QUALITY ASSURANCE PROJECT PLAN (QAPP)

Mississippi Alluvial Plain (MAP) Ecoregion Project

Clean Water Act Section 106
Period of Performance: April 1, 2025 – March 30, 2030
QTRAK # 25-242

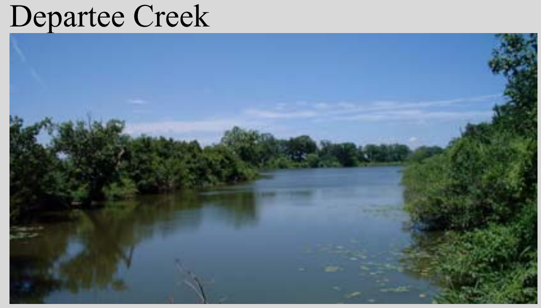
Golden Topminnow

EPA Assistance Agreement #I-02F63401-0

State of Arkansas
Department of Energy & Environment

Division of
Environmental Quality

Departee Creek



Bayou Meto

Slough Darter

Spotted Sunfish

DIVISION OF ENVIRONMENTAL QUALITY
Office of Water Quality
5301 Northshore Drive
North Little Rock, Arkansas 72118

ARKANSAS
ENERGY & ENVIRONMENT

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Element A2: Approval Page

U.S. Environmental Protection Agency (U.S. EPA)

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Element A3: Table of Contents

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List of Abbreviations and Acronyms

COC	Chain of Custody
DEQ	Division of Environmental Quality
E&E	Arkansas Department of Energy and Environment
EPA	Environmental Protection Agency. Sometimes preceded by U.S.
IT	DEQ Agency Information Technology
LIMS	Laboratory Information Management System
MAP	Mississippi Alluvial Plain
OWQ	Office of Water Quality
PE	Performance Evaluation Sample
POM	Project Operations Manager
PQAC	Project Quality Assurance Coordinator
PQAM	Project Quality Assurance Manager
QA	Quality Assurance
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance/Quality Control
QC	Quality Control
QMP	Quality Management Plan
RPD	Relative Percent Difference
SM	Standard Methods
USGS	United States Geological Survey
WSSP	DEQ Wadable Streams Sampling Protocols
WQX	Water Quality Exchange, the U.S. EPA data storage system

Element A4: Purpose, Problem Definition, Background

Project Purpose

The purpose of this project is to collect physical, chemical, and biological data to establish robust and scientifically defensible information that can be utilized by decisions makers for a variety of applications. These may include the refinement of ecoregion boundaries, development of indices of biological integrity and refinement of water quality criteria, among others. DEQ has completed studies in other ecoregions for this same purpose. These studies not only produced invaluable water chemistry information but also produced extensive physical and biological information that yielded a greater understanding of the unique characteristics of individual waterbodies.

Quality Assurance (QA) Planning Documents

The environmental information operations for this project will be carried out following the QA criteria outlined or referenced in this Quality Assurance Project Plan (QAPP). Additional documents with relevant QA guidelines include the Arkansas Department of Energy and Environment Quality Management Plan (QMP) and the WSSP discussed later in this QAPP. The WSSP is not stand-alone document. It is designed to supplement and define in greater detail the QA procedures associated with this QAPP.

Background

The Mississippi Alluvial Plain ecoregion (MAP) presents a unique challenge in managing the chemical, physical, and biological aspects of the waters within the ecoregion. The MAP in Arkansas stretches for almost 250 miles from Missouri to Louisiana and almost 120 miles from Memphis, Tennessee to Little Rock, Arkansas. It is approximately 15,320 square miles in area covering all or part of 26 counties. Four river basins occur in the MAP, Mississippi, St. Francis, Arkansas, and Ouachita. Most of the rivers and streams within the MAP are highly manipulated, mostly being channelized for flood control, prior to the adoption of the Clean Water Act. The least-disturbed MAP waterbodies are most likely being influenced by these manipulations.

Determining the stressor-response condition of MAP biological communities using traditional metrics, macroinvertebrate and fish community compositions, compared solely to water quality components is challenging. Numerous other stream characteristics, including stream channel manipulations, artificial flow regime, and water temperature fluctuations can all affect these communities. In addition, adequately sampling these communities can be challenging. However, it has been shown (Hicks & Taylor, 2018) that establishing stressor-response relationships using diatom composition can be more robust. The science suggests that identifying linkages between stressors associated with land use and responses of bacterial diversity is an important step in understanding and improving resource management (DeVilbiss et al., 2023; DeVilbiss et al., 2025).

Because the MAP is so expansive, the project will be implemented in phases. Each phase will take approximately two years to complete.

