Appendix C: Quality Assurance Protocol Plan

Quality Assurance Project Plan

for

Big Creek Watershed Management Plan
Posey, Vanderburgh, & Gibson County Soil & Water Conservation Districts

ARN # A305-7-6

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Prepared for:

Indiana Department of Environmental Management

Office of Water Management

Watershed Management Section

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Approved By:

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Section 1: Study Description

Historical Information

The watershed area covered by this QAPP drains approximately 160,000 acres of Vanderburgh, Posey, and Gibson Counties in Indiana. The area makes up the Big Creek Drainage Basin, an 11-digit HUC 05120113110. Big Creek empties into the Wabash River northwest of Mt. Vernon and has the potential to impact the Lower Wabash River which is impaired for *E. coli*.

The 2004 303(d) list shows Big Creek sub-watersheds as impaired for nutrients, pH, and biotic communtities. The grant associated with this QAPP was written out of concern for overall watershed health. Cropland and livestock make up the the majority of the land-use in the study area. Conversion to residential development is occurring in the northeast section of the study area and brine contamination from oil wells is known to occur throughout.

Section 1.01 Study Goals

The main objective of the grant project is to gather and research data on the watershed and to lay the ground-work for future education and land treatment applications.

Goal 1: Characterize water quality problems and prioritize areas on a 14-digit HUC level

Goal 2: Develop a watershed management plan that meets IDEM's "What Needs to be in a Watershed Plan" Checklist FFY 2003

Goal 3: Identify possible sources to direct future education and land treatment efforts

Section 1.02 Study Site

Figure 1: Sample Points & Road Overview (page 6) shows the location of the study area and all the points that will be sampled. Locations of sample points may change due to construction activitites or access restrictions but will be finalized before testing commences. *Table 1: Bridges at Sample Points* (next page) indicates roads that cross the watercourses near the sample points.

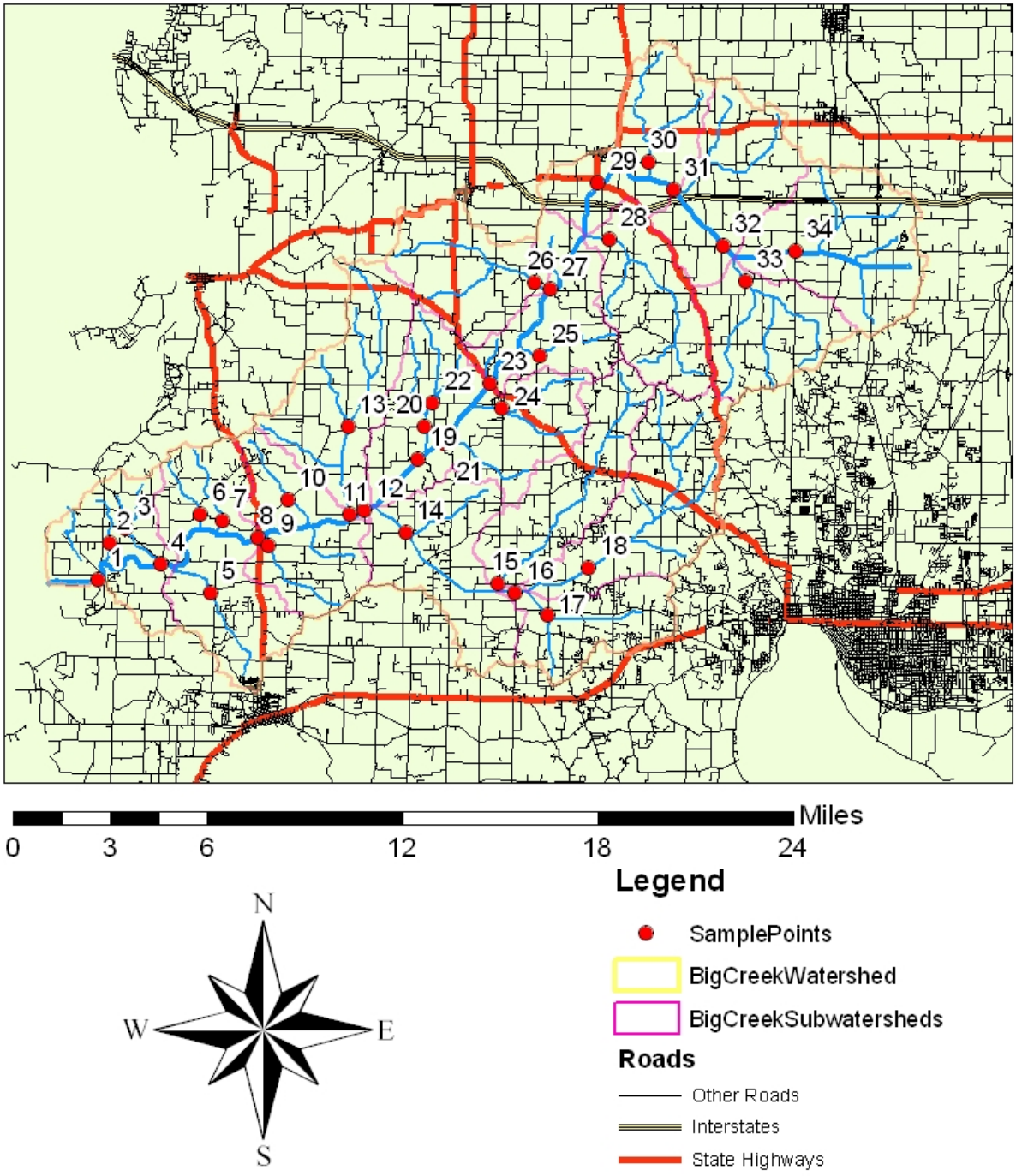
Latitude/Longitude Coordinates of Sample Points

Sample Point	latitude	longitude	Sample Point	Latitude	Longitude
1	37.99346953	-87.99003216	18	38.00096568	-87.71255595
2	38.01041144	-87.98340931	19	38.04903216	-87.80942818
3	38.01665712	-87.97482386	20	38.0638643	-87.80595125
4	38.0011692	-87.95461558	21	38.05614635	-87.79481242
5	37.98806891	-87.92650363	22	38.07461711	-87.80171645
6	38.02360451	-87.93240735	23	38.08314246	-87.76954185
7	38.02053102	-87.92009817	24	38.0724389	-87.76219586
8	38.01320381	-87.89960779	25	38.09590421	-87.74101355
9	38.01002423	-87.89360316	26	38.12882635	-87.74425461
10	38.03064952	-87.88330597	27	38.12604005	-87.73570162
11	38.02411675	-87.84817713	28	38.14849506	-87.70250114
12	38.02582872	-87.83971524	29	38.17339852	-87.70893385
13	38.06328855	-87.84959407	30	38.18304443	-87.68002455
14	38.01617432	-87.81633582	31	38.17096869	-87.66620474
15	37.9936152	-87.76357256	32	38.14595277	-87.63789802
16	37.98980085	-87.7542479	33	38.1302076	-87.62494883
17	37.9797249	-87.73585896	34	38.14357958	-87.59700431

