2016
BASELINE MONITORING WORK PLAN FOR LOWER SALT CREEK WATERSHED

PREPARED BY

Anna Settineri
Targeted Monitoring Section

WATERSHED ASSESSMENT and PLANNING BRANCH (WAPB)
Indiana Department of Environmental Management (IDEM)
Office of Water Quality
100 North Senate Avenue
MC65-40-2 Shadeland
Indianapolis, Indiana 46204-2251

November 13, 2015

B-026-OWQ-WAP-TGM-16-W-R0

This page is intended to be blank

SIGNATURE PAGE

2016
Baseline Monitoring Work Plan for Lower Salt Creek Watershed

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

B-026-OWQ-WAP-TGM-16-W-R0

Reviews and Approvals

Tim Beckman , Project Manager, Targeted Monitoring Section — Date 3/31/16

Staci Goodwin, Total Maximum Daily Load Lead, Watershed Planning and Restoration Section — Date 3/30/16

Kathleen Hagan, Watershed Specialist, Watershed Planning and Restoration Section — Date 03/30/16

Timothy Bowren, Project Quality Assurance Officer, Technical and Logistical Services Section — Date 3-30-2016

Mike Sutton, Section Chief, WAPB Quality Assurance Manager, Technical and Logistical Services Section — Date 3/31/2016

Stacey Sobat, Chief, Probabilistic Monitoring Section — Date 3-31-2016

Cyndi Wagner, Chief, Targeted Monitoring Section — Date 3/30/16

Marylou Renshaw, Branch Chief, Quality Assurance Coordinator, Watershed Assessment and Planning Branch — Date 3/30/16

The IDEM Quality Improvement Section reviewed and approves this Sampling and Analysis Work Plan.

Quality Assurance Staff
IDEM Office of Program Support — Date 4/6/16

WORK PLAN ORGANIZATION

This Sampling and Analysis Work Plan is an extension of the existing Watershed Assessment and Planning Branch's October 2004 "*Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program*" and serves as a link to the existing QAPP and as an independent QAPP of the project. Per the United States Environmental Protection Agency (U.S. EPA) 2006 QAPP guidance (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/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

TABLE OF CONTENTS

This page is intended to be blank

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS

AAC:	Acute Aquatic Criterion
ADC:	Acoustic Doppler Current
ADP:	Acoustic Doppler Profiler
ADV:	Acoustic Doppler Velocimeter
AIMS:	Assessment Information Management System
CAC:	Chronic Aquatic Criteria
CALM:	Consolidated Assessment Listing Methodology
CCC:	Criterion Continuous Concentration
CDL:	Crop Data Layer
CFR:	Code of Federal Regulations
CFU:	Colony Forming Units
CLP:	Contract Laboratory Program
COD:	Chemical Oxygen Demand
CPR:	Cardio-Pulmonary Resuscitation
CRQL:	Contract Required Quantification Limit
DO:	Dissolved Oxygen
DQA:	Data Quality Assessment
DQO:	Data Quality Objectives
E. coli:	Escherichia coli
EPA:	Environmental Protection Agency
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
MDL:	Method Detection Limit
µS/cm	Micro Siemens per Centimeter
mg/L:	Milligram per liter
MHAB:	Multi-habitat
mL:	Milliliter
MPN:	Most Probable Number
MS/MSD:	Matrix Spike/Matrix Spike Duplicate
NTU:	Nephelometric Turbidity Unit(s)
OWQ:	Office of Water Quality
PFD:	Personal Floatation Device
PPE:	Personal Protective Equipment
QA/QC:	Quality Assurance/Quality Control
QAC:	Quality Assurance Coordinator

QAM: Quality Assurance Manager
QAO: Quality Assurance Officer
QAPP: Quality Assurance Project Plan
QHEI: Qualitative Habitat Evaluation Index
RFP: Request for Proposals
RL: Reporting Limit
RPD: Relative Percent Difference
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
TS: Total Solids
TSS: Total Suspended Solids
U.S.: United States
USDA: United States Department of Agriculture
WAPB: Watershed Assessment and Planning Branch

DEFINITIONS

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 in which the one minute kick sample and fifty meter sweep sample collected at a site are combined, elutriated, with macroinvertebrates removed from the resulting sample for 15 minutes while in the field.
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 dip net by taking 20-25 individual “jab” or “sweep” samples, which are then composited.

Geometric site	Sampling site chosen according to its drainage area within a watershed.
One (1) minute kick sample	A stationary sampling accomplished using a box shaped net comprised of canvas bottom and/or sides and 504µ nylon mesh back. The designated area is sampled for one 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.

This page is intended to be blank

I. PROJECT MANAGEMENT/PLANNING

Project Objective

The objective of the Watershed Characterization Project is to provide a comprehensive assessment of the ability of the streams in the Lower Salt Creek Watershed to support aquatic life and recreational uses. Watershed Characterization uses 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 Lower Salt Creek Watershed (see Figure 1, Table 1) for a water quality watershed characterization study. 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. A more complete description of the geometric site 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 Hydrologic Unit Code (HUC) in the watershed, or chosen to characterize sources for TMDL development.

