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2019 WATERSHED CHARACTERIZATION WP FOR LAUGHERY CREEK WATERSHED (HUC 0509020305)

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SIGNATURE PAGE

2019 Watershed Characterization WP
For Laughery Creek Watershed (HUC 0509020305)

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

B-043-OWQ-WAP-TGM-18-W-R0

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WORK PLAN ORGANIZATION

This sampling and analysis work plan is an extension of the existing Watershed Assessment and Planning Branch, March 2017 Quality Assurance Project Plan (QAPP) for Indiana Surface Water Programs and serves as a link to the existing QAPP as well as an independent QAPP of the project. Per the United States Environmental Protection Agency (U.S. EPA) 2006 QAPP guidance, this work plan establishes criteria and specifications pertaining to a specific water quality monitoring project that are usually described in the following four groups (phases) or sections as QAPP elements:

Section I. Project Management/Planning

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

Section II. Measurement/Data Acquisition

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

Section III. Assessment/Oversight

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

Section IV. Data Validation and Usability

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

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LIST OF ACRONYMS

AIMS:	Assessment Information Management System
ASTM:	American Society for Testing and Materials
CAC:	Chronic Aquatic Criteria
CFU:	Colony Forming Units
DO:	Dissolved Oxygen
DQA:	Data Quality Assessment
DQO:	Data Quality Objectives
E. coli:	*Escherichia coli*
GPS:	Global Positioning System
HUC:	Hydrologic Unit Code
IAC:	Indiana Administrative Code
IBC:	Impaired Biotic Community
IBI:	Index of Biotic Integrity
IDEM:	Indiana Department of Environmental Management
µS/cm:	Micro Siemens per Centimeter
mg/L:	Milligram per liter
MHAB:	Multi-habitat
mL:	Milliliter
MPN:	Most Probable Number
NTU:	Nephelometric Turbidity Unit(s)
OWQ:	Office of Water Quality
PPE:	Personal Protective Equipment
QA/QC:	Quality Assurance/Quality Control
QAPP:	Quality Assurance Project Plan
QHEI:	Qualitative Habitat Evaluation Index
S.U.:	Standard Units
SM:	Standard Method
SOP:	Standard Operating Procedures
TDS:	Total Dissolved Solids
TKN:	Total Kjeldahl Nitrogen
TMDL:	Total Maximum Daily Load
TOC:	Total Organic Carbon
TP:	Total Phosphorus
TSS:	Total Suspended Solids
U.S. EPA:	United States Environmental Protection Agency
WAPB:	Watershed Assessment and Planning Branch

DEFINITIONS

Assessment Unit	Reaches of waterbodies with similar features assigned unique identifiers to which all assessment information for that specific reach is associated, and which allow for mapping with geographic information systems
Elutriate	To purify, separate, or remove lighter or finer particles by washing, decanting, and settling.
Geometric site	Sampling site chosen according to its drainage area within a watershed.
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 (50m) 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 “sweep” samples, which are then composited.
Macroinvertebrate	Aquatic animals which lack a backbone, are visible without a microscope, and spend some period of their lives in or around water.
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.
Pour point	The outlet of a subwatershed or the common point where all the water flows out of any given subwatershed.
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.
Targeted site	A sampling site intentionally selected based on specific monitoring objectives or decisions to be made.

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I. PROJECT MANAGEMENT/PLANNING

Watershed Characterization Project Objective

The main objective of the watershed characterization monitoring project is to use an intensive targeted watershed design that characterizes the current condition of an individual watershed. This type of monitoring provides valuable data for the purposes of assessment, Total Maximum Daily Load (TMDL) development, watershed planning, and allows for future comparisons to evaluate changes in the water quality within the watershed(s) studied. Selecting a spatial monitoring design, with sufficient sampling density to accurately characterize water quality conditions, is a critical step in the process of developing an adequate local scale watershed study.

The Indiana Department Environmental Management (IDEM) has selected the Laughery Creek Watershed Characterization Monitoring Sampling Area (10-digit HUC 0509020305) (see Figure 1, Table 1) for a watershed characterization project. Sample sites were chosen using a modified geometric site selection process as well as targeted site selection in order to get the necessary spatial representation of the entire study area. Sites within this watershed were selected based on a geometric progression of drainage areas starting with the area at the mouth of the main stem stream and working upstream through the tributaries to the headwaters. Monitoring sites were then located to the nearest bridge. Three sites were rejected during recon due to best professional judgement of having the potential to go dry (no water present at time of sampling) at some point during the field season.

A more complete description of the Modified Geometric Design Steps for Watershed Characterization Studies selection process is included as Attachment 1. Sample sites were also chosen at the nearest bridge to the pour point (the lowest point in the basin through which all water flows) of each 12-digit HUC in the watershed, or chosen to characterize sources for TMDL development.

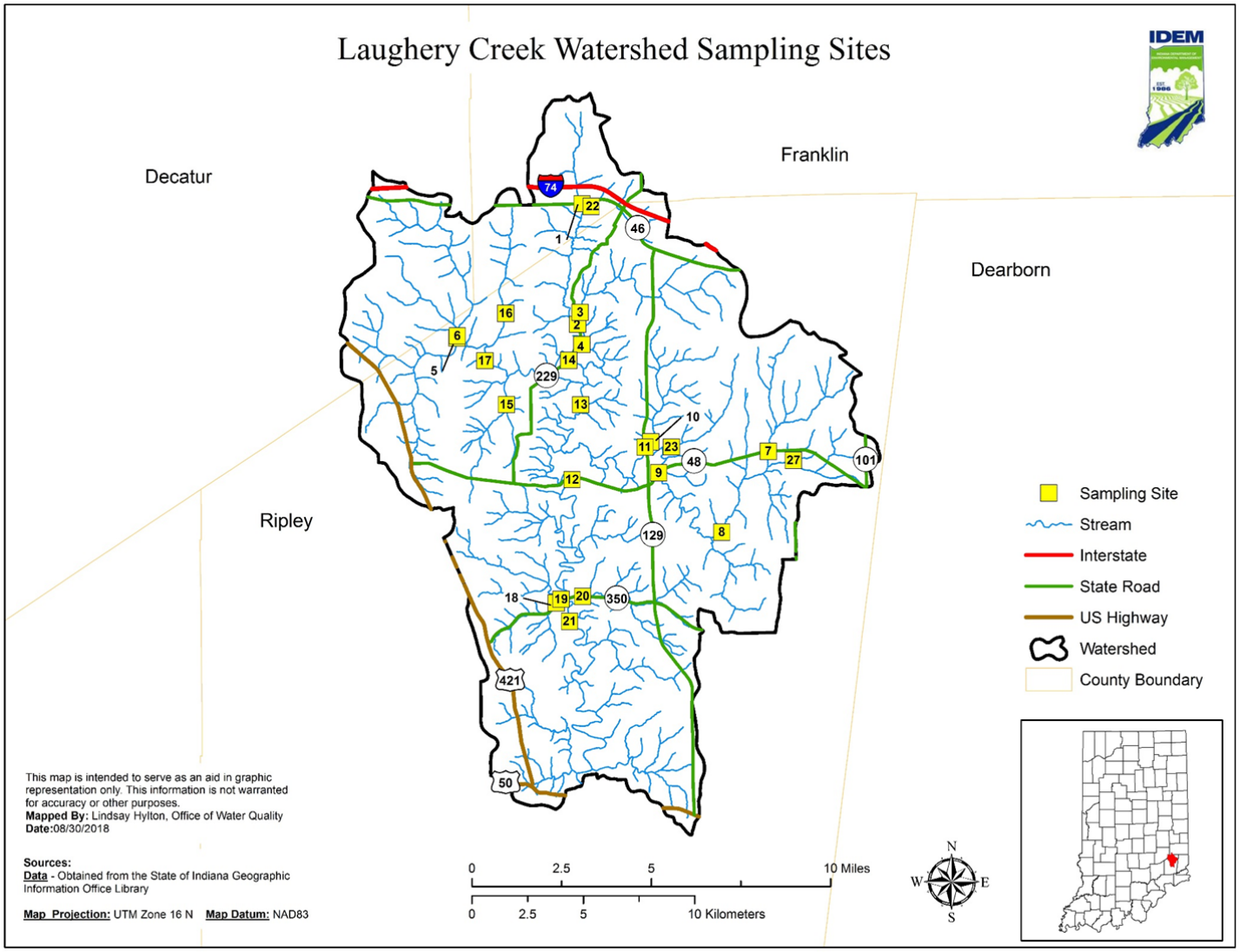
It is anticipated that the water quality data collected through this monitoring effort will provide the information needed to characterize the watershed for the TMDL program, local water quality managers, identify sources of impairment, designate critical areas, and enable users to make valid and informed watershed decisions. This project, by design, will also add new stream reaches for assessment of aquatic life, recreational use support, and will allow for future comparisons to evaluate changes in water quality.