Bridges at Sample Points

Sample Point	Road Name	Road name	Sample Point	Road Name	Road name
1	Wabash	Rd	18	St Phillips	Rd
2	Curtis	Rd	19	Krietenstein	Rd
3	Bundy	Rd	20	Metz	Rd
4	Lower New Harmony	Rd	21	Huey	Rd
5	Copperline	Rd	22	Haines	Rd
6	French	Rd	23	State Highway 66	
7	French	Rd	24	Stierley	Rd
8	State Road 69		25	Schmitt	Rd
9	Johnson	Rd	26	Wagon Wheel	Rd
10	Springfield	Rd	27	John Will	Rd
11	Spring Switch	Rd	28	St Wendel Cynthiana	Rd
12	Oliver	Rd	29	Water Tank	Rd
13	Springfield	Rd	30	County Road 1200	
14	John Mills	Rd	31	County Road 525	
15	Upper Mount Vernon	Rd	32	Nisbet	Rd
16	Ford	Rd	33	Baseline	Rd
17	Wildeman	Rd	34	St Joseph	Ave

Sample Points & Roads Overview



A more detailed view of the sample points is shown in **Appendix A**.

Sampling Design

Monitoring will be done at 34 monitoring points that will be analyzed and profiled with the YSI 6600 for dissolved oxygen, conductivity, temperature, pH, turbidity, ammonium/ammonia, and nitrate. Orthophosphate will be tested using the HACH kit method and *E. coli* will be tested using the Micrology Laboratories easy-gel process. Benthic macroinventebrates will be collected and analyzed using the EPA's Rapid Bioassessment Protocol II. Habitat will also be assessed to determined if the biotic impairment is due to habitat or other reasons using methods described in the EPA's RBP II. Samples will be analyzed for the chemical parameters once monthly from March through October. Stream velocity will be measured at the same time as the chemical parameters and calculated as stream flow. Biological and habitat testing will occur twice a year, once in the spring and once in the fall. The monitoring sites will be selected to achieve each of three goals as described below:

Goal 1: At least one site will be located in each of the 14-digit HUC watersheds so that the sub-watersheds can be compared.

Goal 2: Monitoring will be conducted at the same time as a watershed inventory, steering committee formation, and goal development for the Big Creek watershed. This will provide the steering committee and stakeholders with accurate information for use in planning and prioritizing as outlined in IDEM watershed plan guidance documents.

Goal 3: Monitoring sites will be selected to reflect the land-use and management impacts of a drainage small enough to identify specific sources and large enough to have a full range of flow conditions. Sites will reflect a variety of land-use and management practices to identify all possible sources.

This is the one year protocol and will be repeated the second year.

Study Schedule

12/10/07 – 2/28/07: Determine and locate all sample points and obtain GPS coordinates. Identify potential problems that will affect the monitoring such as dredging or construction activities. Create QAPP and submit to IDEM QA manager for review. Make changes and finalize draft before the end of February.

3/1/07 – 5/31/07: Conduct first three rounds of monitoring for chemical parameters and first round of habitat and biological monitoring.

6/1/07 – 8/31/07: Conduct 3rd, 4th, and 5th rounds of monitoring for chemical parameters. Results of first three rounds of chemical monitoring and 1st round of biological and habitat monitoring will be summarized and reported with interpretation in the SWCD newsletter, at public stakeholder and steering committee meetings, through press releases to local media, and at the Posey Co. booth at the 4-H fair.

9/1/07 – 11/30/07: Conduct 6th, 7th, and 8th rounds of monitoring for chemical parameters. Conduct 2nd round of biological and habitat monitoring. Significant changes in the data will be presented to steering committee and interested stakeholders.

12/1/07 – 2/28/08: Significant work will have already been done on the watershed management plan relating water quality and biological data to land-use and management practices. Differences between each 14 digit HUC sub-watershed should begin to appear. Summary reports will be presented to steering committee members, interested stakeholders, and presented at the Vanderburgh and Posey County SWCD annual meetings.

3/1/08 – 5/31/08: Conduct 9th, 10th, and 11th rounds of monitoring for chemical parameters and 3rd round of habitat and biological monitoring. Communicate to steering committee, stakeholders, and media possible cause-effect relationships, trends, and correllations discovered through monitoring.

6/1/08 – 8/31/08: Conduct 12th, 13th, and 14th rounds of monitoring for chemical parameters. Present significant changes to steering committee and interested stakeholders. Communicate information at Posey Co. booth at 4-H fair.

9/1/08 – 1/05/08: Conduct 15th and 16th rounds of monitoring for chemical parameters and 4th round of biological and habitat monitoring. Summarize all data, trends, correllations, and cause-effect relationships in the watershed management plan with guidance from steering committee and stakeholders.

Weather and dangerous flow conditions have a potential to post-pone monitoring efforts. Reschedules may occur including testing more than once in a month or testing into early november or late february. Biological and habitat monitoring may be post-poned by dredging or other construction activities that may result in a sampling site being relocated. During heavy rain events, sites planned for biological monitoring may not be wadeable and the RBP II method of sampling will not be applicable. Sampling will have to be postponed until the water level lowers. If monitoring cannot be conducted before the end of June for the spring round or the middle of November for the fall round, the data will not be comparable to originally scheduled sampling due to seasonal changes in invertebrate assemblages.