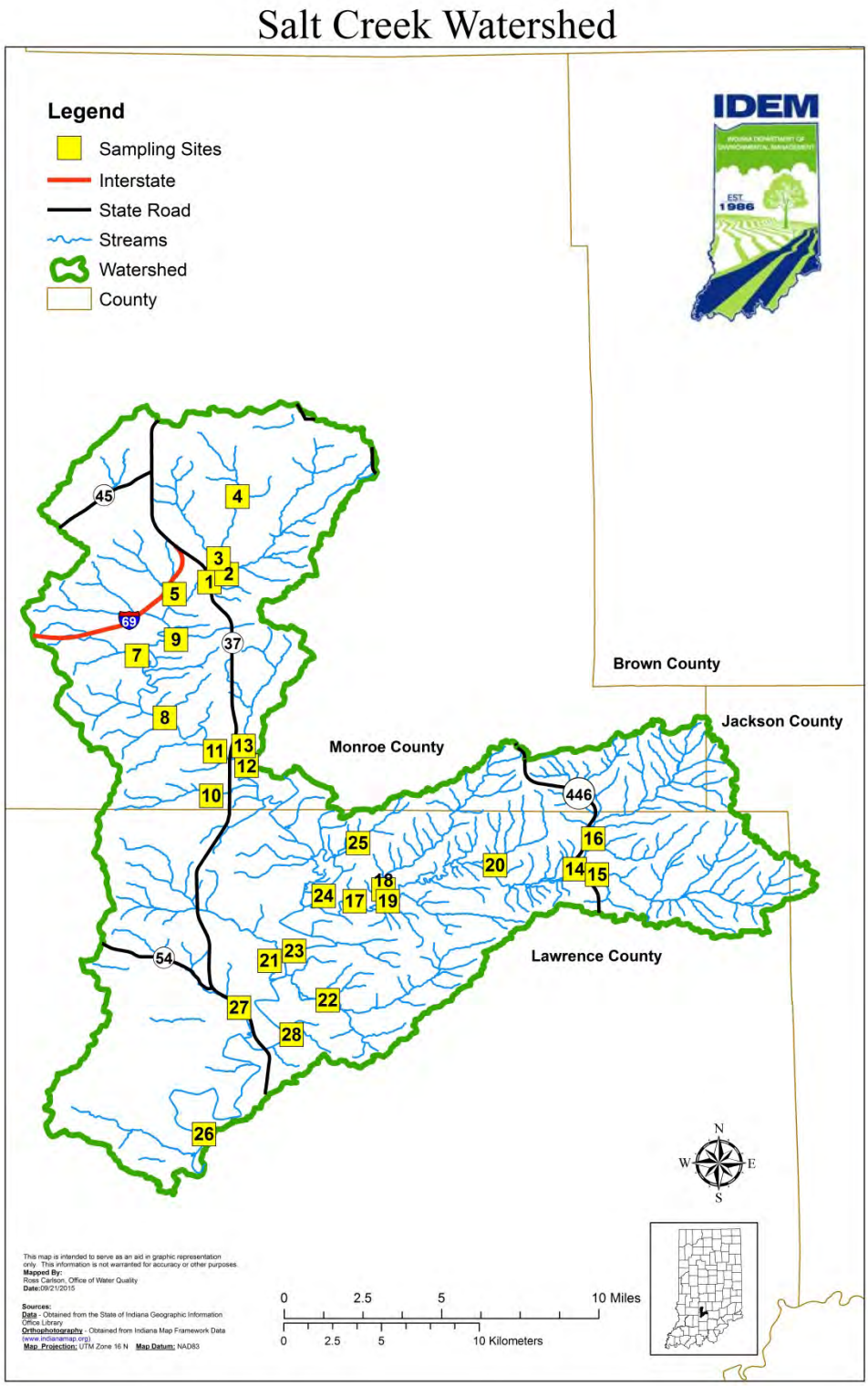
It is anticipated that the water quality data collected through this monitoring effort will provide the information needed to characterize the watershed for the TMDL program and local water quality managers, identify sources of impairment, designate critical areas, and enable users to make valid and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

The draft 2014 303(d) list submitted to the U.S. EPA (IDEM 2014a) details impairments of approximately 121 miles of the Lower Salt Creek Watershed in the following ways:

- Category 5(a): Impaired Biotic Community (IBC), 61.5 miles
- Category 5(a): *Escherichia coli (E. coli)*, 3.5 miles
- Category 5(b): Fish Tissue Impaired (PCB'S), 55.5 miles
- Category 5(b): Fish Tissue Impaired Mercury (Hg), 33.0 miles

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

Figure 1. Lower Salt Creek Watershed Characterization Study Sampling Area[1]



[1] Map site numbers refer to last two digits of site number from Table 1; e.g., 16T-010 is site 10 on map

Table 1. Sampling Locations for Watershed Characterization Study of the Lower Salt Creek[2]

Site #	AIMS Site #	Stream Name	Location	County	Latitude	Longitude
16T-001	WEL-08-0005	Clear Creek	State Road 37	Monroe	39.096528	-86.546361
16T-002	WEL-08-0006	Jackson Creek	South Rogers Street	Monroe	39.100189	-86.538442
16T-003	WEL-08-0007	Clear Creek	W Church Lane	Monroe	39.107384	-86.54218
16T-004	WEL-08-0008	Clear Creek	W Country Club Drive	Monroe	39.135947	-86.5335
16T-006	WEL-08-0010	Tributary to Clear Creek	S Victor Pike	Monroe	39.079577	-86.568863
16T-007	WEL-08-0011	Tributary to Clear Creek	S Victor Pike	Monroe	39.062771	-86.579717
16T-008	WEL-08-0012	Clear Creek	S Ketcham Road	Monroe	39.034126	-86.566867
16T-009	WEL-08-0013	Tributary to Clear Creek	Will Flock Mill Road	Monroe	39.070046	-86.561745
16T-010	WEL-08-0014	Judah Branch	S Old State Road 37	Monroe	38.998267	-86.545529
16T-011	WEL-08-0015	Clear Creek	S Gore Road	Monroe	39.018748	-86.543774
16T-012	WEL-08-0016	Clear Creek	Depot Hill Road	Monroe	39.012097	-86.529284
16T-013	WEL-08-0017	Little Clear Creek	E Monroe Dam Road	Monroe	39.021223	-86.530694
16T-014	WEL-08-0018	Little Salt Creek	State Road 446	Lawrence	38.964505	-86.378228
16T-015	WEL-08-0019	Henderson Creek	Humback Ridge Road	Lawrence	38.962027	-86.368041
16T-016	WEL-08-0020	Little Salt Creek	Hunter Creek Road	Lawrence	38.978505	-86.369714
16T-017	WEL-08-0021	Little Salt Creek	Judah Legan Road	Lawrence	38.949759	-86.47954
16T-018	WEL-08-0022	Knob Creek	Bat Hollow Road	Lawrence	38.955139	-86.466257
16T-019	WEL-08-0023	Little Salt Creek	Bat Hollow Road	Lawrence	38.949755	-86.464231
16T-020	WEL-08-0024	Tributary to Little Salt Creek	Heltonville Bartlettsville Road	Lawrence	38.966282	-86.414897
16T-021	WEL-08-0025	Gulletts Creek	Peerless Road	Lawrence	38.922345	-86.518702
16T-022	WEL-08-0026	Pleasant Run	Peerless Road	Lawrence	38.904176	-86.4919
16T-023	WEL-08-0027	Salt Creek	Peerless Road	Lawrence	38.926835	-86.507369
16T-024	WEL-08-0034	Salt Creek	Guthrie Rd	Lawrence	38.976379	-86.477849
16T-025	WEL-08-0029	Wolf Creek	Guthrie Road	Lawrence	38.976474	-86.477949
16T-026	WEL-08-0033	Salt Creek	Old State Road 450	Lawrence	38.838832	-86.548893

Site #	AIMS Site #	Stream Name	Location	County	Latitude	Longitude
16T-027	WEL-08-0031	Goose Creek	Patton Hill Road	Lawrence	38.900756	-86.532697
16T-028	WEL090-0003	Salt Creek	Oolitic Road	Lawrence	38.888333	-86.508611

[2] 16T-### denotes that these are the selected pour points for this project

Project/Task Organization and Schedule

Sampling for this project will begin in November 2015 and end in October 2016. 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 will be completed in August 2015. 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 the Indiana Administrative Code (IAC, updated October 22, 2014) [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 2015 and the study will conclude in October 2016.

