Ozarks Environmental and Water Resources Institute (OEWRI)
Missouri State University (MSU)

Quality Assurance Project Plan for:

Water Quality Monitoring of the South Creek Stream Restoration Site between Campbell Ave. and Kansas Expressway, Springfield, Missouri

DRAFT

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PROJECT MANAGEMENT

Project and Task Organization

See Table 1 for personnel responsibilities and contact information. The individuals directly involved with the water sampling project and their specific responsibilities are outlined below:

- Marc Owen, Assistant Director-OEWRI, will coordinate field activities, maintain field measurement and analytical databases, and make sure the QAPP is properly implemented.

- Kelly Rose, Graduate Assistant-OEWRI and Laboratory Supervisor, is responsible for data review of analysis performed in the OEWRI Laboratory.

- Kayla Coonen and Hannah Adams, Graduate Assistants-OEWRI, are responsible for storm sample field collection and sample processing at the OEWRI Laboratory.

Problem Definition and Background

The City of Springfield implemented a Section 319 Grant from the Missouri Department of Natural Resources and the Environmental Protection Agency Region VII designed to reduce nonpoint source pollution in South Creek located in south Springfield. This project was completed in 2015 and involved the removal of the concrete low flow channel between Campbell Ave. and Kansas Expressway and replacing it with natural substrate and reintroducing meanders to the channel design with the goal of improving aquatic habitat and water quality. South Creek is a sub-watershed of Wilson Creek, which has a long history of water quality degradation from a variety of point and nonpoint pollution sources associated with urban development (Richards and Johnson 2002; Miller 2006; Hutchinson 2010). Projects that attempt to reintroduce natural channel form and function to an urbanized stream have shown improvement in both water quality and biological conditions compared to the typical altered urban stream (Purcell et al. 2002).

In 2014-2015 pre-construction water quality monitoring was implemented to quantify the existing load prior to the installation of the new channel design. This project is designed to collect water samples at the same locations as the pre-construction water quality monitoring study to compare loads nearly four years after the installation of the new channel design. The Ozarks Environmental and Water Resources Institute (OEWRI) at Missouri State University has been contracted to perform the water quality monitoring component of this project. The purpose of this study is to determine nonpoint source loads under present channel conditions for which to compare with pre-project sampling to assess load reduction along South Creek at

Kansas Expressway (KAN) and Campbell Avenue (CAM) (Figure 1).

PROJECT AND TASK DESCRIPTION

Project Schedule and Time Line

This project will last one year starting March 1, 2019 and ending March 1, 2020.

Sampling Sites and Frequency

Storm Sampling

Storm samples will be collected along South Creek at Campbell Avenue and Kansas Expressway (Figure 1). At least five storm events per year, and sample 1-2 times on each trip at each site. This schedule will produce 10 field samples as it is expected that a maximum of two samples per event will be collected at a site. There will be a minimum of 8 quality control samples (4 duplicates and 4 field blanks) for analysis per year, per site as stated in the contract with the James River Basin Partnership (JRBP). The number of sampling events possible will vary based on weather patterns, rainfall frequency, and sampling logistics. Typically, OEWRI will sample more often and analyze more samples than the minimum numbers described above.

Base Flow Sampling

Base flow samples will be collected along South Creek at Campbell Avenue and Kansas Expressway (Figure 1). There will be 10 base flow samples collected at each site spread throughout the year. There will be total of 10 quality control samples (5 duplicates and 5 field blanks) for analysis per year as stated in the contract with JRBP. Typically, OEWRI will sample more often and analyze more samples than the minimum numbers described above.

Target Water Quality Indicators

Field measured analytes (OEWRI):

1. *Temperature* (SOP: YSI Pro Plus (OEWRI 2015)): Water temperature is an important water quality parameter because it can affect the speed of chemical and biological reactions and the concentration of ions and gases. In karst areas, such as the Ozarks, springs have lower temperatures than surface water runoff in the summer. Data will be collected using the YSI Professional Plus handheld multi-parameter meter.

2. *Specific Conductivity* (SOP: YSI Pro Plus OEWRI 2015): The first flush from surface water runoff in a rain storm carries concentrated analytes dissolved from surfaces, causing conductivity to be high. Data will be collected using the YSI Professional Plus handheld multi-parameter meter.