Section 1.03 Task or step	***Section 1.04 Purpose***	***Section 1.05 Responsible Party***	***Section 1.06 Name & Contact Info***
Section 1.07 Reviewing & approving QAPP and QA reports	Section 1.08 Validate the effectiveness and adequacy of the quality assurance planning and reporting	Section 1.09 IDEM QA Manager	Section 1.10 Betty Ratcliff 317/234-1424 bratclif@IDEM.in.gov
Section 1.11 Financial oversight	Section 1.12 Approve funding for the monitoring involved in project	Section 1.13 Four Rivers RC&D Coordinator & Board president	Section 1.14 Priscilla Kelly, Four Rivers RC&D President Dave Elgin, Four Rivers RC&D Coordinator 812/354-6808
Section 1.15 Project management	Section 1.16 Ensure QAPP is followed. Approve changes when necessary	Section 1.17 Posey County SWCD Board of Supervisors; IDEM 319/205(j) project manager; Four Rivers RC&D	Section 1.18 Jim Droege, Chair jdroege@evansville.net 812/838-4191 ext. 3; Alice Rubin (317) 233-8803 arubin@idem.in.gov; Four Rivers RC&D: Priscilla Kelly, president, Dave Elgin, Coordinator
Section 1.19 Field Work	Section 1.20 Obtain water samples and analyze, collect macroinvertebrates, identify macroinvertebrates, conduct habitat assessment.	Section 1.21 Watershed Coordinator (primary), sub-contractor, SWCD staff	Section 1.22 Posey SWCD coordinator: Jeri Zilliak (as above); Sub-contractor: Practical Resource Management, Joe Craig, 812-354-3880; Dave Elgin, RC&D coordinator
Section 1.23 Field work oversight – biological	Section 1.24 Verification of biological identification and habitat assessment	Section 1.25 Watershed Coordinator	Section 1.26 Dave Elgin, Four Rivers RC&D Coordinator
Section 1.27 Field work oversight – chemical	Section 1.28 Calibration of equipment. Verification of sample analysis and data quality	Section 1.29 Sub-contractor	Section 1.30 Sub-contractor: Practical Resource Management, Joe Craig, 812-354-3880
Section 1.31 Audits & QA reports	Section 1.32 Determine problems early in the process. Submit regular QA reports	Section 1.33 Watershed coordinator	Dave Elgin, Four Rivers RC&D Coordinator 812/354-6808

Section 1.34 Preventative Maintenance & Corrective action	Section 1.35 Take care of equipment in between use	Section 1.36 Four Rivers RC&D staff & sub-contractor (under direction of coordinator)	Section 1.37 Sub-contractor: Practical Resource Management, Consultant Joe Craig, 812-354-3880 Dave Elgin, Four Rivers RC&D Coordinator 812/354-6808

Section 2: Study Organization and Responsibility

Section 1.38 Table 2: Project Organization

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Section 3: Data Quality Objectives

Table 3: Data Quality Objectives & Range

Parameter	Method	Precision	Accuracy	Range
Dissolved oxygen, saturation	YSI 6600 Sonde, EPA Standard Method 360.1	+/- 20%	+/- 2% of reading or 2% of air saturation – whichever is greater	0 – 150% (natural range), 0 – 500% (equipment range)
Dissolved oxygen, concentration	YSI 6600 Sonde, EPA Stanard Method 360.1	+/- 20%	+/- 2% or 0.2 mg/L – whichever is greater	0 – 17 mg/L (natural range), 0 – 50 mg/L (equipment range)
E. coli	Coliscan easygel	+/- 20%	+/- 100 colonies	0 to TNTC* cfu too numerous to count
pH	YSI 6600 Sonde, EPA Standard Method 150.1	+/- 20%	+/- 0.2 pH units	0 to 14 pH
Temperature	YSI 6600 Sonde, EPA Standard Method 170.1	+/- 20%	+/- 0.15 degrees C	-5 to + 45 degrees Celcius (equipment range)
Orthophosphate	Hach model PO-24, HACH company: 8048 (similar to EPA standard method 365.2 except colorimetry done using a color wheel)	+/- 20% “ “	+/- 10% “ “	0 to 1 mg/L 0 to 5 mg/L 0 to 50 mg/L
Nitrate-Nitrogen	YSI 6600 Sonde, Standard Method 4500-NO3 D	+/- 20%	+/- 10% or 2 mg/L – whichever is greater	0 – 36.08 (natural range) 0 – 200 mg/L (equipment range)
Ammonia Nitrogen	YSI 6600 Sonde, EPA Standard Method 350.3	+/- 20%	+/- 10% or 2 mg/L – whichever is greater	0 to 3.0 mg/L (natural range) 0 – 200 mg/L (equipment range)
Turbidity	YSI 6600 Sonde, EPA Standard Method 180.1	+/- 20%	+/- 5% or 2 NTU whichever is greater	0 – 173 NTU (natural range) 0 to 1000 NTU (equipment range)
Conductivity (Specific Conductance @ 25 C)	YSI 6600 Sonde, EPA Standard Method 120.1	+/- 20%	+/- 0.5% of reading	0 – 100 umS/cm (equipment range)
Stream Velocity	Global Water Instrumentation, Inc., Handheld flow meter Model FP-201	+/- 20%	+/- 0.1 ft/s	0.3-15 ft/s

Precision

Table 3 describes the level of precision that needs to be achieved for each chemical parameter in order to meet the goals of the project.

Precision will be determined using the following equation:

$$RPD = \frac{(C - C')}{(C + C')/2} \times 100\%$$

(C indicates the higher score and C' indicates the lower score)

Replicants will be taken every 20 measurements to obtain the Relative Percent Difference (RPD) for all the samples measured.

Precision in the biological monitoring component will be achieved through the successful verification of the identification of each organism by comparing it to a preserved specimen classified earlier in the study. To achieve this, a specimen of each unique organism will be preserved to verify against organisms of the same taxa found later in the project. For identification, 100% precision is needed. Precision in obtaining specimens representative of all the organisms present at the stream reach will be achieved through spending equal time monitoring each stream reach. The time will be divided among the habitat types relative to the percent contribution of each habitat present. To ensure precision in the collection methods used, sampling must be done by the same individual during each sampling round.

A skilled technician is required to achieve the precision in habitat assessment needed to achieve the goals of the project. The technician should have the experience to have conducted assessments on a variety of habitat conditions from extremely poor to undisturbed. The technician will adhere strictly to the method chosen for the assessment.

Accuracy

The maximum achievable accuracy using the methods planned for the chemical parameters are shown in Table 3. Electronic field equipment will be used for most parameters according to manufacturers specifications. Accuracy will be verified using blanks during each round of monitoring.

Accuracy in the biological assessment component will be achieved through the successful identification of each unique species found during the project by a specialist in macroinvertebrate taxonomy.

Accuracy in the habitat assessment component will be achieved through the comparison of the assessment to a similar assessment conducted by a scientific professional who has conducted related research at a masters level or above or an employee of IDEM's Biological Studies Section. The project staff and scientific professional will conduct the assessment at the same time and the same site at 4 different locations. The difference between the two will not be more than +/- 20%. The percentage will be calculated in the same way as the RPD for the chemical parameters.

Completeness

A minimum of 80% completeness will be necessary to meet the goals of the project for chemical and habitat monitoring. A minimum of 60% completeness will be necessary to meet the goals of the project for biological monitoring. The following formula will be used to evaluate the level of completeness

$$\% \text{ completeness} = \frac{\text{(number of valid measurements obtained)}}{\text{(Number of measurements expected)}} \times 100$$

Representativeness

The sites selected are numerous enough to represent the various land-uses and management practices in the area. They will be taken from each major tributary and at least one from each 14-digit sub-watershed.

Comparability

Equipment to be used will be the same as the field testing equipment used by the EPA. The *E. coli* method will be different due to cost constraints. The *E. coli* method will not be comparable to state and federal testing methods, but will be comparable with statewide volunteer monitoring through Hoosier Riverwatch. Orthophosphates will use the HACH method whereas orthophosphates are not tested by the EPA and instead total phosphates is tested in a lab after boiling.

