2019
PROBABILISTIC MONITORING WP FOR THE TRIBUTARIES TO THE OHIO RIVER BASIN

PREPARED BY

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SIGNATURE PAGE

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Indiana Department of Environmental Management
Office of Water Quality
Watershed Assessment and Planning Branch
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WORK PLAN ORGANIZATION

This sampling and analysis work plan is an extension of the existing Indiana Department of Environmental Management (IDEM) Watershed Assessment and Planning Branch (WAPB), March 2017 “Quality Assurance Project Plan (QAPP) for Indiana Surface Water Programs” (Surface Water QAPP) (IDEM 2017a) 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) guidance for QAPPs (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 sections as QAPP elements.

Section I. Project Management

- Project Objective
- Project or Task Organization and Schedule
- Background and Project or 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
- Field Instrument Testing and Calibration

Section III. Assessment and Oversight

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

Section IV. Data Validation and Usability

- Data Handling and Associated QA/QC activities
- QA/QC Review Reports
- Laboratory and Estimated Cost

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF APPENDICES

LIST OF ACRONYMS

AIMS	Assessment Information Management System
ALUS	Aquatic Life Use Support
ASTM	American Society for Testing and Materials
AU	Assessment Unit
CAC	Chronic Aquatic Criterion
CALM	Consolidated Assessment Listing Methodology
CFU	Colony Forming Unit
DQA	Data Quality Assessment
DQO	Data Quality Objective
E. coli	*Escherichia coli*
GPS	Global Positioning System
HUC	Hydrologic Unit Code
IAC	Indiana Administrative Code
IBI	Index of Biotic Integrity
MHAB	Multihabitat
NHD	National Hydrography Database
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
QHEI	Qualitative Habitat Evaluation Index
SM	Standard Method
SOP	Standard Operating Procedure
SU	Standard Units
TMDL	Total Maximum Daily Load
U.S. EPA	United States Environmental Protection Agency
USGS	Unites States Geological Survey

DEFINITIONS

Backwater	A part of the river not reached by the current, where the water is stagnant.
Elutriate	To purify, separate, or remove lighter or finer particles by washing, decanting, and settling.
Fifteen (15) minute pick	A component of the IDEM multihabitat macroinvertebrate sampling method, used to maximize taxonomic diversity while in the field, in which the one minute kick sample and fifty meter sweep sample collected at a site are first combined and elutriated. Macroinvertebrates are then manually removed from the resulting sample for 15 minutes.
Fifty (50) meter sweep	A component of the IDEM multihabitat macroinvertebrate sampling method in which approximately 50 meters (50 m) of shoreline habitat in a stream or river is sampled with a standard 500 micrometer (500 µm) mesh width D-frame dipnet by taking 20–25 individual “jab” or “sweep” samples, which are then composited.
Impoundment	A body of water confined within an enclosure, such as a reservoir.
Lotic	A waterbody, such as a stream or river, in which the water is flowing.
Macroinvertebrate	Aquatic animals which lack a backbone, are visible without a microscope, and spend some period of their lives in or around water.
Marsh	An area of low-lying land that is flooded in wet seasons and typically remains waterlogged at all times.
One (1) minute kick sample	A component of the IDEM multihabitat macroinvertebrate sampling method in which approximately one square meter (1 m^2) of riffle or run substrate habitat in a stream or river is sampled with a standard 500 micrometer (500 µm) mesh width D-frame dipnet for approximately one (1) minute.
Ocular reticle	A thin piece of glass marked with a linear or areal scale that is inserted into a microscope ocular, superimposing the scale onto the image viewed through the microscope.

Perennial Stream	A stream that has continuous flow in the stream bed all year during years of normal rainfall. Water must be present in at least 50% of the stream reach during the time of fish community sampling.
Periphyton	Algae attached to an aquatic substrate.
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 and a maximum length 500 meters. For macroinvertebrate community sampling, the stream reach is 50 meters of all available habitat.
Seston	Organisms and nonliving matter swimming or floating in a water body.
Target	A sampling point which falls on a perennial stream within the basin of interest and the boundaries of Indiana.
Wetland	Land areas that are wet for at least part of the year, are poorly drained and are characterized by hydrophytic vegetation, hydric soils and wetland hydrology.

I. PROJECT MANAGEMENT

Project Objective

The main objective of the probabilistic monitoring project is to provide a comprehensive, unbiased assessment of the ability of rivers and streams in the tributaries to the Ohio River Basin to support aquatic life and recreational uses. A secondary objective of this project is diatom identification and enumeration, with the goal of developing algal metrics as an assessment tool to support nutrient criteria. Sampling for this project will begin in April and continue through October 2019 with collected samples analyzed for chemical, physical, and biological parameters. Laboratory processing and data analysis for the project will continue through spring of 2020. Data collected during probabilistic monitoring will be used for the following purposes:

- To provide water quality and biological data for assessment of aquatic life and recreational uses as integral components of the IDEM's biennial Integrated Water Monitoring and Assessment Report (Integrated Report); thus satisfying Clean Water Act (CWA) sections 305(b) and 303(d) reporting requirements to the U.S. EPA (33 U.S.C. §1251 et seq. 1972).
- To give a statistically valid estimation of the percent of stream miles supporting or nonsupporting for aquatic life and recreational uses in the basin of interest.
- To provide water quality and biological data which may be useful for municipal, industrial, agricultural, and recreational decision making processes. These include the Total Maximum Daily Load (TMDL) process and National Pollutant Discharge Elimination System (NPDES) permit modeling of waste load allocations.
- To compile water quality and biological data for trend analyses and future pollution abatement activities.
- To aid in the development of nutrient criteria as well as refined chemical and narrative biological water quality criteria.

Project or Task Organization and Schedule

Table 1. 2019 Probabilistic Monitoring Tasks, Schedule, and Evaluation

Activity	Date(s)	Number of Sites	Frequency of Sampling Related Activity	Parameter to be Sampled	How Evaluated
Site Selection	Mar 2016	100 per basin of interest			Randomly ordered list generated by the National Health Environmental Effects Research Laboratory (NHEERL), Western Ecology Division, Corvallis, OR. Sites are stratified in statistically equal numbers of 1st, 2nd, 3rd, and 4th + stream order sites
Site Reconnaissance	Jan 7 – Mar 15 2019	All 100 sites	At least one visit but may require several to obtain final approval		Land owner approval, stream access, and safety characteristics for the first 75 "Target" sites; "Nontarget" designations for remaining 25 sites.
Bacteriological Sampling	Apr 8 – Jun 12 2019	First 40 target sites	Five times at equally-spaced intervals over a 30 calendar-day period	*Escherichia coli (E. coli)*	Geometric mean (action level is ≥125 Colony Forming Units (CFU)/100mL or ≥125 Most Probable Number (MPN)/100 mL); sampled during recreational season (April – October)
Biological Sampling	Jun – mid Nov 2019	First 38 target sites	Fish Community (Jun 3 – Oct 18) Macroinvertebrate Community (Jul 15 – Nov 15) QHEI, once per sample	Fish Community; Macroinvertebrate Community; Habitat Quality	Fish Index of Biotic Integrity (IBI) Macroinvertebrate IBI QHEI evaluated separately for fish and macroinvertebrate communities

Table 1. 2019 Probabilistic Monitoring Tasks, Schedule, and Evaluation (cont.)

Activity	Date(s)	Number of Sites	Frequency of Sampling Related Activity	Parameter to be Sampled	How Evaluated
Water Chemistry	April – Sept or Oct 2019	First 45 target sites	Once each in April, July, and Sept or Oct with a minimum 30 days between sampling events	Total Phosphorous Nitrogen, Nitrate + Nitrite Dissolved Oxygen pH Algal conditions Dissolved Metals (See Table 9) Dissolved Arsenic (III) Nitrogen Ammonia Chloride Free Cyanide* Sulfate Total Dissolved Solids	>0.3 mg/L (for nutrients) >10.0 mg/L (for nutrients) <4.0 mg/L (warm water aquatic life); <6.0 mg/L (cold water aquatic life); >12 mg/L (nutrients) >9.0 Standard Units (SU) (for nutrients); <6 or >9 SU (warm water aquatic life) Excessive (for nutrients, based on observation) Chronic Aquatic Criterion (CAC) based on hardness 190 µg/L CAC based on pH and temperature CAC based on hardness and sulfate CAC 5.2 µg/L Based on hardness and chloride 750 mg/L
	Jun – Sept 2019	Subset of 14 target sites	Once each in Jun, July, and Aug with a minimum of 30 days between sampling events	Orthophosphate	There are no criteria for this parameter in the Indiana Administrative Code (IAC). The Indiana Great Lakes Water Quality Agreement (GLWQA) Domestic Action Plan (DAP) for the Western Lake Erie Basin (WLEB) provides a springtime flow weighted mean concentration (FWMC) target of 0.05 mg/L for the Maumee River in Indiana.
Algal Samples	Sept – Oct 2019	First 45 target sites	Once with the 3rd water chemistry sample in Sept or Oct	Algal Diatoms Algal Biomass	Diatom identification and enumeration Chlorophyll *a* and Pheophytin *a*
Dissolved Oxygen Continuous Monitoring	Aug – Sept 2019	Subset of 14 target sites	Once in Aug with two week deployment at 14 sites	Dissolved Oxygen Temperature	Minimum, maximum, and average change in dissolved oxygen for the two week period Minimum, maximum, and average change in temperature for the two week period

*Analyzed only where the total value exceeds the free Cn criterion of 5.2 ug/L.

Background and Project or Task Description

The Probabilistic Monitoring Program, created in 1996, is operated through the WAPB of IDEM. Other organizations which help with data preparation, collection, and analysis include private laboratories under contract with the State of Indiana (e.g., Pace Analytical, see Appendix 1 for Pace Laboratory Inc. accreditation documents), the Department of Biological and Environmental Sciences at Georgia College and State University, the U.S. EPA National Health Environmental Effects Research Laboratory (NHEERL), U.S. EPA Region V, and the Indiana Department of Natural Resources. Landowners and property managers throughout the state also participate in the Probabilistic Monitoring Program by assisting staff with access to remote stream locations for sample collection.

The Probabilistic Monitoring Program provides a comprehensive, unbiased assessment of all Indiana streams for their ability to support aquatic life and recreational uses by sampling randomly-generated sites in major Indiana river basins. Major river basins are sampled using a nine-year rotating basin approach to assess and characterize overall water quality and biological integrity (see Section II on MEASUREMENT AND DATA ACQUISITION for random site selection details, QAPP ELEMENT B1, IDEM 2017a). For target sites, the following categories of data will be investigated and utilized for assessment purposes: bacteriological contamination indicated by *E. coli* counts; water chemistry; algal samples (seston and periphyton); fish and macroinvertebrate assemblages; and habitat evaluations. At a subset of 14 target sites, Onset Hobo® U26-001 D.O. data loggers will record diel dissolved oxygen and temperature swings.

The U.S. EPA recommends the use of multiple bioindicators (i.e., fish and macroinvertebrate communities, and amount of chlorophyll *a* derived from algae) (U.S. EPA 2004), which facilitate the “weight-of-evidence” approach (U.S. EPA 2016) for interpretation of biomonitoring results. This approach involves interpreting data from multiple sources to arrive at conclusions about an environmental system or stressors such as nutrients. Multiple lines of evidence, utilizing more than one bioindicator, can be valuable in correlating critical levels of nutrients available to stream biota. Diatom identification and enumeration will aid in establishing algal metrics as part of Indiana’s development of nutrient criteria for lotic surface waters.

Data Quality Objectives (DQO)

The DQO process (U.S. EPA 2006) is a planning tool for data collection activities. It provides a basis for balancing control of data uncertainty against available resources. The DQO process is required for all significant data collection efforts of a project. The process is a seven-step systematic planning process used to clarify study objectives, define the types of data needed to achieve the objectives, and establish decision criteria for evaluating data quality. The DQO process for the Probabilistic Monitoring Program is identified in the following seven steps.

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 IAC 2-1-3]. This project will gather bacteriological, biological (algal, fish, and macroinvertebrate communities), chemical, and habitat data for the purpose of assessing the designated use attainment status for each of the Indiana tributaries to the Ohio River Basin.

Nutrient Criteria: The U.S. EPA mandated that states either adopt U.S. EPA’s nutrient criteria or develop criteria specific to waters within each state by the year 2004 (U.S. EPA 2000a, 2000b, 2000c). An extension was given to several states, including Indiana, submitting plans which describe data needs, analyses, and protocols for developing nutrient water quality criteria. Since 2001, IDEM and the Unites States Geological Survey (USGS) have collaborated on several projects which provide the technical background for developing nutrient criteria for rivers and streams in Indiana. The U.S. EPA has recommended a multiple-lines-of-evidence approach for developing nutrient criteria and approved the implementation of a program that includes the identification and enumeration of diatoms. In order to develop numeric nutrient criteria for rivers and streams in Indiana, IDEM and the USGS have statistically analyzed water chemistry, fish, macroinvertebrate, and chlorophyll data from 2005–2009 (Caskey et al. 2013). Taxonomic analysis of periphyton samples and diel dissolved oxygen during this project set will add another line of evidence in the development of nutrient criteria.

2. Identify the Goals of the Study

An objective of this project is to produce a statistically valid estimation of the percent of stream miles supporting or nonsupporting for aquatic life use and recreational use in the tributaries to the Ohio River Basin. To produce this estimation, each target site will be sampled for physical, chemical, and biological parameters and evaluated as “supporting” or “nonsupporting” when compared with water quality criteria shown in Table 2 [327 IAC 2-1-6] following Indiana’s 2018 Consolidated Assessment Listing Methodology (CALM, IDEM 2018a, 2018b).

In addition to the chemical and bacteriological criteria listed in Table 2, data for several nutrient parameters will be evaluated with the benchmarks listed below (IDEM 2018b). Assuming a minimum of three sampling events, if two or more of the conditions below are met on the same date, the waterbody will be classified as nonsupporting due to excessive nutrients.

- Total Phosphorus: one or more measurements >0.3 mg/L
- Nitrogen, (Nitrate + Nitrite): one or more measurements >10.0 mg/L
- Dissolved Oxygen: one or more measurements <4.0 mg/L, or measurements that are consistently at/close to the standard, in the range of 4.0-5.0 mg/L, or >12.0 mg/L
- pH: one or more measurements >9.0 SU or measurements consistently at or close to the standard, in the range of 8.7–9.0 SU

- Algal Conditions: visually observed as “Excessive” by trained staff using best professional judgment. Further explanation of this observance is documented in Measurement/Data Acquisition under Algal Community Data on page 33.

Biological Criteria:

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]. 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 2018b).

Nutrient criteria and algal numeric criteria are being developed through the collection of benthic diatoms and chemical, chlorophyll *a*, and pheophytin *a* data from each site, along with field parameters and physical site descriptions. Once collected, the samples will be preserved and transported to the IDEM laboratory, located in the IDEM Shadeland facility. Diatoms will be identified and enumerated as part of the development of algal metrics by Georgia College and State University, Department of Biological and Environmental Sciences (Milledgeville, Georgia).

Following the assessment of each site sampled in the tributaries to the Ohio River Basin, the percent of stream miles attaining and not attaining recreational use and aquatic life use designations will be calculated. First a spreadsheet is developed which lists the following site information:

- All sites that were initially drawn
- Their status (i.e., access denied; site sampled for biology, chemistry, or both; an overdraw site that was not needed)
- The assessment status of the site (impaired; not impaired; NA for denials and unused overdraw sites)
- A weight (based on stream order and stream miles within the basin).

This data is then analyzed by a software package (*spsurvey*) used with the R statistics environment. Instructions on how to download and use the software are available at: http://archive.epa.gov/nheerl/arm/web/html/software.html. The end product of this analysis is an estimate of the number of stream miles that are impaired (or not) along with confidence intervals for that particular basin. Calculated mileages will be reported to U.S. EPA in the 2022 update of Integrated Report. Sites not attaining recreational use criteria will be listed in the CWA section 303(d) List of Impaired Waters for Indiana (Consolidated List). Sites not attaining the aquatic life use support (ALUS) designation will be forwarded to the Targeted Monitoring Program for possible additional sampling to determine the extent, cause(s), and likely source(s) of the ALUS nonattainment area.