Biological sampling activities will begin in the summer of 2016 and end no later than October 16, 2016. The basin will be sampled for fish community, macroinvertebrate community, and habitat quality at all sites in the watershed. Specific dates for fish community and macroinvertebrate 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 Escherichia coli (*E. coli*) will take place monthly from April through October of 2016 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 2016 to determine a geometric mean.

Stream flow will be quantified over the sampling year at sites designated as “pour points” (Table 1) during the monthly water chemistry sampling in each 12 digit HUC. The first measurement event will be conducted in November 2015 and the study will conclude in October 2016.

Background and Project/Task Description

The Watershed Characterization Study program was instituted to assist in characterizing existing conditions in watersheds throughout the state. The Lower Salt Creek watershed characterization 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 and 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, stream flow, bacteriological

contamination in the form of *E. coli*, fish community, macroinvertebrate assemblages, and habitat evaluations.

Data Quality Objectives (DQOs)

The DQO process (U.S. EPA 2006) is a planning tool for data collection activities. It provides a basis for balancing decision uncertainty with available resources. The DQO is required for all significant data collection efforts for a project. It is a seven-step systematic planning process used to clarify study objectives, define the appropriate types of data, and establish decision criteria on which to base the final use of the data. The DQO for the watershed characterization of the Lower Salt 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" and "will be capable of supporting" a "well-balanced, warm water aquatic community" [327 IAC 2-1-3]. Data from the intensive sampling of the Lower Salt Creek Watershed is needed to develop a TMDL and fully characterize the current water quality condition of the watershed. This project will gather stream flow, water chemistry, bacteriological, biological (fish and macroinvertebrates), and habitat data for the purpose of assessing the designated use attainment status of the Lower Salt Creek Watershed.

2. Identify the Decision

The 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 the extent of impairment if they are non-supporting. All sites will be sampled for concentrations of physical, chemical, and biological parameters and evaluated as "supporting" or "non-supporting" when compared with water quality criteria shown in Table 2 [327 IAC 2-1-6] following Indiana's 2014 Consolidated Assessment Listing Methodology (CALM, IDEM 2014b pages 24-28).

In addition to the physical, chemical, and bacteriological criteria listed in Table 2, data for several nutrient parameters will be evaluated with the benchmarks described below (IDEM 2014b). 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 >0.3 mg/L
- Nitrogen (measured as Nitrate + Nitrite): one or more measurements >10.0 mg/L
- Dissolved Oxygen (DO): any measurement <4.0 mg/L; any measurements consistently at or close to the standard, range 4.0-5.0 mg/L; or, any measurement >12.0 mg/L
- pH: any measurement >9.0 Standard Units (S.U.); or, measurements consistently at or close to the standard, range 8.7-9.0 S.U.

Biological Criteria:
Indiana narrative biological criteria located [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 non-supporting for aquatic life use when the monitored fish or macroinvertebrate community receives an Index of Biotic Integrity (IBI) score of less than 36, which is considered "Poor" or "Very Poor" (IDEM 2014b).

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

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
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	Calculated CAC

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

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 3. Field measurements (Table 4, page 17) will be conducted at each site during each sampling event. Visual field observations will

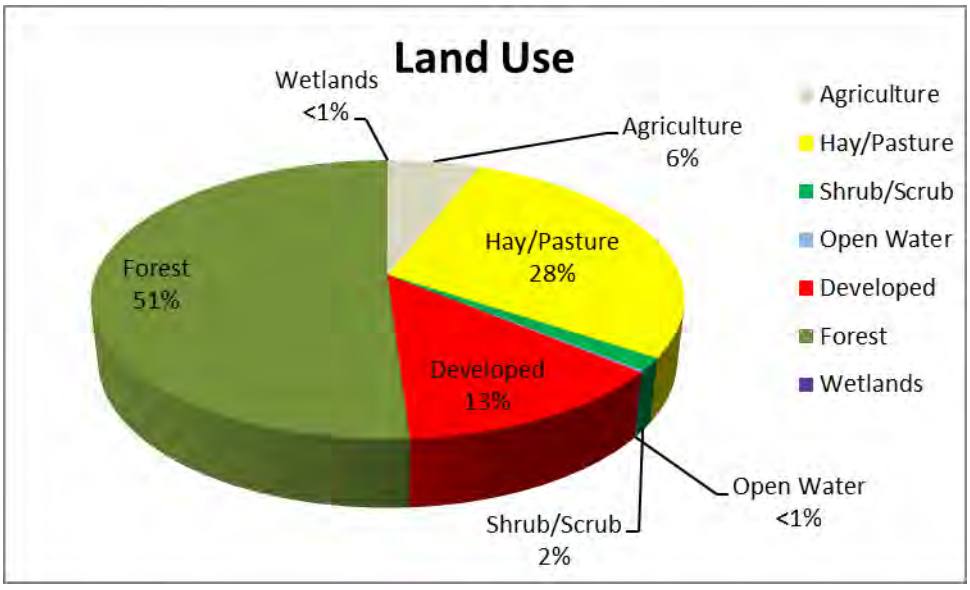
include weather conditions, stream conditions, and percent stream canopy at each sampling location. All samples collected for bacteriological samples will be analyzed for *E. coli* using the Idexx Colilert Enzyme Substrate Standard Method SM9223B (Clesceri et al., 1998). Surface water chemistry samples will be collected monthly and processed and analyzed by the Indiana State Department of Health (ISDH) Environmental Lab using the analytical methods listed in Table 3. Stream discharge will also be measured monthly at pour points to determine total stream loadings. 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 Lower Salt Creek Watershed covers 203.5 square miles and is located primarily in Monroe, Lawrence, and Jackson counties. The watershed is approximately 51% forested, 28% hay/ pasture, 13% developed, and 6% agriculture. See Figure 2 for the Lower Salt Creek Watershed 2012 land use.

See Figure 1 for the Lower Salt Creek Watershed Watershed Characterization sampling area and Table 1 for the list of sampling locations.

Figure 2. Lower Salt Creek Watershed Land Use[2]



[2]United States Department of Agriculture (USDA) 2012 Crop Data Layer (CDL)

5. Develop a Decision Rule

For assessment purposes in the Indiana Integrated Report (IDEM 2014b), 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 2014 Consolidated Assessment and Listing Methodology (CALM, IDEM 2014b pages 24-28).

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. 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.

Good quality data are essential for minimizing decision error. By minimizing errors in the sampling design, measurement, and laboratory for physical, chemical, and biological parameters, more confidence can be placed in 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 minimize 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; Ohio Environmental Protection Agency 2006) and Standard Operating Procedures (SOPs, IDEM 1992b, 1992c, 1992d, 1992e, 2010a).

The QA/QC process detects deficiencies in the data collection as set forth in the IDEM QAPP for the Indiana Surface Water Quality Monitoring Program (IDEM 2004). 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. 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, pages 130-131. 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 45-47 and Table B2-2: Field Parameters page 81.