The draft 2018 303(d) list submitted to the U.S. EPA (IDEM 2018) identifies 20.34 miles of impaired streams in the Laughery Creek Watershed with some reaches containing multiple impairments. The total number of miles per each impairment in the Laughery Creek Watershed is reported in the following ways:

- Category 5(a): Impaired Biotic Community (IBC), 20.13 miles
- Category 5(a): Dissolved Oxygen Impaired (DO), 13.51 miles
- Category 5(a): *Escherichia coli (E. coli)*, 13.92 miles

Assessment data in this watershed have been collected by IDEM from multiple programs and projects.

Figure 1. Laughery Creek Watershed Characterization Sampling Area1



[1] Map site numbers refer to last two digits of site number from Table 1; e.g., 19T-010 is site 10 on map

Table 1. Sampling Locations for Watershed Characterization of Laughery Creek2 (HUC 0509020305)

Site #	AIMS Site #	Stream Name	Location	County	Latitude	Longitude	AUID
19T-001	OML-05-0020	Little Laughery Creek	SR 46	Franklin	39.30857332	-85.23941749	INV0352_01
19T-002	OML-05-0021	Little Laughery Creek	SR 229	Ripley	39.25989773	-85.24287125	INV0352_02
19T-003	OML-05-0022	Bobs Creek	CR 1300 N	Ripley	39.26468766	-85.24125633	INV0352_T1008
19T-004	OML-05-0023	Little Laughery Creek	CR 1250 N/Legion Rd	Ripley	39.25170692	-85.24063126	INV0352_03
19T-005	OML-05-0009	Laughery Creek	CR Road 250 W	Ripley	39.25521301	-85.30561537	INV0351_05
19T-006	OML-05-0024	Tub Creek	CR 250 W	Ripley	39.25605262	-85.30550502	INV0351_T1003
19T-007	OML-05-0025	Ripley Creek	SR 48	Ripley	39.20713489	-85.14499922	INV0353_01
19T-008	OML-05-0026	Ripley Creek	N Old Milan Rd	Ripley	39.17480935	-85.17003061	INV0353_02
19T-009	OML-05-0027	Ripley Creek	SR 48	Ripley	39.19924234	-85.20209378	INV0354_03
19T-010	OML-05-0028	North Branch Ripley Creek	N Adams Church Rd	Ripley	39.21176538	-85.20597762	INV0354_T1002
19T-011	OML-05-0029	Ripley Creek	SR 129	Ripley	39.20992231	-85.20909662	INV0354_04
19T-012	OML-05-0030	Laughery Creek	SR 48	Ripley	39.19730511	-85.24750742	INV0355_07
19T-013	OML-05-0031	Laughery Creek	E Salem Rd	Ripley	39.22742162	-85.24204040	INV0355_06
19T-014	OML060-0007	Laughery Creek	SR 229	Ripley	39.24543958	-85.24787431	INV0355_03
19T-015	OML060-0005	Tributary of Laughery Creek	CR 1050 N	Ripley	39.22799483	-85.28042191	INV0355_T1002
19T-016	OML-05-0032	Walnut Fork	CR 1300 N	Ripley	39.26481694	-85.28004847	INV0355_T1001
19T-017	OML060-0006	Laughery Creek	CR 200 W	Ripley	39.24577892	-85.29132908	INV0355_02
19T-018	OML-05-0033	Plum Creek	SR 350	Ripley	39.14758198	-85.25612245	INV0356_T1006
19T-019	OML-05-0042	Laughery Creek	SR 350	Ripley	39.1490962075	-85.25413092	INV0356_04
19T-020	OML-05-0034	Castators Creek	SR 350	Ripley	39.14989845	-85.24303974	INV0356_T1013
19T-021	OML-05-0012	Laughery Creek	CR 450 N	Ripley	39.14006311	-85.24962282	INV0357_02
19T-022	OML-05-0035	Tributary of Little Laughery Creek	Huntersville Road	Franklin	39.30726705	-85.23477216	INV0352_T1001
19T-023	OML-05-0036	Tributary of Ripley Creek	CR 950 N	Ripley	39.20961488	-85.19524489	INV0354_T1013
19T-027	OML-05-0040	Tributary of Ripley Creek	N Spades Rd/CR 700 E	Ripley	39.20315874	-85.13211737	INV0353_T1003

[2]19T-### denotes that these are the selected pour points for this project

Project/Task Organization and Schedule

The main objective of this project is to provide a comprehensive assessment of the ability of the streams in the Laughery Creek Watershed to support aquatic life and recreational uses. Sampling for this project will begin in November 2018 and end in October 2019. Barring any hazardous weather conditions or unexpected physical barriers to accessing the site, samples will be collected for physical, chemical, bacteriological parameters, and biological communities.

Timeframes for sampling activities include:

Site reconnaissance activities were completed in May 2018. Reconnaissance activities will be conducted in the office and through physical site visits.

Water chemistry will be sampled monthly at all sites in the watershed, during the recreational season defined as April through October in [327 IAC 2-1-6]. During the months of November through March, only sites at the pour point of each 12-digit HUC will be sampled monthly. The first sampling event will be conducted in November 2018 and the study will conclude in October 2019.

Biological sampling activities will begin in the summer of 2019 and end no later than October 18, 2019. The basin will be sampled for fish community, macroinvertebrate community, and habitat quality at all sites in the watershed. Specific dates for fish and macroinvertebrate community collections cannot be given, since sampling may be postponed due to scouring of the stream substrate or in-stream cover caused by a high water event, which would result in non-representative samples.

Bacteriological sampling for *E. coli* will take place monthly from April through October of 2019 at all sites in the watershed. In addition, *E. coli* samples will be collected five times from each site at equally spaced intervals over a 30-day period during the recreational season of April to October 2019 to determine a geometric mean.

Background and Project/Task Description

The Watershed Characterization Monitoring program was instituted to assist in characterizing existing conditions in watersheds throughout the state. The Laughery Creek watershed data set will be utilized by the TMDL program and shared with local watershed groups, and any other interested parties. This monitoring will provide data for TMDL development, watershed planning uses, and will aid in the evaluation of future changes within the basin. For this study, the following media will be used for assessment purposes: Water chemistry, bacteriological contamination in the form of *E. coli*, fish community, macroinvertebrate assemblages, and habitat evaluations.