Orthophosphates evaluates the amount of total phosphates available for plant growth at the time sampling was done. Habitat and Biological monitoring will be done according to methods accepted by the EPA.

Historical testing done in the study area includes testing done near Wadesville on 5/21/1979 and 10/16/1979 by the USGS. No data could be found on the method used except that it was not done in a laboratory as stated in the "Barr Creek Watershed Post-Construction Study." Chemical monitoring was also done during the post-construction summary conducted in 2004 and the base-line study in 1994. The monitoring done in 2004 used an ion selective electrode method similar to the YSI 6600 Sonde and should be comparable. No information is provided in the 1994 study "Rapid Bioassessment of the Barr Creek and Big Creek Watersheds Using Benthic Macroinvertebrates" on the methods or equipment used for chemical monitoring, but it was considered comparable to the 2004 study. In the 1994 study the RBP III was used. Riffles and CPOM were sampled, but the methods used did not follow the sampling procedures for multihabitat sampling and the specimens were subsampled. In addition, samples were collected in December. In contrast, both the 2004 study and the upcoming study will use the RBP II, the multi-habitat approach, and samples will not be taken during the winter months. This study will be comparable to the the 2004 study but not the 1994 study. Information about the 1994 study may still be provided and compared in the report, but with a disclaimer.

Data from each sampling point and sampling round will be comparable to other sampling points and sampling rounds in the study.

Section 4: Sampling Procedures

Samples will be taken from near midstream; and when possible, samples will be collected at the same time of day during each of the sampling events. Actual water withdrawal from the stream will be accomplished by using a sampling tube.

Sample analysis may be completed on-site, or, samples may be collected in appropriate glass containers for later analysis. Dissolved oxygen, oxygen saturation, turbidity, conductivity, nitrate-nitrogen, ammonia-nitrogen, pH, and temperature will be analyzed on site. Samples for *E.coli* and orthophosphate will be collected in the designated containers, kept on ice, and transported to Practical Resource Management for further processing.

All chemical parameters (see table 2) except for *E. coli* and orthophosphate will be analyzed using the YSI-6600 Sonde electronic monitoring system. Methods will be followed according to the operations manual and the system will be calibrated by a sub-contractor at the beginning of each day of testing. *E. coli* will be tested using coliscan gel following the Hoosier Riverwatch HACH method and orthophosphate will be tested with the HACH model PO-24 field kit using the Hoosier Riverwatch HACH method.

Stream velocity will be measured using a stream velocity meter. A cross-section of the stream will be determined once for each site during the study and later used in stream flow calculation.

Biological monitoring will be conducted according to the EPA's Rapid Bioassessment Protocol using "Field Sampling Procedures for Multihabitat." A 100 m stream reach will be assessed that is located near established sample points 100 m upstream of the nearest bridge. Sampling equipment will include a D-frame dip net, a kick-net, and a sieve bucket. All equipment will be thoroughly washed after each round of sampling and rinsed after each sampling site.

The habitat sample reach will be chosen according to EPA's RBP "A Visual Based Habitat Assessment" and the Ohio EPA's "Qualitative Habitat Evaluation Index" methods. Pictures will be taken of each site at the time of sampling and a sketch will be drawn showing major habitat types, structures, and landmark

Section 5: Custody Procedures

If analysis is done on-site, then the data will be entered on a field data sheet (Appendix C). If analysis is to be done at the office, samples will be collected in appropriate containers, labeled with site ID, unique sample number, name of collecting individual, date and time of collection, then iced (except where noted above) and transported. If equipment fails and samples must be taken back to the office for testing after the equipment is fixed, samples should be monitored within a "Max Holding Time," Samples should be analyzed within 6 h after sampling and within 2 h from receipt of sample in lab for compliance or 24 h for routine monitoring(Standard Methods, 20th ed Section 9060B): however, a 6 h holding time for all samples is highly recommended (Myers and Sylvester, 1997). In addition, a sample to test for orthophosphate will be collected, kept on ice, and brought to the Four Rivers RC&D office for analysis. Samples collected to test for *E. coli* will be kept on ice and transported to Practical Resource Management for incubation and analysis. Analyses or incubation will be completed within 6-8 hours of collection, if it goes over 8 hours the results will be rejected. All results will be entered on field data sheets, which will be maintained at the Four Rivers RC&D office.

Section 6: Calibration Procedures and Frequency

The YSI 6600 unit requires calibration which will be done before each day of sampling. An experienced sub-contractor will be used to calibrate the equipment. The equipment will be calibrated according to manufacturers instructions

Section 7: Sample Analysis Procedures

All analysis will be done in the field except for the *E. coli*. Field analysis will be done using the YSI 6600 unit (all chemical parameters except for *E. coli* and orthophosphate) and the HACH model PO-24 (orthophosphate only). Analysis using the YSI 6600 unit will be done according to manufacturers instructions. Orthophosphate analysis will be done according to the method indicated in the Hoosier Riverwatch Manual for the HACH kit. The parameters, analysis method, and units are listed in table 3. A sample will be retained for *E. coli* analysis. It will be kept on ice and incubated within 6-8 hours of collection. The sample will be plated according to coliscan easy-gel methods and incubated at 35° celcius for 24 hours at which point colonies will be counted.

Imformation for the performance range/detection limits for the YSI 6600 can be found in table 3.

Biological samples will be analyzed on site when possible. Samples will be spread on a white tray. One or more technicians will pick through the sampled materials to extract specimens. Remaining sampled material will be sifted through a sieve. Specimens may be identified or transported to an appropriate space preserved in 70% alcohol. As identification occurs, results will be logged on data sheets. Any specimens that cannot be identified will be preserved in 70% alcohol and retained at the Four Rivers RC&D office until a specialist can be found to indentify the specimen definitively. Every unique specimen that is found will be preserved in 70% ethanol and retained at the Four Rivers RC&D office until a specialist can verify the identification.

The habitat sample reach will be analyzed using the EPA's RBP "A Visual Habitat Assessment" and the Ohio EPA's "Qualitative Habitat Evaluation Index."