Site-specific data will be used to classify associated assessment units (AU) into one of five major categories in the state's Consolidated list (IDEM 2018b), which is included in the Integrated Report (IDEM 2018a). The geographical extent and location of each AU have been defined for mapping purposes through a process called reach indexing, which assigns a unique AU identification number to one or more reaches in the National Hydrography Dataset (NHD). This "key" is called the Reach Index and allows IDEM to map its assessment information (U.S. EPA and USGS 2005).

With the exception of the Ohio River, AUs are associated with eight-digit Hydrologic Unit Codes (HUCs), flowing waters are divided into reaches. Each reach is assigned a unique AU identifier (AUID) in accordance with the 12-digit HUC in which it is located. Together, these AUIDs represent most of the flowing waters (rivers and streams) in Indiana.

In flowing waters, Strahler Stream Order is the primary factor in determining AU extent. This is because the mechanisms of large streams and rivers are very different from those of small streams and tributary systems thereby making it logical to separate these into individual AUs. For example, AUs for smaller 1st and 2nd order streams may include all of the waters within the streams' watershed boundary. AUs for larger 3rd and 4th order streams may be larger and include several small 1st or 2nd order tributaries. Sample results from 5th+ order streams are generally only applicable to the main stem of the river (not including any tributaries), and the AU may begin or end at a point where a major tributary enters the stream.

Other factors, such as the following, are also considered when deciding how to define a water quality AU:

Varying land uses within a watershed are considered because rural development has different impacts on a stream than urban areas, both of which,, in turn, have different impacts on a stream segment than do forested areas.

- The presence and locations of any permitted wastewater discharge facility is considered because the volume of its discharge can impact the hydrology of the receiving stream. The chemical makeup of its effluent can also impact water quality depending on the type of facility and whether the facility is operating efficiently.
- IDEM also considers any other known factors that might reasonably be expected to impact hydrology or water quality, or both, such as the presence of dams and wetlands, and whether the stream has been channelized.
- Aerial photography provides additional information about the presence and thickness of riparian buffers, the presence and spatial extent of rural development, and the types of land use practices in the watershed.

Categories in Indiana's Consolidated List (IDEM 2018b, U.S. EPA 2005) are:

Category 1 **The available data or information, or both, indicate that all designated uses are supported and no use is threatened.** Waters are listed in this category if there are data and/or other information that meet the

requirements of Indiana's CALM to support a determination that all designated uses are supported and no designated use is threatened.

Category 2 **The available data or information, or both, indicate that the individual designated use is supported.** Waters are listed in this category if there are data and/or other information that meet the requirements of Indiana's CALM to support a determination that the individual designated use is supported.

Category 3 **The available data or other information, or both, are insufficient to determine if the individual designated use is supported.** Waters are listed in this category if there are no data or other information available to determine if the individual designated use is supported, or if the available data and/or other information are not consistent with the requirements of Indiana's CALM.

Category 4 **The available data or information, or both, indicate that the individual designated use is impaired or threatened but a TMDL is not required based on one of the following conditions:**

A. A TMDL for one or more pollutants has been completed and approved by the U.S. EPA and is expected to result in attainment of all water quality standards (WQS) applicable to the designated use.

B. Other pollution control requirements are reasonably expected to result in attainment of all water quality criteria applicable to the designated use in a reasonable period of time. Consistent with the regulation under 40 Code of Federal Regulations Part 130.7(b)(i), (ii), and (iii), waters are listed in this subcategory where other pollution control requirements required by local, state, or federal authority are stringent enough to achieve any water quality criteria applicable to the designated use.

C. Impairment is not caused by a pollutant. Waters are listed in this subcategory if the designated use impairment is not caused by a pollutant but is instead attributed to other types of pollution for which a TMDL cannot be calculated.

Category 5 The available data, or information, or both indicate that the individual designated use is impaired or threatened, and a TMDL is required. The following subcategories together constitute Indiana's CWA Section 303(d) List of Impaired Waters:

A. This subcategory constitutes the CWA section 303(d) list of waters impaired or threatened by one or more pollutants for which a TMDL is required. Waters are listed in this category if it is determined in accordance with Indiana's CALM that a pollutant has caused, is suspected of causing, or is projected to cause impairment. Where more than one pollutant is associated with the impairment of a single AU, the AU will remain in Category 5 for each pollutant until the TMDL for that pollutant has been completed and approved by the U.S. EPA.

B. This subcategory constitutes the CWA section 303(d) list of waters that are impaired due to the presence of mercury, PCBs, or both in the edible tissue of fish collected from the AUs at levels exceeding Indiana's human health criteria for these contaminants.

Table 2. Water Quality Criteria [327 IAC 2-1-6]

Parameter	Level	Criterion
Dissolved Metals (Cd, Cr III, Cr VI, Cu, Pb, Ni, Zn	Calculated based on hardness	CAC
Dissolved Arsenic III	190 µg/L	CAC
Ammonia Nitrogen	Calculated based on pH and temperature	CAC
Chloride	Calculated based on hardness and sulfate	CAC
Free Cyanide	5.2 µg/L (analyzed only if Total Cyanide result exceeds the CAC for Free Cyanide)	CAC
Dissolved Oxygen	At least 5.0 mg/L (warm water aquatic life) At least 6.0 mg/L (cold water fish*)	Not less than 4.0 mg/L at any time. Not less than 6.0 mg/L at any time and shall not be less than 7.0 mg/L in areas where spawning occurs during the spawning season and in areas used for imprinting during the time salmonids are being imprinted.
pH	6.0 – 9.0 SU	Must remain between 6.0 and 9.0 SU except for daily fluctuations that exceed 9.0 due to photosynthetic activity
Nitrogen, Nitrate + Nitrite	10 mg/L	HHC at point of drinking water intake
Sulfate	Calculated based on hardness and chloride	In all waters outside the mixing zone
E. coli (April–October Recreational season)	125 CFU/100mL or 125 MPN/100 mL 235 CFU/100 mL or 235 MPN/100 mL	5 sample geometric mean based on at least 5 samples equally spaced over a 30 day period Not to exceed in any one sample in a 30 day period except in cases where there are at least 10 samples, 10% of the samples may exceed the criterion
Dissolved Solids	750 mg/L	Not to exceed at point of drinking water intake

CAC = Chronic Aquatic Criterion, SU = Standard Units, HHC = Human Health Criteria, MPN = Most Probable Number, CFU = Colony Forming Unit

*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.

3. Identify Information Inputs

Under the probabilistic design, field monitoring activities are required to collect physical, chemical, algal, bacteriological, biological, and habitat data. These data are required to address the necessary decisions previously described. Monitoring activities take place at target sites for which permission to access has been granted by the necessary landowners or property managers. Due to the statistical nature of the survey design, historical data will not be used in the calculation of predicted stream mileages supporting or nonsupporting aquatic life or recreational uses. Collection procedures for field measurements, bacteriological, algal, chemical, biological, and habitat data will be described in detail under Section II. MEASUREMENT AND DATA ACQUISITION.

4. Define the Boundaries for the Study

For the purpose of this program, the tributaries to the Ohio River Basin (Figure 1) are geographically defined as within the borders of Indiana contained by the eight-digit HUCs 05090203, 05140101, 05140104, 05140201, and 05140202 (excluding the main stem Ohio River as well as the watersheds for the Wabash, Whitewater, or Great Miami rivers). This area includes:

- The Middle Ohio – Laughery subbasin (05090203) located in southeastern Indiana drains approximately 805 square miles. Using the 2011 National Land Cover Database for the Conterminous United States, predominant land uses are forest (51%), pasture (21%), cropland (17%), and urban (7%) (Homer et al. 2015).
- The Silver – Little Kentucky subbasin (05140101) located in southeastern Indiana drains approximately 676 square miles within Indiana borders. Predominant land uses are forest (53%), cropland (18%), pasture (14%), and urban (12%) (Homer et al. 2015).
- The Blue – Sinking subbasin (05140104) located in south central Indiana drains approximately 1253 square miles within Indiana borders. Predominant land uses are forest (53%), pasture (25%), cropland (13%), and urban (5%) (Homer et al. 2015).
- The Lower Ohio – Little Pigeon subbasin (05140201) located in southwestern Indiana drains approximately 988 square miles within Indiana borders. Predominant land uses are forest (44%), cropland (34%), pasture (10%), and urban (8%) (Homer et al. 2015).
- The Highland – Pigeon subbasin (05140202) located in southwestern Indiana drains approximately 526 square miles within Indiana borders. Predominant land uses are cropland (54%), forest (19%) and urban (18%) (Homer at al. 2015).

The target sample population for the basin is defined as all perennial streams in the tributaries to the Ohio River Basin that lie within the geographic boundaries of Indiana. The sample frame is comprised of all rivers, streams, canals, and ditches as indexed through the NHD-Plus dataset (U.S. EPA and USGS 2005). Marshes, wetlands, backwaters, impoundments, dry sites, and streams with no apparent channel (i.e., submerged, or run underground either through natural processes or by anthropogenic channel alterations) are excluded as they are considered nontarget populations. Table 3 gives the site status for 100 potential

sampling sites for the tributaries to the Ohio River Basin. From these 100 potential sites, the first 45 target sites will be sampled for physical, chemical, and algal parameters. Bacteriological sampling will be completed at the first 40 target sites. Biological communities and habitat information will be sampled at the first 38 target sites. Fourteen target sites will be sampled for diel dissolved oxygen and orthophosphate. For those sites listed as "Target, Approved" but not sampled in Table 3, the site will be listed as "Not-needed" when using the *R* statistics environment software (R Core Team 2014) package *spsurvey* (available on the U.S. EPA Aquatic Resources Monitoring and Analysis webpage, http://archive.epa.gov/nheerl/arm/web/html/software.html or at https://cran.r-project.org/web/packages/spsurvey/spsurvey.pdf) to calculate the percent of perennial stream miles in the basin that support or do not support aquatic life and recreational uses. Sites listed as "Other, Deadline 3/15/2019" in Table 3 were thought to be part of the target population; however, the landowner could not be contacted before the site reconnaissance deadline which occurred on March 15, 2019.

5. Develop the Analytical Approach

Samples will be collected for physical, chemical, bacteriological parameters, and algal and biological communities, if the flow is not dangerous for staff to enter the stream (e.g., water levels at or below median base flow); barring any hazardous weather conditions (e.g., thunderstorms or heavy rain in the vicinity); or unexpected physical barriers to accessing the site. The field crew chief makes the final determination as to whether or not a stream is safe to enter. Even if the weather conditions and stream flow are safe, sample collections for algal and biological communities may be postponed at a particular site for one to four weeks due to scouring of the stream substrate or instream cover following a high water event resulting in nonrepresentative samples.

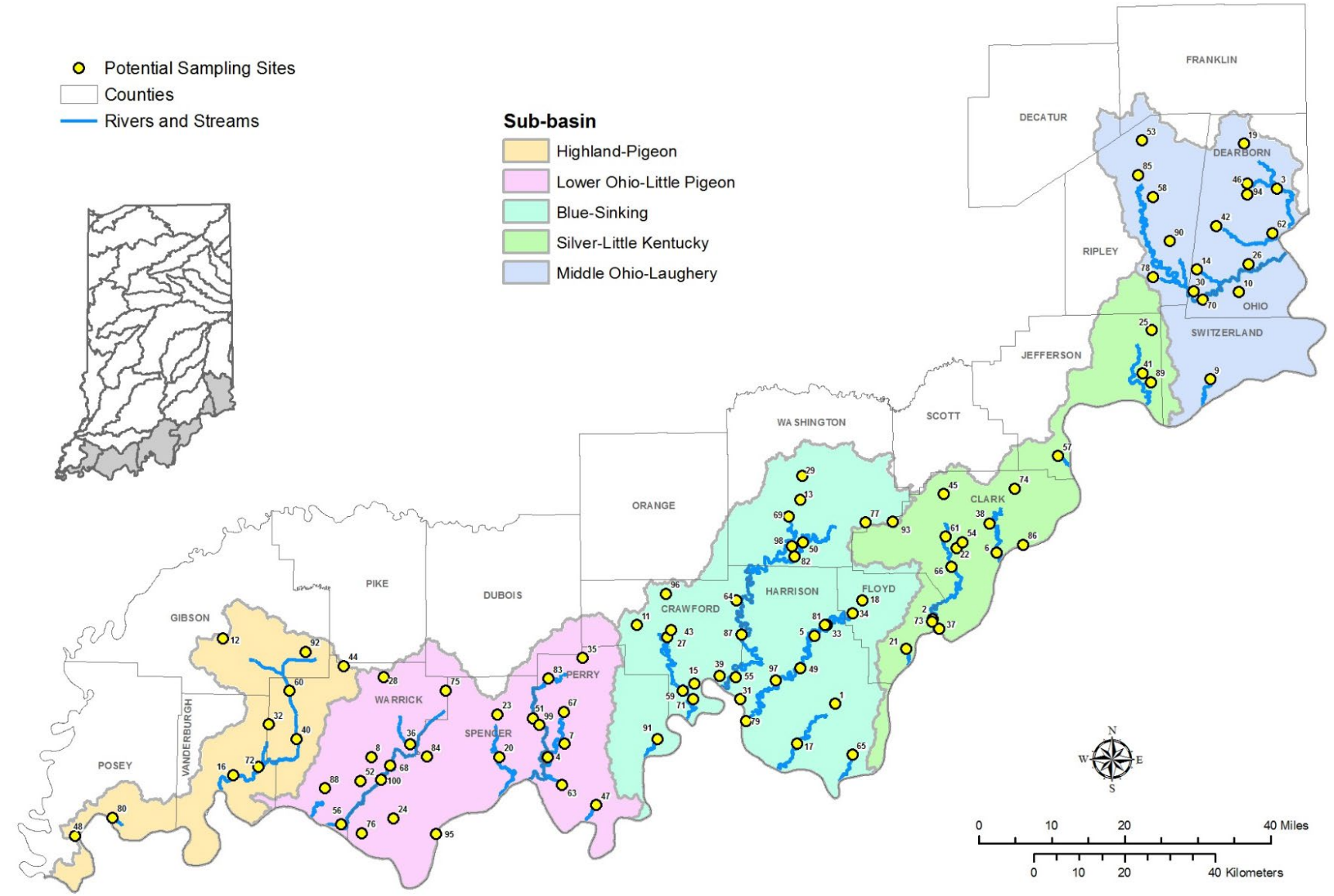
For assessment purposes in the Integrated Report, aquatic life use and recreational use support decisions will include independent evaluations of chemical, biological, and bacteriological criteria as outlined in Indiana's 2018 CALM (IDEM 2018b, pages 17–19). The fish assemblage will be evaluated at each site using the appropriate IBI (Dufour 2002; Simon 1997, DRAFT; Simon and Dufour, 1998, 2005). Macroinvertebrate multihabitat samples will also be evaluated using a statewide IBI developed for lowest practical taxonomic level identifications. Specifically, a site will be considered nonsupporting for aquatic life use when IBI scores are less than 36. Where biological or chemical criteria are nonsupporting for aquatic life use, the site will be forwarded to the Targeted Monitoring Program for possible investigation to identify the extent of the nonsupport status, determine potential causes, and list the most probable sources of the identified stressors.

Statistical estimations of the percentage of perennial stream miles in the tributaries to the Ohio River Basin that support or do not support aquatic life and recreational uses will be made following use-attainment decisions for each site sampled. Estimations will be calculated using the *R* statistics environment software (R Core Team 2014) package *spsurvey* available on the U.S. EPA Aquatic Resources Monitoring and Analysis webpage, http://archive.epa.gov/nheerl/arm/web/html/software.html, or at https://cran.r-

project.org/web/packages/spsurvey/spsurvey.pdf. The percent attainment and nonattainment for the target population (tributaries to the Ohio River Basin) will be published in a table within the 2022 Integrated Report.