Data Quality Objectives (DQOs)

The DQO process (Guidance for the Data Quality Objectives Process EPA QA/G-4) is a planning tool for data collection activities. It provides a basis for balancing decision uncertainty with available resources. The DQO is required for all significant data collection efforts for a project and 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 for the Watershed

Characterization Monitoring of the Laughery Creek Watershed is identified in the following seven steps.

1. State the Problem

Indiana is required to assess all waters of the state to determine their designated use attainment status**.** Surface waters of the state are designated for full-body contact recreation; will be capable of supporting a well-balanced, warm water aquatic community; and put-and-take trout fishing [327 IAC 2-1-3] in some northern portions of the state. Data from the intensive sampling of the Laughery Creek Watershed is needed to develop a TMDL and fully characterize the current water quality condition of the watershed. This project will gather water chemistry, bacteriological, biological (fish and macroinvertebrates), and habitat data for the purpose of assessing the designated use attainment status of the Laughery Creek Watershed.

2. Identify the Decision

The main objective of this study is to fully assess whether the surface waters in this watershed are supporting or non-supporting for aquatic life use and recreational use, and if they are non-supporting, then the extent of impairment. All sites will be sampled for concentrations of physical, chemical, and biological parameters; and evaluated as supporting or non-supporting following the decision-making processes described in Indiana's 2018 Consolidated Assessment Listing Methodology (IDEM 2018a), which is based upon the water quality criteria shown in Table 2.

In addition to the physical, chemical, and bacteriological criteria listed in Table 2, data for several nutrient parameters will be evaluated with the benchmarks below (IDEM 2018a). 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 non-supporting due to nutrients.

- Total Phosphorus (TP):
  - One or more measurements greater than 0.3 mg/L
- Nitrogen (measured as Nitrate + Nitrite):
  - One or more measurements greater than 10.0 mg/L
- Dissolved Oxygen (DO):
  - Any measurement less than 4.0 mg/L
  - Any measurements consistently at or close to the standard, range 4.0-5.0 mg/L
  - Any measurement greater than12.0 mg/L
- pH:
  - Any measurement greater than 9.0 Standard Units (SU)
  - Measurements consistently at or close to the standard, range 8.7-9.0 SU

Table 2. Water Quality Criteria [327 IAC Article 2]

Parameters	Water Quality Criteria	Criterion
E. coli (April-October Recreational season)	≤125 MPN/100 mL	5-Sample Geometric Mean
	≤235 MPN/100 mL	Single Sample Maximum
Total Ammonia (NH_3-N)	Calculated based on pH and Temperature	Calculated CAC
Nitrate+Nitrite-Nitrogen	≤10 mg/L	Human Health point of drinking water intake
Sulfate	Calculated based on hardness and chloride	In all waters outside the mixing zone
Dissolved Oxygen	At least 5.0 mg/L (Warm Waters)	Daily Average
	Not less than 4.0 mg/L at any time	Single Reading
pH	6.0 - 9.0 S.U. except for daily fluctuations that exceed 9.0 due to photosynthetic activity	Single Reading
Temperature	Varies Monthly	1% Annual; Maximum Limits
Chloride	Calculated based on hardness and sulfate values	Calculated CAC
Dissolved Solids	750 mg/L	Public water supply

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

Biological Criteria:

Indiana narrative biological criteria [327 IAC 2-1-3] states that "(2) All waters, except [limited use waters] will be capable of supporting: (A) a well-balanced, warm water aquatic community." The water quality standard definition of a "well-balanced aquatic community" is "[327 IAC 2-1-9] (59)] An aquatic community that: (A) is diverse in species composition; (B) contains several different trophic levels; and (C) is not composed mainly of pollution tolerant species." An interpretation or translation of narrative biological criteria into numeric criteria would be as follows: A stream segment is non-supporting 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 2018a).

Assessment of each site sampled will be reported to U.S. EPA in the 2020 update of Indiana's Integrated Water Monitoring and Assessment Report. Site-specific data will be used to classify associated assessment units into one of five major categories in the State's Consolidated 303(d) list. Category definitions are available in Indiana's Consolidated Assessment and Listing Methodology (CALM) (IDEM 2018a, p. 46-47).

3. Identify the Inputs to the Decision

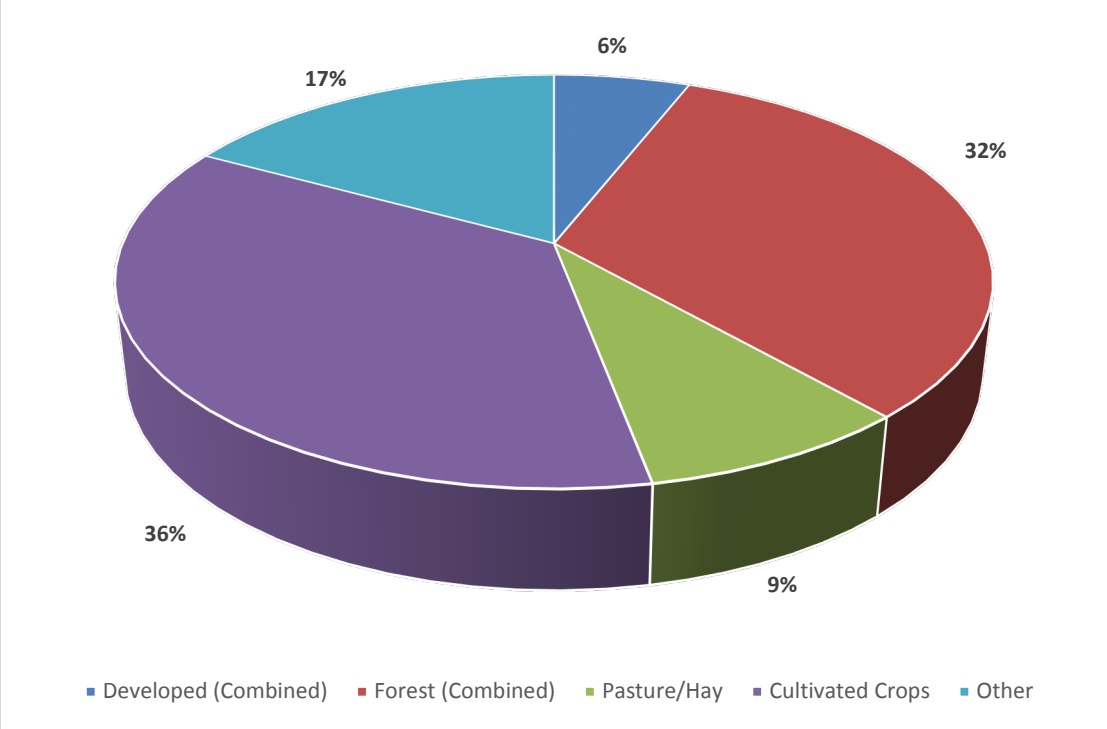
Grab samples will be collected at the surface water sampling locations for *E. coli* and the parameters listed in Table 4. Field measurements (Table 5) will be conducted at each site during each sampling event. Visual field observations will include weather conditions, stream conditions, and percent stream canopy at each sampling location. All samples collected for bacteriological samples will be analyzed for *E. coli* using the Idexx Colilert Enzyme Substrate Standard Method SM9223B (Clesceri et al., 2012). Surface water chemistry samples will be collected monthly, and processed and analyzed by TestAmerica Laboratories, using the analytical methods listed in Table 4. A fish and macroinvertebrate community sample will be collected once at each site with a corresponding habitat evaluation.

4. Define the Boundaries of the Study

The Laughery Creek Watershed covers 167.40 square miles and is located in Ripley, Franklin, and Decatur counties. The watershed is approximately 42% Cultivated Crops, 38% Forest (combined types), 10% Pasture/Hay, 7% Developed Land (combined types), and 2% other uses. See Figure 2 for the Laughery Creek Watershed land use.