3. *pH* (SOP: YSI Pro Plus OEWRI 2015): pH is a measure of the activity of hydrogen ions (H^+) in a solution and, therefore, its acidity or alkalinity. Low pH in rainfall can be a problem in some areas, however, due to the abundance of limestone in the region the Ozarks soil has a high buffering capacity and runoff pH generally remains around neutral, that is, pH of 7.0. Data will be collected using the YSI Professional Plus handheld multi-parameter meter.

4. *Dissolved Oxygen* (SOP: YSI Pro Plus OEWRI 2015): The level of dissolved oxygen in water affects aquatic life, chemical activity, and pollutant behavior. Acceptable levels for Missouri streams are >5 mg/L for warm and cool water fisheries and >6 mg/L for cold water fisheries. Data will be collected using the YSI Professional Plus handheld multi-parameter meter.

<u>Laboratory measured analytes:</u>

1. *Total Suspended Solids* (SOP: Total Suspended Solids (OEWRI 2007b): Total suspended solids, such as silt, decaying plant and animal matter, industrial wastes, and sewage, can effect stream health and aquatic life. Nutrients, pesticides, and metals that bind to solids on land are released when the solids are suspended in a water body increasing concentrations of pollutants in the water. Filter mass differential calculations are used to determine the total suspended solids in each sample. Samples will be analyzed using an analytical balance.

2. *Total Phosphorus* (SOP: Total Phosphorus (OEWRI 2010a)): Nutrients promote aquatic plant growth such as algae in waterways which can increase turbidity and deplete dissolved oxygen which can be detrimental to a healthy aquatic biological community. All forms of phosphorus, including organic phosphorus, are converted to orthophosphate by an acid-persulfate digestion. Digested samples are compared to colorimetric assay absorbance readings from a spectrophotometer and those absorbances are used to determine TP concentrations. Genesys 10S UV-Vis spectrophotometer.

3. *Total Nitrogen* (SOP: Total Nitrogen (OEWRI 2010b)): Nutrients promote aquatic plant growth such as algae in waterways which can increase turbidity and deplete dissolved oxygen which can be detrimental to a healthy aquatic biological community. Total nitrogen is a measure of organic nitrogen, ammonia, nitrite, and nitrate nitrogen.

Digested samples are compared to colorimetric assay absorbance readings from a spectrophotometer and those absorbances are used to determine total nitrogen (TN) concentrations. Samples will be analyzed using a Genesys 10S UV-Vis spectrophotometer.

4. *Chloride* (SOP: Chloride (OEWRI 2013a)): Chloride originates in surface waters from natural sources. Anthropogenic sources include sewage and industrial effluent and urban stormwater runoff. Chloride concentration is used as an aesthetic indicator of water quality and can indicate point source pollution. Chloride is a chemical indicator of fecal contamination, industrial and municipal discharges, and road deicing and can be toxic to aquatic species. Samples will be analyzed using an Accumet excel XL25 Dual Channel pH/Ion Meter.

5. *Total Coliform and Escherichia coli* (SOP: E. Coli IDEXX (OEWRI 2013b)): The presence of *E. coli* in water samples is an indicator of fecal contamination. Fluorogenic substrates are used to detect the enzyme β-D- glactosidase that is produced by E.coli bacteria and that hydrolyzes the substrate to produce a product that fluoresces under ultraviolet light. Multiple wells are used and positive tests results are used to estimate bacterial density. The presence of *E. coli* in water samples is an indicator of fecal contamination. The IDEXX Quanti-Tray/2000 system is used to analyze samples for *E. coli* levels.

Quality Objectives and Criteria for Measurement Data

The purpose of this study is to determine nonpoint source loads under present channel conditions for which to compare with pre-project sampling to assess load reduction along South Creek at Kansas Expressway and Campbell Avenue. All field and laboratory analytical data are evaluated based on established measurement performance criteria outlined in standard methods and SOPs used for this project.

Data Quality Indicators, Definitions

Accuracy: a measure of the overall agreement of a measurement to a known value; includes a combination of random error (precision) and systematic error (bias) components of both sampling and analytical operations. Accuracy will be measured by analyzing a reference material and spiked matrix samples.

Bias: a consistent deviation of measured values from the true value, caused by systematic errors in a procedure. Bias will be measured by analyzing reference materials and spiked matrix samples.