Element A5: Project Task Description

Description of Work to be Performed

Physical, chemical, and biological data will be collected from sites across the MAP (Table 1 and Figure 1). In situ parameters (pH, dissolved oxygen, temperature), conventional water chemistry (Table 2), diurnal parameters (pH, dissolved oxygen, temperature), flow, biological communities (fish, macroinvertebrate), and habitat data will be collected according to DEQs most recent Wadable Stream Sampling Protocols (WSSP) (E&E 2022). Diatom sampling will follow the procedures described in Moulton et al., 2002. Bacteria sampling and analysis will be conducted according to the methodologies described in DeVilbiss et al., 2023. Sample timing and frequency will occur according to Table 3. Physicochemical and water chemistry data will be loaded into the LIMS database. Fish and macroinvertebrate data will be tabulated into spreadsheets, reviewed for quality assurance, and then entered in the respective DEQ databases. It is anticipated that the entire project will take at least five years to complete.

Table 1: Sampling Sites

Station ID	Waterbody Name	Latitude	Longitude	Projected Water Sample Years	Projected Biological Sample Year[1]
OUA0290	Rush Bayou	33.10745	-91.22696	2025-2026	2025
OUA0289	Boeuf River	33.69382	-91.36447	2025-2026	2025
WHI0297	Big Creek	34.24459	-91.17682	2025-2026	2025
ARK0262	Waterloo Ditch	34.32826	-92.00103	2025-2026	2025
WHI0303	North Lambrook Ditch	34.35059	-90.98527	2025-2026	2025
ARK0259	Wabbaseka Bayou	34.41103	-91.89733	2025-2026	2025
WHI0307	Lick Creek	34.53408	-90.76915	2025-2026	2025
WHI0310	Ditch to Big Cypress Creek	34.76054	-90.81930	2025-2026	2025
WHI0277	Collins Creek	34.92243	-91.76501	2025-2026	2025
WHI0278	Brush Creek	35.00958	-91.85554	2025-2026	2025
FRA0045	Fifteenmile Bayou	35.17582	-90.23688	2025-2026	2025
FRA0046	Little Bivens Bayou	35.20835	-90.55524	2025-2026	2025
FRA0049	Hog Slough	35.43206	-90.57401	2025-2026	2025
WHI0285	Overcup Slough	35.44528	-91.16876	2025-2026	2025
WHI0286	Flag Slough Ditch	35.49332	-91.00528	2025-2026	2025
WHI0288	Skillet Ditch	35.63676	-91.12226	2025-2026	2025
WHI0313	Unnamed trib to Big Running Water Ditch	35.91126	-91.16237	2025-2026	2025

[1] Diurnal parameters, flow, habitat, fish, macroinvertebrates, diatom, and bacteria sampling will occur during the same year.

Station ID	Waterbody Name	Latitude	Longitude	Projected Water Sample Years	Projected Biological Sample Year[1]
FRA0057	Bay Ditch #1	35.92158	-90.47772	2025-2026	2025
WHI0294	Unnamed Trib to Kramer Ditch	36.28004	-90.60632	2025-2026	2025
WHI0311	Kramer Ditch	36.35027	-90.55174	2025-2026	2025
WHI0312	Main Ditch	36.42229	-90.55059	2025-2026	2025
OUA0286	Camp Bayou Canal	33.06178	-91.51207	2025-2026	2026
OUA0288	Dry Bayou	33.24269	-91.45126	2025-2026	2026
WHI0298	Tarleton Creek	34.24892	-91.13897	2025-2026	2026
WHI0300	Tarelton Creek	34.28019	-91.16485	2025-2026	2026
ARK0260	Caney Creek Ditch	34.54471	-91.83517	2025-2026	2026
ARK0261	Clearpoint Creek	34.55263	-91.57856	2025-2026	2026
WHI0309	Spring Creek	34.68792	-90.89647	2025-2026	2026
WHI0282	Hill Bayou	34.97491	-91.40268	2025-2026	2026
FRA0062	Hinton Creek	34.97923	-90.82303	2025-2026	2026
WHI0283	Caney Creek	35.07421	-91.12890	2025-2026	2026
FRA0063	Lick Creek	35.17808	-90.84697	2025-2026	2026
FRA0064	Bear Creek	35.19068	-90.84645	2025-2026	2026
FRA0065	Unnamed Ditch	35.26589	-91.02217	2025-2026	2026
FRA0052	Ditch #50	35.59060	-90.11314	2025-2026	2026
WHI0289	Tiger Ditch	35.70769	-91.09214	2025-2026	2026
FRA0056	Little Bay Ditch	35.81555	-90.58986	2025-2026	2026
WHI0316	Maple Ditch	35.82857	-91.11944	2025-2026	2026
WHI0292	Main Lateral	36.04002	-90.75276	2025-2026	2026
WHI0293	Petersburg Ditch	36.23802	-90.68839	2025-2026	2026
WHI0314	Main Ditch	36.28727	-90.91583	2025-2026	2026
FRA0060	Hampton Slough	36.28893	-90.13966	2025-2026	2026
OUA0285	Caney Bayou	33.05174	-91.33109	2027-2028	2027
OUA0291	Bayou Macon	33.28499	-91.32158	2027-2028	2027
OUA0150	Jacks Bayou	34.10185	-91.76236	2027-2028	2027
WHI0296	Cocklebur Slough	34.22218	-91.09947	2027-2028	2027
WHI0301	Panther Branch	34.29719	-91.11742	2027-2028	2027
ARK0263	Black Bayou Canal	34.46191	-91.97271	2027-2028	2027
WHI0306	Beaver Bayou Ditch	34.49367	-90.72484	2027-2028	2027
WHI0308	Lateral #2	34.62129	-90.94557	2027-2028	2027
WHI0276	Faras Run	34.88899	-91.60286	2027-2028	2027
WHI0281	Turkey Creek	34.97250	-91.23012	2027-2028	2027
FRA0034	Williams Creek	35.20584	-90.83711	2027-2028	2027
FRA0047	Bellhammer Slough	35.37961	-90.23418	2027-2028	2027
FRA0066	Caney Creek	35.39928	-90.90245	2027-2028	2027