Sampling locations for the 2019 Laughery Creek Watershed Characterization study are listed in Table 1 and can be viewed spatially in Figure 1.

Figure 2. Laughery Creek Watershed Land Use[3]



[3] Data collected/calculated from ArcGIS GIO.Library – Landcover_2011_NLCD_USGS layer

5. Develop a Decision Rule

Samples will be collected for physical, chemical, and bacteriological parameters, as well as biological communities, except when the flow is potentially too dangerous for staff to enter the stream (e.g., water levels well above median base flow); there are 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 when weather conditions and stream flow are safe, sample collections for biological communities may be postponed at a particular site for one to four weeks. The cause of the postponement would be a high water event resulting in scouring of the stream substrate or instream cover creating non-representative samples.

For assessment purposes in the Indiana Integrated Report (IDEM 2018a), recreational use attainment decisions will be based on bacteriological criteria developed to protect primary contact recreational activities [327 IAC 2-1-6]. Aquatic life use support decisions will include independent evaluations of biological and chemical data as outlined in Indiana's 2018 Consolidated Assessment and Listing Methodology (CALM, IDEM 2018a). The fish assemblage will be evaluated at each site using the appropriate IBI (Simon and Dufour, 2005). Macroinvertebrate multi-habitat samples will also be evaluated using a statewide IBI developed for lowest practical taxonomic level identifications.

6. Specify Tolerable Limits on Decision Errors

Sampling design error is minimized by utilizing a comprehensive checklist of informational sources, evaluation of historical information, and a thorough watershed pre-survey. Described in Section B.1.5.3 of the Quality Assurance Project Plan for Indiana Surface Water Programs (Surface Water QAPP), this sampling design has been formulated to address data deficiencies and render the optimum amount of data needed to fill gaps in the decision process (IDEM 2017).

Good quality data are essential for minimizing decision error. By minimizing both sampling design error and measurement error for physical and biological parameters, more confidence can be placed in the conclusions drawn on the stressors and sources affecting the water quality in the study area.

Site specific aquatic life use and recreational use assessments include program specific controls to identify the introduction of errors. These controls include blanks and duplicates for water chemistry and bacteriological samples; biological site revisits or duplicates; and laboratory controls through verification of species identifications as described in field procedure manuals (IDEM 2002; Ohio Environmental Protection Agency (OHEPA 2006), and SOPs (IDEM 1992a, 1992b, 1992c, 1992d, 1992e, 2010a, 2016c).

The QA/QC process detects deficiencies in the data collection as set forth in the IDEM QAPP for Indiana Surface Water Programs (IDEM 2017). 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, review the laboratory analytical results for quality assurance. 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 of, rejection of, or application of data quality flags to results is presented in the QAPP’s Table D3-1: Data Qualifiers and Flags. Precision and accuracy goals, with acceptance limits for applicable analytical methods, are provided in the QAPP’s Table A7-1: Precision and Accuracy Goals for Data Acceptability by Matrix, and the QAPP’s Table B2.1.1.8-2: Field Parameters. Further investigation will be conducted, in response to consistent “rejected” data, to determine 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 to troubleshoot error introduced throughout the entire data collection process. Corrective actions will be implemented once the source of error is determined.

7. Optimize the Design for Obtaining Data

A Modified Geometric Design (OHEPA 1999, 2012) site selection process in Attachment 1 is used in this study to get the necessary spatial representation of the entire study area. Sites within this watershed have been selected based on a geometric progression of drainage areas and then located to the nearest bridge. Sample sites at road crossings allow for more efficient sampling of the watershed.

Training and Staffing Requirements

Table 3. 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 AIMS II database - Oversee development of Project Work Plan - Oversee entry and QC of field data - Querying data from AIMS II to determine results not meeting Water Quality Criteria	- AIMS II Database User Guide - IDEM Surface Water QAPP 2017 - U.S. EPA 2006 Quality Assurance (QA) Documents on developing Work Plans (QAPPs)
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 Standard Operating Procedures (SOP) documents for field operations	- Completion of field data sheets - Taxonomic accuracy - Sampling efficiency and representation - Voucher specimen tracking - Overall operation of the field crew when remote from central office - Adherence to safety and field SOP procedures by crew members - Ensure that multi-probe analyzers are calibrated weekly prior to field sampling activities - Ensure that field sampling equipment is functioning properly and loaded into field vehicles prior to field sampling activities	- Barbour et al. 1999 - Hydrolab Corporation 2002 - IDEM 1992a, 1992b, 1992c, 1992d, 1992e,2002, 2010a, 2010b, 2010c, 2015b, 2016c - Klemm et al. 1990 - Plafkin et al. 1989 - Simon and Dufour 1998, 2005 - U.S. EPA 1995 - YSI 2002
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, 1992d, 1992e, 2002, 2010a, 2010b, 2010c, 2015b, 2016c - Klemm et al. 1990

Role	Required Training/Experience	Responsibilities	Training References
			- Plafkin et al. 1989 - U.S. EPA 1995 - YSI 2002
No 2015b in Field Crew Chief - Water Chemistry 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 multi-probe analyzers are calibrated weekly prior to field sampling activities - Ensure that field sampling equipment is functioning properly and loaded into field vehicles prior to field sampling activities	- Hydrolab Corporation 2002 - IDEM 1997, 2002, 2010b, 2010c, 2015b, 2016d - YSI 2002
Field Crew Members - Water Chemistry 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, 2010b, 2010c, 2015b, 2016d - YSI 2002
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	- IDEM 1992a, 1992e, 2004, 2010b, 2010c, 2012a - AIMS II Database User Guide

Role	Required Training/Experience	Responsibilities	Training References
		- 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	
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 1992a, 1992e, 2004, 2010b, 2010c, 2012a - AIMS II Database User Guide
Laboratory Supervisor - Water Chemistry 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 2010b, 2010c, 2015a - AIMS II Database User Guide
Quality Assurance 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	- IDEM 2017b, 2012a - U.S. EPA 2006 documentation on QAPP development and data qualification

Role	Required Training/Experience	Responsibilities	Training References
		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	- AIMS II Database User Guide

II. MEASUREMENT/DATA ACQUISITION

Sampling Design and Site Locations

The proposed site locations are chosen using a modified geometric and targeted design as described previously in the "Watershed Characterization Monitoring Program Objective" section of this workplan.

Site reconnaissance activities are conducted in-house and through physical site visits. In-house activities include preparation and review of site maps and aerial photographs. Physical site visits include verification of accessibility, safety considerations, equipment needed to properly sample the site, and property owner consultations, if required. All information will be recorded on the IDEM Site Reconnaissance Form (Attachment 2) and entered into the AIMS II database. Precise coordinates for each site will be determined during the physical site visits or at the beginning of the sampling phase of this project, using a Trimble Juno ™ SB Global Positioning System or a Trimble Juno 3D GPS, both of which have an accuracy of two to five meters (IDEM 2015). These coordinates will be entered into the AIMS II database.

"Sampling Locations for Watershed Characterization of Laughery Creek" (Table 1) provides a list of the selected sampling sites with the stream name, AUID, AIMS Site Number, County Name, and the latitude and longitude of each site. Figure 1, titled "Laughery Creek Watershed Characterization Sampling Area," gives a spatial overview of the site locations for this project.

Sampling Methods and Sample Handling

Water Chemistry

One team of two staff will collect water chemistry grab samples, record water chemistry field measurements, and record physical site descriptions on the IDEM Stream Sampling Field Data Sheet (Attachment 3). All water chemistry sampling will adhere to the Water Quality Surveys Section Field Procedure Manual Section 2.1 (IDEM 2002).