7. Optimize the Design for Obtaining Data

A Modified Geometric Design (OHEPA 1999, 2012) site selection process (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

The WAPB uses many Standard Operating Procedures (SOPs), so any new staff member must be trained by experienced IDEM professionals on how to operate field and laboratory equipment for the collection of chemical, physical, and biological parameters as well as how to perform required QA/QC procedures (information about SOPs is given in Sections II MEASUREMENT/DATA ACQUISITION and IV DATA VALIDATION and USABILITY). Before sampling starts, IDEM staff spend several days reviewing SOPs with field and laboratory personnel that may be involved with the project.

The fish or macroinvertebrate community field Crew Chief must have a Bachelor of Science degree with a concentration in biology or other closely related area and at least one year of experience with the sampling methodology and taxonomy of the aquatic communities in the region. Prior to conducting electrofishing for fish community sampling, all crew members should review the Principles and Techniques of Electrofishing correspondence course provided by the U.S. Fish & Wildlife Service, National Conservation Training Center. Field Crew Chiefs will test electrofishing equipment and conduct field training with less experienced crew members. The field Crew Chief will be responsible for completion of field data sheets, taxonomic accuracy, sampling efficiency and representation, and voucher specimen tracking.

Staff from the Technical and Logistical Services Section will assist with laboratory work requests and review laboratory data for adherence to QA/QC requirements specified in analytical test methods, contract requirements, and the IDEM QAPP for the Indiana Surface Water Quality Monitoring Program (IDEM 2004) as well as importing electronic data into the Assessment Information Management System (AIMSII) database which is used by the WAPB. The Quality Assurance Officer will create QA/QC review reports for each laboratory analysis set. Quality Assurance staff will conduct audits of field sampling procedures utilized by WAPB staff. Monitoring staff will oversee the entry of the field and laboratory data into AIMSII and perform data QA/QC for accuracy and completeness.

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 “Project Objective” section of this Work Plan.

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. Final 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 TM SB handheld Series Global Positioning System

(GPS), with an accuracy of two to five meters (IDEM 2015). These coordinates will be entered into the AIMS II database.

Table 1 provides a list of the selected sampling sites with the stream name, AIMS Site Number, County Name, and the latitude and longitude of each site. The map at Figure 1, paired with that table, provides a good overview of the various sampling site locations.

Sampling Methods

Water Chemistry

One team of two staff will collect grab water chemistry samples and record physical site observations on the IDEM Stream Sampling Field Data Sheet (Attachment 3), during monthly sampling events. All water chemistry sampling will adhere to the Water Quality Surveys Section Field Procedure Manual Section 2.0 (Field Procedure Manual IDEM 2002, pages 8-14).

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 for the Colilert® Test Method. Per Element A4 Project Organization and Schedule (above), the expected time frame for bacteriological sampling will be April through October of 2016. Staff will collect the samples in a 120 mL pre-sterilized wide-mouth container from the center of flow if stream is wadeable or from the shoreline using a pole sampler if the stream is not 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 appropriate IDEM *E. coli* Laboratory for analyses within the bacteriological holding time of six hours.

The IDEM Mobile *E. coli* 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 IDEM Mobile *E. coli* Laboratory (Van) provides work space containing storage for samples, 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 depending on stream size and site accessibility. Fish assemblage assessments will be performed in a sampling reach of 15 times the length of 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 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 (IDEM 1992a, 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).

Prior to processing fish specimens and completion of the fish collection datasheet, one to two individuals per species will be preserved in 3.7% formaldehyde solution for future reference if there are more than 10 individuals for that species collected in the sampling reach, the specimens can be positively identified, and the individuals for preservation are small enough to fit in a 2000 mL jar. If however, there are few individuals captured or the specimens are too large to preserve, a photo of key characteristics 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 (especially those that co-occur like the Striped and Common Shiner), if they are individuals that appear to be hybrids or have unusual anomalies, or they are dead specimens that are taxonomically valuable for un-described taxa (like the 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. Once the data have been recorded, specimens will be released within the sampling reach if 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 with 500 µm mesh (Barbour et al. 1999; IDEM 2010a; Klemm et al. 1990; Plafkin et al. 1989). 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 (. The 50 meter length of riparian corridor that is sampled at each site will be defined using a rangefinder or GPS unit. 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 where the collector (while still on-site) will conduct a 15-minute pick of macroinvertebrates at a single organism rate with an effort to pick for maximum organism diversity through turning and examination of the entire sample in the tray. The resulting picked sample will be preserved in 70% isopropyl alcohol and 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 be completed for the sample. A completed Biological Samples’ chain-of- custody form (Attachment 6) accompanies the samples through the identification process.

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) Qualitative Habitat Evaluation Index (QHEI), 2006 edition (OHEPA 2006; Rankin 1995). A separate QHEI (Attachment 7) must be completed for these two media types since the sampling reach length may differ (i.e., 50 meters for macroinvertebrates and between 50 and 500 meters for fish).

Field Parameter Measurements

Dissolved oxygen (DO), pH, water temperature, specific conductance, and DO percent saturation will be measured with a data sonde during each sampling event regardless of the media type being collected (IDEM 2002). Measurement procedures and operation of the data sonde 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, pages 67-79). Turbidity will be measured with a Hach™ turbidity kit, and the meter number written in the comments under the field parameter measurements. All field parameter measurements and weather codes will be recorded on the IDEM Stream Sampling Field Data Sheet (Attachment 3) with other sampling observations. A digital photo will also be taken upstream and downstream of the site during each sampling event.

Flow Measurements

Flow measurements are to be taken by the water chemistry crew at the pour point sites during each sampling run using the SonTek Acoustic Doppler Profiler (ADP) at non-wadeable sites and the FlowTracker Handheld Acoustic Doppler Velocimeter (ADV)®, Ott Acoustic Digital Current (ADC), or Ott MF pro at the wadeable sites. Procedures shall be according to Section 2.6.5 of the Surveys Section Field Procedure Manual (IDEM 2002) and the manufacturers' operating manuals. (SonTek/YSI Inc 2007; 2001).

Analytical Methods

Laboratory Procedure for *E. coli* Measurements:

At the end of each sampling run and while still in the field, 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 TM Colilert Test. The Colilert Test is a multiple-tube Enzyme Substrate Standard Method SM-9223 B (Clesceri et al., 1998). The *E. coli* test method and quantification limit are identified below in Table 3.

Nutrient and General Chemistry Parameters Measurements:

Nutrient and general chemistry measurement analysis is performed at ISDH Environmental Lab in accordance with pre-approved test methods and allotted time frames. The nutrient and general chemistry parameters and their respective test methods and quantification limits are identified below in Table 3. A chain-of-custody form created by the AIMS II database (Attachment 8) and a sample analysis request form (Attachment 9) accompanies each sample set through the analytical process.