Table 4: Analytical Procedures

Parameter	Analytical Method	Units	Detection Limit	Holding time requirements	Preservatives Used
Dissolved oxygen, saturation	YSI 6600 Sonde	Percent (based on temperature and DO concentration)	n/a	Tested on site	None
Dissolved oxygen, concentration	YSI 6600 Sonde	Milligrams per liter (mg/L)	0.05 mg/L	Tested on site	None
E. coli	Coliscan Easy-gel; Sample incubated for 24 hours @ 35° Celcius; Colony count w/ possible dilution	Colonies/100mL	1 CFU/ 100mL	<6-8 hours before incubation	Ice
pH	YSI 6600 Sonde	Unitless	n/a	Tested on Site	None
Temperature	YSI 6600 Sonde	Degrees Celcius (°C)	n/a	Tested on Site	None
Orthophosphate	Hach model PO-24	Milligrams per liter (mg/L)	0.004 mg/L	<24 hours	ice
Nitrate	YSI 6600 Sonde	Milligrams per liter (mg/L)	0.14 mg/L	Tested on Site	None
Ammonia Nitrogen	YSI 6600 Sonde	Milligrams per liter (mg/L)	0.03 mg/L	Tested on site	None
Turbidity	YSI 6600 Sonde	Milligrams per liter (mg/L)	0 NTU	Tested on site	None
Conductivity	YSI 6600 Sonde	Millisiemens per centimeter (mS/cm)	n/a	Tested on site	None
Flow/ Discharge	Stream velocity multiplied by cross-sectional depth	Cubic Feet per second (CFS, ft^3/sec)	0.0003 CFU (0.3 ft/s * 0.001 ft^2 Cross-sectional area)	Tested on site	None

Section 8: Quality Control Procedures

Table 4 shows the quality control procedures that will be conducted before, after, and during the sampling. In addition, quality control procedures will be done for biological monitoring. At least once on half of the sample reaches, the sample will be split in half and the specimens will be counted individually by two trained technicians. Each unique specimen found will be verified by a specialist. Habitat assessments will also be replicated. In addition, technicians used in the sampling, identification, and habitat assessment will be trained or have proven experience and will follow procedures outlined in the EPA RBP.

Table 5: Quality Control Procedures

Quality Control Procedure	Field (Yes/No)	Laboratory (Yes/No)	Frequency
field replicates	Y	N	One for every 20 samples
equipment calibration	N	Y	before sampling each day
lab duplicates	N	N	No
reference standards	Y	N	Yes, pH 7 before sampling each site
control samples	Y	N	One for every 20 samples
spiked samples	n/a	n/a	n/a
method blanks	Y	N	Once every day
Calibration curves	n/a	n/a	n/a
spiked duplicates	n/a	n/a	n/a

Section 9: Data Reduction, Analysis, Review, and Reporting

Data Reduction

All parameters except for orthophosphate and *E. coli* will be read directly from the YSI 6600 Sonde Unit and logged on the field sheets. Orthophosphate calculations will be done according to the Hoosier Riverwatch Manual for the HACH kit and may depend on the range of the orthophosphate concentration. *E. coli* data reduction will also be done according to the Hoosier Riverwatch Manual and depends on the size of the water sample used.

Stream flow data will be calculated using the formula:

Total Flow = $(W_1*SD_1*SV_1) + (W_2*SD_2*SV_2) + (W_n*SD_n*SV_n)$

Where W = width, SD=stream depth, and SV=stream velocity

Habitat and biological data will be logged on data sheets in the field. A variety of indices may be used later in the project to evaluate the data based on the desires of the steering committee and project management.

Data Analysis

The chemical data will be analyzed in a variety of ways including correlations between land uses and management practices, trend data, correlations to storm events, and cause-effect relationships. Averages may be computed to establish baseline conditions or to show relative differences within the study area.

Macroinvertebrate data may analyzed using the mIBI, EPT index, and/or an index showing the amounts of index in trophic levels (number of shredders/scrapers). The presence, absence, or abundance of individual families may be used to establish

cause-effect relationships. Habitat will be analyzed using the QHEI and individual components may be referenced for cause-effect relationships.

Data Review

The sample technician will review the data for accuracy in mathematics and recording and validate it. Sample results outside of the typical ranges expected for each chemical test (see Appendix B) will be considered outliers, and repeat samples analyzed. If the results of the repeat sample are also out of range, and no extenuating circumstances exist, the results will be considered valid.

Data Reporting

The data collected under this QAPP will be reported periodically to the SWCD supervisors and staff. Other Farm Service Center staff, including IDNR and USDA-NRCS employees will also have access to the data as needed.

All raw data and data analysis results generated as part of this grant project will be submitted in an electronic format with the Final Report to the IDEM Project Manager or Quality Assurance Manager. It will be submitted with all the temporal and spatial data in a database compatible format (ACCESS)

Section 10: Performance and System Audits

Audits will be conducted to ensure the monitoring is meeting the goals of the QAPP. It will evaluate the precision and accuracy and present a report to an internal and external reviewer (IDEM). The audit will be conducted twice a year by the watershed coordinator with assistance from Four Rivers RC&D staff.

IDEM reserves the right to conduct external performance and/or systems audits of any component of this study.

Section 11: Preventative Maintenance

Preventative maintenance will be done on the YSI unit according to manufacturers specification by Four Rivers RC&D or a sub-contractor under the authority of the RC&D. Equipment used to sample water will be rinsed before and after each use and cleaned thoroughly at the end of each sampling round. Equipment used in sampling macroinvertebrates will be rinsed after each use and cleaned thoroughly in between sampling rounds. All equipment will be stored at Four Rivers RC&D and maintained under the authority of the RC&D.

Section 12: Data Quality Assessment

Precision

The data will be determined as inprecise if it falls short of the goals described in section 3. A cause for the error will be determined and will be the basis for accepting or throwing out the data. If it is close to being within the acceptable precision level, the data may still be used but will carry a disclaimer.

Accuracy

The data will be determined as inaccurate if it falls short of the goals described in section 3. A cause for the error will be determined and will be the basis for accepting or throwing out the data. If it is close to being within the acceptable accuracy level, the data may still be used but will carry a disclaimer.

Completeness

The data will be determined as incomplete if it falls short of the goals described in section 3. A cause for the incompleteness will be determined and will be the basis for accepting or throwing out the data. If it is close to being within the acceptable completeness level, the data may still be used but will carry a disclaimer.

Section 13: Corrective Action

If data is found to be outside of acceptable levels of completeness, accuracy, precision, the first corrective action will be to redo the testing if possible.

Section 14: Quality Assurance Reports

Quality Assurance (QA) reports will be submitted to IDEM's Watershed Management Section twice a year as part of the Quarterly Progress Report and/or Final Report.

The QA report will include a summary of the accuracy, precision, and completeness levels that were calculated during the period of the report. Any significant problems encountered or data that had to be corrected or thrown out will be included as well as preventative measures that will be taken in the future.

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; OfficeofWater; Washington, D.C.

Volunteer Stream Monitoring Training Manual: Hoosier Riverwatch – Indiana's Volunteer Stream Monitoring Program. Indiana Department of Natural Resources, November 2000.