Bacteriological Sampling

The bacteriological sampling will be conducted by one team consisting of one or two staff. Samples will be processed in an IDEM fixed and/or mobile *E. coli* laboratory equipped with all materials and equipment necessary to perform the Colilert® Test Method (Standard Method 9223B), per Project Organization and Schedule (above). The expected time frame for bacteriological sampling will be April through October of 2019. Staff will collect the samples in a 120 mL pre-sterilized 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 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, which allows any sampling crew to deliver them to the appropriate IDEM *E. coli* laboratory for analyses within the bacteriological holding time of six hours.

The IDEM mobile *E. coli* laboratory, used in this project, facilitates *E. coli* testing by eliminating the necessity of transporting samples to distant contract laboratories within a six hour holding time. The IDEM mobile *E. coli* laboratory (van) provides a work space containing sample storage; supplies for Colilert® Quanti-tray testing; and all equipment needed for collecting, preparing, incubating, and analyzing results in the same manner as the IDEM fixed *E. coli* laboratory. All supplies will be obtained from IDEXX Laboratories, Inc., Westbrook, Maine.

Fish Community Sampling

The fish community sampling will be completed by teams of three to five staff. Sampling will be performed using various standardized electrofishing methodologies dependent upon the 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 (Simon and Dufour 2005; U.S. EPA 1995). An attempt will be made to sample all habitat types available 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-20 Series backpack electrofishers; the Smith-Root model 1.5KVA electrofishing system; the Smith-Root model 2.5 Generator Powered Pulsator 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 non-wadeable sites, the Smith-Root model 6a electrofisher assembled in a 16 foot Loweline™ boat (2017, 1992b, 1992c, 1992d).

Sample collections during high flow or turbid conditions will be avoided due to 1) low collection rates which result in non-representative samples and 2) safety considerations for the sampling team. Sample collections during late autumn and seasonal cold temperatures will be avoided due to the lack of responsiveness to the electrical field by

some species that can also result in samples that are not representative of the streams' fish assemblage (Simon 1990; U.S. EPA 1995).

Fish will be collected using dip nets with fiberglass handles and netting of 1/8-inch bag mesh. Fish collected in the sampling reach will be sorted by species into baskets and buckets. Young-of-the-year fish, less than 20 millimeters (mm) total length, will not be retained in the community sample (Simon 1990; U.S. EPA 1995).

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 Collection Data Sheet (Attachment 4), one to two individuals per new species encountered will be preserved in 3.7% formaldehyde solution to serve as representative fish vouchers. A fish voucher specimen must be positively identified, and the individuals for preservation 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. 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; or dead specimens that are taxonomically valuable for un-described taxa (e.g., Red Shiner or Jade Darter); life history studies; or research projects.

Data will be recorded for non-preserved fish on the IDEM Fish Collection Data Sheet (Attachment 4) consisting of the following: number of individuals; minimum and maximum total length in millimeters (mm); mass weight in grams (g); and number of individuals with deformities, eroded fins, lesions, tumors, and other anomalies (DELTs). Once the data is recorded, specimens will be released within the sampling reach from which they were collected when possible. Data will be recorded for preserved fish specimens following taxonomic identification in the laboratory.

Macroinvertebrate Sampling

The macroinvertebrate community sampling may be conducted immediately following the fish community sampling event or on a different date by crews of two to three staff. Samples are collected using a modification of the U.S. EPA Rapid Bioassessment Protocol multi-habitat (MHAB) approach using a D-frame dip net (Plafkin et al. 1989; Klemm et al. 1990; Barbour et al. 1999; IDEM 2010a). The IDEM MHAB approach (IDEM 2010a) is composed of a 1-minute "kick" sample within a riffle or run and a 50-meter "sweep" sample of shoreline habitats. A 1-minute "kick" sample is collected by disturbing one square meter of stream bottom substrate in a riffle or run habitat and collecting the dislodged macroinvertebrates within the dipnet. A 50-meter "sweep" sample is 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 rangefinder or tape

measure. 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" and 50-meter "sweep" samples are combined in a bucket of water which 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 on-site, conducts a 15-minute pick of macroinvertebrates at a single organism rate, with an effort to pick for maximum organism diversity and relative abundance. The effort is accomplished through turning and examination of the entire sample in the tray. The resulting picked sample will be preserved in 70% 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 5) will also be completed for the sample.

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 QHEI (OHEPA 2006; Rankin 1995). A separate IDEM OWQ Biological QHEI (Attachment 6) 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 2016c for a description of the method used in completing the QHEI.

Field Parameter Measurements

Dissolved oxygen (DO), pH, water temperature, specific conductance, and DO percent saturation will be measured with a datasonde, during each sampling event, regardless of the sample type being collected. Measurement procedures and operation of the datasonde shall be performed according to the manufacturers' manuals (Hydrolab Corporation 2002; YSI 2002) and Sections 2.10 – 2.13 of the Water Quality Surveys Section Field Procedure Manual (IDEM 2002). 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 Datasonde 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 3).

Analytical Methods

Laboratory Procedure for *E. coli* Measurements:

While still in the field and at the end of each sampling run, water samples are processed and analyzed for *E. coli* within the six-hour holding time for collection and transportation, and the two-hour holding time for sample processing. All waters sampled are processed and analyzed for *E. coli* in the IDEM *E. coli* mobile laboratory or IDEM Shadeland laboratory, which is equipped with required materials and equipment necessary for the Idexx™ Colilert Test. The Colilert Test is a multiple-tube enzyme substrate standard

method SM-9223B (Clesceri et al., 2012). The *E. coli* test method and quantification limit are identified below in Table 4.

Nutrient and General Chemistry Parameters Measurements:

Analyses of nutrient and general chemistry parameters is performed at TestAmerica Laboratories, in accordance with pre-approved test methods and within the allotted time frames. The nutrient and general chemistry parameters, and their respective test methods and quantification limits are identified below in Table 4. A COC form created by the AIMS II database IDEM OWQ COC (Attachment 7) and an IDEM Water Sample Analysis Request form (Attachment 8) accompany each sample set through the analytical process. Additionally, a Test America COC form (Attachment 9) will accompany samples sent to the lab. Shipping labels will be created using Test America account numbers.

Table 4. *E. coli*, Nutrient, and General Chemistry Parameters Test Methods[4]

Parameter	Method	Limits of Quantification	Units	Preservative	Holding Times
E. coli	SM-9223B Enzyme Substrate Test	1.0	*MPN /100 mL	0.0008% $Na_2S_2O_3$ for CL_2	8 hours
Alkalinity (as $CaCO_3$)	EPA 310.2	10.0	mg/L	Ice	14 days
Solids, Total Residue (TS)	SM 2540B	10.0	mg/L	Ice	7 days
Solids, Non-filterable Residue (TSS)	SM 2540D	1.0	mg/L	Ice	7 days
Solids, Filterable Residue (TDS)	SM 2540C	10.0	mg/L	Ice	7 days
Sulfate (Dissolved)	EPA 300.0	0.05	mg/L	Ice	28 days
Chloride	EPA 300.0	0.06	mg/L	Ice	28 days
Hardness (as $CaCO_3$)	SM 2340B	1.41	mg/L	HNO_3	6 months
Nitrogen, as Ammonia	SM 4500NH3-D	0.10	mg/L	H_2SO_4	28 days
Nitrogen, Kjeldahl (TKN)	SM4500N(Org)-B	0.30	mg/L	H_2SO_4	28 days
Nitrogen, Nitrate-nitrite	SM4500NO3-F	0.10	mg/L	H_2SO_4	28 days
Phosphorous (Applicable to all)	EPA 365.1	0.05	mg/L	H_2SO_4	28 days
Total Organic Carbon (TOC)	SM 5310C	1.0	mg/L	H_2SO_4	28 days

Parameter	Method	Limits of Quantification	Units	Preservative	Holding Times
Chemical Oxygen Demand	EPA 410.4	10.0	mg/L	H_2SO_4	28 days
Calcium	EPA 200.7	40	mg/L	HNO_3	6 months
Magnesium	EPA 200.7	100	mg/L	HNO_3	6 months

***** Clesceri et al., 2012. 1 MPN = 1 CFU/100 mL [4] Methods accredited by EPA (State of Illinois, 2018)

Field Parameters Measurements:

The field measurements of DO, temperature, pH, conductivity, and turbidity are taken each time a sample is collected. The field parameters, their respective test methods, and sensitivity limits are identified below in Table 5.