Comparability: the measure of confidence that one data set can be compared to another and can be combined, if applicable, for the decisions to be made.

Completeness: a measure of the amount of data needed to be obtained from a measurement system. It is expected that all samples will be collected and analyzed. However, it is known that lost samples and missed analyses can occur.

Precision: a measure of the degree of agreement among replicate analyses of a sample. For this project, samples will be collected in duplicate (field duplicates) and single samples will be analyzed in duplicate in the laboratory (laboratory duplicates).

Representativeness: the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Sensitivity: the capability of a method or instrument to discriminate between measurement responses representing different level of the variable of interest. This is also known as the detection limit. For this project the method detection limit (MDL) is determined.

Special Training and Certification

All personnel who collect and analyze samples for this project will receive appropriate training for all methods needed to complete the study following the necessary SOPs.

Documents and Records

Field personnel will keep appropriate records of field events and include such items as site name, water chemistry parameters, date, collection time, samples collected, weather conditions, etc. The sampler should sign or initial for each date that the notebook is used. These notebooks will be archived with the project records in the OEWRI office for at least 10 years. OEWRI will maintain sample collection database for both storm and base flow samples to eventually calculate loads. Analytical, collection, and other procedures are documented in individual SOPs for each entity. These documents may be updated over the project period. Project personnel are required to review all SOPs that pertain to their functions and responsibilities. SOPs used for this project are listed in Table 2.

DATA GENERATION AND ACQUISITION

Sampling Process Design

Refer to "Project/Task Description." All sampling and analyses will be conducted in accordance with accepted procedures outlined in the listed Standard Operating Procedures (SOP) and standard methods.

Sampling Methods

Storm Samples

Storm samples will be collected in clean 500 mL plastic bottles using a depth integrated sampler following OEWRI Water Sample Collection and Sample Bottle Prep SOPs (OEWRI 2006, OEWRI 2007). Grab sampling for bacteria analysis will be completed using a 120 mL sterile vessel and placed on ice for transport to the laboratory (OEWRI 2013b). Water chemistry parameters will be collected in the field using an YSI Professional Plus multi-parameter probe with data recorded in a field book using OEWRI YSI Pro Plus SOP (OEWRI 2015). The date and collection time will also be recorded in field book. A list of SOPs used for this project is available in Table 2.

Base Flow Samples

Base flow samples will be collected in clean 500 mL plastic bottles using a grab sampling technique following OEWRI Water Sample Collection and Sample Bottle Prep SOPs (OEWRI 2006, OEWRI 2007). Grab sampling for bacteria analysis will be completed using a 120 mL sterile vessel and placed on ice for transport to the laboratory (OEWRI 2013b). Water chemistry parameters will be collected in the field using an YSI Professional Plus multi-parameter probe with data recorded in a field book using OEWRI YSI Pro Plus SOP (OEWRI 2015). The date and collection time will also be recorded in field book. A list of SOPs used for this project is available in Table 2.

Sample Handling and Custody

Sample bottles that are not used for immediate analysis will be stored in the laboratory refrigerator. Upon completion of the analyses, including review of data, the sample may be discarded. Re-analysis can occur if sample remains in the bottle and the holding time has not been exceeded. At no time will a re-analysis take place on samples when the holding time has expired.

Analytical Methods

Samples will be analyzed at the OEWRI Laboratory at MSU in accordance with the appropriate SOPs based on the Environmental Protection Agency (EPA) methods. Field analysis for pH, temperature, conductivity and dissolved oxygen will be performed in the manner consistent

with SOPs developed by OEWRI.

Quality Control
For all sampling events there will be total of 36 quality control samples (18 duplicates and 18 field blanks) for analysis per year.

Instrument and Equipment Testing, Inspection, and Maintenance
Field and laboratory equipment and instruments will be maintained to prevent down time and missed sample data according to manufactures recommendations and SOPs developed by OEWRI.

Instrument and Equipment Calibration and Frequency
Laboratory and field analytical instrumentation calibration follows the instrument manufacturer's recommendations and SOPs developed by OEWRI. Calibration verification will be done by analyzing a certified standard periodically to ensure that the instrument performance has not changed.