Sample Points: Detailed

Sample Points & Roads: Detailed #1

Miles

0 0.4 0.8 1.6 2.4 3.2

N

W E

S

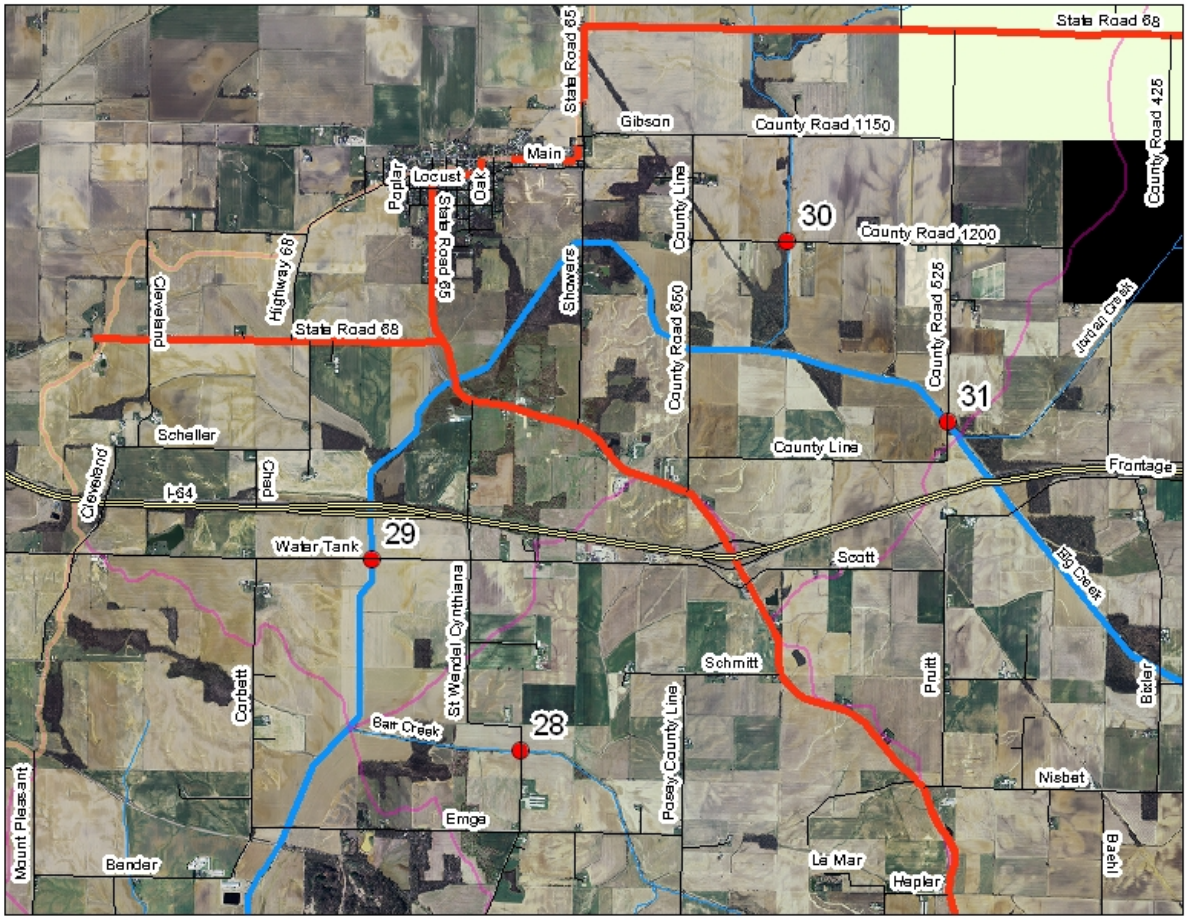
Legend

- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

Roads

- Other Roads
- Interstates
- State Highways

Sample Points & Roads: Detailed #2



Miles

0 0.4 0.8 1.6 2.4 3.2

N

W E

S

Legend

BigCreekRoads

<all other values>

FENAME

I-64

State Highways

SamplePoints

BigCreekWatershed

BigCreekSubwatersheds

Sample Points & Roads: Detailed #3

Miles

0 0.45 0.9 1.8 2.7 3.6

N

W E

S

Legend

- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

Roads

- Other Roads
- Interstates
- State Highways

Sample Points & Roads: Detailed #4

Miles

0 0.3 0.6 1.2 1.8 2.4

N

W E

S

Legend

- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

Roads

- Other Roads
- Interstates
- State Highways

Sample Points & Roads: Detailed #5

Miles

0 0.375 0.75 1.5 2.25 3

N

W E

S

Legend

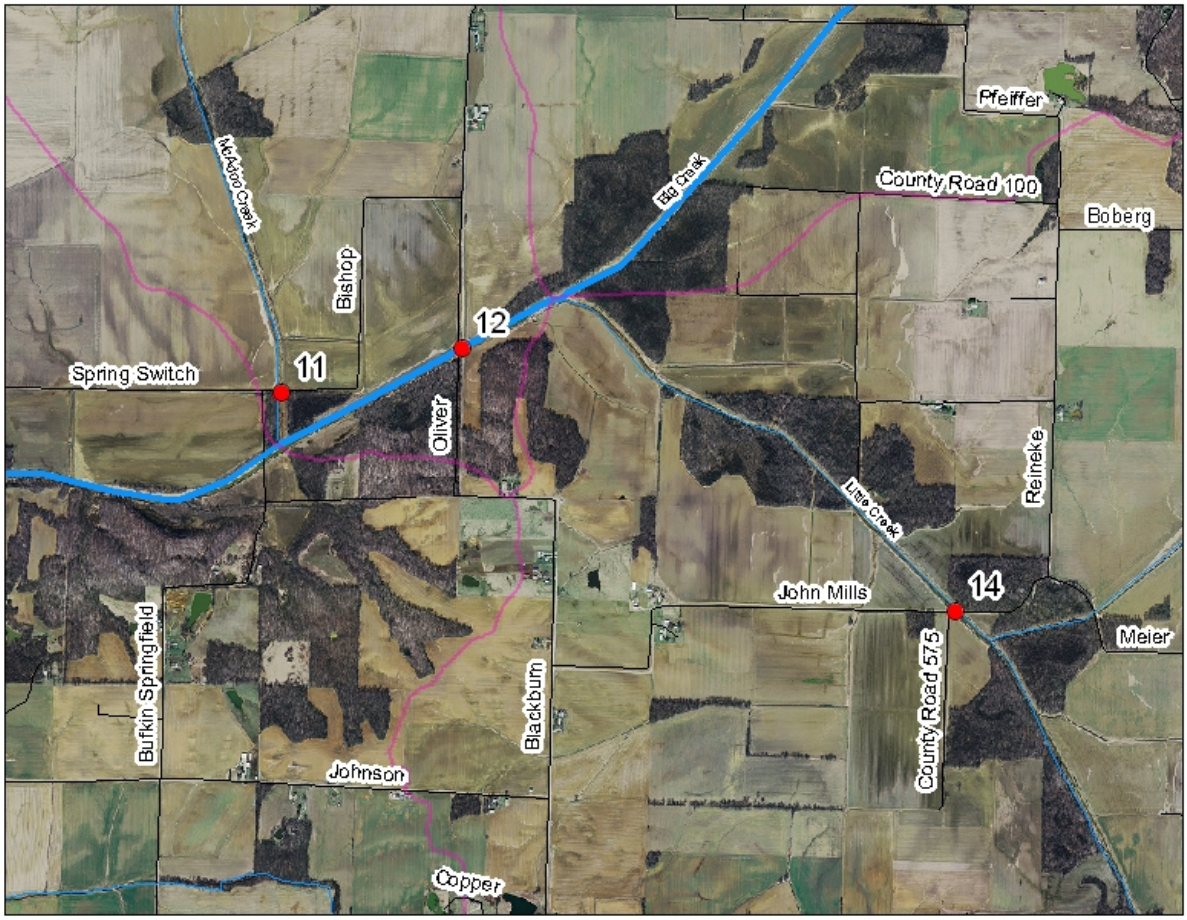
- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