During each sampling run, field observations from each site and ambient weather conditions at the time of sampling are noted and documented on IDEM Stream Sampling Field Data Sheets (Attachment 3). Digital photos up-stream and down-stream of the sampling site will be taken, logged, and documented for later references.

Table 5. Field Parameters Test Methods

Parameter	Method	Sensitivity Limit	Units
DO (Datasonde optical)	ASTM D888-09(C)	0.01	mg/L
DO (Winkler Titration)	SM 4500-OC[5]	0.2	mg/L
DO % Saturation (Datasonde optical)	ASTM D888-09(C)	0.01	%
Turbidity (Datasonde)	SM2130B	0.02	NTU
Turbidity (Hach Turbidimeter)	EPA 180.1[5]	0.01	NTU
Specific Conductance (Datasonde)	SM 2510B	1.0	µS/cm
Temperature (Datasonde)	SM 2550B(2)	0.1	°C
Temperature (field meter)	SM 2550B(2)[5]	0.1	°C
pH (Datasonde)	EPA 150.2	0.01	SU
pH (field meter)	SM 4500-HB[5]	0.01	SU

[5] Method used for Field Calibration Verification

Quality Control and Custody Requirements

Quality assurance protocols will follow part B5 of the “Quality Assurance Project Plan (QAPP) for Indiana Surface Waters,” Revision 4, by Timothy Bowren (IDEM 2017).

Field Parameter Measurements/Instrument Testing/Calibration

The datasonde will be calibrated immediately prior to each week’s sampling (IDEM 2002). Calibration results and drift values will be recorded, maintained, stored, and archived in log books located in the calibration laboratories at the Shadeland facility. The drift value is the difference between two successive calibrations. Field parameter calibrations will conform to the procedures as described in the instrument users’ manuals (Hydrolab Corporation 2002; YSI 2002). The DO component of the calibration procedure will be conducted using the air calibration method. The unit will be field

checked for accuracy once during the week by comparison with a Winkler DO test, Hach™ turbidity, and an Oakton pH and temperature meter. Weekly calibration verification results will be recorded on the IDEM Stream Sampling Field Data Sheets (Attachment 3) and entered into the AIMS II database. A Winkler DO test will also be conducted at sites where the DO concentration is 4.0 mg/L or less.

Field 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 (Table 5). Quality control checks (such as duplicate measurements, measurements of a secondary standard, or measurements using a different test method or instrument), which are performed on field or laboratory data, are usable for estimating precision, accuracy, and completeness for the project.

Bacteriological Sampling

Bacteriological samples will be analyzed using the SM 9223B Enzyme Substrate Coliform Test Method, see Table 4 for quantification limits. Samples will be collected using 120 mL pre-sterilized wide-mouth containers and adhere to the six-hour holding time. Analytical results, from an IDEM fixed or mobile *E. coli* 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). Any method deviations will be thoroughly documented in the raw data. All QA/QC samples will be tested according to the following guidelines:

Field Duplicate:	Field Duplicates will be collected at a frequency of one per batch or at least one for every 20 samples collected (≥ 5%).
Field Blank:	Field Blanks will be collected at a frequency of one per batch or at least one for every 20 samples collected (≥ 5%).
Laboratory Blank:	Laboratory Blanks (sterile laboratory water blanks) will be tested at a frequency of one per day.
Positive Control:	Each lot of media will be tested for performance using *E. coli* bacterial cultures.
Negative Controls:	Each lot of media will be tested for performance using non-*E. coli* and noncoliform bacterial cultures.

Water Chemistry Data

Sample bottles and preservatives used will be certified for purity by the manufacturer. Sample collection containers for each parameter, preservative, and holding time (Table 4) will adhere to U.S. EPA requirements. Field duplicates and matrix spike/matrix spike duplicates 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 will be taken at a

rate of one set per sample analysis set or one per every 20 samples, whichever is greater.

Fish Community Data

Fish community sampling revisits will be performed at a rate of 10 percent of the total fish community sites sampled, in this case, two in the watershed (U.S. EPA 1995). Revisit sampling will be performed once all initial sites have been sampled, with at least two 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 (U.S. EPA 1994; U.S. EPA 1995). The resulting IBI and QHEI total score between the initial visit and the revisit will be used to evaluate precision. The IDEM OWQ COC form (Attachment 7) is used to track samples from the field to the laboratory. Fish taxonomic identifications made by IDEM staff in the laboratory may be verified by regionally recognized non-IDEM freshwater fish taxonomists. 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

Duplicate macroinvertebrate field samples will be collected at a rate of 10 percent of the total macroinvertebrate community sites sampled, in this case, three in the watershed. The macroinvertebrate community duplicate sample and corresponding habitat assessment will be performed by the same team member who performed the original sample, immediately after the initial sample is collected. This will result in a precision evaluation based on a 10% duplicate of samples collected. The IDEM OWQ COC form (Attachment 7) is used to track samples from the field to the laboratory. Laboratory identifications and QA/QC of taxonomic work is maintained by the laboratory supervisor of the Probabilistic Monitoring Section of IDEM.

III. ASSESSMENT/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 of field and laboratory duplicate; accuracy measurements by percent of recovery of matrix spike and matrix spike duplicate samples analyzed in the laboratory; and completeness measurements by the percent of planned samples that are actually collected, analyzed, reported, and usable for the project (IDEM 2017).

Field audits will be conducted to ensure that sampling activities adhere to approved SOPs. Audits are systematically conducted by WAPB Quality Assurance 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 and WAPB management. Corrective actions will be communicated to and implemented by field staff as a result of the audit process (IDEM 2017).

Data Quality Assessment Levels

The samples and various types of data collected by this program are intended to meet the quality assurance criteria and rated DQA Level 3, as described in Section D3 of the Surface Water QAPP (IDEM 2017).

IV. DATA VALIDATION AND USABILITY

Quality assurance reports to management, and data validation and usability are also important components of Indiana's Surface Water QAPP which ensures good quality data for this project. A quality assurance audit report will be submitted to the QA Manager and Project Manager for review for this project should problems arise, need to be investigated, and corrected. As described in Section D of the Surface Water QAPP, 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) (IDEM 2017). These steps allow users to assess the data to ensure it meets the project DQO.

Quality Assurance/Data Qualifiers and Flags

The various data qualifiers and flags that will be used for quality assurance and validation of the data are found in Section D3.2.4 of the Surface Water QAPP (IDEM 2017).

Data Usability

The environmental data collected and its usability are qualified per each lab or field result obtained and classified. Classification is into one or more of the four categories: Acceptable Data, Enforcement Capable Results, Estimated Data, and Rejected Data as described in Section D3.2.4 of the Surface Water QAPP (IDEM 2017).