IDEM's intention is to use algal metrics, once determined, as part of nutrient criteria being developed for Indiana's surface waters. Eventually, IDEM also plans to use algal metrics with macroinvertebrate and fish metrics for ALUS decisions. Given that ecological tolerances for many diatom species are known, changes in diatom community composition can be used to diagnose the environmental stressors affecting ecological health (Stevenson 1998; Stevenson and Pan 1999); thus, periphyton IBI metrics have been developed and tested in many regions (Kentucky Department of Environmental Protection 1993; Hill et al. 1997). The periphyton assemblage may be used to assess biological integrity of a waterbody without any other information; however, periphyton are most effective when used with habitat and macroinvertebrate assessments, particularly because of the close relationship between periphyton and these elements of stream ecosystems (Barbour et al. 1999). For this reason, algal sampling will be conducted at the same sites where macroinvertebrates, fish, habitat, chemical, and physical data will be collected as part of the Probabilistic Monitoring Program.

Figure 1. Potential Sampling Sites for the Tributaries to the Ohio River Basin



This map is intended to serve as an aid in graphic representation only. This information is not warranted for accuracy or other purposes.

Mapped By: Joanna Wood, Office of Water Quality **Date:**01/23/2019

Data Sources - Obtained from the State of Indiana Geographic Information Office Library

Map Projection: UTM Zone 16 N **Map Datum:** NAD83

Table 3. List of Potential Sites for the Tributaries to the Ohio River Basin.

Site #	AIMS Site Name	Stream Name and Location	County	Latitude (Decimal Degree)	Longitude (Decimal Degree)	Topo	Stream Order	Site Status
1	OBS-02-0001	Buck Creek	Harrison	38.14598103	-86.04158987	J-35	2	Other, Deadline 3/15/2019
2	OSK-08-0014	Silver Creek @ Gutford Road	Floyd	38.31291184	-85.79350539	J-18	4	Target, Approved
3	OML-03-0004	Tanners Creek @ Kelsey Road	Dearborn	39.15663562	-84.90017801	G-69	4	Target, Approved
4	OLP-03-0007	Middle Fork Anderson River	Perry	38.04359626	-86.76552488	J-48	3	Other, Deadline 3/15/2019
5	OBS-04-0001	Indian Creek @ State Road 335	Harrison	38.28123035	-86.09270534	J-16	4	Target, Approved
6	OSK-04-0004	Fourteenmile Creek @ Charlestown State Park	Clark	38.44339852	-85.62978906	I-58	3	Target, Approved
7	OLP-03-0008	Theis Creek @ Atlanta Road	Perry	38.07053095	-86.72394278	J-49	1	Target, Approved
8	OLP-10-0006	Otter Creek @ Degonia Road	Warrick	38.04431396	-87.20952669	J-45	2	Target, Approved
9	OML-09-0004	Indian Creek @ Posten Road	Switzerland	38.78065389	-85.07936217	H-68	3	Target, Approved
10	OML-07-0001	Mud Lick Creek	Ohio	38.95293875	-85.00233516	H-45	1	Other, Deadline 3/15/2019
11	OBS-11-0002	Otter Creek @ Mifflin Community Church	Crawford	38.30565686	-86.53944315	J-12	3	Target, Approved
12	OHP-01-0001	Tributary of West Fork Pigeon Creek	Gibson	38.27872717	-87.58466449	J-04	1	Non-target, Access Denied
13	OBS-07-0022	Blue River @ Cauble Road	Washington	38.55426777	-86.12480857	I-35	3	Target, Approved
14	OML-06-0002	Boyd Branch @ Grelle Road	Dearborn	38.99961444	-85.10745394	H-45	1	Target, Approved
15	OBS-11-0003	Turkey Fork	Crawford	38.18923676	-86.39631616	J-32	3	Non-target, Access Denied
16	OHP-03-0001	Pigeon Creek @ Stream Valley Park	Vanderburgh	38.00628256	-87.55738733	J-42	4	Target, Approved
17	OBS-02-0002	Buck Creek @ Squire Boone Caverns	Harrison	38.06766468	-86.13853227	J-53	3	Target, Approved
18	OBS-03-0001	Indian Creek @ Old Vincennes Road	Floyd	38.3522878	-85.97099544	J-17	3	Target, Approved
19	OML-03-0005	East Fork Tanners Creek @ Dog Ridge	Dearborn	39.24872819	-84.98215978	G-69	2	Target, Approved
20	OLP-05-0002	Crooked Creek @ County Road 1100 North	Spencer	38.04380242	-86.88461151	J-47	3	Target, Approved
21	OSK-09-0001	French Creek @ Two Mile Lane	Floyd	38.25504074	-85.86076735	J-18	1	Target, Approved
22	OSK-08-0015	Sinking Fork @ Brick Church Road	Clark	38.45269663	-85.73083265	I-58	3	Target, Approved
23	OLP-05-0001	Tributary of Crooked Creek @ Old State Road 162	Spencer	38.12861111	-86.89238309	J-28	1	Target, Approved
24	OLP-10-0012	Tower Ditch	Spencer	37.92206655	-87.1544079	J-63	1	Non-target, Dry
25	OSK-02-0024	Miller Branch	Jefferson	38.88128272	-85.22592905	H-44	1	Other, Deadline 3/15/2019
26	OML-07-0002	Tributary of Laughery Creek	Dearborn	39.007817	-84.97680947	H-23	2	Other, Deadline 3/15/2019
27	OBS-11-0008	Little Blue River @ Old State Road 37	Crawford	38.2810756	-86.46390337	J-13	4	Target, Approved
28	OLP-09-0023	Tributary of Coles Creek @ Scales Road	Warrick	38.20337101	-87.1790631	J-26	1	Target, Approved
29	OBS-07-0019	West Fork Blue River	Washington	38.6005495	-86.11974213	I-35	3	Other, Deadline 3/15/2019
30	OML-06-0003	Laughery Creek @ Cutter Road	Ohio	38.95637224	-85.11761256	H-45	3	Target, Approved
31	OBS-10-0001	Cold Friday Hollow Creek	Harrison	38.15763396	-86.28064288	J-33	1	Non-target, Dry
32	OHP-03-0002	Bluegrass Creek @ Warrick County Line Road	Warrick	38.10799052	-87.46858635	J-43	1	Target, Approved
33	OBS-04-0002	Indian Creek @ State Road 335	Harrison	38.30346957	-86.06150529	J-16	4	Target, Approved
34	OBS-03-0002	Indian Creek @ Hamby Road	Floyd	38.32672247	-85.99521282	J-17	4	Target, Approved
35	OLP-04-0015	Sigler Creek	Perry	38.2406389	-86.67664268	J-30	1	Non-target, Access Denied
36	OLP-09-0024	Coles Creek @ Wilson Lane	Warrick	38.06996136	-87.11203843	J-46	2	Target, Approved
37	OSK-09-0002	Mill Creek @ Ohio River Greenway	Clark	38.29255946	-85.77747964	J-18	1	Target, Approved
38	OSK-04-0005	Dry Branch @ Charlestown New Market Road	Clark	38.50058426	-85.64681469	I-38	1	Target, Approved
39	OBS-09-0002	Dry Run	Crawford	38.20385123	-86.33298022	J-33	2	Non-target, Dry
40	OHP-02-0001	Tributary of Pigeon Creek	Warrick	38.07948748	-87.39751558	J-43	1	Non-target, Wetland
41	OSK-02-0025	Brushy Fork @ Brushy Fork Road	Jefferson	38.79584807	-85.25155071	H-66	2	Target, Approved
42	OML-04-0007	Allen Branch @ Akes Road	Dearborn	39.08555939	-85.05652581	H-22	1	Target, Approved
43	OBS-11-0004	Bogard Creek	Crawford	38.29540787	-86.45362864	J-13	2	Other, Deadline 3/15/2019
44	OHP-01-0002	Smith Fork @ Spurgeon Road	Warrick	38.22500482	-87.27975994	J-25	1	Target, Approved
45	OSK-08-0016	Miller Fork @ US Highway 31	Clark	38.56134134	-85.7609833	I-37	2	Target, Approved
46	OML-03-0006	West Fork Tanners Creek @ Konvadi Road	Dearborn	39.16880633	-84.97506114	G-69	3	Target, Approved
47	OLP-01-0001	East Deer Creek @ Triplett Road	Perry	37.94783071	-86.64377321	J-67	2	Target, Approved
48	OHP-06-0007	BeaverDam Creek	Posey	37.88312245	-87.95320252	J-57	2	Non-target, Impounded
49	OBS-04-0003	Indian Creek @ Cedar Glade Avenue	Harrison	38.21771051	-86.12824379	J-34	4	Target, Approved
50	OBS-06-0026	South Fork Blue River @ Dalton Lane	Washington	38.46861504	-86.1205988	I-55	3	Target, Approved

Table 3 (continued). List of Potential Sites for the Tributaries to the Ohio River Basin.

Site #	AIMS Site Name	Stream Name and Location	County	Latitude (Decimal Degree)	Longitude (Decimal Degree)	Topo	Stream Order	Site Status
51	OLP-04-0019	Anderson River @ Angelo Road	Perry	38.12056865	-86.80368946	J-48	3	Target, Approved
52	OLP-10-0007	Caney Creek @ New Hope Road	Warrick	37.99645709	-87.23624396	J-63	1	Target, Approved
53	OML-05-0047	Little Laughery Creek @ State Road 229	Ripley	39.25837751	-85.24134584	G-43	2	Target, Approved
54	OSK-08-0017	Sinking Fork @ Charlestown Memphis Road	Clark	38.46431712	-85.7157349	I-58	2	Target, Approved
55	OBS-09-0004	Blue River @ State Road 62	Crawford	38.20140345	-86.29126302	J-33	4	Target, Approved
56	OLP-10-0008	Little Pigeon Creek	Warrick	37.91007731	-87.28523105	J-62	4	Non-target, Impounded
57	OSK-03-0001	Big Saluda Creek	Jefferson	38.6333213	-85.47041913	I-18	1	Other, Deadline 3/15/2019
58	OML-05-0049	Castators Creek @ State Road 350	Ripley	39.14629582	-85.21653673	G-67	1	Target, Approved
59	OBS-11-0005	Little Blue River @ Beechwood Road	Crawford	38.1750484	-86.424836	J-32	4	Target, Approved
60	OHP-02-0002	Pigeon Creek	Warrick	38.17526058	-87.41658418	J-24	4	Other, Unsafe
61	OSK-08-0018	Silver Creek	Clark	38.4760623	-85.75718819	I-57	4	Other, Deadline 3/15/2019
62	OML-04-0008	North Hogan Creek	Dearborn	39.06837593	-84.91339349	H-23	3	Non-target, Impounded
63	OLP-04-0016	Brushy Fork @ Sagebrush Road	Perry	37.98797068	-86.73047183	J-67	1	Target, Approved
64	OBS-08-0001	Whiskey Run @ Milltown Road	Crawford	38.35310499	-86.28853914	J-14	3	Target, Approved
65	OBS-01-0001	Mosquito Creek	Harrison	38.04452595	-85.99967429	J-55	1	Other, Deadline 3/15/2019
66	OSK-07-0003	Muddy Fork	Clark	38.41658942	-85.74339321	I-58	3	Other, Deadline 3/15/2019
67	OLP-03-0009	Middle Fork Anderson River @ Huffman Road	Perry	38.13385777	-86.72574595	J-30	2	Target, Approved
68	OLP-10-0009	Little Pigeon Creek @ Campbell Road	Warrick	38.02665111	-87.16293966	J-45	4	Target, Approved
69	OBS-07-0020	Blue River @ Organ Springs Road	Washington	38.51997373	-86.15407791	I-34	3	Target, Approved
70	OML-06-0004	Laughery Creek @ West Laughery Creek Road	Dearborn	38.9399885	-85.09432581	H-45	4	Target, Approved
71	OBS-11-0006	Little Blue River @ Beechwood Road	Crawford	38.15850672	-86.39977872	J-32	4	Target, Approved
72	OHP-03-0003	Pigeon Creek @ Fawn Lake Drive	Vanderburgh	38.02333317	-87.49408061	J-43	4	Target, Approved
73	OSK-08-0019	Silver Creek	Clark	38.30738684	-85.79462481	J-18	4	Other, Deadline 3/15/2019
74	OSK-04-0006	Fourteenmile Creek @ Cole Road	Clark	38.57022744	-85.58061508	I-39	3	Target, Approved
75	OLP-09-0025	North Fork Little Pigeon Creek	Warrick	38.17679586	-87.02206354	J-27	2	Other, Deadline 3/15/2019
76	OLP-10-0010	Baker Creek	Spencer	37.89201726	-87.23376785	J-63	1	Target, Approved
77	OBS-06-0029	Tributary of South Fork Blue River @ Blankenbaker Road	Washington	38.50640133	-85.95953283	I-36	1	Target, Approved
78	OML-06-0005	Raccoon Creek	Ripley	38.98686759	-85.22102106	H-44	1	Target, Approved
79	OBS-05-0002	Indian Creek	Harrison	38.11403736	-86.26682341	J-52	4	Non-target, Impounded
80	OHP-06-0006	Cypress Slough	Posey	37.91991842	-87.8600205	J-58	2	Non-target, Impounded
81	OBS-04-0004	Indian Creek	Harrison	38.30415437	-86.06624009	J-16	4	Target, Approved
82	OBS-06-0027	South Fork Blue River	Washington	38.44088442	-86.14043239	I-54	3	Target, Approved
83	OLP-04-0017	Anderson River	Perry	38.20001899	-86.76337036	J-29	2	Target, Approved
84	OLP-09-0026	East Fork Little Pigeon Creek	Spencer	38.04453896	-87.07051874	J-46	2	Target, Approved
85	OML-05-0048	Laughery Creek	Ripley	39.18977134	-85.25377	G-66	3	Target, Approved
86	OSK-06-0004	Owen Creek	Clark	38.45766912	-85.56175548	I-59	1	Non-target, Impounded
87	OBS-09-0003	Blue River @ Roth Rock Mill Road	Harrison	38.28512647	-86.27544793	J-14	4	Target, Approved
88	OLP-11-0001	Cypress Creek	Warrick	37.981409	-87.32631721	J-62	2	Target, Approved
89	OSK-02-0026	Dry Fork	Jefferson	38.77733684	-85.23099756	H-67	1	Target, Approved
90	OML-06-0006	Caesar Creek	Ripley	39.05686129	-85.17585279	H-21	1	Target, Approved
91	OBS-12-0001	Little Oil Creek	Perry	38.07883799	-86.48938648	J-51	2	Non-target, Impounded
92	OHP-01-0003	Donohue Creek	Gibson	38.25319923	-87.37572735	J-05	1	Target, Approved
93	OBS-06-0028	Whiskey Run	Washington	38.50785978	-85.89061018	I-36	1	Target, Approved
94	OML-03-0007	Flys Run	Dearborn	39.14646808	-84.97475133	G-69	1	Target, Approved
95	OLP-08-0001	Huffman Ditch	Spencer	37.89135867	-87.04767042	J-64	2	Non-target, Impounded
96	OBS-11-0007	Bird Hollow Creek @ State Road 37	Crawford	38.36785522	-86.46592252	J-13	1	Target, Approved
97	OBS-05-0003	Indian Creek @ Mathis Road Southwest	Harrison	38.19427208	-86.19008043	J-34	4	Target, Approved
98	OBS-07-0021	Blue River	Washington	38.46141952	-86.14706512	I-54	3	Target, Approved
99	OLP-04-0018	Anderson River	Perry	38.10738252	-86.78644301	J-48	3	Target, Approved
100	OLP-10-0011	Little Pigeon Creek @ State Road 161	Warrick	37.99807758	-87.18534657	J-63	4	Target, Approved

6. Specify Performance or Acceptance Criteria

Good quality data are essential for minimizing decision error. By identifying errors in the sampling design; measurement; and laboratory for physical, chemical, and biological parameters, more confidence can be placed in the percentage of perennial stream miles in the river basin that support or do not support aquatic life and recreational uses; and in algal metrics produced. In this project, it is desired to make decisions protective of human health and the environment; therefore, the null hypothesis is that the reach is not supportive of Indiana's aquatic life and recreational uses. The resulting Type 1 and Type 2 decision errors in this project are listed in Table 4 below.