Station ID	Waterbody Name	Latitude	Longitude	Projected Water Sample Years	Projected Biological Sample Year[1]
FRA0048	Fortune Slough	35.41701	-90.55238	2027-2028	2027
WHI0287	Browns Creek Ditch	35.57848	-91.15820	2027-2028	2027
FRA0053	Ditch 1	35.65663	-90.64222	2027-2028	2027
FRA0054	Viney Slough Ditch	35.71963	-90.65067	2027-2028	2027
WHI0290	Willow Ditch	35.86959	-91.02606	2027-2028	2027
WHI0291	Gum Slough Ditch	35.93640	-90.82501	2027-2028	2027
FRA0058	Locust Creek Ditch	36.05238	-90.38649	2027-2028	2027
WHI0318	Tupeo Ditch	36.15076	-90.89772	2027-2028	2027
WHI0295	Ditch #19	36.36597	-90.46712	2027-2028	2027
OUA0287	Fleschmans Bayou	33.11199	-91.46398	2027-2028	2028
OUA0292	Boggy Bayou	33.53884	-91.25216	2027-2028	2028
WHI0299	Essex Bayou	34.26057	-91.11632	2027-2028	2028
WHI0302	Yellow Bank Slough	34.30715	-90.84806	2027-2028	2028
WHI0304	Big Creek	34.37039	-91.23921	2027-2028	2028
WHI0305	Coffee Creek	34.49315	-90.95581	2027-2028	2028
FRA0042	South Alligator Bayou	34.83442	-90.53411	2027-2028	2028
WHI0148	Hurricane Creek	34.83897	-91.52735	2027-2028	2028
WHI0280	Unnamed	34.89108	-91.33966	2027-2028	2028
FRA0061	Coffee Creek	34.95019	-90.87717	2027-2028	2028
WHI0279	Lick Creek	35.01750	-91.91041	2027-2028	2028
FRA0043	Little Bivens Bayou	35.12940	-90.55719	2027-2028	2028
FRA0044	Ditch 19	35.16189	-90.37257	2027-2028	2028
WHI0284	Eight Mile Creek	35.43087	-91.10994	2027-2028	2028
FRA0050	Ditch 1 @ HWY 77	35.43816	-90.25837	2027-2028	2028
FRA0051	Tyronza Bayou	35.58721	-90.04904	2027-2028	2028
WHI0315	Tuckerman Ditch	35.73173	-91.20093	2027-2028	2028
FRA0055	Maple Slough Ditch	35.80780	-90.54772	2027-2028	2028
WHI0317	Village Creek	36.09058	-90.93960	2027-2028	2028
FRA0059	Big Slough Ditch	36.24593	-90.24781	2027-2028	2028