Information, Data, and Reports

Data collected in 2018-2019 will be recorded in the AIMS II database and presented in two compilation summaries. The first summary will be a general compilation of the watershed field and water chemistry data prepared for use in the 2020 Indiana Integrated Water Monitoring and Assessment 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. 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.,). This workplan will be uploaded into virtual file cabinet (VFC), all field sheets will be stored in the AIMS II database, and results will be uploaded to The Water Quality Exchange (WQX), allowing the data to be shared with EPA.

Laboratory and Estimated Cost

Laboratory analysis and data reporting for this project will comply with the QAPP for Indiana Surface Water Programs (IDEM 2017); Request for Proposals (RFP) 16-074 (see IDEM 2016d); and the IDEM QMP. TestAmerica Laboratories in University Park, IL performs the analytical tests, on the general chemistry and nutrient parameters outlined in Table 4, with a total estimated cost of $39,000. IDEXX Laboratories, Inc., Westbrook, Maine supplies the bacteriological sampling, with a total estimated cost for this project of $1,400. Bacteriological samples will be tested and analyzed by IDEM staff. All fish and macroinvertebrate samples will be collected and analyzed by IDEM staff.

Reference Manuals and Personnel Safety:

Table 6. Personnel Safety and Reference Manuals

Role	Required Training/Experience	Training References	Training Notes
All Staff that Participate in Field Activities	- Basic First Aid and Cardio-Pulmonary Resuscitation (CPR) - Personal Protective Equipment (PPE) Policy - Personal Flotation Devices	- A minimum of 4 hours of in-service training provided by WAPB (IDEM 2010b) - IDEM 2008 - February 29, 2000 WAPB internal memorandum regarding use of approved Personal Flotation Devices	-Staff lacking 4 hours of in-service training or appropriate certification will be accompanied in the field at all times by WAPB staff that meet Health and Safety Training requirements - When working on boundary waters 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.

REFERENCES:

U.S. EPA March 1994. Environmental Monitoring and Assessment Program, Surface Waters and Region 3 Regional Environmental Monitoring and Assessment Program, 1994 Pilot Field Operations and Methods Manuals for Streams. EPA/620/R-94/004F. Edited by Donald J. Klemm and James M. Lazorchak. Bioassessment and Ecotoxicology Branch, Ecological Monitoring Research Division, Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, Ohio

U.S. EPA 1995. Region 5 R-EMAP Full Proposal: Spatial Evaluation of the Eastern Corn Belt Plain Rivers and Streams for the Development of Reference Condition using EMAP Sampling Design and Indicators, with Comparison of Results to Nonrandom Intensive Survey results in Ohio. U.S. Environmental Protection Agency, Region V, Water Division, Monitoring Standards and Assessment Section, Chicago, Illinois.*

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

Indiana Administrative Code, Title 327 Water Pollution Control Division, Article 2. Water Quality Standards

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Attachment 1: Modified Geometric Design Steps for Watershed Characterization Studies

Introduction

A relatively new design that has recently been implemented in Indiana is termed the Geometric Site Selection process. This design is employed within watersheds that correspond to the 12-14 digit HUC scale in order to fulfill multiple water quality management objectives, not just the conventional focus on status assessment. It is employed at a spatial scale that is representative of the scale at which watershed management is generally being conducted.

Sites within the watershed are allocated based on a geometric progression of drainage areas starting with the area at the mouth of the main stem river or stream (pour point) and working “upwards” through the various tributaries to the primary headwaters. This approach allocates sampling sites in a semi-random fashion and according to the stratification of available stream and river sizes based on drainage area. The Geometric Site Selection process is then modified by adding a targeted selection of additional sampling sites that are used to focus on localized management issues such as point source discharges, habitat modifications, and other potential impacts within a watershed. These sites are then “snapped to bridges” to facilitate safe and easy access to the stream. This design also fosters data analysis that takes into consideration overlying natural and human caused influences within the streams of a watershed. The design has been particularly useful for watersheds that are targeted for TMDL development because missing, incomplete, or outdated assessments can be addressed prior to TMDL development.

Selection Process

In ArcGIS, download from NHD Plus site (http://www.horizon-systems.com/nhdplus/HSC-wthMS.php) the following files for Region 5 (and then again for Region 7) and zip them into the appropriate file structure.

File Description	File Name (.zip***)	Format
Region 05, Version 01_01, Catchment Grid	NHDPlus05V01_01_Catgrid	ESRI Grid
Region 05, Version 01_01, Catchment Shapefile	NHDPlus05V01_01_Catshape	Shapefile
Region 05, Version 01_02, Catchment Flowline Attributes	NHDPlus05V01_02_Cat_Flowline_Attr	DBF
Region 05, Version 01_02, Elevation Unit a	NHDPlus05V01_02_Elev_Unit_a	ESRI Grid
Region 05, Version 01_02, Elevation Unit b	NHDPlus05V01_02_Elev_Unit_b	ESRI Grid
Region 05, Version 01_02, Elevation Unit c	NHDPlus05V01_02_Elev_Unit_c	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit a	NHDPlus05V01_01_FAC_FDR_Unit_a	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit b	NHDPlus05V01_01_FAC_FDR_Unit_b	ESRI Grid
Region 05, Version 01_01, Flow Accumulation and Flow Direction Unit c	NHDPlus05V01_01_FAC_FDR_Unit_c	ESRI Grid
Region 05, Version 01_02, National Hydrography Dataset	NHDPlus05V01_03_NHD	Shapefile and DBF
Region 05, Version 01_01, Stream Gage Events	NHDPlus05V01_01_StreamGageEvent	Shapefile
Region 05, Version 01_01, QAQC Sinks Spreadsheet	NHDPlus05V01_01_QAQC_Sinks	Excel Spreadsheet

Create a new point shapefile (or geodatabase featureclass) named Geometric Design within ArcCatalog with the same projection as the unzipped layers above.

Within an ArcMap project, add the following:

- nhdflowline layer
- Geometric Design layer
- catchment shapefile
- the FlowlineAttributesFlow table

Add the following fields to the nhdflowline layer:

- LENGTHMi (type: double, precision: 9, scale 4)
- DrainMi (type: double, precision: 9, scale 4)
- MinElev (type: double, precision: 9, scale 4)
- MaxElev (type: double, precision: 9, scale 4)
- Gradient (type: double, precision: 9, scale 4)

Add the following field to the GeometricDesign layer (use the add field-batch tool):

- Geometric (type: double, precision: 5, scale 2)
- Lat (type: double, precision: 8, scale 5)
- Long (type: double, precision: 8, scale 5)
- COMID (type: long, precision: 9)

Join the nhdflowline layer with the FlowlineAttributesFlow table based on the COMID field.

Use the field calculator within the nhdflowline attribute table, with the appropriate metric to imperial conversion to populate the following fields:

- LENGTHMi (from LENGTHKM – kilometers to miles)
- DrainMia (from CumDrainage – square kilometers to square miles (sq mi))
- MinElev (from MinElevSmo – meters to feet)

- MaxElev (from MaxElevSmo – meters to feet)
- Gradient ((MaxElev-MinElev)/LENGTHMI).

Unjoin the FlowlineAttributesFlow table.

Label the "nhdflowline" layer based new "LengthMi" field – note: this field shows the cumulative drainage at the *end* of the line segment, which is rarely more than 2-3 miles in between nodes.

Calculate the geometric break points (i.e., for a 500 sq mi watershed: 500, 250, 125, 62.5, 31, 15, 7, 4, 2).

It is recommended to change the symbology (Symbology: Show Quantities: Classification (Manual)) of the actual flowline to reflect the drainage. This will help identify when and where sites need to be allocated.

Start a new editing session, with the GeometricDesign layer as your target layer.

Add a new point within this layer to the pour point for the watershed (500 sq mi in this case).