Table 4. Decision Error Associated with Probabilistic Monitoring.

	Actual Status of Sampled Stream Reaches of the Studied Watershed	
WAPB Work Plan Findings	**Stream reach IS supportive of aquatic life and recreational use**	**Stream reach IS NOT supportive of aquatic life and recreational use**
Stream reach IS supportive of aquatic life and recreational use	Stream reach is correctly identified as supporting aquatic life and recreational use	**Decision Error (Type 1)**
Stream reach IS NOT supportive of aquatic life and recreational use	**Decision Error (Type 2)**	Stream reach is correctly identified as NOT supporting aquatic life and recreational use

The probabilistic sampling design provides estimations of the proportion of streams in the basin attaining designated uses with a 95% confidence level. A minimum of 38 probabilistic sites will be sampled in the basin to assure this confidence level is reached for overall stream mileage estimations (see Sampling Design and Site Locations, pg 23).

Site specific aquatic life use and recreational use assessments include program specific controls to identify the introduction of errors. These controls include water chemistry and bacteriological blanks and duplicates, biological site revisits or duplicates, and laboratory controls through verification of species identifications as described in field procedure manuals (IDEM 2002; OHEPA 2006) and SOPs (IDEM 1992a, 1992b, 1992c, 2015a, 2018c, 2019a,2019b).

The QA/QC process detects deficiencies in the data collection as set forth in the Surface Water QAPP (IDEM 2017a). The QAPP requires all contract laboratories to adhere to rigorous standards during sample analyses and to provide good quality usable data. Chemists within the WAPB provide a QA review of the laboratory analytical results. Any data which is "Rejected" due to analytical problems or errors will not be used for water quality assessment decisions. Any data flagged as "Estimated" may be used on a case by case basis and is noted in the QA/QC report. Criteria for acceptance or rejection of results as well as application of data quality flags is presented in the QAPP, Table D3-1: Data Qualifiers and Flags, page 184. Precision and accuracy goals with acceptance

limits for applicable analytical methods are provided in the QAPP, Table A7-1: Precision and Accuracy Goals for Data Acceptability by Matrix, pages 61–63; and Table B2.1.1.8-2 Field Parameters, page 117. Further investigation will be conducted in response to consistent "rejected" data in determining the source of error. Field techniques used during sample collection and preparation, along with laboratory procedures will be subject to evaluation by both the WAPB QA Manager and Project Manager in troubleshooting error introduced throughout the entire data collection process. Corrective actions will be implemented once the source of error is determined, Surface Water QAPP (IDEM 2017a).

If funding and resources are available, results showing nonsupport for aquatic life use will be subsequently verified through a targeted monitoring program prior to completion of the Integrated Report. Those stream reaches showing nonsupport may also be verified through the TMDL development process.

7. Develop the Plan for Obtaining Data

The rotating basin, probability design is optimal for assessing the recreational use and ALUS status of river and stream resources in Indiana. The design facilitates statistically valid estimations of the total percent of perennial stream miles within the basin of interest that are nonsupporting for aquatic life and recreational uses. The estimations are derived from total perennial stream miles in the basin of interest and the design requires minimal use of sampling and staff resources (see Sampling Design and Site Locations, pg 23).

Periphyton assemblages are impacted by habitat and macroinvertebrate community structure. Thus, to develop algal metrics and subsequent nutrient criteria, algal samples will be collected from the same sites generated using the rotating basin, probability design from which fish and macroinvertebrate communities and habitat data are collected.

Training and Staffing Requirements

Table 5. Project Roles, Experience, and Training

Role	Required Training/Experience	Responsibilities	Training References
Project Manager	-Bachelor of Science Degree in biology or other closely related area plus four years of experience in aquatic ecosystems (Master's Degree with two years aquatic ecosystems experience may substitute) -Database experience -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 -Calculating predicted percentage of perennial stream miles nonsupporting for aquatic life uses and recreational uses in the river basin of interest	-AIMS II Database User Guide -U.S. EPA 2006 Guidance for QAPPs (Work Plans)

Role	Required Training/Experience	Responsibilities	Training References
Field Crew Chief – Fish or Macroinvertebrate Community Sampling	-Bachelor of Science Degree in biology or other closely related area -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 -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 multiprobe 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	-Barbour et al. 1999 -Dufour 2002 -Hydrolab Corporation 2002 -IDEM 1992a, 1992b, 1992c, 2002, 2010a, 2010b, 2015b, 2018c, 2019a, 2019b -Klemm et al. 1990 -Plafkin et al. 1989 -Simon 1997, DRAFT -Simon and Dufour, 1998, 2005 -YSI 2006
Field Crew members – Fish or Macroinvertebrate Community Sampling	-Complete hands-on training for sampling methodology prior to participation in field sampling activities -Review the Principles and Techniques of Electrofishing -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	-Barbour et al. 1999 -Hydrolab Corporation 2002 -IDEM 1992a, 1992b, 1992c, 2002, 2010a, 2010b, 2015b, 2018c, 2019a, 2019b -Klemm et al. 1990 -Plafkin et al. 1989 -YSI 2006
Field Crew Chief – Water Chemistry, Algal, and/or Bacteriological Sampling	-Bachelor of Science Degree in biology or other closely related area -At least one year of experience in sampling methodology -Annually review relevant safety procedures -Annually review relevant SOP documents for field operations	-Completion of field data sheets -Sampling efficiency and representation -Overall operation of the field crew when remote from central office -Adherence to safety and field SOP procedures by crew members -Ensure that multiprobe analyzers are calibrated weekly prior to field sampling activities -Ensure that field sampling equipment is	-Hydrolab Corporation 2002 -IDEM 1997, 2002, 2010a, 2010b, 2015b, 2018d -YSI 2006

Role	Required Training/Experience	Responsibilities	Training References
		functioning properly and loaded into field vehicles prior to field sampling activities	
Field Crew Members – Water Chemistry, Algal, and/or Bacteriological Sampling	-Complete hands-on training for sampling methodology prior to participation in field sampling activities -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	-Hydrolab Corporation 2002 -IDEM 1997, 2002, 2010a, 2010b, 2015b, 2018d -YSI 2006
Laboratory Supervisor – Fish or Macroinvertebrate Community Sample Processing	-Bachelor of Science Degree in biology or other closely related area -At least one year of experience in taxonomy of aquatic communities in the region -Annually review relevant safety procedures -Annually review relevant SOP documents for laboratory operations	-Identification of fish and macroinvertebrate specimens collected during field sampling -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 II Database -Ensure that required QA/QC are performed on the data -Querying data from AIMS II to determine results not meeting Water Quality Criteria	-IDEM 1992c, 2004, 2010a, 2010b, 2012e -AIMS II Database User Guide
Laboratory Staff – Fish or Macroinvertebrate Community Sample Processing	-Complete hands-on training for laboratory sample processing methodology prior to participation in laboratory sample processing activities -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 and macroinvertebrate specimens collected during field sampling -Completion of laboratory data sheets, perform necessary calculations on data, enter field sheets	-IDEM 1992c, 2004, 2010a, 2010b, 2018e -AIMS II Database User Guide

Role	Required Training/Experience	Responsibilities	Training References
Laboratory Supervisor – Water Chemistry, Algal and/or Bacteriological Sample Processing	-Bachelor of Science Degree in biology or other closely related area -Annually review relevant safety procedures -Annually review relevant SOP documents for field operations	-Completion of laboratory data sheets -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	-IDEM 2010a, 2010b, 2015a -AIMS II Database User Guide
QA Officer	-Bachelor of Science in chemistry or a related field of study -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 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	-IDEM 2017c, 2018e -U.S. EPA 2006 Guidance for QAPPs and data qualification -AIMS II Database User Guide

II. MEASUREMENT AND DATA ACQUISITION

Sampling Design and Site Locations

Sites are generated by the U.S. EPA, NHEERL, Western Ecology Division, in Corvallis, Oregon using Environmental Monitoring Assessment Program selection methods. The Environmental Monitoring Assessment Program design uses a statistically valid number of randomly selected sites to assess and characterize the overall water quality and biotic integrity of the basin of study. To statistically estimate the percent of the basin attaining designated uses with a

95% confidence level, a minimum of 38 probabilistic sites will be sampled in the basin of interest. This minimum required number of sites was determined by analyzing IDEM fish community IBI metric scores from 317 sites sampled from 1996–2000 with the following formula:

$$n = \frac{s^2}{(p)^2(\bar{x})^2}$$

where ***n*** is the number of sites required, ***s*** is the sample standard deviation (10.98922), $\bar{x}$ is the sample mean (35.52366), and ***p*** is the p-value (set at 0.05 for a 95% confidence level) (Elliott 1983). A sample size of 38 was thereby determined to be sufficient to arrive at the "true" average IBI score for a basin 95% of the time. This sample size was also found to be sufficient to provide 80% estimations for eight of the more frequently used individual metrics used in the calculation of the fish community IBI.

Site selection is stratified to ensure effort is equally distributed between stream orders for equal representation of the various stream sizes within the basin. IDEM's site selection process incorporates a stratified random probability design in order to select an approximately equal number of 1st, 2nd, 3rd, and 4th order and higher streams in the basin. Utilizing the stratification method ensures that a greater number of sampling sites on lesser order streams are not chosen based on proportion of stream miles. An over draw of sampling sites is requested to compensate for denial of access, dry stream conditions, and sites presenting extremely difficult or unsafe access.

Site reconnaissance activities will be conducted in-house and through physical site visits. In-house activities will include preparation and review of site maps and aerial photographs; initial evaluation of target or nontarget site status; potential access routes; and initial property owner searches. Physical site visits will include property owner consultations; verification of site status (target or nontarget); confirmation and documentation of access routes; and determination of equipment needed to properly sample the site. Precise coordinates for each approved target site will be determined using an agency approved handheld Global Positioning System (GPS) unit which can verify horizontal precision of five meters or less (IDEM 2015b). All 100 potential sites are to be visited at least once during site reconnaissance to determine target or nontarget status (marsh, dry, backwater, etc.). However, landowner permission and site access will be determined for only the first 75 potential sites with the remaining 25 sites noted only as "Target" or "NonTarget". After each site has been visited once, and at least 45 sites have been approved in the basin of interest, field work for site reconnaissance activities should be minimal. Although eight weeks is the maximum time allotted for site reconnaissance field work (see Section I on PROJECT MANAGEMENT for site reconnaissance activities, QAPP ELEMENT A4), most work can be completed in a six-week period (dependent upon weather, drive time to sites, and other unforeseeable constraints). The remaining work, if possible, can be done in the office with phone calls to seek landowner permission. If permission to visit a site is then granted before the 12 week deadline, a daytrip or overnight may be needed to determine access routes, equipment, and more accurate GPS coordinates. Once the deadline is reached,

those sites that were not accessible through bridge right-of-way, yet appeared to be “target” from the nearest bridge, will be entered into the database with the Reconnaissance Decision as “No, Other” with the following text in the Comments field “Unable to contact landowner by deadline" along with the date and initials of the person entering the data and writing it on the IDEM Site Reconnaissance Form (Attachment 1).

Table 3 lists the potential sampling sites generated by U.S. EPA Corvallis for the Tributaries to the Ohio River Basin. Target sampling sites will be taken in sequential order as shown in Table 3 until the 45 sites are sampled for algal community and water chemistry, 40 sites for bacteriological sampling, and 38 sites for biological sampling programs. If a site is considered “nontarget” (dry, backwater, marsh/wetland, etc.) or unavailable to sample for some other reason (physical barrier, landowner denial, etc.), the next target site on the list will be taken. Figure 1 depicts potential sampling sites generated by U.S. EPA Corvallis for this project and their approximate locations.

In order to provide additional information on the relationships between diel dissolved oxygen swings, nutrients, and algal communities, Onset Hobo® U26-001 D.O. data loggers will be deployed at 14 of the 45 Target sampling sites. Target sampling sites were ranked on their potential to be impaired by nutrients based on land use characteristics, stream substrate, and best professional judgement of the staff conducting water chemistry sample collection. This ranking will be used to select the ten most likely and ten most unlikely sites for potential nutrient impairment; seven sites from each group of ten will be randomly selected for deployment of HOBO data loggers following the first round of water chemistry sample collection.

Sampling Methods and Sample Handling

Bacteriological Sampling

The bacteriological sampling will be conducted by one or two teams consisting of two staff. The work effort will require an average of one hour per site per week. Samples will be processed in an IDEM *E. coli* Mobile Laboratory (van) equipped with all materials and equipment necessary for the Standard Method (SM) 9223B Colilert® *E. coli* Test Method near the sampling sites. Five samples from each site (40 sites total) will be collected at equally spaced intervals over a thirty calendar-day period. Staff will collect the samples in a 120 mL presterilized wide mouth container from the center of flow (if the stream is wadeable) or from the shoreline using a pole sampler (if the stream is not wadeable). This is subject to field staff determination based on available Personal Protective Equipment (PPE), turbidity, and other factors. However, streams waist deep or shallower are generally considered wadeable. All samples will be consistently labeled, cooled, and held at a temperature less than 10ºC during transport. All *E. coli* samples will be collected on a schedule such that any sampling crew can deliver them to the IDEM *E. coli* Mobile Laboratory for analyses within the bacteriological holding time of six hours.

The IDEM *E. coli* Mobile Laboratory is used in this project to facilitate *E. coli* testing by eliminating the necessity of transporting samples to distant contract laboratories

within a six-hour holding time. The *E. coli* Mobile Laboratory provides work space containing storage for samples, supplies for Colilert® Quanti-tray testing, and all equipment needed for collecting, preparing, incubating, and analyzing results. All supplies will be obtained from IDEXX Laboratories, Inc., Westbrook, Maine.

Water Chemistry Sampling

During three discrete sampling events, one team of two staff will collect grab water chemistry samples, and record water chemistry field measurements and physical site descriptions on the IDEM Stream Sampling Field Data Sheet (Attachment 2). All water chemistry sampling will adhere to the Water Quality Surveys Section Field Procedure Manual (IDEM 2002, pp 8–14). Orthophosphate will only be collected at the 14 sites at which a HOBO data logger will be deployed. Samples will be collected on a separate sampling trip from the water chemistry sampling due to the shorter (48 hr) holding times for this analyte. Water chemistry sampling usually takes 30 minutes to complete for each site, depending on accessibility.

Algal Sampling

In addition to standard water chemistry sampling, one team of two staff will collect chlorophyll *a* and pheophytin *a* from the seston community at sites with a drainage area greater than 1000 square miles and periphyton community at all sites during the third round of water chemistry in September and October (Table 1). Sampling for an average site that includes all of the above parameters will require approximately 2.5 hours of effort. The Algal Biomass Lab Datasheet (Attachment 3) and Probabilistic Monitoring Section Physical Description of Stream Site Form (Attachment 4) will be used to record information regarding substrates sampled for periphyton and physical parameters of the stream sampling area. See IDEM 2018d for a description of methods used in algal community sampling.

Laboratory Procedures for Diatom Identification and Enumeration

See IDEM 2015a for a description of methods used in diatom identification and enumeration.

Fish Community Sampling

Fish community sampling will be performed using various standardized electrofishing methodologies depending on stream size and site accessibility. Fish assemblage assessments will be performed in a sampling reach of 15 times the average wetted width, with a minimum reach of 50 meters and a maximum reach of 500 meters (IDEM 2018c). An attempt will be made to sample all habitat types available (i.e., pools, shallows; see IDEM 2019b, pg 10–11, for more potential habitat types) within the sample reach to ensure adequate representation of the fish community present at the time of the sampling event. The possible list of electrofishers to be utilized include: the Smith-Root LR-24 or LR-20B Series backpack electrofishers; the Smith-Root 1.5kVa electrofishing system; the Smith-Root 2.5 Generator Powered Pulsator (GPP) electrofisher with RCB-6B junction box and rat-tail cathode cable; or Midwest Lake Electrofishing Systems (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

foot Loweline boat); or, for nonwadeable sites, the Smith-Root Type VI-A electrofisher assembled in a 16 foot Loweline boat (IDEM 1992a, 1992b, 1992c, 2018c).