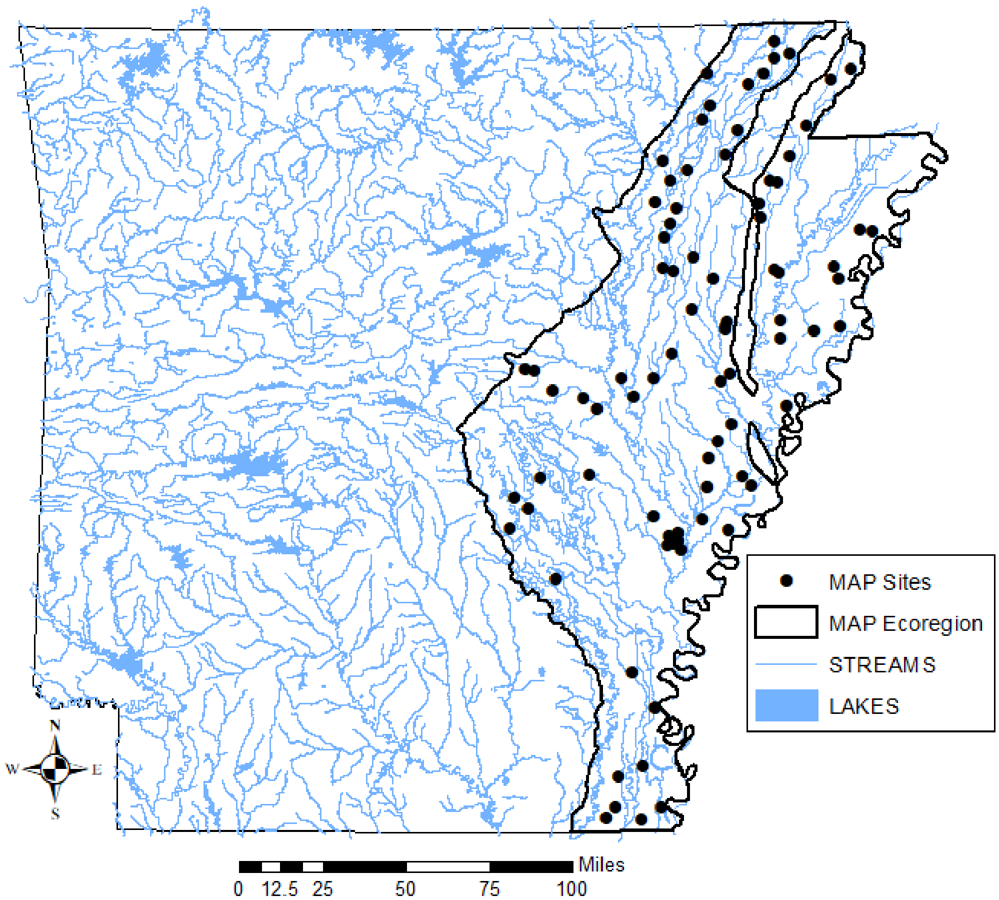

Figure 1: Site Map

Table 2: Water Chemistry Analytes

Parameters			**Total and Dissolved Metals**	
Alkalinity as $CaCO_3$	Orthophosphate as P		Aluminum	Lead
Ammonia (as N)	Sulfate		Arsenic	Magnesium
Bromide	Total Kjeldahl Nitrogen		Barium	Manganese
Chloride	Dissolved Organic Carbon		Beryllium	Nickel
Conductivity	Total Phosphorus		Cadmium	Potassium
Fluoride	Solids, Total Dissolved		Calcium	Selenium
Hardness as $CaCO_3$	Solids, Total Suspended		Chromium	Silver
Nitrate + Nitrite	Turbidity		Cobalt	Sodium
Nitrogen-Total			Copper	Thallium
			Iron	Zinc

Table 3: Sampling Frequency

Sample Type	Sample Timing	Number of Samples Per Site
In situ parameters	Approximately monthly for two years	20
Conventional water chemistry	Approximately monthly for two years	20
Diurnal parameters	Twice during one critical season[2]	2
Flow	Once during one critical season[2]	1[3]
Habitat	Once during one critical season[2]	1
Fish	Once during one critical season[2]	1
Macroinvertebrate	Once during one critical season[2]	1
Diatom	Once during one critical season[2]	1
Bacteria	Once during one critical season[2]	1

Products Produced

Deliverables from these activities include:

- water samples;
- chemical analyses of the water samples;
- in situ data;
- biological data; and
- physical data.

[2] Critical season is that period of the year when water temperatures exceed twenty-two degrees Celsius (>22°C (71.6°F)). This is normally the hot, dry season and after the majority of the fish spawning activities have ceased. This season occurs during a different time frame in different parts of the state, but normally exists from about mid-May to mid-September. Diurnal parameters, flow, habitat, fish, macroinvertebrates, diatom, and bacteria sampling will occur during the same year.

[3] If fish and macroinvertebrate samples are taken of separate days, then flow will be collected once each day.

Element A6: Data Quality Objectives and Performance/Acceptance Criteria

A high confidence level in the data must be attained and maintained to meet the objectives of the program. The data must be representative of the conditions being measured and be reported in units which allows for the comparison of the data to baseline information and criteria.