Travel upstream through the mainstem and "find" the next place on the stream where the river drainage brackets 250 sq mi. Use the catchment shapefile layer to identify more precisely the drainage value if needed.

Populate the "Geometric" field within the GeometricDesign layer accordingly to the identified drainage level, then change the symbology (Symbology: Categories: Unique Values: Geometric field) of this layer to reflect the drainage levels.

Proceed through the watershed (either around the outer portions or start with largest values and work in), adding points accordingly to each geometric level. Change the symbology to find areas or levels that were missed. Note – the drainage level must be exact. Use the catchment shapefile to subtract drainage areas from larger drainage areas until the exact drainage level is reached. It is ok to "skip" a geometric level if it is not exactly reached. Sometimes there are large tributaries whose contribution to the mainstem skips a drainage level.

Populate the COMID (manually), and Lat/Long (right click on field and select calculate geometry – lat = x-coordinates and long = y-coordinates) accordingly for reference within the GeometricDesign Layer.

Once sites are selected in this fashion, they will need to be snapped to a bridge or access point.

Additional sites should be placed at pour points of subwatersheds (12-digit HUCs) to meet TMDL document requirements.

Once the initial sites are selected, the following features are taken into account to move or add sites:

- Permitted facilities
- Urban areas
- Historical sampling sites
- Assessment Unit IDs (AUID)
- External stakeholder information
- Resources - maximum of 35 sites per project

After refining site selections, there may be additional sites added to ensure spatial representation of the project area.

Sites may be removed or changed after site reconnaissance if there are problems accessing the site or if sites are dry.

Notes regarding the NHD dataset:

All units are initially set to metric and need to be converted to imperial.

Within the nhdflowline layer, the GNIS_Name/ID refers to the whole river name and ID, while the COMID is a unique identifier for the particular segment.

There is *not* a value GNIS_Name/ID for every river, especially where primary streams and ditches are concerned.

Segments within the nhdflowline layer are based on linear miles between "nodes," which are broken up (typically) by tributary. Typically these lengths are less than 2-3 miles.

The cumulative drainage values in the NHD dataset have been compared against other and deemed "reasonable" (read – not statistically compared). Also note that the drainage is calculated through the model to be at the pour point of that segment.

The elevation values, however, are **not** reliable and require supervision. These values are calculated from the associated digital elevation model (DEM) and sometimes have null values for either the maximum or minimum elevation values. In addition, the length of the stream is not long enough (i.e. >1 mile) to calculate gradient. In either case, this associated value is helpful to identify contour changes against a USGS contour map. However, to note the calculated gradient from the NHD information has been observed to be within several tenths of mile compared to a manual calculation of gradient.

Important tables from NHD

- FlowlineAttributesFlow (found in: Region 05, Version 01_02, Catchment Flowline Attributes)
- Key fields: CumDrainag, Max ElevRaw, MinElevSmo,

Important Layers from NHD

- Region 05, Version 01_01, Catchment Shapefile
- Region 05, Version 01_02, National Hydrography Dataset

Attachment 2: 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/Contract 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
Canoe
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 3: IDEM Stream Sampling Field Data Sheet

IDEM Stream Sampling Field Data Sheet

Analysis Set #	EPA Site ID	Rank

Sample #	Site #	Sample Medium	Sample Type	Duplicate Sample #

Stream Name:		River Mile:		County:	

Site Description:

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

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

Special Notes:

Field Data:

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

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

Weather Code Definitions

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

Field Calibrations:

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

Calibration Type
pH
DO
Turbidity

Preservatives/Bottle Lots:

Group: Preservative	Preservative Lot #	Bottle Type	Bottle Lot #

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

Data Entered By: _____ QC1: _____
QC2: _____

Stream Sampling Field Data Sheet

Attachment 4: IDEM Fish Collection Data Sheet

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 OWQ Macroinvertebrate Header Form

Office of Water Quality: Macroinvertebrate Header

L-Site #	Event ID	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

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):	Velocity (ft/s):

Stream Type:
☐ Cold
☐ Warm

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

Salinity (mg/L): _____

ORP (mV): _____

☐ **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 03/14/13

Attachment 6: IDEM OWQ Biological QHEI (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	BEST TYPES PRESENT P/G	BEST TYPES PRESENT R/R	OTHER TYPES PREDOMINANT	OTHER TYPES PRESENT P/G	OTHER TYPES 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]

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

Substrate Maximum 20

Comments

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

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

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

Cover Maximum 20

Comments

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

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

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

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

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

Channel Maximum 20

Comments

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

River right looking downstream

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

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

L	R	FLOOD PLAIN QUALITY
☐	☐	FOREST, SWAMP [3]
☐	☐	SHRUB OR OLD FIELD [2]
☐	☐	RESIDENTIAL, PARK, NEW FIELD [1]
☐	☐	FENCED PASTURE [1]
☐	☐	OPEN PASTURE, ROWCROP [0]

L	R	
☐	☐	CONSERVATION TILLAGE [1]
☐	☐	URBAN OR INDUSTRIAL [0]
☐	☐	MINING /CONSTRUCTION [0]

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

Riparian Maximum 10

Comments

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

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

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

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

Indicate for reach – pools and riffles.

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

Pool/ Current Maximum 12

Comments

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

☐ 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 (mi^2)

- ☐ 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 6 (continued): 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 7: 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 8: IDEM Water Sample Analysis Request Form

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 Laughery Creek **Composite ☐ Grab ☒**

OWQ Sample Set	18BLW	IDEM Sample Nos.	AB35020-AB35038
Crew Chief	Tim Beckman	Lab Sample Nos.	
Collection Date		Lab Delivery Date	

Anions and Physical Parameters			
Parameter	Test Method	Total	Dissolved
Alkalinity	SM2320B	☒ **	☐
Total Solids	SM2540B	☒ **	
Suspended Solids	SM2540D	☒ **	
Dissolved Solids	SM2540C		☒ **
Sulfate	300.0	☐ **	☒ **
Chloride	300.0	☐ **	☒ **
Hardness (Calculated)	SM-2340B	☒ **	☐
Fluoride	300.0	☐ **	☐

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	☐	☐

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	420.2	☐
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	SM4500NO3-F	☒	☐
Total Phosphorus	SM4500P-E	☒	☐
TOC	SM 5310C	☒	☐
COD	SM5220C	☒	☐
Cyanide (Total)	SM4500CN-E	☐	☐
Cyanide (Free)	SM4500CN-I	☐ *	☐
Cyanide (Amenable)	SM4500CN-G	☐ *	☐
Sulfide, Total	SM4500S2-F	☐	☐

RFP 16-074 Contract Number:	SCM # 19855 PO # 17555305-4

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*

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

Testing Laboratory:
Phone: 708.534.5200

Test America
Attn: Robin Kintz
2417 Bond Street
University Park, IL 60484

Attachment 9: Test America Chain of Custody Form

TestAmerica Chicago
2417 Bond Street

University Park, IL 60484-3101
phone 708.534.5200 fax 708.534.5211

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager:**	**Site Contact:**	**Date:**	COC No:
Your Company Name here	**Tel/Fax:**	**Lab Contact:**	**Carrier:**	_____ of _____ COCs
Address	**Analysis Turnaround Time**			Sampler:
City/State/Zip	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(xxx) xxx-xxxx Phone	TAT if different from Below _____			Walk-in Client:
(xxx) xxx-xxxx FAX	☐ 2 weeks			Lab Sampling:
Project Name:	☐ 1 week			
Site:	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Sample Specific Notes:

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other _____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for_____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No | Custody Seal No.: | Cooler Temp. (°C): Obs'd:_____ Corr'd:_____ Therm ID No.:_____

Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.11, dated 1/24/2017