Roads

- Other Roads
- Interstates
- State Highways

Sample Points & Roads: Detailed #6

Sample Points & Roads: Detailed #7



Miles

0 0.3 0.6 1.2 1.8 2.4

N

W E

S

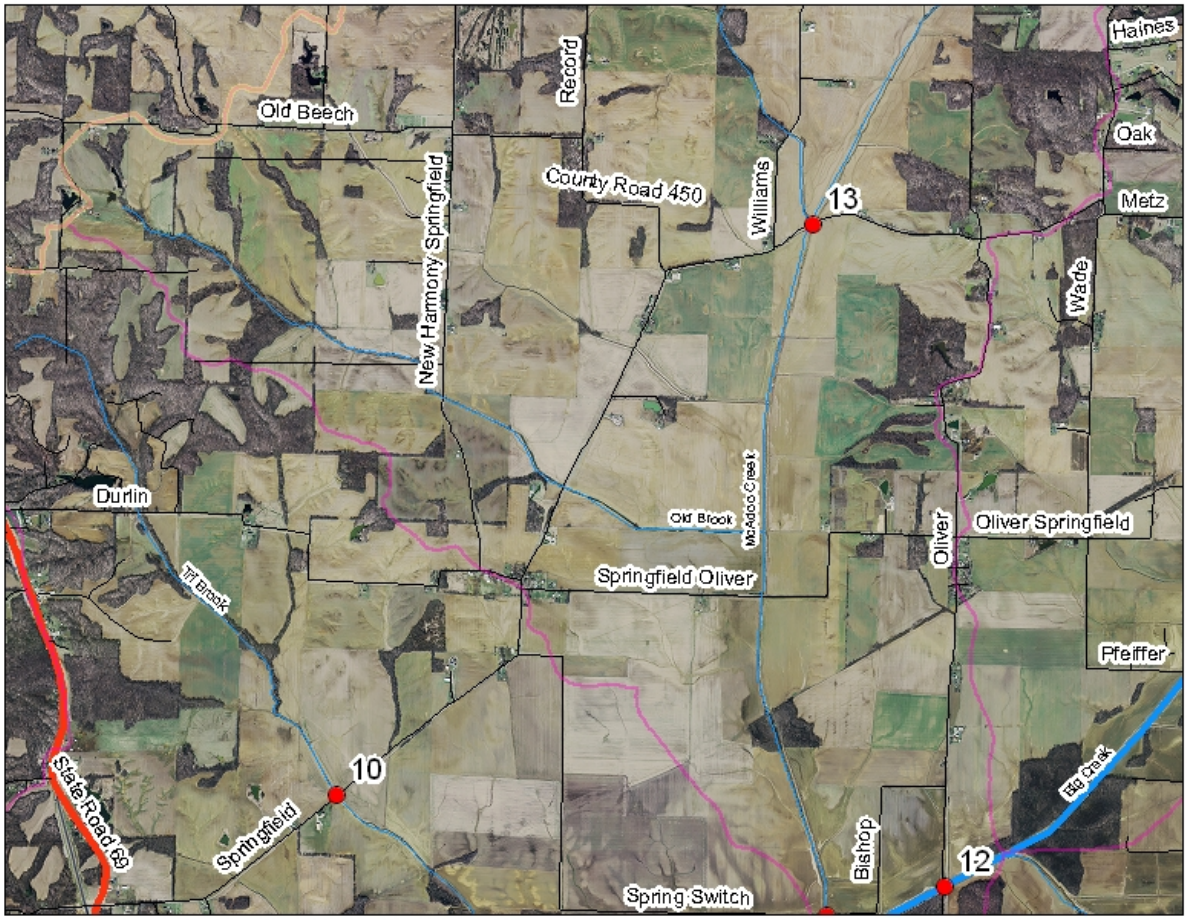
Legend

- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

Roads

- Other Roads
- Interstates
- State Highways

Sample Points & Roads: Detailed #8



Miles

0 0.45 0.9 1.8 2.7 3.6

N

W E

S

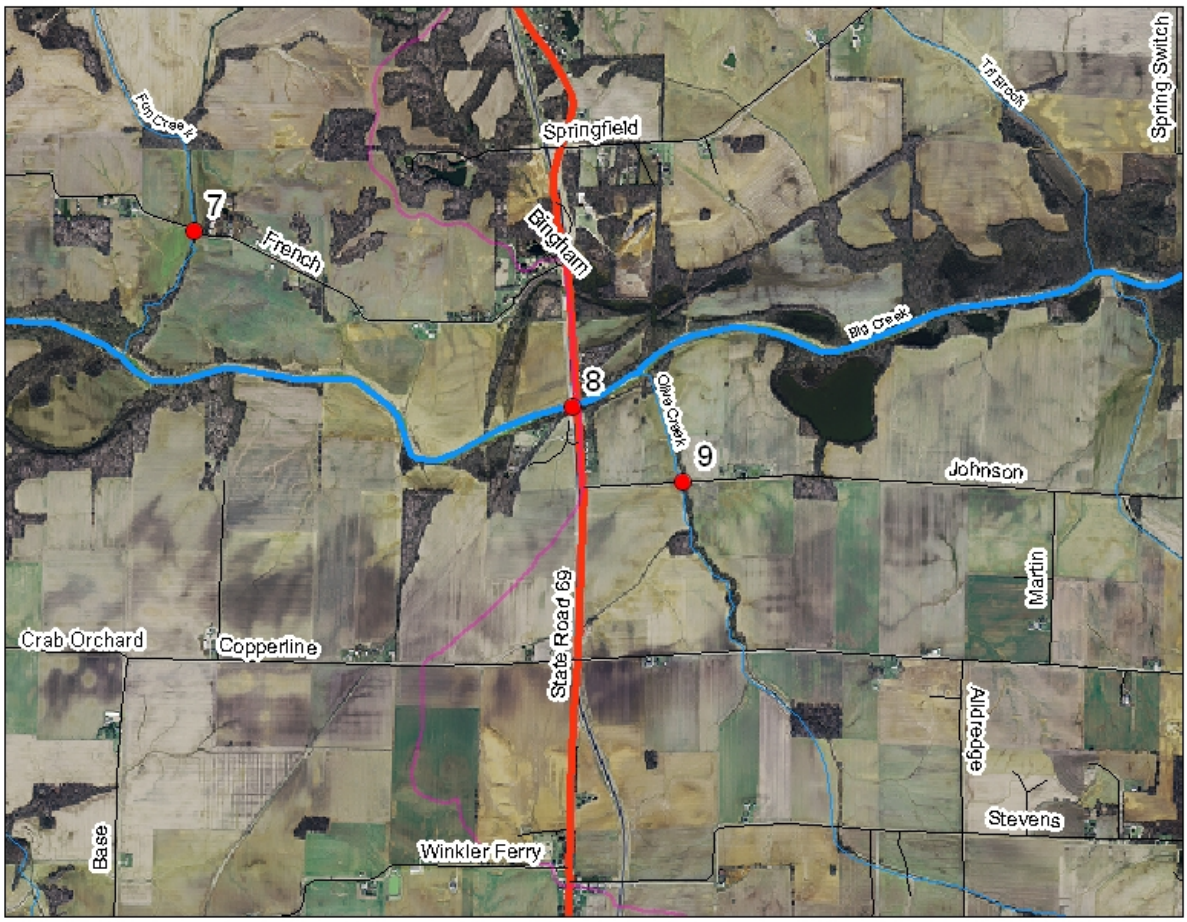
Legend

- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

Roads

- Other Roads
- Interstates
- State Highways

Sample Points & Roads: Detailed #9



Miles