Representativeness

The measurements and samples must be representative of the waterbody. The data quality objective is to take samples and perform analyses that depict the existing environmental conditions as accurately as possible. The quantitative goal is to have 95% of field duplicate samples be within the acceptance criteria as outlined in Element B4.

Comparability

U.S. EPA approved analytical procedures listed in 40 C.F.R. § 136, current methods from *Standard Methods for the Examination of Water and Wastewater* (SM), or other EPA approved methods are used to assure data comparability.

Precision

The precision objectives are the control limits as determined by the procedures in Element B4. These control limits are based on the Relative Percent Difference (RPD) of the duplicate and spike analyses. The quantitative goals for precision of field sampling activities are depicted Element B4.

Bias

Bias is the difference between the average of measurements of an analyte and its true value. A measurement is considered unbiased when the value reported does not differ from the true value. Field blanks evaluate potential bias from the process of sample handling, processing and analysis.

Accuracy

The accuracy objectives are the control limits as determined by the procedures in Element B4. These control limits are based upon the percent recovery of spiked samples. Acceptable accuracy is defined by the analytical method used as described in 40 C.F.R. § 136 or other EPA approved methods procedures.

Completeness

Data completeness is the amount of valid data obtained compared to the amount expected. Improper sample collection, sample contamination, and out of control analytical procedures can cause data loss. The goal for completeness is to have 90% of data collected meet acceptance criteria.

Element A7: Distribution List

The individuals (or successor) listed in Element A2 will receive a copy of, or have access to, this QAPP.

Element A8: Project Organization

Personnel from the OWQ are responsible for

- Collecting in situ, water, macroinvertebrate and fish community samples:
- Delivering the samples to the laboratory;
- Processing samples;
- Data management;
- QA of the above activities; and
- Project QA.

Personnel from USGS responsible for

- Collecting in situ, water, diatom, and bacteria samples;
- Delivering or shipping the samples to the laboratory;
- Data management; and
- QA of the above activities.

E&E Quality Assurance Manager (QAM)

The responsibilities of the QAM include management and implementation of the Quality Assurance Program. Specific duties for this project include:

- Annual review of the E&E QMP;
- Accreditation of laboratories; and
- Annual review of this QAPP.

DEQ Project Senior Manager

The responsibilities of the Senior Manager include:

- Project leadership authority;
- Providing resources; and
- Project implementation oversight.

DEQ Project Quality Assurance Manager (PQAM)

The duties of the PQAM include:

- Overall project quality assurance;
- Implementation of corrective actions;
- Assessing the effectiveness of this QAPP; and
- Annual review of this QAPP.

DEQ Project Operations Manager (POM) and Quality Assurance Coordinator (PQAC)

The duties of the DEQ POM and PQAC include:

- Overall project management;
- Appointing designee(s) management responsibilities;
- Ensuring all procedures and reports meet quality assurance (QA) requirements;
- Approval of sampling work plans and analytical parameters;
- Implementation of corrective actions;
- Establishing QA audits if necessary;
- Reporting any field quality control (QC) failures to the DEQ QAM; and
- Annual review of this QAPP.

USGS Project Operations Manager

The duties of the USGS POM include:

- Ensuring all procedures and reports meet QA requirements;
- Ensuring all sediment and diatom samples and metagenomic analysis of these samples meet QA requirements;
- Implementation of corrective actions;
- Reporting any field QC failures to the PQAC; and
- Annual review of the QAPP.

Element A9: Project QAM Independence

As discussed in the most current E&E QMP, the QAM is responsible for the oversite of the QA program and is independent of the environmental information operations associated with this QAPP.

Element A10: Project Organizational Chart and Communications

DEQ is responsible for conducting the environmental information operations associated with this QAPP. Communication between the primary collector of environmental information and the POMs of the project should occur almost daily and as soon as possible after every QA issue arises. For sampling, all issues should then be reported to the PQAC. More significant QA issues, such as routine meter failure or sample contamination should be reported to the PQAM.

Addressing non-significant issues can be done by the PQAC. Addressing more significant and re-occurring issues should include communication between the data collector, PQAM and the Project Senior Manager. In addition, communication with U.S. EPA during scheduled reporting time may occur.

Figure 2: Project Organizational Chart

Element A11: Personnel Training Requirements/Certifications

Field Personnel

Field personnel are trained on proper water quality sampling, sample handling and preservation techniques, equipment usage and maintenance, and other field and in-house procedures under the supervision of senior scientists or managers. This training includes, but is not limited to:

- On-line training modules for most sampling activities included in the WSSP;
- Annual training occurs as a refresher to those methods routinely used in sampling;
- Periodic training of the entire field personnel when new, specialized sampling techniques for unusual constituents occur;
- Specialized, field training as needed, or as soon after a problem has been identified by field reports, senior staff members, or supervisors;
- Additional federal, state, or private sponsored training when available;
- The PQAC or designee performs QA/QC training of field personnel regarding the operation of field monitoring equipment and special monitoring assignments.