Table 3. *E. coli*, Nutrient and General Chemistry Parameters Test Methods

Parameter	Method	Limits of Quantification	Units	Preservative	Holding Times
E. coli	SM-9223 B 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	None	14 days

Parameter	Method	Limits of Quantification	Units	Preservative	Holding Times
Total Solids	SM 2540B	10.0	mg/L	None	7 days
Total Suspended Solids	SM 2540D	6.0	mg/L	None	7 days
Total Dissolved Solids	SM 2540C	10.0	mg/L	None	7 days
Sulfate	EPA 375.2	5.0	mg/L	None	28 days
Chloride	SM4500Cl-E	5.0	mg/L	None	28 days
Hardness (as $CaCO_3$)	EPA 130.1	30.0	mg/L	HNO_3 < pH 2	6 months
Ammonia Nitrogen	EPA 350.1	0.10	mg/L	H_2SO_4 < pH 2	28 days
TKN	EPA 351.2	0.30	mg/L	H_2SO_4 < pH 2	28 days
Nitrate+Nitrite	EPA 353.1	0.1	mg/L	H_2SO_4 < pH 2	28 days
Total Phosphorus	EPA 365.1	0.03	mg/L	H_2SO_4 < pH 2	28 days
TOC	SM 5310B	1.0	mg/L	H_2SO_4 < pH 2	28 days
COD	SM 5220D	10.0	mg/L	H_2SO_4 < pH 2	28 days

***** Clesceri et al., 1998. 1 MPN = 1 CFU/100 mL

Field Parameters Measurements:

The field measurements of DO, temperature, pH, conductivity, and turbidity are taken each time a sample is collected. The field parameters and their respective test methods and sensitivity limits are identified below in Table 4.

Table 4. Field Parameters Test Methods

Parameter	Method	Sensitivity Limit	Units
Dissolved Oxygen (data sonde optical)	ASTM D888-09(C)	0.01	mg/L
Dissolved Oxygen (Winkler Titration)	SM 4500-OC[1]	0.2	mg/L
Dissolved Oxygen % Saturation (data sonde optical)	ASTM D888-09(C)	0.01	%
Turbidity (data sonde)	SM2130B	0.02	NTU
Turbidity (Hach Turbidimeter)	EPA 180.1[1]	0.01	NTU
Specific Conductance (data sonde)	SM 2510B	1.0	µS/cm
Temperature (data sonde)	SM 2550B(2)	0.1	^{o} C
Temperature (field meter)	SM 2550B(2)[1]	0.1	^{o} C
pH (data sonde)	EPA 150.2	0.01	SU
pH (field meter)	SM 4500H-B[1]	0.01	SU

[1] Method used for Field Calibration Verification

Quality Control and Custody Requirements

Quality assurance protocols will follow part B5 of the WAPB QAPP (IDEM 2004 page 119-121).

Field Parameter Measurements/Instrument Testing/Calibration

The data sonde will be calibrated prior to each week's sampling (IDEM 2002). The DO component of the calibration procedure will be conducted using the air calibration method (IDEM 2002 page 74). Calibration results and drift values will be recorded and stored in log books located in the calibration laboratories at the Shadeland facility. The

drift value is the difference between two successive calibrations. Field parameter calibrations will conform to the procedures as described in the instrument users' manuals (Hydrolab Corporation 2002; YSI 2002). The unit will be field checked for accuracy once during the week by comparison with a Winkler DO test (IDEM 2002 page 64), as well as Hach™ turbidity, pH, and temperature meters. Weekly calibration verification results will be recorded on the Stream Sampling Field Data Sheet (Attachment 3) and entered into the AIMS II database. A Winkler DO test will also be conducted at sites where the DO concentrations detected using a data sonde are 4.0 mg/L or less.

Field Analysis Data

In-situ water chemistry field data will be 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 have been set for each analysis (Table 4). 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 9223 Enzyme Substrate Coliform Test Method, see Table 3 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 and/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 for each parameter, preservatives and holding times (Table 3) will adhere to U.S. EPA requirements (U.S. EPA 2007).

- 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.
- Field blank samples using ASTM D1193091 Type I water will be taken at a rate of one set per sample analysis set or one per every 20 samples, whichever is greater.

The IDEM OWQ Chain of Custody Form (Attachment 8) and the Sample Analysis Request Form (Attachment 9) accompanies each sample set through the analytical process.

Fish Community Data

Replicate fish community sampling will be performed at a rate of 10 percent of the total fish community sites sampled, three sites chosen using a random numbers table in the basin (IDEM 1992a; U.S. EPA 1995). Replicate sampling will be performed with at least two weeks of recovery between the initial and replicate sampling events. The fish community replicate 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 Biological Samples Field Chain-of-Custody Form is used to track samples from the field to the laboratory (Attachment 6). Fish in the laboratory may be verified by regionally recognized non-IDEM freshwater fish taxonomists. All data are 1) checked for completeness 2) calculations performed 3) data entered into the AIMS II database and 4) checked again for data entry errors.

Macroinvertebrate Community Data

Replicate macroinvertebrate field samples will be collected at a rate of 10 percent of the total macroinvertebrate community sites sampled, approximately three for the project. The macroinvertebrate community replicate sample and habitat assessment will be performed by the same team member who performed the original sample, immediately after the intial sample is collected. This will result in a precision evaluation based on a 10 percent replicate of samples collected. The IDEM Biological Samples Field Chain of Custody Form is used to track samples from the field to the laboratory (Attachment 6). Laboratory identifications and QA/QC of taxonomic work is maintained by the laboratory supervisor, Macroinvertebrate Community Program Manager.

III. ASSESSMENT/OVERSIGHT

Field and laboratory performance and system audits will be conducted to ensure good quality data. The field and laboratory performance includes precision measurements by relative percent difference (RPD) of field and laboratory duplicate, accuracy

measurements by percent of recovery of MS/MSD 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.

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.

Data Quality Assessment Levels

The samples and various types of data collected by this program are intended to meet the quality assurance criteria and Data Quality Assessment (DQA) Levels as described in the WAPB QAPP (IDEM 2004, pages 128-129).

IV. DATA VALIDATION AND USABILITY

Quality Assurance/Data Qualifiers and Flags

The various data qualifiers and flags that will be used for quality assurance and validation of the data are found on pages 130-131 of the WAPB QAPP (IDEM 2004).

Data Usability

The environmental data collected and their usability are qualified and classified into one or more of the four categories: Enforcement Capable Results, Acceptable Data, Estimated Data, and Rejected Data as described on page 130 of the WAPB QAPP (IDEM 2004).

Data collected for this project will be recorded in the AIMS II database and presented in three compilation summaries:

- A general compilation of the site field and water chemistry data prepared for use in the Indiana Integrated Water Monitoring and Assessment Report.
- A 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.
- Laboratory bench sheets of the species taxa names and enumerations of all taxon collected.