Sample collections during high flow or turbid conditions will be avoided due to 1) low collection rates which result in nonrepresentative samples and 2) safety considerations for the sampling team. Sample collection during late autumn will be avoided 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 samples that are not representative of the stream's fish assemblage (IDEM 2018c).

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

For each field taxonomist (generally the crew leader), a complete set of fish vouchers are retained for any different species encountered during the summer sampling season. Vouchers may consist of either preserved specimens or digital images. Prior to processing fish specimens and completion of the fish community datasheet, one to two individuals per new species encountered will be preserved in 3.7% formaldehyde solution to serve as representative fish vouchers if the fish specimens can be positively identified and the individuals for preservation are small enough to fit in a 2000 mL jar. If however, the specimens are too large to preserve, a photo of key characteristics (e.g., fin shape, size, body coloration) will be taken for later examination (IDEM 2016a, p. 8; IDEM 2018c). Also, prior to sampling, 10% of the sites will be randomly selected for revisiting and a few representative individuals of all species found at the site will be preserved or photographed to serve as vouchers. Taxonomic characteristics for possible species encountered in the basin of interest will be reviewed prior to field work. Fish specimens should also be preserved if they cannot be positively identified in the field (i.e., those that co-occur like the Striped and Common Shiners or are difficult to identify when immature); individuals that appear to be hybrids or have unusual anomalies; and dead specimens that are taxonomically valuable for undescribed taxa (e.g., Red Shiner or Jade Darter), life history studies, or research projects (IDEM 2018c).

Data will be recorded for nonpreserved fish on the IDEM Fish Collection Data Sheet (Attachment 5) 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). Once the data have been recorded, specimens will be released within the sampling reach from which they were collected. Data will be recorded for preserved fish specimens following taxonomic identification in the laboratory (IDEM 2018c).

Macroinvertebrate Sampling

Aquatic benthic macroinvertebrate samples are collected using a modification of the U.S. EPA Rapid Bioassessment Protocol multihabitat (MHAB) approach using a D-frame dip net (Plafkin et al. 1989; Barbour et al. 1999; Klemm et al. 1990; IDEM 2019a). The IDEM MHAB approach (IDEM 2019a) is composed of a 1-minute "kick" sample within a riffle or run (collected by disturbing one square meter of stream bottom substrate in a riffle or run habitat, and collecting the dislodged macroinvertebrates within the dipnet); and a 50 meter "sweep" sample of additional instream habitats (collected by disturbing habitats such as emergent vegetation, root wads, coarse particulate organic matter, depositional zones, logs, and sticks; and collecting the dislodged macroinvertebrates within the dipnet). The 50 meter length of riparian corridor that is sampled at each site will be defined using a tape measure or rangefinder. If the stream is too deep to wade, a boat will be used to sample the 50 meter zone along the shoreline that has the best available habitat. The 1-minute "kick" (if collected) and 50 meter "sweep" samples are combined in a bucket of water. The sample will be elutriated through a U.S. standard number 35 (500 µm) sieve a minimum of five times so that all rocks, gravel, sand, and large pieces of organic debris are removed from the sample. The remaining sample is then transferred from the sieve to a white plastic tray. The collector (while still onsite) will conduct a 15-minute pick of macroinvertebrates at a single organism rate with an effort to pick for maximum organism diversity and relative abundance through turning and examination of the entire sample in the tray. The resulting picked sample will be preserved in 80% isopropyl alcohol; returned to the laboratory for identification at the lowest practical taxonomic level (usually genus or species level, if possible); and evaluated using the MHAB macroinvertebrate IBI. Before leaving the site, an IDEM OWQ Macroinvertebrate Header Form (Attachment 6) will be completed for the sample (IDEM 2019c).

Habitat Assessments

Habitat assessments will be completed immediately following macroinvertebrate and fish community sample collections at each site using a slightly modified version of the Ohio Environmental Protection Agency (OHEPA) Procedures for Completing the QHEI, 2006 edition (Rankin 1995; OHEPA 2006). A separate QHEI (Attachment 7) must be completed for these two sample types since the sampling reach length may differ (i.e., 50 meters for macroinvertebrates and between 50 and 500 meters for fish). See IDEM 2019b for a description of the method used in completing the QHEI.

Field Parameter Measurements

Dissolved oxygen, pH, water temperature, specific conductance, and dissolved oxygen percent saturation will be measured with a data sonde during each sampling event, regardless of the sample type being collected. Measurement procedures and operation of the data sonde shall be performed according to the manufacturers' manuals (Hydrolab Corporation 2002; YSI 2006) and Sections 2.10–2.13 of the Water Quality Surveys Section Field Procedure Manual (IDEM 2002, pp 67–79). Turbidity will be 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, the data sonde measurement for turbidity

will be recorded and noted in the comments. All field parameter measurements and weather codes will be recorded on the IDEM Stream Sampling Field Data Sheet (Attachment 2) with other sampling observations. A digital photo will also be taken upstream and downstream of the site during each sampling event (IDEM 2018d).

Dissolved Oxygen Continuous Data Logger Measurements

During the low-flow portion of the sampling season (generally from the end of August to mid-September), an Onset Hobo® U26-001 D.O. data logger will be deployed in a representative location, within the targeted stream segment of 14 preselected Target sample sites, to record D.O. measures at 10 minute intervals for no less than 14 consecutive days (IDEM 2017b). A programmed and calibrated data logger will be attached to a 16”x4”x8” cinder block, post, or other securing device dependent on the particular conditions observed at the stream sampling site, and placed in a calm glide portion of the stream segment with a water depth of between 0.3 and 1.0 meters. The data logger is not to be placed directly below a riffle, a turbulent run, or in a deep pool. The cross sectional location to the channel for placement should be near the center, if possible. GPS coordinates point of the exact placement of each data logger will be determined using an agency approved handheld GPS unit which can verify horizontal precision of 5 meters or less (IDEM 2015b). At least one photograph/digital image will be taken of this placement point in relation to the stream reach to document location and stream flow conditions to the extent possible in a photograph. *In-situ* water quality measurements will be recorded at the time of each data logger deployment. Upon retrieval of the D.O. data logger all data will be off-loaded to a Hobo U-DTW-1 Waterproof shuttle. Once data are off-loaded the data logger will be returned to the WAPB calibration room at the Western Select Property IDEM OWQ laboratory and prepared (programmed and calibrated) for redeployment at another location. *In-situ* water quality measurement will also be recorded during the retrieval of each D.O. data logger.

Analytical Methods

Table 6 lists the *E. coli* bacteriological and field parameters with their respective test method and IDEM quantification limits. Table 7 lists the algal parameters with test method and IDEM quantification limits. Table 8 shows bacteriological and water chemistry sample container, preservative, and holding time requirements (all samples iced to 4 Degrees Celsius °C). Table 9 lists numerous parameters (priority metals, anions/physical, and nutrients/organic) with their respective test methods, IDEM reporting limits, and contract laboratory reporting limits. The IDEM OWQ Chain of Custody Form (Attachment 8) and the 2019 Corvallis Water Sample Analysis Request Form (Attachments 9 and 10) accompanies each sample set through the analytical process.

Diatoms will be collected in the field using protocols described in IDEM 2018d.

Quality Control and Custody Requirements

QA protocols will follow part B5 of the Surface Water QAPP (IDEM 2017a, p 170).

Bacteriological Data

Bacteriological samples will be analyzed using the SM 9223B Enzyme Substrate Coliform Test Method (see Table 6 for quantification limits). Samples will be collected using 120 mL presterilized wide mouth containers and adhere to the six hour holding time (Table 8). Analytical results from the IDEM *E. coli* Mobile Laboratory include QC check sample results from which precision, accuracy, and completeness can be determined for each batch of samples. Raw data are archived by analytical batch for easy retrieval and review. Chain of custody procedures must be followed, including: time of collection, time of setup, time of reading the results, and time and method of disposal (IDEM 2002, pg 18–21). Any method deviations will be thoroughly documented in the field notes.

All QA/QC samples will be tested according to the following guidelines:

Field Duplicate:	Field Duplicates will be collected at a frequency of 1 per batch or at least 1 for every 20 samples collected (≥ 5%).
Field Blank:	Field Blanks will be collected at a frequency of 1 per batch or at least 1 for every 20 samples collected (≥ 5%).
Laboratory Blank:	Laboratory Blanks (sterile laboratory water blanks) will be tested at a frequency of 1 per day.
Positive Control:	Each lot of media will be tested with *E. coli* bacterial cultures for positive performance (SM 9020 B.8 and B.9).
Negative Controls:	Each lot of media will be tested with bacterial cultures other than *E. coli* or a noncoliform for negative performance (SM 9020 B.8 and B.9).

QA documentation for each batch of samples consists of a chain of custody form, a QA/QC summary sheet, and spreadsheets of results. This documentation is submitted to the Technical and Logistical Services Section for QA review and the assignment of an appropriate DQA Level.

Water Chemistry Data

Sample bottles and preservatives certified for purity will be used. Sample collection procedures, including the container and preservative used for each parameter and holding times will adhere to U.S. EPA requirements for water chemistry testing (see Table 8). Field duplicates and matrix spike/matrix spike duplicates (MS/MSD) shall be collected at the rate of one per sample analysis set or one per every 20 samples, whichever is greater. Additionally, field blank samples using American Society for Testing and Materials (ASTM) D1193-91 Type I water will be taken at a rate of one set per sampling crew for each week of sampling activity. All samples collected for water chemistry analysis will be processed by Pace Analytical Services, Inc. (Indianapolis, Indiana) following the specifications set forth in Request for Proposals 16-074 (IDEM 2016b), except orthophosphate which will be analyzed by the Indiana State Department of Health (ISDH, Indianapolis, Indiana).

Table 6. Bacteriological and Field Parameters showing method and IDEM quantification limit.

Parameters	Method	IDEM Quantification Limit
E. coli (Enzyme Substrate Coliform Test)	SM 9223B	1 MPN [2] / 100 mL
Dissolved Oxygen (data sonde optical)	ASTM D888-09	0.05 mg/L
Dissolved Oxygen (data sonde)	SM 4500-OG	0.03 mg/L
Dissolved Oxygen (Winkler Titration)	SM 4500-OC [3]	0.20 mg/L
Dissolved Oxygen % Saturation (data sonde optical)	ASTM D888-09	0.05 %
Dissolved Oxygen % Saturation (data sonde)	SM 4500-OG	0.01 %
pH (data sonde)	U.S. EPA 150.2	0.10 SU
pH (field pH meter)	SM 4500H-B [3]	0.10 SU
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) [3]	0.1 Degrees Celsius (°C)
Turbidity (data sonde)	SM 2130B	0.02 NTU [4]
Turbidity (Hach™ turbidity kit)	U.S. EPA 180.1	0.05 NTU [4]

[1] SM = Standard Method
[2] 1 MPN (Most Probable Number) = 1 CFU (Colony Forming Unit)
[3] Method used for Field Calibration Check
[4] NTU = Nephelometric Turbidity Unit(s)

Table 7. Algal Parameters showing method and IDEM quantification limit.

Algal Parameter	Method	IDEM Quantification Limit
Seston (Corrected) Chlorophyll *a* – Suspended	U.S. EPA 445.0	TBD
Seston Pheophytin *a* – Suspended	U.S. EPA 445.0	TBD
Seston (Uncorrected) Chlorophyll *a* – Suspended	Modified U.S. EPA 445.0	TBD
Periphyton (Corrected) Chlorophyll *a* – Attached	U.S. EPA 445.0	TBD
Periphyton Pheophytin *a* – Attached	U.S. EPA 445.0	TBD
Periphyton (Uncorrected) Chlorophyll *a* – Suspended	Modified U.S. EPA 445.0	TBD

Table 8. Bacteriological and Water Chemistry Sample Container, Preservative, and Holding Time Requirements[1]

Parameter	Container	Preservative	Holding Time
[1,2] Alkalinity as $CaCO_3$*	1 L, HDPE, narrow mouth	None	14 days
[3] Ammonia-N**	1 L, glass, Amber Boston Round	H_2SO_4 < pH 2	28 days
Chloride*	1 L, HDPE, narrow mouth	None	28 days
Chemical Oxygen Demand**	1 L, glass, Amber Boston Round	H_2SO_4 < pH 2	28 days
Cyanide (All forms)	1 L, HDPE, narrow mouth	NaOH > pH 12	14 days
E. coli	120 mL, presterilized, wide mouth	$Na_2S_2O_3$	6 hours
Hardness (as $CaCO_3$*) Calculated	1 L, HDPE, narrow mouth	HNO_3 < pH 2	6 months
Metals (Total & Dissolved)	1 L, HDPE, narrow mouth	HNO_3 < pH 2	6 months
Nitrogen, Nitrate + Nitrite**	1 L, glass, Amber Boston Round	H_2SO_4 < pH 2	28 days
Total Phosphorus**	1 L, glass, Amber Boston Round	H_2SO_4 < pH 2	28 days
Orthophosphate**	500 mL, Brown HDPE, narrow mouth	Dry ice	7 days
Solids (All Forms)*	1 L, HDPE, narrow mouth	None	7 days
Sulfate*	1 L, HDPE, narrow mouth	None	28 days
Total Kjeldahl Nitrogen**	1 L, glass, Amber Boston Round	H_2SO_4 < pH 2	28 days
Total Organic Carbon**	1 L, glass, Amber Boston Round	H_2SO_4 < pH 2	28 days

[1] All samples iced to 4°C
[2] General chemistry includes all parameters noted with an *
[3] Nutrients include all parameters noted with a **
[4] HDPE – High Density Polyethylene

Table 9. Water Chemistry Parameters with Test Method and IDEM and Laboratory Reporting Limits.

Priority Metals

Parameter	Total	Dissolved	Test Method	IDEM-requested Reporting Limit (µg/L)	Pace Laboratory Reporting Limit (µg/L)
Aluminum	☒	☒	U.S. EPA 200.8	10	10
Antimony	☒	☒	U.S. EPA 200.8	1	1
Arsenic	☒	☒	U.S. EPA 200.8	2	1
Calcium	☒	☐	U.S. EPA 200.7	20	1,000
Cadmium	☒	☒	U.S. EPA 200.8	1	0.2
Chromium	☒	☒	U.S. EPA 200.8	3	2
Copper	☒	☒	U.S. EPA 200.8	2	1
Lead	☒	☒	U.S. EPA 200.8	2	1
Magnesium	☒	☐	U.S. EPA 200.7	95	1,000
Nickel	☒	☒	U.S. EPA 200.8	1.5	0.5
Selenium	☒	☒	U.S. EPA 200.8	4	1
Silver	☒	☒	U.S. EPA 200.8	0.3	0.5
Zinc	☒	☒	U.S. EPA 200.8	5	3

Nutrients/Organic (ISDH)

Parameter	ISDH Test Method	IDEM-requested Reporting Limit (mg/L)	ISDH Laboratory Reporting Limit (mg/L)
Orthophosphate	U.S. EPA 365.3	0.006	0.006

Anions/Physical

Parameter	Pace Test Method	IDEM-requested Reporting Limit (mg/L)	Pace Laboratory Reporting Limit (mg/L)
Alkalinity (as $CaCO_3$)	U.S. EPA 310.2	10	2
Total Solids	SM 2540B	1	10
Total Suspended Solids	SM 2540D	1	5
Dissolved Solids	SM 2540C	10	10
Sulfate	U.S. EPA 300.0	0.05	0.25
Chloride	U.S. EPA 300.0	1	0.25
Hardness (as $CaCO_3$) by calculation	SM 2340B	0.4	1

Nutrients/Organic (Pace)

Parameter	Pace Test Method	IDEM-requested Reporting Limit (mg/L)	Pace Laboratory Reporting Limit (mg/L)
Total Kjeldahl Nitrogen (TKN)	U.S. EPA 351.2	0.1	0.5
Ammonia-N	U.S. EPA 350.1	0.01	0.1
Nitrogen, Nitrate + Nitrite	U.S. EPA 353.2	0.05	0.1
Total Phosphorus	U.S. EPA 365.1	0.01	0.05
Total Organic Carbon (TOC)	SM 5310C	1	1
Cyanide-Total	U.S. EPA 335.4	0.01	0.005
Cyanide-Weak Acid Dissociable	SM 4500CN-I	0.01	0.005
Chemical Oxygen Demand (COD)	U.S. EPA 410.4	3	10

Org: Organic
SM: Standard Methods for the Examination of Water and Wastewater
U.S. EPA: United States Environmental Protection Agency

Algal Community Data

Excessive algal conditions will be recorded by staff if an algal bloom is observed on the water's surface or in the water column. Staff are not calibrated on this rating (i.e., the decision as to the severity of the bloom is based on best professional judgement), but an algal mat on the surface of the water or a bloom that gives the water the appearance of green paint would be justification for a decision of excessive algal conditions.