Element A12: Documentation and Records

Data Retention Procedures

Bench sheets, QC checks, calibration logs, instruments printouts, chain of custody forms, and field sheets are scanned and stored per DEQ Records Retention Policy. In addition, QA documents and project reports are retained in accordance with the DEQ Records Retention Policy (ADEQ 2006).

Training Records

Training records are kept electronically as per the DEQ Records Retention Policy.

Element B1: Environmental Information Operations

Environmental Information Operations is a collective term for work performed to collect, produce, evaluate, or use environmental information and the design, construction, operation, or application of environmental technology.

Environmental Measurement Methods

Environmental Measurement Methods, sampling protocols, are documented in the most recent version of the WSSP. Environmental information is collected such that data can be utilized for its intended uses as indicated in Element A4. Most importantly, the frequency and seasonality of collection must be sufficient to reflect the characteristics of the main water mass throughout the year. The precision of the measurements must be such that it allows for the comparison of the data between the actual measurement and the required data quality objectives.

Element B2: Methods for Environmental Information Acquisition

Surface Waters (Chemical, Biological, and Physical)

Collection and preservation methods are described in the most current WSSP for sampling chemical, physical, and biological constituents. Diatom sampling will follow the procedures described in Moulton et al., 2002. Bacteria sampling and analysis will be conducted as per the methodologies described in DeVilbiss et al., 2023. Laboratory analytical and preservative methods, and holding times are listed in Appendix 1. If deviations from these procedures are necessary, the methods used and the reasons for the deviation will be documented as well as the identification of the field personnel involved in the sampling. DEQ personnel will perform most of the field sampling. However, personnel from the USGS will conduct diatom and sediment bacteria sampling for metagenomics[4].

Diatom and bacteria samples will be sent to the EPA ORD laboratory in Cincinnati, OH and analyses will be conducted following methodologies in Smucker et al. 2020 and DeVilbiss et al. 2025. Appropriate QA/QC measures for extraction and amplification of DNA samples will be conducted by EPA ORD laboratory (contact: Erik Pilgrim, (513) 569-7797, pilgrim.erik@epa.gov).

Element B3: Integrity of Environmental Information

All environmental information operations will be carried out following the QA criteria outlined or referenced in this QAPP. Additional documents with relevant QA guidelines include the State of Arkansas Department of Energy and Environment Quality Management Plan (QMP) and the WSSP, discussed later in this document. The WSSP is not a stand-alone document but is designed to supplement and define in greater detail the QA procedures associated with this QAPP.

[4] Metagenomics is the study of the structure and function of entire nucleotide sequences isolated and analyzed from all the organisms in a bulk sample.

Field Activities

The measures and activities to assure the integrity of environmental information collected during field sampling are outlined in the most recent WSSP. The individual, or a designee, that collected the sample is responsible for transporting and/or delivering it to an accredited laboratory.

Laboratory Activities

Any laboratory performing work on behalf of DEQ must be accredited as per the requirements set forth in Arkansas Code Annotated §§ 8-2-201 et seq. State Environmental Laboratory Accreditation Program Act, August 1, 2017.

Element B4: Quality Control

Field Sampling

Duplicate samples and in situ measurements are collected at a rate of 10% or a minimum of one per week, if less than ten samples are collected per week per field personnel. The WSSP outlines the requirements for collecting field duplicate sample.

Assess precision and accuracy of all data immediately after analyses are performed. Data from all duplicate and spiked samples will be checked against the acceptance criteria.

Precision

- Determine data precision from field duplicate samples.
- Base field precision on the relative percent difference between the sample and its field duplicate. Calculate the RPD as follows:

$$RPD = (\{Duplicate - Original\}/\{(Duplicate + Original)/2\})*100$$

Accuracy

The accuracy of field measurements is most commonly accepted when both the precision criteria are attained and when the accuracy of the field equipment used in collecting the environmental information is achieved. Accuracy of the field equipment is tested using the following procedures.

- Temperature – The percent difference between the reading of the meter versus the reading of a certified thermometer.
- pH - The percent difference between the reading of the meter versus a standard.
- Dissolved oxygen – The percent difference of the reading of the meter versus the reading of another, or several other meters.

Corrective Action

- The purpose of a corrective action is to document and promptly address major and/or minor problems, and to develop a plan that will eliminate the potential for repetition of the problem.
- Corrective actions are taken when:
    - Quality control checks reveal a problem.

- The QC data are out of control.
- Deficiencies are cited during an audit.
- Samples are lost.