Inspection and Acceptance of Supplies and Consumables
Adequate quantities of supplies and consumables are inventoried for this project. When the number of items needed begins to run low, replacements are ordered from the vendor. Chemicals are ordered as needed for laboratory analyses. Reference standards for calibrating instruments are received with "certificates of analysis" documents from the supplier. Other supplies, for example, bottles, filter paper, and pH test strips, are not tested prior to use. Analysts will employ good laboratory practices and observe all processes for changes that may be caused by a new batch of supply items. If a process does appear to be affected by a supply item, a corrective action response will be initiated. This may require discontinuing the use of that item and ordering replacement items.

Data Management
Laboratory data will be reviewed by the OEWRI Laboratory Supervisor, the OEWRI Director, and the OEWRI Assistant Director.

ASSESSMENT AND OVERSIGHT

Assessments and Response Actions
The Project's activities will be assessed to identify and correct any potential or existing problems before the data is affected. A readiness review will be conducted prior to starting the project. Proficiency test samples will be procured for assessing analytical skill. A

surveillance assessment will be conducted throughout the project. Each of these assessments is discussed below. Handling of the results for these assessments is discussed in the next section.

Reports to Management

A monitoring technical report containing statistical evaluations of all water quality and discharge data collected in the study will be prepared at the end of the one year sampling period. This report will include objectives, methodology, results, interpretations, tables, graphs, pictures and maps to be submitted April 15, 2020. Brief summary reports of the assessment findings, discussed above, will be prepared by the OEWRI Assistant Director as needed. Copies of all reports will be stored in the project file in the OEWRI office and sent to the project administer who will forward the information to the MDNR project manager.

DATA VALIDATION AND USABILITY

QA activities that occur after the data collection phase of the project is complete include data review, validation, verification, and review of the consistency of the data with predefined user requirements. Implementation of these elements determines whether the data conform to the specified criteria, thus satisfying the project objectives.

Data Review, Verification and Validation

The analytical data will be peer reviewed by a qualified analyst and the OEWRI Laboratory Supervisor. The OEWRI Director and Assistant Director will be responsible for overall verification and final approval of the data.

Verification and Validation Methods

Laboratory data will be validated in accordance Standard Methods and SOPs developed by OEWRI. The OEWRI Director and Assistant Director will perform the final review of the data prior to it being approved. This will consist of a comparison of the sample descriptions with the field sample collection data sheet for consistency. Field duplicate results will be reviewed by the OEWRI Director and Assistant Director. Any anomalies in the data are appropriately documented and communicated to OEWRI Director and Assistant Director.

Reconciliation with User Requirements

The OEWRI Director and Assistant Director are responsible for evaluating the results of the sampling event. Sample results will be evaluated by the OEWRI Laboratory Supervisor, the OEWRI Director, and the OEWRI Assistant Director; however, if problems are identified

during the validation process, the OEWRI Director will be consulted regarding site-specific requirements/conditions, and the usability of the data will be flagged accordingly. Data that is deemed unusable will be discarded and sampling will re-occur if possible.

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TABLES

Table 1. Personnel and Responsibilities

Name and Title	Organization	Responsibilities	Contact Information
Robert Pavlowsky, Director	Missouri State University - OEWRI	Overall supervision of entire project, review data, assign tasks	417-836-8473 BobPavlowsky@MissouriState.edu
Marc Owen, Assistant Director	Missouri State University - OEWRI	Coordinates field work, review data, maintains overall database	417-836-3197 mowen@MissouriState.edu
Kelly Rose, Graduate Assistant	Missouri State University - OEWRI	Laboratory supervision, field sampling, sampling processing	417-836-8705 Rose333@live.missouristate.edu
Kayla Coonen, Graduate Assistant	Missouri State University - OEWRI	Field sampling and sampling processing	417-836-3198 @live.missouristate.edu
Hannah Adams, Graduate Assistant	Missouri State University - OEWRI	Field sampling and sampling processing	417-836-3198 @live.missouristate.edu
Tiffany Frey, Executive Director	JRBP	Project sponsor	417-836-8878 TFrey@missouristate.edu