To decrease the potential for cross contamination and bias of the algal samples, all equipment that has come in contact with the sample will be cleaned with detergent and rinsed with ASTM D1193-91 Type III water after sampling has been completed at a given site. All sample labels must be accurately and thoroughly completed, including AIMS II sample numbers, date, stream name, and sampling location. Chain of Custody forms will be completed in the field to document the collection and transfer of samples to the laboratory. Upon arrival to the laboratory, samples will be checked in by the laboratory manager. For the diatom samples, there will be another Chain of Custody form to document when the sample is removed from storage to be processed and made into a permanent mount.

Analysis methods for chlorophyll *a* and pheophytin *a* can be viewed in Table 7. Beginning in 2019, all samples collected for chlorophyll *a* and pheophytin *a* will be processed by the new IDEM WAPB Algal Laboratory. Two methods will be used for the determination of total chlorophyll *a* during this sampling season. The first is the traditional U.S. EPA Method 445.0, which determines a "corrected" total chlorophyll *a* concentration fluorometrically by measuring both the initial chlorophyll *a* concentration followed by acidification to determine the pheophytin *a* concentration. The total corrected chlorophyll *a* concentration of a sample is determined quantitatively (equations 12.2 – 12.3 in U.S. EPA Method 445.0). The second method used will be the modified U.S. EPA Method 445.0, in which the "uncorrected" total chlorophyll *a* value is measured fluorometrically via a set of very narrow bandpass excitation and emission filters that are specific to chlorophyll *a*. No pheophytin *a* concentration is determined in the modified method, and this method is not impacted by other chlorophyll *a* degradation products which may be prevalent in inland waters. Method quantification limits for both methods will be determined using U.S. EPA Method 445.0 Section 9.0 Quality Control during laboratory set up prior to the 2019 sampling season.

Blank filters will be run for periphyton and seston chlorophyll *a*. All chlorophyll *a* and pheophytin *a* filters will be processed in quadruplicate for QC purposes (four filters are processed from the same sample per analysis method). Ten percent of these replicate field samples will be analyzed at a separate laboratory (TBD).

QC of the diatom sampling, enumeration, and identification project will be documented by QC checks of both field and laboratory data. See page 22 in IDEM 2015a for a description of QA/QC protocols used in Diatom Identification and Enumeration. All diatom samples will be verified by the Department of Biological and Environmental Sciences of Georgia College and State University (Milledgeville, Georgia) following the specifications set forth in IDEM 2015a.

Fish Community Data

Fish community sampling revisits will be performed at a rate of 10 percent of the total fish community sites sampled, approximately 4 in the basin (IDEM 2018c). Revisit sampling will be performed with at least 2 weeks of recovery between the initial and revisit sampling events. The fish community revisit sampling and habitat assessment will be performed with either a partial or complete change in field team members (IDEM 2018c). The resulting IBI and QHEI total score between the initial visit and the revisit will be used to evaluate precision. The IDEM OWQ Chain of Custody Form is used to track samples from the field to the laboratory (Attachment 8). 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.

Macroinvertebrate Community Data

Sites at which duplicate macroinvertebrate field samples will be collected are randomly selected prior to the beginning of the field season and occur at a rate of 10 percent of the total macroinvertebrate community sites sampled, approximately 4 in the basin. The macroinvertebrate community duplicate sample and corresponding habitat assessment will be performed by the same team member who performed the original sample, and will be conducted immediately after the initial sample is collected. This will result in a precision evaluation based on a 10% duplicate of samples collected. Sites in the basin will be divided equally among the macroinvertebrate staff; each staff will be responsible for collecting at least one duplicate sample. The IDEM OWQ Chain of Custody Form is used to track samples from the field to the laboratory (Attachment 8). Laboratory identifications and QA/QC of taxonomic work is maintained by the IDEM macroinvertebrate laboratory supervisor. 10% of samples (the initial samples taken at sites where duplicate samples were collected) will be verified by an outside taxonomist (IDEM 2019a).

Field Parameter Measurements/Instrument Testing/Calibration

The data sonde will be calibrated immediately prior to each week's sampling (IDEM 2002). The dissolved oxygen component of the calibration procedure will be conducted using the air calibration method. Calibration results and drift values will be recorded, maintained, stored, and archived 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 described in the instrument users manuals (Hydrolab Corporation 2002; YSI 2006). The unit will be field checked for accuracy once during the week by comparison with a Winkler dissolved oxygen test (IDEM 2002, page 64), as well as Hach turbidity and Oakton pH and temperature meters. Weekly field calibration records will be recorded in the field calibrations portion of Attachment 2 and entered into the AIMS II database. A Winkler dissolved oxygen test will also be conducted in the field at sites where the dissolved oxygen concentration is 4.0 mg/L or less.

The Onset Hobo® U26-001 D.O. data loggers utilize optical D.O. measurement technology specified in ASTM D888-12 (ASTM 2012). Calibration and maintenance of these units will follow the manufacturers procedures listed in the "HOBO® Dissolved Oxygen Logger (U26-001) Manual" (IDEM 2017b).

Field Analysis Data

In-situ water chemistry field data are collected in the field using calibrated or standardized equipment. 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 and ranges have been set for each analysis. QC checks are performed on information for field or laboratory results to estimate precision, accuracy, and completeness for the project, as described in the Surface Water QAPP (IDEM 2017a) Section C1.1 on page 176.

Algal Community Data

IDEM 2018d describes the equipment required for the collection of periphyton include; none of this equipment requires calibration. Equipment has been field tested to ensure its capability of appropriately removing periphyton from different types of substrate (rocks, sticks, sand/silt) (IDEM 2018d).

IDEM 2015a describes the equipment required for the preparation of permanent diatom mounts; other than the micropipetter, none of the laboratory equipment requires calibration. The micropipetter will be checked and recalibrated as necessary according to manufacturer's specifications (IDEM 2015a).

A Nikon differential interference contrast (DIC) microscope, and Nikon Elements D camera and imaging system will be used for identification and enumeration of diatoms. Branch staff calibrated the ocular reticle in the microscope. The ocular reticle was calibrated at each magnification with a stage micrometer. The calibration should be checked again if the microscope is moved to a new location.

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 2017a, pp. 56, 61–63), accuracy measurements by percent of recovery of MS/MSD samples analyzed in the laboratory (IDEM 2017a, 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 2017a, 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 QA criteria and rated DQA Level 3, as described in the Surface Water QAPP (IDEM 2017a, 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 used for QA and validation of the data are found on pages 184–185 of the Surface Water QAPP (IDEM 2017a).

Data Usability

The environmental data collected and its usability are qualified per each lab or field result obtained and classified into one or more of the four categories: Acceptable Data, Enforcement Capable Results, Estimated Data, and Rejected Data as described on page 184 of the Surface Water QAPP (IDEM 2017a).

Information, Data, and Reports

Data collected in 2019 will be recorded in the AIMS II database and presented in three compilation summaries. The first summary will be a general compilation of the 2019 Tributaries to the Ohio River Basin field and water chemistry data prepared for use in the 2022 Integrated Report. The second summary will be in database report format containing biological results and habitat evaluations, which will be produced for inclusion in the Integrated Report as well as individual site folders. All site folders are maintained at the WAPB facility. The third summary will include diatom species taxa names and enumerations on laboratory bench sheets. Using U.S. EPA's *spsurvey* package, written in the "R" programing language (R Core Team 2014), the percent of perennial stream miles in the basin that support, or do not support aquatic life and recreational uses will be made following use attainment decisions for each site sampled. 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 (TMDL, NPDES permit modeling, Watershed Restoration Projects, Water Quality Criteria refinement, etc.).

Laboratory and Estimated Cost

Laboratory analysis and data reporting for this project will comply with the Surface Water QAPP and TMDL Program (B-001-OWQ-WAP-XX-17-Q-R4, see IDEM 2017a), Request for Proposals 16-074 (see IDEM 2016b), and the IDEM Quality Management Plan (IDEM 2018e). Analytical tests on the water chemistry parameters outlined in Table 9 will be performed by Pace Analytical Services in Indianapolis, Indiana. Orthophosphate will be analyzed by ISDH. Accreditation related to Pace Indy is included as Appendix 1. Supplies for the bacteriological sampling will come from IDEXX Laboratories, Inc., Westbrook, Maine. Algal samples will be collected by IDEM staff. Chlorophyll *a* and pheophytin *a* will be analyzed by the IDEM WAPB Algal Laboratory by IDEM staff. Diatom identification and enumeration will be performed by IDEM staff and 10% of the samples by an outside contractor, the Department of Biological and Environmental Sciences, Georgia College and State University. All fish and macroinvertebrate samples will be collected and analyzed by IDEM staff. Ten percent of macroinvertebrate samples will be verified by Rhithron Associates, Inc. The anticipated budget for laboratory cost for the project is outlined in Table 10.

Table 10. Total Estimated Laboratory Cost for the Project.

Analysis	Number of Samples Collected	Laboratory	Estimated Cost
Water Chemistry	3 times @ 45 sites + 12 duplicates (1 per sample week) = 159 samples	Pace Analytical Services 7726 Moller Road. Indianapolis, Indiana 46268	$69,000
Orthophosphate	3 times @ 14 sites + 3 duplicates (1 per sample week) = 45 samples	ISDH, Environmental Laboratory Division 550 West 16th Street Indianapolis, IN 46202	$0
Bacteriological (*E. coli)*	5 times @ 40 sites + 10 blanks + 10 duplicates = 220 samples	IDEM Mobile Laboratory Supplies IDEXX Laboratories, Inc. One IDEXX Drive Westbrook, Maine 04092	$1,100
Algal Biomass	1 time @ 45 sites + 5 duplicates (1 per sample week) = 50 samples	IDEM WAPB Algal Laboratory 2525 Shadeland Avenue, Indianapolis, IN 46204	$7,024
Diatom Identification and Enumeration	1 time @ 45 sites + 5 duplicates (1 per sample week) = 50 samples 5 samples (10%) sent out for verification	Department of Biological and Environmental Sciences Georgia College and State University 320 S. Wayne St. Milledgeville, Georgia 31061	$1500
Macroinvertebrate Identification	1 time @ 38 sites + 4 duplicates = 42 samples 4 samples (10%) sent out for verification	Rhithron Associates, Inc. 33 Fort Missoula Road Missoula, Montana 59804	$880
		Total	$79,504

Table 11. Personnel Safety and Reference Manuals

Role	Required Training/Experience	Training References	Training Notes
All Staff that Participate in Field Activities	-Basic First Aid and Cardiopulmonary Resuscitation (CPR)	-A minimum of 4 hours of in-service training provided by WAPB (IDEM 2010a)	-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
	-Personal Protective Equipment (PPE) Policy	-IDEM 2008	-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 (SOLAS) certified strobe light.
	-Personal Flotation Devices (PFD)	-February 29, 2000 WAPB internal memorandum regarding use of approved PFDs	

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Code of Federal Regulations, 40 CFR Part 130.7 Total maximum daily loads (TMDL) and individual water quality-based effluent limitations

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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

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	Chromium VI(1636): NaOH	250T	250mL Teflon
MeHg	Methyl Mercury(1630): HCl	500T	500mL Teflon
		125T	125mL Teflon

Data Entered By: _____ QC1: _____
QC2: _____

Attachment 3. IDEM Algal Biomass Lab Data Sheet

Algal Biomass Lab Datasheet

Sample #	Site	Stream

Supporting Site Information

Traditional Forestry % Closed Canopy: ☐ <=10m ☐ >10m (Measure center only if width <=10m, record to nearest whole percent)

	North	East	South	West	Average x 1.04 =
Left Bank					
Center					
Right Bank					
Total %CC (Average from above, or Center only = %CC)				100 - %CC	

Phytoplankton Information

Sampling Method: ☐ Grab Sample (Dip) ☐ Multiple Verticles Number of Verticles:

Chlorphyll A	Blank	Filter 1	Filter 2	Filter 3	Filter 4
Sample Time					
Sample Volume (mL)					

Periphyton Information

Periphyton Habitat: ☐ Epilithic (Area-Scape) ☐ Epidendric (Cylinder Scrape) ☐ Epipsammic (Petri Dish)

Diatom Sample Collected: ☐ Yes ☐ No | Diatom Volume: mL | Formalin Volume: mL | Slurry Volume mL

Chlorphyll A	Blank	Filter 1	Filter 2	Filter 3	Filter 4
Sample Time					
Sample Volume (mL)					

Periphyton Area Calculation

Cylinder Scrape

Snag #	Length (cm)(L)	Circumference U_1	U_2	U_3	U	Area (L * U)
1						
2						
3						
4						
5						
				Total Area (cm²)		

Area Scrape (Using SG-92)

Rock#	1	2	3	4	5
Area (cm²)	7.38	7.38	7.38	7.38	7.38
Total (cm²)	36.9				

Petri Dish

Number of Discrete Samples (n):	
Total Area of One Sampler (a):	19.01 cm²
Total Sample Area (n * a):	

Stream Discharge / Rainfall Information

Nearest USGS Gage Site: ☐ Upstream ☐ Downstream ☐ No USGS Gage Near

River miles from site:	Discharge CFS at sampling: CFS
Gage location:	Discharge days since 50% flow exceeded: days
Rainfall data source: ☐ NOAA ☐ CoCoRaHS ☐ Indiana State Climate Office ☐ USGS gage rain gauge ☐ Other:	
Total precipitation at sampling: in. on date:	Cumulative rain 7 days previous to sampling: in.
Rain station location, county:	Inches since last rainfall previous to sampling: in.
	Days since last rainfall previous to sampling: days

Identifier	Date	Reviewer 1	Date	Reviewer 2	Date	Notes:
		☐ Review 1 Completed		☐ Review 2 Completed		

Attachment 4. IDEM Physical Description of Stream Site Form (front)

Revised 4/20/12

Probabilistic Monitoring Section Physical Description of Stream Site

Stream :_____ **AIMS #**_____ **Program #:**_____

Date: _____ **Time:** _____ **Crew Chief:**_____ **Crew**_____

General Stream Description:

_____
_____
_____
_____
_____

Characteristics at the site and immediately upstream (check All that apply).