0 0.3 0.6 1.2 1.8 2.4

N

W E

S

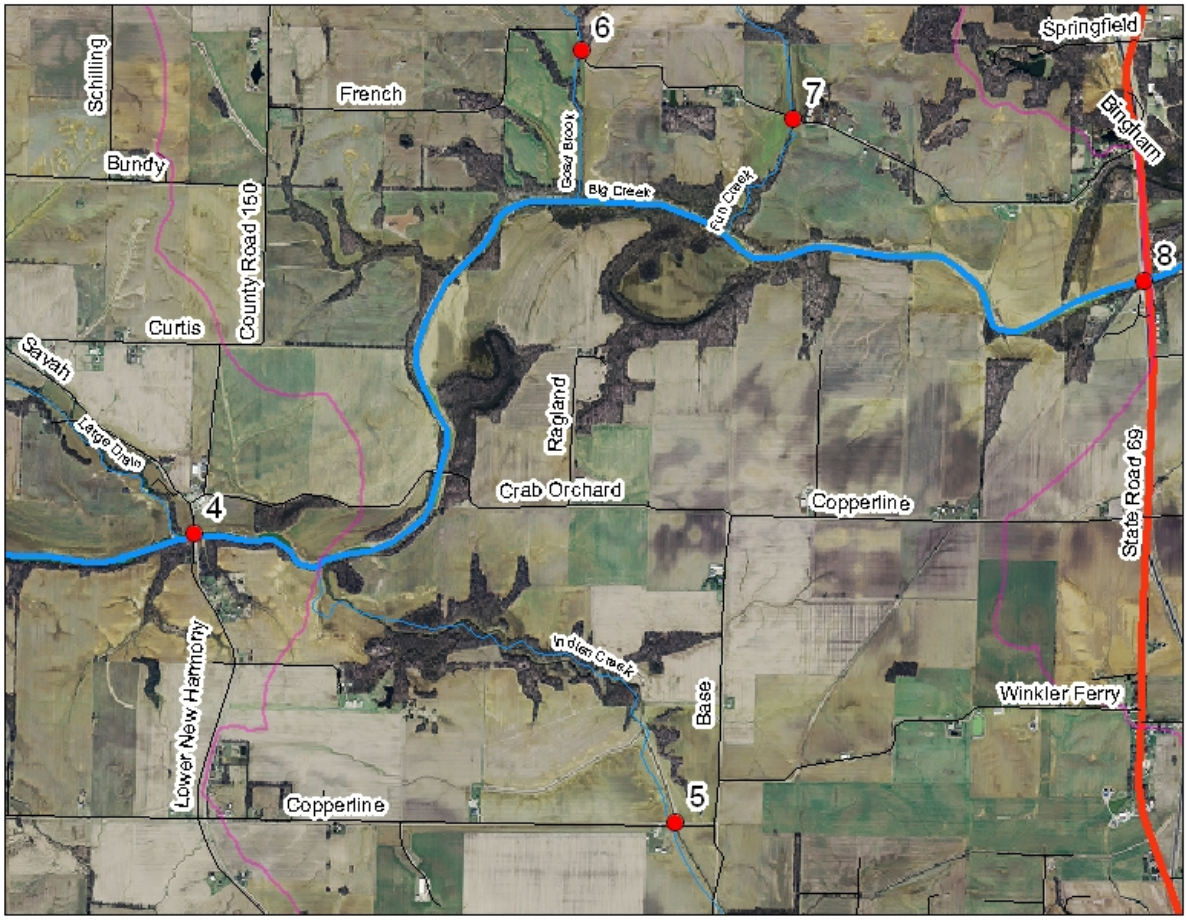
Legend

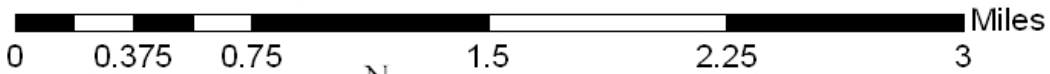
- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

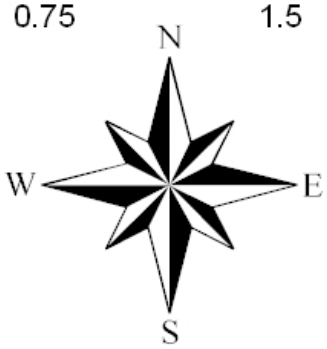
Roads

- Other Roads
- Interstates
- State Highways

Sample Points & Roads: Detailed #10







Legend

- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

Roads

- Other Roads
- Interstates
- State Highways

Sample Points & Roads: Detailed #11

Miles

0 0.3 0.6 1.2 1.8 2.4

N

W E

S

Legend

- SamplePoints
- BigCreekWatershed
- BigCreekSubwatersheds

Roads

- Other Roads
- Interstates
- State Highways