OEWRI = Ozarks Environmental and Water Resources Institute

JRBP = James River Basin Partnership

Table 2. List of SOPS and Standard Methods

SOP	Title	Date
Sample Bottle Prep	Preparation of Sample Bottles For non-Metals Analyses https://oewri.missouristate.edu/assets/OEWRI/0150R01_Bottle_Prep_non-Metals.pdf	2006
Sampling Procedure	Water Sample Collection https://oewri.missouristate.edu/assets/OEWRI/SOP_1040R03_Water_Sampling.pdf	2007
YSI Pro Plus	The Measurement of Dissolved Oxygen, Temperature, Specific Conductance, pH, and Chloride using the YSI Professional Plus Handheld Multiparameter Meter https://oewri.missouristate.edu/assets/OEWRI/SOP_YSI_ProPlusWQprobe-_August_15.pdf	2015
E. Coli IDEXX	Escherichia coli and Total Coliform using the IDEXX Quanti-Tray/2000 System with Colilert Reagent https://oewri.missouristate.edu/assets/OEWRI/4010R03_Ecoli_IDEXX.pdf	2013
Total Suspended Solids	Total Suspended Solids https://oewri.missouristate.edu/assets/OEWRI/TSSolids.pdf	2007
Total Phosphorus	Total Phosphorus Analyses Using Genesys 10S UV-Vis https://oewri.missouristate.edu/assets/OEWRI/Total_P_Absorbance_Genesys_R01.pdf	2010
Total Nitrogen	Total Nitrogen Analyses Using Genesys 10S UV-Vis https://oewri.missouristate.edu/assets/OEWRI/Total_N_Genesys_R04.pdf	2010
Chloride	Accumet Excel XL25 Dual Channel pH/Ion Meter for Chloride Concentration Determination https://oewri.missouristate.edu/assets/OEWRI/Chloride_R02.pdf	2013

SOP = Standard operating procedure

Table 3. Analytical Requirements

Sample Matrix	Parameter Test	Sample Preservative	Hold Times	Est. # of Analysis
Nonpotable Water	Total Suspended Solids	NA	7 days	38
Nonpotable Water	Total Nitrogen	H_2SO_4 to pH ≤ 2	28 days	38
Nonpotable Water	Total Phosphorus	H_2SO_4 to pH ≤ 2	28 days	38
Nonpotable Water	Chloride	NA	28 days	38
Nonpotable Water	Total Coliform/*E. coli*	NA	2 hours-lab	38
Nonpotable Water	Temperature	NA	NA	38
Nonpotable Water	pH	NA	NA	38
Nonpotable Water	Specific Conductivity	NA	NA	38
Nonpotable Water	Dissolved Oxygen	NA	NA	38

Table 4. Measurement Performance Criteria for Field Instruments

Parameter	Data Quality Indicator	Measurement Performance Criteria	QC Sample Type to assess Measurement Performance
Dissolved Oxygen	Accuracy	± 20%	Reference standard
	Bias	± 20%	Reference standard
	Precision	± 20% RPD	LD, FD
	Sensitivity	1 unit	NA
pH	Accuracy	± 20%	Reference standard
	Bias	± 20%	Reference standard
	Precision	± 20% RPD	LD, FD
	Sensitivity	1 unit	NA
Specific Conductivity	Accuracy	± 20%	Reference standard
	Bias	± 20%	Reference standard
	Precision	± 20% RPD	LD, FD
	Sensitivity	0.00 µS	NA
Temperature	Accuracy	± 20%	Reference standard
	Bias	± 20%	Reference standard
	Precision	± 20% RPD	LD, FD
	Sensitivity	0.00 µS	NA

Table 5. Measurement Performance Criteria for Laboratory Instruments

Parameter	Data Quality Indicator	Measurement Performance Criteria	QC Sample Type to assess Measurement Performance
Total Nitrogen	Accuracy	± 10%	LB, LS
	Bias	± 20%	LB, LS
	Precision	± 10% RPD	LD
	Sensitivity	≤ 0.03 mg/N/L	MDL, LRB
Total Phosphorus	Accuracy	± 10%	LB, LS
	Bias	± 5%	LB, LS
	Precision	± 5% RPD	LD
	Sensitivity	≤ 0.01 mgP/L	MDL, LRB
Total Suspended Solids	Accuracy	NA	LB
	Bias	NA	LB
	Precision	± 5% RPD	LD
	Sensitivity	≤ 1.0 mg/L	MDL, LRB
Escherichia coli	Accuracy	NA	LB
	Bias	NA	LB
	Precision	± 20% RPD	LD
	Sensitivity	1 Coli/100mL	MDL, LRB
Chloride	Accuracy	± 1%	Reference standard
	Bias	± 5%	Reference standard
	Precision	± 5% RPD	LD, FD
	Sensitivity	≤ 0.001 mg/L	NA