Outer Riparian Zone L R	Inner Riparian Zone L R	L.Width(m)	R.Width(m)
☐ ☐ Agricultural Row crop	☐ ☐ Agricultural Rowcrop	_____	_____
☐ ☐ Agricultural Pasture	☐ ☐ Agricultural Pasture	_____	_____
☐ ☐ Devoid of Vegetation	☐ ☐ Devoid of Vegetation	_____	_____
☐ ☐ Fallow	☐ ☐ Fallow	_____	_____
☐ ☐ Forested	☐ ☐ Forest	_____	_____
☐ ☐ Residential	☐ ☐ Residential	_____	_____
☐ ☐ Commercial/Industrial	☐ ☐ Commercial/Industrial	_____	_____
☐ ☐ Weeds and Scrub	☐ ☐ Treeline	_____	_____
☐ ☐ Other _____	☐ ☐ Weeds and Scrub		
	☐ ☐ Other _____	_____	_____

Flow above site	Flow at site	Substrate (if visable)
☐ Riffle	☐ Riffle	☐ Cobble
☐ Pool	☐ Pool	☐ Boulder
☐ Eddy	☐ Eddy	☐ Sand
☐ Run	☐ Run	☐ Muck
☐ Glide	☐ Glide	☐ Silt
☐ Other _____	☐ Other _____	☐ Gravel
_____	_____	☐ Bedrock
_____	_____	☐ Other _____

Characteristics at site and immediately upstream (check ONE).

Water Description	Sinuosity of Channel	Discharge Pipe Present
☐ Clear	☐ High	☐ No
☐ Grey (Septic)	☐ Moderate	☐ Yes
☐ Murky	☐ Low	If yes, Effluent Flowing?
☐ Black	☐ Channelized	☐ No
☐ Brown		☐ Yes
☐ Green		Description of Effluent _____
☐ Other _____		_____

Continued on back

Attachment 4. IDEM Physical Description of Stream Site Form (back)

Revised 4/20/12

Stream Bank

Functional Slope: L R	Bank Erosion: L R	
☐ ☐ 0-30°	☐ ☐ Low	Percent Canopy Closed: _____
☐ ☐ 31-50°	☐ ☐ Moderate	Stream Stage 1-5 (Low-High): _____
☐ ☐ 51-70°	☐ ☐ High	Velocity of Stream 1-5 (Slow-Fast): _____
☐ ☐ 71-90°		

Visible Stream Degradation? ☐ Yes ☐ No

Description: _____

Aquatic Life Observed? ☐ Yes ☐ No

Description: _____

Algae Observed? ☐ Yes ☐ No

Description: _____

Rooted Macrophytes Observed? ☐ Yes ☐ No

Description: _____

Additional Comments:

_____
_____
_____
_____

Follow Up Date:_____Time:_____Crew Chief:_____Crew:_____
_____
_____
_____
_____

Follow Up Date:_____Time:_____Crew Chief:_____Crew:_____
_____
_____
_____
_____

Photography Date:_____ Time:_____ Number(s):_____; _____;_____

Notes (include items relevant for determining scale – items of known measurement, etc.)
_____
_____
_____

Attachment 5. 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 5. 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 6. IDEM OWQ Macroinvertebrate Header Form

Office of Water Quality: Macroinvertebrate Header

L-Site	Stream Name	Location	County	Surveyor

Sample Date	Sample #	Macro#	# Containers

Macro Sample Type:
☐ Black Light ☐ Kick
☐ CPOM ☐ MHAB
☐ Hester-Dendy ☐ Qualitative

☐ Normal _____
☐ Duplicate _____
☐ Replicate _____

☐ **Habitat Complete** ☐ **Sample Quality Rejected**

Riparian Zone/Instream Features

Macro Sub Sample (Field or Lab): _____

Macro Reach Sampled (m): _____

Watershed Erosion:
☐ Heavy
☐ Moderate
☐ None

Watershed NPS Pollution:
☐ No Evidence
☐ Obvious Sources
☐ Some Potential Sources

Stream Depth Riffle (m):	Stream Depth Run (m):	Stream Depth Pool (m):

Distances Riffle-Riffle (m):	Distances Bend-Bend (m):

Stream Width (m):	High Water Mark (m):

Stream Type:
☐ Cold
☐ Warm

Turbidity (Est):
☐ Clear ☐ Slightly Turbid
☐ Opaque ☐ Turbid

☐ **Channelization** ☐ **Dam Present**

Predominant Surrounding Land Use: ☐ Forest ☐ Field/Pasture ☐ Agricultural ☐ Residential ☐ Commercial ☐ Industrial
Other

Sediment

Sediment Odors: ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ Anaerobic ☐ None Other

Sediment Deposits: ☐ Sludge ☐ Sawdust ☐ Paper Fiber ☐ Sand ☐ Relic Shells Other

Sediment Oils: ☐ Absent ☐ Moderate ☐ Profuse ☐ Slight

☐ Are the undersides of stones, which are not deeply embedded, black?

Substrate Components

(Note: Select from 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, or 100% for each inorganic/ organic substrate component)

Inorganic Substrate Components (% Diameter)						
Bedrock	Boulder (>10 in)	Cobble (2.5-10 in)	Gravel (0.1-2.5 in)	Sand (gritty)	Silt	Clay (slick)

Organic Substrate Components (% Type)			
Detritus (sticks, wood)	Detritus (CPOM)	Muck/Mud (black, fine FPOM)	Marl(gray w/ shell fragments)

Water Quality

Water Odors: ☐ Normal ☐ Sewage ☐ Petroleum ☐ Chemical ☐ None Other

Water Surface Oils: ☐ Slick ☐ Sheen ☐ Glob ☐ Flocks ☐ None

IDEM 03/8/18

Attachment 7. IDEM OWQ Biological Qualitative Habitat Evaluation Index (front)

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	PRESENT R/R	OTHER TYPES PREDOMINANT	PRESENT P/G	PRESENT R/R
☐☐ BLDR/SLABS [10]	☐	☐	☐☐ HARDPAN [4]	☐	☐
☐☐ BOULDER [9]	☐	☐	☐☐ DETRITUS [3]	☐	☐
☐☐ COBBLE [8]	☐	☐	☐☐ MUCK [2]	☐	☐
☐☐ GRAVEL [7]	☐	☐	☐☐ SILT [2]	☐	☐
☐☐ SAND [6]	☐	☐	☐☐ ARTIFICIAL [0]	☐	☐
☐☐ BEDROCK [5]	☐	☐	(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]

SILT/NUTRIENT/MUCK
- ☐ 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] ___ POOLS > 70cm [2] ___ OXBOWS, BACKWATERS [1]
___ OVERHANGING VEGETATION [1] ___ ROOTWADS [1] ___ AQUATIC MACROPHYTES [1]
___ SHALLOWS (IN SLOW WATER) [1] ___ BOULDERS [1] ___ LOGS OR WOODY DEBRIS [1]
___ ROOTMATS [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	DEVELOPMENT	CHANNELIZATION	STABILITY
☐ HIGH [4]	☐ EXCELLENT [7]	☐ NONE [6]	☐ HIGH [3]
☐ MODERATE [3]	☐ GOOD [5]	☐ RECOVERED [4]	☐ MODERATE [2]
☐ LOW [2]	☐ FAIR [3]	☐ RECOVERING [3]	☐ LOW [1]
☐ NONE [1]	☐ POOR [1]	☐ RECENT OR NO RECOVERY [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

L R EROSION	L R RIPARIAN WIDTH	L R FLOOD PLAIN QUALITY	L R
☐☐ NONE/LITTLE [3]	☐☐ WIDE > 50m [4]	☐☐ FOREST, SWAMP [3]	☐☐ CONSERVATION TILLAGE [1]
☐☐ MODERATE [2]	☐☐ MODERATE 10-50m [3]	☐☐ SHRUB OR OLD FIELD [2]	☐☐ URBAN OR INDUSTRIAL [0]
☐☐ HEAVY/SEVERE [1]	☐☐ NARROW 5-10m [2]	☐☐ RESIDENTIAL, PARK, NEW FIELD [1]	☐☐ MINING/CONSTRUCTION [0]
	☐☐ VERY NARROW [1]	☐☐ FENCED PASTURE [1]	
	☐☐ NONE [0]	☐☐ OPEN PASTURE, ROW CROP [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:

☐ 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 Check ONE (Or 2 & average)
- ☐ 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 02/28/2018

Attachment 7 (cont.). IDEM OWQ Biological QHEI (back)

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 Depth
Pool: ☐ > 100 ft² ☐ > 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	___ %	___ %	___ %	___ %
	X	X	X	

Stream Drawing:

IDEM 02/28/2018

Attachment 8. 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 9. 2019 Corvallis Water Sample Analysis Request Form (Pace Analytical)

Indiana Department of Environmental Management
Office of Water Quality
Watershed Planning and Assessment Branch
www.idem.IN.gov

Water Sample Analysis Request

Project Name: 2019 Probabilistic Monitoring **Composite ☐ Grab ☒**

OWQ Sample Set	19WQW	IDEM Sample Nos.	
Crew Chief	Todd Davis	Lab Sample Nos.	
Collection Date	Apr. - Oct.	Lab Delivery Date	

Anions and Physical Parameters

Parameter	Test Method	Total	Dissolved
Alkalinity	310.2	☒ **	☐
Total Solids	SM2540B	☒ **	
Suspended Solids	SM2540D	☒ **	
Dissolved Solids	SM2540C		☒ **
Sulfate	300.0	☐ **	☒ **
Chloride	300.0	☐ **	☒
Hardness (Calculated)	SM-2340B	☒ **	☐
Fluoride	SM4500-F-C	☐ **	☐

Priority Pollutant Metals Water Parameters

Parameter	Test Method	Total	Dissolved
Antimony	200.8	☒	☒
Arsenic	200.8	☒	☒
Beryllium	200.8	☐	☐
Cadmium	200.8	☒	☒
Chromium	200.7	☒	☒
Copper	200.8	☒	☒
Lead	200.8	☒	☒
Mercury, Low Level	1631, Rev E.	☐	☐
Nickel	200.8	☒	☒
Selenium	200.8	☒	☒
Silver	200.8	☒	☒
Thallium	200.8	☐	☐
Zinc	200.7	☒	☒

Cations and Secondary Metals Parameters

Parameter	Test Method	Total	Dissolved
Aluminum	**200.7**, 200.8	☒	☒
Barium	200.8	☐	☐
Boron	200.8	☐	☐
Calcium	**200.7**, 200.8	☒ ***	☐
Cobalt	200.8	☐	☐
Iron	200.7	☐	☐
Magnesium	**200.7**, 200.8	☒ ***	☐
Manganese	200.8	☐	☐
Sodium	200.7	☐	☐
Silica, Total Reactive	200.7	☐	☐
Strontium	200.8	☐	☐

Send reports (Fed. Ex. or UPS) to:
Tim Bowren - IDEM
STE 100
2525 North Shadeland Ave.
Indianapolis, IN 46219

Deliver reports to:
Tim Bowren – IDEM
STE 100
2525 North Shadeland Ave.
Indianapolis, IN 46219

Organic Water Parameters

Parameter	Test Method	Total
Priority Pollutants: Oranochlorine Pesticides and PCBs	608	☐
Priority Pollutants: VOCs - Purgeable Organics	624	☐
Priority Pollutants: Base/Neutral Extractables	625	☐
Priority Pollutants: Acid Extractables	625	☐
Phenolics, 4AAP	420.4	☐
Oil and Grease, Total	1664A	☐

Nutrient & Organic Water Chemistry Parameters

Parameter	Test Method	Total	Dissolved
Ammonia Nitrogen	SM4500NH3-G	☒	☐
$CBOD_5$	SM5210B	☐	
Total Kjeldahl Nitrogen (TKN)	SM4500N(Org)	☒	☐
Nitrate + Nitrite	353.2	☒	☐
Total Phosphorus	365.1	☒	☐
TOC	SM 5310C	☒	☐
COD	410.4	☒	☐
Cyanide (Total)	335.4	☒	☐
Cyanide (Free)	SM4500CN-I	☒ *	☐
Cyanide (Amenable)	SM4500CN-G	☐ *	☐
Sulfide, Total	376.2	☐	☐

RFP 16-74 Contract Number:	018620 (Pace-Indy) PO # 0017549294-6 (Pace-Indy)

30 day reporting time required.

Notes:
** **= DO NOT RUN PARAMETER IF SAMPLE IDENTIFIED AS A BLANK ON THE CHAIN OF CUSTODY**
* **= RUN ONLY IF TOTAL CYANIDE IS DETECTED**
*** *= Report Calcium, Magnesium as Total Hardness components*

Testing Laboratory: Pace Analytical Services, Inc.
Attn: Sue Brotherton
Phone: 317-228-3136 7726 Moller Road
Indianapolis, IN 46268

Attachment 10. 2019 Corvallis Water Sample Analysis Request Form (ISDH)

Indiana Department of Environmental Management
Office of Water Quality
Watershed Planning and Assessment Branch
www.idem.IN.gov

Water Sample Analysis Request

Project Name: 2019 Corvallis Composite ☐ Grab ☒

OWQ Sample Set	19WQW	IDEM Sample Nos.	
Crew Chief	Todd Davis	Lab Sample Nos.	
Collection Date	Apr. - Oct.	Lab Delivery Date	

Anions and Physical Parameters

Parameter	Test Method	Total	Dissolved
Alkalinity (as $CaCO_3$)	EPA 310.2	☐ **	☐
Total Solids	SM 2540B	☐ **	
Suspended Solids	SM 2540D	☐ **	
Dissolved Solids	SM 2540C		☐ **
Sulfate	EPA 375.2	☐ **	☐ **
Chloride	SM 4500Cl-E	☐ **	☐
Hardness (as $CaCO_3$)	EPA 130.1	☐ **	☐
Fluoride	380-75WE	☐ **	☐
Silica (Reactive)	SM 4500-SiD	☐ **	☐

Priority Pollutant Metals Water Parameters

Parameter	Test Method	Total	Dissolved
Antimony	200.8	☐	☐
Arsenic	200.8	☐	☐
Beryllium	200.8	☐	☐
Cadmium	200.8	☐	☐
Chromium (Hex)	SM 3500Cr-D	☐	☐
Chromium (Total)	200.8	☐	☐
Copper	200.8	☐	☐
Lead	200.8	☐	☐
Mercury,	EPA 245.1	☐	☐
Nickel	200.8	☐	☐
Selenium	200.8	☐	☐
Silver	200.8	☐	☐
Thallium	200.8	☐	☐
Zinc	200.7	☐	☐

Cations and Secondary Metals Parameters

Parameter	Test Method	Total	Dissolved
Aluminum	200.7, 200.8	☐	☐
Barium	200.8	☐	☐
Boron	200.8	☐	☐
Calcium	200.7, 200.8	☐ ***	☐
Calcium (as $CaCO_3$)	SM 3500Ca-D	☐	☐
Cobalt	200.8	☐	☐
Iron	200.7	☐	☐
Magnesium	200.7, 200.8	☐ ***	☐
Manganese	200.8	☐	☐
Potassium	SM 3500-K D	☐	☐
Sodium	200.7	☐	☐
Strontium	200.7	☐	☐

Send reports (Fed. Ex. or UPS) to:

David Jordan - IDEM
Mail Code 65-40-2 (Shadeland)
100 N. Senate Ave.
Indianapolis, IN 46204-2251

Deliver reports to:

David Jordan - IDEM
STE 100
2525 North Shadeland Ave.
Indianapolis, IN 46219
DJordan@idem.in.gov

Organic Water Parameters

Parameter	Test Method	Total
Priority Pollutants: Oranochlorine Pesticides and PCBs	EPA 608	☐
Polynuclear Aromatic Hydrocarbons	EPA 610	☐
Priority Pollutants: VOCs - Purgeable Organics	EPA 624	☐
Priority Pollutants: Base/Neutral Extractables	EPA 625	☐
Priority Pollutants: Acid Extractables	EPA 625	☐
Phenolics, 4AAP	EPA 420.4	☐
Oil and Grease, Total	EPA 1664A	☐
Semi-volatile Organics & Pesticides	EPA 525.2	☐

Nutrient & Organic Water Chemistry Parameters

Parameter	Test Method	Total	Dissolved
Ammonia Nitrogen	EPA 350.1	☐	☐
$CBOD_5$	SM 5210B	☐	
$CBOD_U$	SM 5210B	☐	
Total Kjeldahl Nitrogen (TKN)	EPA 351.2	☐	☐
Nitrate + Nitrite	EPA 353.1	☐	☐
Total Phosphorus	EPA 365.1	☐	☐
Phosphorus, DRP	EPA 365.1	☐	☒
TOC	SM 5310B	☐	☐
COD (Low Level)	SM 5220D	☐	☐
Cyanide (Total)	EPA 335.4	☐	☐
Cyanide (Free)	SM 4500CN-I	☐ *	☐
Cyanide (Amenable)	SM 4500CN-G	☐ *	☐

Bacteriological Water Parameters

Parameter	Test Method	Total	Dissolved
E. coli (Colilert Method)	SM9223B	☐	

30 day reporting time required.