All data and reports will be made available to public and private entities that find the data useful.

Laboratory and Estimated Cost

Laboratory analysis and data reporting for this project will comply with the WAPB QAPP (IDEM 2004), Request for Proposals (RFP) 12-48 (IDEM 2012), and the OWQ Quality Management Plan(IDEM 2012b). Analytical tests on the general chemistry and nutrient parameters outlined in Table 3 will be performed by the Indiana State Department of Health (ISDH) Environmental Lab in Indianapolis, Indiana at no direct cost. Supplies for

the bacteriological sampling will come from IDEXX Laboratories, Inc., Westbrook, Maine with a total estimated cost for this project of $1,700. All fish and macroinvertebrate samples will be collected and analyzed by IDEM staff.

Personnel Safety and Reference Manuals

All staff persons who participate in the field component of this study are required to have completed Basic First Aid and Cardio-Pulmonary Resuscitation (CPR) training. According to the memorandum "Change in status of Water Assessment Branch staff in accordance with the Agency training policy," dated November 29, 2010, OWQ WAPB staff is exempt from initial and annual training requirements set forth in Section 6.0 of the IDEM Health and Safety Training Policy (IDEM 2010b). The memorandum also states "as an alternative to the training requirements of the policy, the WAPB will conduct in-service training at a minimum of four (4) hours per year on topics directly related to duties performed by staff." New hires or those changing job responsibilities without the minimum four-hour training must be accompanied in the field by a staff member who has met the requirements of the branch Health and Safety training.

Field personnel collecting water chemistry and bacteriological samples will follow policies and procedures established in the Surveys Section Field Procedures Manual (IDEM 2002) and the Hazardous Communication Plan Supplement (IDEM 1997). Field personnel collecting fish and macroinvertebrate community samples must read and comply with the Biological Studies Section SOP Manual: Section II. Hazard Communications Manual (IDEM 1992e) which includes four yellow three-ring binders consisting of the:

1) WAPB Safety Manual;
2) IDEM Hazard Communications SOP;
3) Occupational Safety and Health Administration Handbooks;
4) Material Safety Data Sheets;
5) "Field and Laboratory Operating Procedures for use, handling and storage of chemicals in the laboratory" (Newhouse 1998a); and,
6) "Field and Laboratory Operating Procedures for Use, Handling, and Storage of Solutions Containing Formaldehyde" (Newhouse 1998b).

Sampling on surface waters requires safety consciousness of staff members and the use of specialized equipment; thus, staff will comply with the IDEM Personal Protective Equipment (PPE) Policy (IDEM 2008). If an injury or illness arises in the field, staff will follow the IDEM Injury and Illness Resulting from Occupational Exposure Policy (IDEM 2010c).

Operating in and around waterbodies carries inherent risks of drowning; thus, personnel involved in sample collection will wear appropriate clothing and PPE when operating boats or sampling in deep water or swift currents. According to the memorandum "Use of Personal Flotation Devices (PFDs) by Branch Personnel," dated February 29, 2000, WAPB staff must wear U.S. Coast Guard approved Type I, II, or III PFDs whenever:

- the planned work requires them to enter the water and the maximum water depth at any portion of the work site is over their knee (note that this depth depends on the employee but it will usually be between 12 and 20 inches or 300-500 mm);
- the employee is in a watercraft of any kind that is being launched, is in the water, or is being retrieved from the water; or,
- the employee must work from structures that do not possess guard rails and are over or alongside water where the water depth is or could reasonably be expected to be three feet deep or greater.

In addition, when work is being done in boats on co-jurisdictional waters (as defined by Indiana Code (IC) 14-8-2-315) or during hours of darkness 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.

Safety issues are the responsibility of all crew members; however, any questions in the field should be directed to the field crew leader. The field crew leader is responsible for the completion of all work listed in the Work Plan, the health and safety aspects of the sampling event, and successful interactions with landowners and members of the public.

REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder and J.B. Stribling. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA/841/B-99/002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C. Report available at http://water.epa.gov/scitech/monitoring/rsl/bioassessment/

Clesceri, L.S., Greenburg, A.E., Eaton, A.D., 1998. SM-Standards Methods for the Examination of Water and Wastewater 20th Edition. American Public Health Association.

Code of Federal Regulations (CFR). 40 CFR Part 136, Appendix B Revised March 12, 2007. Available at http://www.gpo.gov/fdsys/pkg/CFR-2012-title40-vol24/pdf/CFR-2012-title40-vol24-part136-appB.pdf

Hydrolab Corporation. 2002, revision c. Quanta Water Quality Monitoring System Operating Manual. Loveland, Colorado. Available at http://www.hachhydromet.com/web/ott_hach.nsf/id/pa_users_manuals_e.html

IAC(Indiana Administrative Code), Title 327 Water Pollution Control Division, Article 2. Water Quality Standards. Last updated November 4, 2015. Available at http://www.in.gov/legislative/iac/iac_title?iact=327

IDEM. 1992a, revision 1. Section 3, Quality Assurance Project Plan, Development of Biological Criteria (Fish) for the Ecoregions of Indiana. Biological Studies Section, Surveillance and Standards Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 1992b, revision 1. Section 4, Standard Operating Procedures for Fish Collections, Use of Seines, Electrofishers, and Sample Processing. Biological Studies Section, Surveillance and Standards Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 1992c, revision 1. Section 5, Standard Operating Procedures for Conducting Rapid Assessment of Ambient Water Quality Using Fish (RBP-V). Biological Studies Section, Surveillance and Standards Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 1992d, revision 1. Section 11, Standard Operating Procedures-Appendices of Operational Equipment Manuals and Procedures. Biological Studies Section, Surveillance and Standards Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 1992e, revision 1. Section 2, Biological Studies Section Hazards Communications Manual (List of Contents). Biological Studies Section, Surveillance and Standards Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana. (This Manual is not available in

electronic format but may be inspected at the Watershed and Assessment Branch offices at 2525 North Shadeland, Indianapolis, IN.)

IDEM. 1997. Water Quality Surveys Section Laboratory and Field Hazard Communication Plan Supplement. IDEM 032/02/018/1998, Revised October 1998. Assessment Branch, Indiana Department of Environmental Management, Indianapolis, Indiana

IDEM. 2002. Water Quality Surveys Section Field Procedure Manual, Assessment Branch, Indiana Department of Environmental Management, Indianapolis, Indiana. IDEM, April 2002.

IDEM. 2004. Quality Assurance Project Plan (QAPP) for Indiana Surface Water Quality Monitoring and Total Maximum Daily Load (TMDL) Program, (Rev. 3, Oct. 2004).