Representativeness

Determining whether the results from a sample represent the characteristics of the main water mass sampled is controlled by the project design, sample location, and sampling process. The DEQ POM, or designee, is responsible for site selection and implementation of sampling procedures.

Completeness

Completeness is determined by comparing the amount of work intended to be completed and the amount of work accomplished. A mid-year and an end-of-year progress report, incorporating the work completed to date is prepared by the DEQ POM or designee.

Element B5: Instrument Calibration, Testing, Inspection, and Maintenance

Field Instruments

Instantaneous and in situ field measurements are conducted using single or multiparameter instruments. The resolution, range, and accuracy of each instrument ensures that data quality objectives will be attained. The procedures and frequency for calibrating, testing, inspecting, and performing maintenance of all field instruments are contained in the WSSP. Most repair and operating parts are maintained at DEQ for use as needed. Additional information is in the DEQ supplemental guide, “Yellow Springs Instrument User and Troubleshooting Guide.”

Inspections and Acceptance Testing of Instruments

All instruments should meet specific performance criteria before acceptance. Each instrument will be inspected during its scheduled cleaning as per manufacturers’ recommendations or operating instructions.

Resolution of Deficiencies

If deficiencies are found during the testing procedure, corrective actions will be taken to rectify the problem within the available time allowed by the project and funding mechanisms.

Element B6: Inspection/Acceptance Requirements for Supplies and Services

The DEQ POM, or designee, purchases supplies and consumables. The individual receiving the items inspects them and checks the items received against the packing slip.

All chemicals and reagents are inspected for proper expiration dates. Chemical standards used for calibration are purchased from reputable vendors with Certificates of Analysis listing the certified chemical content.

Element B7: Environmental Information Management

Field Data

Data collected in the field are recorded on field sheets and transferred to a COC. Upon receipt of the sample by the laboratory, the sample data is entered into DEQ databases and/or the Laboratory Information Management System (LIMS). Each sample is given a unique log number. Filed data are only entered after they have been checked for reasonable results by the data entry analyst. Data are transferred to the DEQ server and backed up daily. Data from all water quality monitoring networks are regularly transferred to the WQX.

Control Mechanisms for Detection/Correcting Errors

Data must pass all precision and accuracy checks. The data must be within the allowed range, *i.e.* pH between 0 and 14 standard units and for logical errors, *i.e.* dissolved fraction greater than the total concentration.

Data Handling Equipment and Procedures

Computer hardware and software are acquired according to the DEQ Information Technology (IT) Budget and Expenditure Plan. IT is responsible for the computer and network infrastructure as well as all DEQ software needs. The datacenter is equipped with a large Uninterruptible Power Supply and a generator backup. An off-site disaster recovery site helps maintain a backup and image of data housed at the main campus.

Data Storage

Data in LIMS are stored on each computer hard drives, transferred to the DEQ main computer, and backed up daily. Biological data are stored in individual databases.

Data Use

Data generated are available to users from several sources. The DEQ computer system is available to staff directly and through the website. Data in the WQX system is available to all users.

Element C1: Assessment and Response Actions

Field Activities

Field duties are evaluated by POM or designee to assess sampling methodologies, data handling, field quality control procedures, and personnel. Annual "refresher training" courses are made available to sample collectors on sampling methodologies and quality control procedures.

Element C2: Oversite and Reports to Management

An annual summary QA report may be prepared and submitted to either the POM or the PQAM if requested. The report should identify any quality assurance issues that resulted in a significant amount of data loss and the corrective measures that were immediately taken, if any, to address the issue. The report may also discuss recommendations to help prevent future QA failures and/or any actions that did occur that may help limit future QA issues. All quality assurance issues, either major (significant loss of data) or minor (meter failure) should be verbally reported to one of the above individuals as soon as possible. Minor QA issues may or may not be included in the annual report.

The LSM, or a designee, may prepare a report that includes metrics of samples analyzed, percent of qualified data, systems audits and other QA metrics, if requested. The report may also discuss recommendations to help prevent future QA failures and/or any actions that did occur that may help limit future QA issues.

One additional report that may be prepared, if requested, is the results of a periodic evaluation the data produced by the projects associated with this QAPP. The report may include information such an assessment of the data quality in terms of precision, accuracy and completeness of the project as described in Element D1, and D2.

As a result of these reports, senior management may or may not instruct the PQAC or the PQAM to establish training or educational opportunities to enhance the quality assurance knowledge of field personnel. These opportunities may include training on new sampling and preservation methods, documentation records, corrective action procedures, and other QA related activity.

Element D1: Environmental Information Review

Data integrity must be validated prior to entry into the database. The POM is responsible for ensuring all field and biological data are properly reviewed and verified and are in the proper format for submittal to storage databases. All data must meet data quality objectives outlined in Element A6. Data that do not meet data quality objectives will not be input into data storage databases.