Notes:

**** = DO NOT RUN PARAMETER IF SAMPLE IDENTIFIED AS A BLANK ON THE CHAIN OF CUSTODY**

*** = RUN ONLY IF TOTAL CYANIDE IS DETECTED**

**** = Report Calcium, Magnesium as Total Hardness components if Hardness is calculated*

Testing Laboratory:
Indiana State Department of Health (ISDH)
Environmental Laboratory Division
550 W. 16th Street
Indianapolis, IN 46202
Phone: 317-921-5815 (Ray Beebe) (Rev. 02/2019)

Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents

Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents (cont.)

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Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents (cont.)

EPA Number: *IN00043* **Scope of Accreditation for Certification Number: E-10177** Page 7 of 25

Pace Analytical Services, Inc - Indianapolis IN

	Primary AB
Program/Matrix: *CWA (Non Potable Water)*	
Conductivity	KS
Method SM 2540 B-2011	
Residue-total	KS
Method SM 2540 C-2011	
Residue-filterable (TDS)	KS
Method SM 2540 D-2011	
Residue-nonfilterable (TSS)	KS
Method SM 2540 F-2011	
Residue-settleable	KS
Method SM 3500-Cr B-2011	
Chromium VI	KS
Method SM 4500-Cl G-2011	
Total residual chlorine	KS
Method SM 4500-Cl^- E-2011	
Chloride	KS
Method SM 4500-CN^- C-2011	
Cyanide	KS
Method SM 4500-CN^- E-2011	
Cyanide	KS
Method SM 4500-CN^- G-2011	
Amenable cyanide	KS
Method SM 4500-F^- C-2011	
Fluoride	KS
Method SM 4500-H+ B-2011	
pH	KS
Method SM 4500-NH3 G-2011	
Ammonia as N	KS
Method SM 4500-P E-2011	
Orthophosphate as P	KS
Method SM 4500-$S2^-$ D-2000	
Sulfide	KS
Method SM 4500-$S2^-$ D-2011	
Sulfide	KS
Method SM 5210 B-2011	
Biochemical oxygen demand	KS
Carbonaceous BOD, CBOD	KS
Method SM 5310 C-2011	
Total organic carbon	KS
Method SM 5540 C-2011	
Surfactants - MBAS	KS
Method TKN-NH3-CAL	
Organic nitrogen	KS

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Kansas Department of Health and Environment
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Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents (cont.)

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EPA Number: ***IN00043*** **Scope of Accreditation for Certification Number: E-10177** Page 10 of 25

Pace Analytical Services, Inc - Indianapolis IN

	Primary AB
Program/Matrix: ***RCRA (Non Potable Water)***	
Toxaphene (Chlorinated camphene)	KS
Method EPA 8082A	
Aroclor-1016 (PCB-1016)	KS
Aroclor-1221 (PCB-1221)	KS
Aroclor-1232 (PCB-1232)	KS
Aroclor-1242 (PCB-1242)	KS
Aroclor-1248 (PCB-1248)	KS
Aroclor-1254 (PCB-1254)	KS
Aroclor-1260 (PCB-1260)	KS
Method EPA 8141B	
Atrazine	KS
Azinphos-methyl (Guthion)	KS
Chlorpyrifos	KS
Chlorpyrifos-methyl	KS
Demeton-o	KS
Demeton-s	KS
Diazinon	KS
Dichlorovos (DDVP, Dichlorvos)	KS
Dimethoate	KS
Disulfoton	KS
Famphur	KS
Malathion	KS
Merphos	KS
Methyl parathion (Parathion, methyl)	KS
Naled	KS
Parathion, ethyl	KS
Phorate	KS
Ronnel	KS
Simazine	KS
Terbufos	KS
Tetrachlorvinphos (Stirophos, Gardona) E-isomer	KS
Method EPA 8151A	
2,4,5-T	KS
2,4-D	KS
2,4-DB	KS
3,5-Dichlorobenzoic acid	KS
Acifluorfen	KS
Bentazon	KS
Chloramben	KS
Dalapon	KS
DCPA di acid degradate	KS
Dicamba	KS
Dichloroprop (Dichlorprop)	KS
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	KS
MCPA	KS
MCPP	KS
Pentachlorophenol	KS

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EPA Number: ***IN00043*** **Scope of Accreditation for Certification Number: E-10177** Page 17 of 25

Pace Analytical Services, Inc - Indianapolis IN

	Primary AB
Program/Matrix: ***RCRA (Solid & Hazardous Material)***	
Method EPA 1010A	
Ignitability	KS
Method EPA 1311	
Toxicity Characteristic Leaching Procedure (TCLP)	KS
Method EPA 1312	
Synthetic Precipitation Leaching Procedure (SCLP)	KS
Method EPA 6010B	
Aluminum	KS
Antimony	KS
Arsenic	KS
Barium	KS
Beryllium	KS
Boron	KS
Cadmium	KS
Calcium	KS
Chromium	KS
Cobalt	KS
Copper	KS
Iron	KS
Lead	KS
Magnesium	KS
Manganese	KS
Molybdenum	KS
Nickel	KS
Potassium	KS
Selenium	KS
Silver	KS
Sodium	KS
Strontium	KS
Thallium	KS
Tin	KS
Titanium	KS
Vanadium	KS
Zinc	KS
Method EPA 6020	
Aluminum	KS
Antimony	KS
Arsenic	KS
Barium	KS
Beryllium	KS
Cadmium	KS
Chromium	KS
Cobalt	KS
Copper	KS
Lead	KS
Manganese	KS

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Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents (cont.)

EPA Number: *IN00043* **Scope of Accreditation for Certification Number: E-10177** Page 18 of 25

Pace Analytical Services, Inc - Indianapolis IN

	Primary AB
Program/Matrix: *RCRA (Solid & Hazardous Material)*	
Nickel	KS
Selenium	KS
Silver	KS
Thallium	KS
Vanadium	KS
Zinc	KS
Method EPA 7196A	
Chromium VI	KS
Method EPA 7470A	
Mercury	KS
Method EPA 7471A	
Mercury	KS
Method EPA 8015D	
Diesel range organics (DRO)	KS
Ethanol	KS
Ethylene glycol	KS
Gasoline range organics (GRO)	KS
Isobutyl alcohol (2-Methyl-1-propanol)	KS
Isopropyl alcohol (2-Propanol, Isopropanol)	KS
Methanol	KS
n-Butyl alcohol (1-Butanol, n-Butanol)	KS
n-Propanol (1-Propanol)	KS
Propylene glycol	KS
Method EPA 8081B	
4,4'-DDD	KS
4,4'-DDE	KS
4,4'-DDT	KS
Aldrin	KS
alpha-BHC (alpha-Hexachlorocyclohexane)	KS
alpha-Chlordane, cis-Chlordane	KS
beta-BHC (beta-Hexachlorocyclohexane)	KS
Chlordane (tech.)(N.O.S.)	KS
delta-BHC	KS
Dieldrin	KS
Endosulfan I	KS
Endosulfan II	KS
Endosulfan sulfate	KS
Endrin	KS
Endrin aldehyde	KS
Endrin ketone	KS
gamma-BHC (Lindane, gamma-HexachlorocyclohexanE)	KS
gamma-Chlordane	KS
Heptachlor	KS
Heptachlor epoxide	KS
Methoxychlor	KS
Toxaphene (Chlorinated camphene)	KS

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Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents (cont.)

EPA Number: *IN00043* **Scope of Accreditation for Certification Number: E-10177** Page 19 of 25

Pace Analytical Services, Inc - Indianapolis IN

	Primary AB
Program/Matrix: *RCRA (Solid & Hazardous Material)*	
Method EPA 8082A	
Aroclor-1016 (PCB-1016)	KS
Aroclor-1221 (PCB-1221)	KS
Aroclor-1232 (PCB-1232)	KS
Aroclor-1242 (PCB-1242)	KS
Aroclor-1248 (PCB-1248)	KS
Aroclor-1254 (PCB-1254)	KS
Aroclor-1260 (PCB-1260)	KS
Method EPA 8141B	
Atrazine	KS
Azinphos-methyl (Guthion)	KS
Chlorpyrifos	KS
Chlorpyrifos-methyl	KS
Demeton-o	KS
Demeton-s	KS
Diazinon	KS
Dichlorovos (DDVP, Dichlorvos)	KS
Dimethoate	KS
Disulfoton	KS
Famphur	KS
Malathion	KS
Merphos	KS
Methyl parathion (Parathion, methyl)	KS
Naled	KS
Parathion, ethyl	KS
Phorate	KS
Ronnel	KS
Simazine	KS
Terbufos	KS
Tetrachlorvinphos (Stirophos, Gardona) E-isomer	KS
Method EPA 8151A	
2,4,5-T	KS
2,4-D	KS
2,4-DB	KS
3,5-Dichlorobenzoic acid	KS
Acifluorfen	KS
Bentazon	KS
Dalapon	KS
DCPA di acid degradate	KS
Dicamba	KS
Dichloroprop (Dichlorprop)	KS
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	KS
MCPA	KS
MCPP	KS
Pentachlorophenol	KS
Picloram	KS
Silvex (2,4,5-TP)	KS

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Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents (cont.)

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EPA Number: ***IN00043*** **Scope of Accreditation for Certification Number:** **E-10177** Page 21 of 25

Pace Analytical Services, Inc - Indianapolis IN

	Primary AB
Program/Matrix: ***RCRA (Solid & Hazardous Material)***	
Chloroform	KS
cis-1,2-Dichloroethylene	KS
cis-1,3-Dichloropropene	KS
Dibromomethane (Methylene bromide)	KS
Dichlorodifluoromethane (Freon-12)	KS
Diethyl ether	KS
Ethyl acetate	KS
Ethyl methacrylate	KS
Ethylbenzene	KS
Hexachlorobutadiene	KS
Iodomethane (Methyl iodide)	KS
Isopropylbenzene	KS
Methacrylonitrile	KS
Methyl bromide (Bromomethane)	KS
Methyl chloride (Chloromethane)	KS
Methyl methacrylate	KS
Methyl tert-butyl ether (MTBE)	KS
Methylene chloride (Dichloromethane)	KS
m-Xylene	KS
Naphthalene	KS
n-Butyl alcohol (1-Butanol, n-Butanol)	KS
n-Butylbenzene	KS
n-Propylbenzene	KS
o-Xylene	KS
Propionitrile (Ethyl cyanide)	KS
p-Xylene	KS
sec-Butylbenzene	KS
Styrene	KS
tert-Butyl alcohol	KS
tert-Butylbenzene	KS
Tetrachloroethylene (Perchloroethylene)	KS
Toluene	KS
trans-1,2-Dichloroethylene	KS
trans-1,3-Dichloropropylene	KS
trans-1,4-Dichloro-2-butene	KS
Trichloroethene (Trichloroethylene)	KS
Trichlorofluoromethane (Fluorotrichloromethane, Freon 11)	KS
Vinyl acetate	KS
Vinyl chloride	KS
Xylene (total)	KS
Method EPA 8270C	
1,2,4,5-Tetrachlorobenzene	KS
1,2,4-Trichlorobenzene	KS
1,2-Dichlorobenzene (o-Dichlorobenzene)	KS
1,2-Diphenylhydrazine	KS
1,3-Dichlorobenzene	KS
1,3-Dinitrobenzene (1,3-DNB)	KS

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Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents (cont.)

EPA Number: *IN00043* **Scope of Accreditation for Certification Number: E-10177** Page 22 of 25

Pace Analytical Services, Inc - Indianapolis IN

Program/Matrix: *RCRA (Solid & Hazardous Material)*	Primary AB
1,4-Dichlorobenzene	KS
1,4-Naphthoquinone	KS
1,4-Phenylenediamine	KS
1-Methylnaphthalene	KS
1-Naphthylamine	KS
2,2'-Oxybis(1-chloropropane), bis(2-Chloro-1-methylethyl)ether	KS
2,3,4,6-Tetrachlorophenol	KS
2,4,5-Trichlorophenol	KS
2,4,6-Trichlorophenol	KS
2,4-Dichlorophenol	KS
2,4-Dimethylphenol	KS
2,4-Dinitrophenol	KS
2,4-Dinitrotoluene (2,4-DNT)	KS
2,6-Dichlorophenol	KS
2,6-Dinitrotoluene (2,6-DNT)	KS
2-Acetylaminofluorene	KS
2-Chloronaphthalene	KS
2-Chlorophenol	KS
2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)	KS
2-Methylaniline (o-Toluidine)	KS
2-Methylnaphthalene	KS
2-Methylphenol (o-Cresol)	KS
2-Naphthylamine	KS
2-Nitroaniline	KS
2-Nitrophenol	KS
2-Picoline (2-Methylpyridine)	KS
3,3'-Dichlorobenzidine	KS
3,3'-Dimethylbenzidine	KS
3-Methylcholanthrene	KS
3-Methylphenol (m-Cresol)	KS
3-Nitroaniline	KS
4-Aminobiphenyl	KS
4-Bromophenyl phenyl ether	KS
4-Chloro-3-methylphenol	KS
4-Chloroaniline	KS
4-Chlorophenyl phenylether	KS
4-Dimethyl aminoazobenzene	KS
4-Methylphenol (p-Cresol)	KS
4-Nitroaniline	KS
4-Nitrophenol	KS
4-Nitroquinoline 1-oxide	KS
5-Nitro-o-toluidine	KS
7,12-Dimethylbenz(a) anthracene	KS
a-a-Dimethylphenethylamine	KS
Acenaphthene	KS
Acenaphthylene	KS
Acetophenone	KS

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Appendix 1. Pace Laboratory Inc., Indianapolis: Accreditation Documents (cont.)

EPA Number: *IN00043* **Scope of Accreditation for Certification Number: E-10177** Page 23 of 25

Pace Analytical Services, Inc - Indianapolis IN

Program/Matrix: *RCRA (Solid & Hazardous Material)*	**Primary AB**
Aniline	KS
Anthracene	KS
Aramite	KS
Benzidine	KS
Benzo(a)anthracene	KS
Benzo(a)pyrene	KS
Benzo(b)fluoranthene	KS
Benzo(g,h,i)perylene	KS
Benzo(k)fluoranthene	KS
Benzoic acid	KS
Benzyl alcohol	KS
bis(2-Chloroethoxy)methane	KS
bis(2-Chloroethyl) ether	KS
Butyl benzyl phthalate	KS
Carbazole	KS
Chlorobenzilate	KS
Chrysene	KS
Di(2-ethylhexyl) phthalate (bis(2-Ethylhexyl)phthalate, DEHP)	KS
Diallate	KS
Dibenz(a,h) anthracene	KS
Diethyl phthalate	KS
Dimethoate	KS
Dimethyl phthalate	KS
Di-n-butyl phthalate	KS
Di-n-octyl phthalate	KS
Diphenylamine	KS
Disulfoton	KS
Ethyl methanesulfonate	KS
Famphur	KS
Fluoranthene	KS
Fluorene	KS
Hexachlorobenzene	KS
Hexachlorobutadiene	KS
Hexachlorocyclopentadiene	KS
Hexachloroethane	KS
Hexachlorophene	KS
Hexachloropropene	KS
Indeno(1,2,3-cd) pyrene	KS
Isodrin	KS
Isophorone	KS
Isosafrole	KS
Kepone	KS
Methapyrilene	KS
Methyl methanesulfonate	KS
Methyl parathion (Parathion, methyl)	KS
Naphthalene	KS
Nitrobenzene	KS

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