IDEM. 2008. IDEM Personal Protective Equipment Policy, revised May 1 2008. A-059-OEA-08-P-R0. Office of External Affairs, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 2010a. Multi-habitat (MHAB) Macroinvertebrate Collection Technical Standard Operating Procedure. S-001-OWQ-W-BS-10-T-R0. Watershed Planning and Assessment Branch, Office of Water Quality, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 2010b. IDEM Health and Safety Training Policy, revised October 1 2010. A-030-OEA-10-P-R2.Office of External Affairs, Indiana Department of Environmental Management, Indianapolis, Indiana.

IDEM. 2010c. IDEM Injury and Illness Resulting from Occupational Exposure Policy, revised October 1 2010. A-034-OEA-10-P-R2. Office of External Affairs, Indiana Department of Environmental Management, Indianapolis, Indiana

IDEM. 2012. Request for Proposals 12-48, Solicitation for Analyses. IDEM. Indiana Department of Administration. Indianapolis, Indiana.

IDEM. 2012b. IDEM Agency Wide Quality Management Plan. IDEM, Indiana government Center North, 100 N. Senate Ave., Indianapolis, Indiana, 46204. Available at http://www.in.gov/idem/files/idem_qmp_2012.pdf IDEM. 2014a. Draft 2014 303(d) List Submitted to U.S. EPA on April 1, 2014. Edited by Jody Arthur. Office of Water Quality, Indiana Department of Environmental Management, Indianapolis, Indiana. Available at http://www.in.gov/idem/nps/2647.htm

IDEM. 2014b. Indiana's 2014 Consolidated Assessment and Listing Methodology (CALM) Revised. Edited by Jody Arthur. Office of Water Quality, Indiana Department of Environmental Management, Indianapolis, Indiana. Available at http://www.in.gov/idem/nps/files/ir_2014_report_apndx_h_calm.pdf

IDEM. 2015. Global Positioning System (GPS) Data Creation Technical Standard Operating Procedure. B-001-OWQ-WAP-XXX-15-T-R0. Office of Water Quality,

Watershed Assessment and Planning Branch. Indianapolis, Indiana. Located at https://extranet.idem.in.gov/standards/docs/sops/owq/B-001-OWQ-WAP-XXX-15-T-R0.pdf

Klemm, D.J., P.A. Lewis, F.Fulk and J.M. Lazorchak. 1990. Macroinvertebrate Field and Laboratory Methods for Evaluating the Biological Integrity of Surface Waters. EPA/600/4-90/030. Environmental Monitoring Systems Laboratory, Monitoring Systems and Quality Assurance, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.

Newhouse, S.A. 1998a. Field and laboratory operating procedures for use, handling and storage of chemicals in the laboratory. IDEM/32/03/007/1998. Biological Studies Section, Assessment Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana.

Newhouse, S.A. 1998b. Field and laboratory operating procedures for use, handling and storage of solutions containing formaldehyde. IDEM/32/03/006/1998. Biological Studies Section, Assessment Branch, Office of Water Management, Indiana Department of Environmental Management, Indianapolis, Indiana.

Ohio Environmental Protection Agency (OHEPA). 1999. Ohio EPA Five-Year Surface Water Monitoring Strategy: 2000 – 2004. Ohio EPA Technical Bulletin MAS/1999-7-2. Division of Surface Water, Lazarus Government Center, 211 S. Front Street, Columbus, Ohio 43215. Page 70. Report available at: http://www.epa.gov/nheerl/arm/documents/ohiofiveyearmonitstratdraft.pdf

Ohio Environmental Protection Agency (OHEPA). 2006. Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI). OHIO EPA Technical Bulletin EAS/2006-06-1. Revised by the Midwest Biodiversity Institute for State of Ohio Environmental Protection Agency, Division of Surface Water, Ecological Assessment Section, Groveport, Ohio. Report available at http://www.epa.state.oh.us/portals/35/documents/qheimanualjune2006.pdf

Ohio Environmental Protection Agency (OHEPA). 2012. 2011 Biological and Water Quality Study of Mill Creek and Tributaries, Hamilton County, Ohio. Technical Report MBI/2012-6-10. MSD Project Number 10180900. Prepared for: Metropolitan Sewer District of Greater Cincinnati, 1081 Woodrow Street, Cincinnati, OH 45204. Submitted by: Midwest Biodiversity Institute, P.O. Box 21561, Columbus, Ohio 43221-0561. Pages 40-1. Report available at: http://projectgroundwork.org/downloads/reports/2011_mill_creek_biological_water_quality_study.pdf

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/440/4-89/001. Assessment and Watershed Protection Division, U.S. Environmental Protection Agency, Washington, D.C. Report available at http://nepis.epa.gov/Exe/ZyNET.exe/9100LGCA.TXT?ZyActionD=ZyDocument&Clie

nt=EPA&Index=1986+Thru+1990&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C86thru90%5CTxt%5C00000022%5C9100LGCA.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=p%7Cf&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL

Rankin, E.T. 1995. Habitat Indices in Water Resource Quality Assessments. pp. 181-208, Chapter 13, Biological Assessment and Criteria: Tools for the Risk-based Planning and Decision Making, edited by Wayne S. Davis and Thomas P. Simon, Lewis Publishers, Boca Raton, Florida.

Simon, T.P. 1990. Quality Assurance Program Plan: Development of Biological Criteria for the Ecoregions of Indiana. Region V, Environmental Sciences Division, Central Regional Laboratory, Organic Chemistry Section: Biology Team, U.S. Environmental Protection Agency, Chicago, Illinois.

Simon, T.P. and R.L. Dufour. 2005. Guide to appropriate metric selection for calculating the Index of Biotic Integrity (IBI) for Indiana Large and Great Rivers, Inland Lakes, and Great Lakes nearshore. U.S. Department of the Interior, Fish and Wildlife Service, Bloomington Field Office, Bloomington, Indiana.

SonTek/YSI Inc 2001, SonTek/YSI ADP® Acoustic Doppler Profiler Technical Documentation. 2001. Available at http://www.sontek.com/adp-adcp.php

SonTek/YSI Inc 2007, FlowTrackers® User's Manual. 2007. Available at http://www.sontek.com/flowtracker.php

United States Environmental Protection Agency (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. Report available at http://www.epa.gov/emap2/html/pubs/docs/groupdocs/surfwatr/field/ws_abs.html

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.