FIGURES

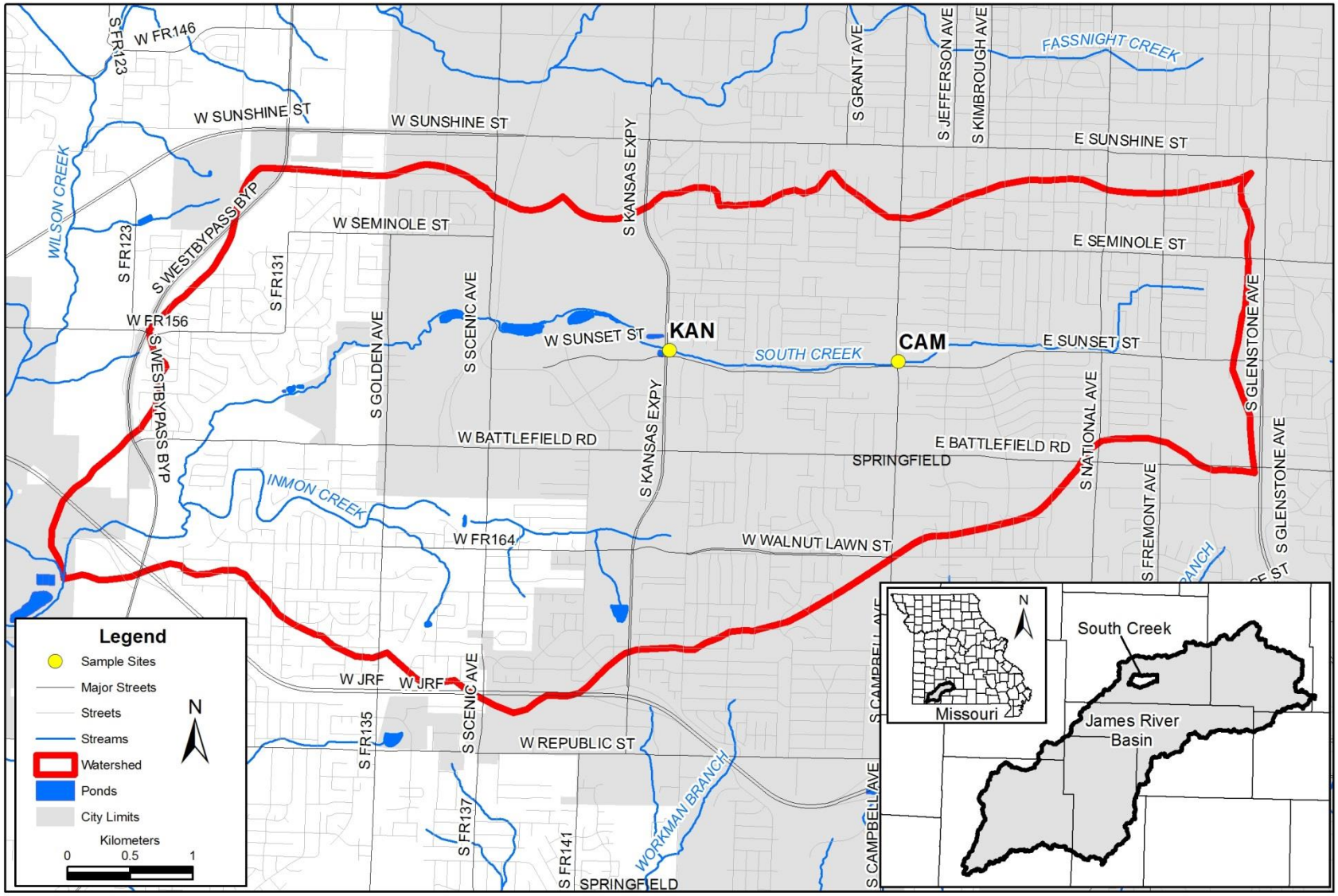

Figure 1. Sampling site location along South Creek Springfield, Missouri.