Element D2: Useability Determination

Data Verification

Verification refers to the process of confirming a process or procedure was followed. Data verification is performed using self-assessments and by a technical review by the DEQ POM. Data to be verified are evaluated against project specifications and are checked for errors in transcriptions, calculations, and data input. Potential outliers are handled by the procedure listed below. Issues that can be resolved will be corrected and documented.

Data Validation

The DEQ POM is responsible for validating that the verified data are usable and reportable. They are also responsible for re-evaluating the data to determine whether any anomalies are present.

Data integrity is verified at several points during the collection and reporting process. The principal checks are performed by the accredited laboratory and field personnel. Additional checks are performed by data users and QA personnel.

The data processing checks are designed to assure the accurate transfer of the data from the laboratory report forms to the computer system. The data are verified by a computer program which inspects the data for values out of the permissible or normal range.

Outliers

- Quality Control Data
    - Outliers discovered during the laboratory quality control checks of field data may indicate sampling or data input errors. Comparing entered data with chain-of-custody and/or field sheets may correct the error.
    - If reasons for the problem are not found, examine the QC data to help determine data accuracy.
- Sample Data
    - When a value in a data set is suspiciously high or low, examine to see if it must be discarded to avoid biasing the data set. The first check should be to see if there is any physical reason, e.g. high flow, low flow, abnormal temperature, or any other explanation for the abnormal data.

- o If a reason for the suspicious value is not found it must be tested to see if it is statistically judged to be an outlier. The suspect data point and the eleven closest data points in the data set should be used in the test.

Results obtained from projects associated with this QAPP are evaluated periodically and at the end of the project to determine if data quality objectives are being obtained. Project completeness will be reconciled with the expected outputs. Data precision and accuracy developed for the project will be reported to the decision makers to establish the limits that should be placed on the data.

Appendix 1: Environmental Information Analytical Testing Methods

Parameter	Analytical Reference Method	Sample Container	Preservative	Holding Time
Alkalinity as $CaCO_3$	EPA 310.2 (1974) (modified)	Plastic, half gallon or quart jug	$\leq 6^0C$	14 Days
Ammonia (as N)	SM 4500—NH_3H—2011	Plastic, half gallon or quart jug	H_2SO_4	28 Days
Anions (Bromide, Chloride, Fluoride, Sulfate)	EPA 300.0, Rev. 2.1 (1993)	Plastic, half gallon or quart jug	$\leq 6^0C$	28 Days
Conductivity	EPA 120.1, Rev. 1982	Plastic, half gallon or quart jug	$\leq 6^0C$	27 Days
Hardness as $CaCO_3$	SM 2340 B 2011	125 ml plastic bottle	HNO_3	6 Months
Dissolved Metals	EPA 200.8, Rev. 5.4 (1994)/EPA 200.7 Rev. 4.4 (1994)	125 ml plastic bottle	HNO_3	6 Months
Total Metals	EPA 200.8, Rev. 5.4 (1994)/EPA 200.7 Rev. 4.4 (1994)	125 ml plastic bottle	HNO_3	6 Months
Nitrate + Nitrite	4500-NO_3^- F--2016	Plastic, half gallon or quart jug	H_2SO_4	28 Days
Nitrogen-Total (TKN)	SM 4500-N_{org} C—2011	Plastic, half gallon or quart jug	H_2SO_4	48 hours
Orthophosphate as P	4500-P G--2011	Plastic, half gallon or quart jug	$\leq 6^0C$	48 hours
Phosphorus--Total	SM 4500-P J—2011	Plastic, half gallon or quart jug	H_2SO_4	28 Days
Phosphorus--Total	SM 4500-P J—2011	Plastic, half gallon or quart jug	$\leq 6^0C$	48 Hours
Dissolved Organic Carbon (DOC)	SM 5310 C-2014	40 mL glass vial with septa	H_2SO_4	28 Days
Solids, Total Dissolved (TDS)	SM 2540 C--2015	Plastic, half gallon or quart jug	$\leq 6^0C$	7 Days
Solids, Total Suspended (TSS)	SM 2540 D--2015	Plastic, half gallon or quart jug	$\leq 6^0C$	7 Days
Turbidity	EPA 180.1 Rev 2.0 1993	Plastic, half gallon or quart jug	$\leq 6^0C$	48 Hours

Parameter	Analytical Reference Method	Sample Container	Preservative	Holding Time
Diatoms	Pilgrim et al. (2022), Smucker et al. (2020) Smucker et al. (2024)	50-mL Falcon™ tube	dry ice/ -80^0C	Indefinite
Bacteria	DeVilbiss et al. (2025)	50-mL Falcon™ tube	dry ice/ -80^0C	Indefinite

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