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

YSI Incorporated. 2002, revision b. 6-Series Environmental Monitoring Systems Manual, Yellow Springs, Ohio. Available at http://www.ysi.com/mwg-internal/de5fs23hu73ds/progress?id=fdaTJVUSbg

DISTRIBUTION LIST

Electronic Distribution Only:

Name	Organization
Jody Arthur	IDEM/OWQ/WAPB/Technical E7
Tim Beckman	IDEM/OWQ/WAPB/Targeted Monitoring Section
Timothy Bowren	IDEM/OWQ/WAPB/Technical and Logistics Section
Ross Carlson	IDEM/OWQ/WAPB/Watershed Planning and Restoration Section
Kevin Crane	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Todd Davis	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Monika Elion	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Cory Fischer	IDEM/OWQ/WAPB/Targeted Monitoring Section
Kevin Gaston	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Staci Goodwin	IDEM/OWQ/WAPB/Watershed Planning and Restoration Section
Kathleen Hagan	IDEM/OWQ/WAPB/Watershed Planning and Restoration Section
David Jordan	IDEM/OWQ/WAPB/Technical and Logistical Services Section
Paul McMurray	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Myra McShane	IDEM/OWQ/WAPB/Technical and Logistical Services Section
Martha Clark Mettler	IDEM/OWQ/Assistant Commissioner
Reid Morehouse	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Stacy Orlowski	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Dave Parry	IDEM/ Office of Compliance Support/Planning and Assessment/Quality Improvement Section
Marylou Renshaw	IDEM/OWQ/WAPB/Branch Chief
Joe Schmees	IDEM/OWQ/WAPB/Watershed Planning and Restoration Section
Anna Settineri	IDEM/OWQ/WAPB/Targeted Monitoring Section
Stacey Sobat	IDEM/OWQ/WAPB/Probabilistic Monitoring Section
Michael Spinar	IDEM/ Office of Compliance Support/Planning and Assessment/Quality Improvement Section
MikeSutton	IDEM/OWQ/WAPB/Technical and Logistics Section
Cyndi Wagner	IDEM/OWQ/WAPB/Targeted Monitoring Section
Kayla Werbianskyj	IDEM/OWQ/WAPB/Targeted Monitoring Section

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/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 3: Blank 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 (cfs/sec)	Flow Estimated?	Algae?	Aquatic Life?
										☐	☐	☐

Sample Taken?	Aliquots	Water Flow Type	Water Appearance	Canopy Closed %
☐ Yes ☐ No; Frozen ☐ No; Stream Dry ☐ No; Other ☐ No; Owner refused Access	☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 6 ☐ 8 ☐ 12 ☐ 24 ☐ 48 ☐ 72 ☐ All-Flow	☐ Riffle ☐ Dry ☐ Stagnant ☐ Pool ☐ Run ☐ Flood ☐ Glide ☐ Eddy ☐ Other	☐ Clear ☐ Green ☐ Sheen ☐ Murky ☐ Black ☐ Other ☐ Brown ☐ Gray (Septic/Sewage)	☐ 0-20% ☐ 60-80% ☐ 20-40% ☐ 80-100% ☐ 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, Coming Filter
Gly	Glyphosate: Thiosulfate	500PF	500mL Plastic, Coming Filter
Hg	Mercury(1631): HCl	60P	60mL Plastic
CrS	Chromium VI(1636): NaOH	250T	250mL Teflon
MeHg	Methyl Mercury(1630): HCl	500T	500mL Teflon
		125T	125mL Teflon

Data Entered By: _____ QC1: _____
QC2: _____

Stream Sampling Field Data Sheet

Attachment 4: 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			

MKM: Rev/February 19, 2014

Attachment 5: 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: Biological Samples Field Chain-of-custody Form

IDEM

INDIANA DEPARTMENT OF
ENVIRONMENTAL MANAGEMENT
OFFICE OF WATER QUALITY
BIOLOGICAL STUDIES SECTION

BIOLOGICAL SAMPLES FIELD CHAIN OF CUSTODY

I certify that the sample(s) listed below was/were collected by me or in my presence.

Signature:

Date: ____/____/____

Sample Type:
(ie. fish, macro, algae) ____________

EVENT ID (YY _ _ _)/ MACRO # (9 DIGIT)	IDEM SAMPLE # (AB _ _ _ _ _)	200mL Nalgene	250mL Nalgene	125mL Glass	Type (AD or AS)	Volume (mL)	COLLECTED		PLACED IN STORAGE		Storage Room #	Check line for sample present and accounted for! One check per bottle.
							Date (mm/dd/yyyy)	Time (24 hr)	Date (mm/dd/yyyy)	Time (24 hr)		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		
								:		:		

SIGNATURE	DATE AND TIME	Comments:
RELINQUISHED BY:	/ /	
RECEIVED BY:	:	
RELINQUISHED BY:	/ /	
RECEIVED BY:	:	

Lab Custodian

I certify that I received the above sample(s) and is/are recorded in the official record book. The same samples will be in custody of competent laboratory personnel at all times or locked in a secure area.

Signature: ______________________________ Date: / / Time: :

Lab: Indiana Department of Environmental Management | Address: 2525 N. Shadeland Ave., Indianapolis, IN 46219

Attachment 7: Blank OWQ Biological Studies QHEI (Qualitative Habitat Evaluation Index) form (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; estimate % and check every type present

BEST TYPES PREDOMINANT	PRESENT	TOTAL %	OTHER TYPES PREDOMINANT	PRESENT	TOTAL %
☐☐ 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		

NUMBER OF BEST TYPES: ☐ 4 or more [2] ☐ 3 or less [0] sludge from point-sources)

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 and estimate percent: **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.)

% Amount		% Amount		% Amount	
___ ___	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
- ☐ 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)

L R (River right looking downstream) 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 (Circle 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]

Check ONE (Or 2 & average)

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

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

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

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

Riffle/ Run Maximum 8

Comments

6] *GRADIENT* (ft/mi)

DRAINAGE AREA (mi²)

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

%POOL: ____ %GLIDE: ____

%RUN: ____ %RIFFLE: ____

Gradient Maximum 10

IDEM 11/15/12

Attachment 7 (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	____ %	____ %	____ %	____ %

Stream Drawing:

IDEM 11/15/12

Attachment 8: Chain-of-custody Form

Indiana Department of Environmental Management
OWQ Chain of Custody Form

Project: _____
Team: _____
OWQ Analysis Set: _____

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

Signature: _____ Section: _____

Lab Assigned Number	IDEM Control Number	Sample Type	ID	1000 ml P, N, BA.	1000 ml G, N, M.	40 ml VIAL	120 ml G (Bact)	500 ml P, N, BA.	250 ml P, N, BA.			Date And Time Collected	
												Date	Time

P = Plastic G = Glass N. M. = Narrow Mouth Bact = Bacteriological Only Should samples be iced? Y N

Carriers

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

Signature	Date	Time	Seals Intact		Comments
Relinquished By:					
Received By:			Y	N	
Relinquished By:					
Received By:			Y	N	
Relinquished By:					
Received By:			Y	N	

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: _____

Attachment 9: 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: _____ **Composite ☐ Grab ☒**

OWQ Sample Set	1	IDEM Sample Nos.	
Crew Chief		Lab Sample Nos.	
Collection Date		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	☐	☐

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	☒	☐
Dissolved Reactive Phosphorus	SM4500-P	☐	☐
Total Phosphorus	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*

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

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. 6/2013)