐-1-0%

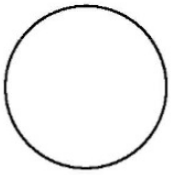
	Gear	Distance	Water Clarity	Wave Height
First Sampling Pass:	_____	_____	_____	_____
Second Sampling Pass:	_____	_____	_____	_____
Third Sampling Pass:	_____	_____	_____	_____

☐ Subjective Rating (1-10) ☐ Aesthetic Rating (1-10)

Photos: _____

WATERBODY MEASUREMENTS: AVERAGE WIDTH: _____ AVERAGE DEPTH: _____ Maximum Depth: _____

DRAWING OF SITE:

North Arrow: 

June 2010